APRIL 2021

AGGREGATING REGULATORY CAPITAL REQUIREMENTS ACROSS JURISDICTIONS

THEORETICAL AND PRACTICAL CONSIDERATIONS

American Academy of Actuaries
Research Paper 2021, No. 1

American Academy of Actuaries
Objective. Independent. Effective.™

ACTUARY.ORG

This research paper was written primarily by Steve Jackson, Ph.D., assistant director for research (public policy), American Academy of Actuaries ("Academy"). The paper was sponsored by Tom Wildsmith, Academy international secretary with advice and guidance from Academy members Elizabeth Brill, Maryellen Coggins, and William Hines. The paper also benefited from discussions with and helpful comments by Carmen Suro-Bredie, Qamar Islam, Ned Tyrrell, Matt Walker, and members of the Academy's Solvency Committee.

The American Academy of Actuaries is a 19,500-member professional association whose mission is to serve the public and the U.S. actuarial profession. For more than 50 years, the Academy has assisted public policy makers on all levels by providing leadership, objective expertise, and actuarial advice on risk and financial security issues. The Academy also sets qualification, practice, and professionalism standards for actuaries in the United States.

American Academy *of* Actuaries

Objective. Independent. Effective.

AMERICAN ACADEMY OF ACTUARIES
1850 M STREET NW, SUITE 300, WASHINGTON, D.C. 20036
202-223-8196 | WWW.ACTUARY.ORG

Aggregating Regulatory Capital Requirements across Jurisdictions

Theoretical and Practical Considerations

Research Paper 2021, No. 1 | April 2021

Contents

Executive Summary 3

Section 1: Background and Introduction 8

Section 2: The Purpose of Scalars 10

From Entity Capital Adequacy to Group Capital Adequacy 10

'Ideal' Form of Scalars: Constructed at the Entity Level 11

'Ideal' Approximation: Aggregate Adjustments for Differences in Accounting, Safety, and Industry 17

Section 3: Criteria for the Assessment of Scalers 19

Section 4: Assessments of Scalar Methodologies 23

No Scalar 23

Scalar Equal to 1 23

Scalar Identified by Double-Accounting 25

Capital Ratios 27

Pure Ratio 27

Excess Capital Ratio 33

Equivalence of Two Points 39

Probability of Negative Outcomes 42

Section 5: Conclusion 51

References 56

Executive Summary

Especially since the financial crisis of 2007–08, regulators in the U.S. and around the world have recognized that the solvency of insurance groups as well as that of their individual legal entities needs to be examined. Efforts toward global regulatory convergence were launched by the International Association of Insurance Supervisors (IAIS), initiated by the Financial Stability Board (FSB). These efforts include the negotiation of a group solvency capital standard for all Internationally Active Insurance Groups (IAIGs): Insurance Capital Standard 2.0 (ICS 2.0). The approach the IAIS has taken with the International Capital Standard has been largely resisted by regulatory and industry stakeholders in the United States (and some other countries) based on the nature of its current regulatory structures. The IAIS has agreed to consider an alternative approach based on comparability with ICS 2.0—referred to as the aggregation method (AM).

The AM was born of practical necessity. In the United States, the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank) requires the Federal Reserve Board (FRB) to regulate holding companies, which include banks and insurance companies. In 2016, an FRB paper proposed a building block approach (BBA) to regulate the capital of these mixed entities. As banks and insurance companies do not "share any common capital assessment methodology," the FRB proposed relying on the existing methodologies for each sector and to aggregate capital requirements across regulatory frameworks with the use of a "translating mechanism" called a "scalar."[1]

This paper is offered to help clarify the objectives, both conceptual and practical, of a scalar methodology. It assembles an inventory of possible methodologies. It derives a set of criteria for the evaluation of methodologies from existing discussions of possible methodologies and from standard statistical principles. It evaluates each of the methodologies according to the specified criteria.

1 Board of Governors of the Federal Reserve System, "Comparing Capital Requirements in Different Regulatory Frameworks," 2019, page iii.

Scalars are designed to allow regulators in a jurisdiction to have access to a metric of the capital adequacy of an insurance group—or more generally, of a financial services group—based on the capital adequacy metrics of its individual components, including those entities regulated in other jurisdictions. While scalars might be developed for all kinds of entities, the focus of this paper is on scalars for entities regulated by jurisdictions that specify a measure of capital adequacy based on the ratio of some measure of available capital to some measure of the risk inherent in their operations. This measure of inherent risk (which is also referred to as "required capital" in this paper) might vary: for insurance, it might express the capital required to account for asset, interest rate, underwriting and/or other risks; for banking, it might express a risk-weighted measure of assets.

The ideal form of scalars is one where an entity in one jurisdiction hypothetically calculates its available and required capital as if it operated in the originating jurisdiction while adjusting (or controlling for) other factors that might affect the safety of the group's ongoing operations. Of course, this conceptual "ideal" may be impractical requiring, as it would, each entity with ownership in a different jurisdiction to maintain two sets of books: one with accounting principles and solvency measures calculated according to local requirements and a second one aligning with the principles and practices of the jurisdiction of its ownership. This ideal might also require adjusting for all other relevant factors, and doing so in a manner that recognizes the possibility that different accounting practices and/or different levels of safety inherent in calculations of required capital might already reflect awareness by jurisdictional regulators of some or all of these other factors.

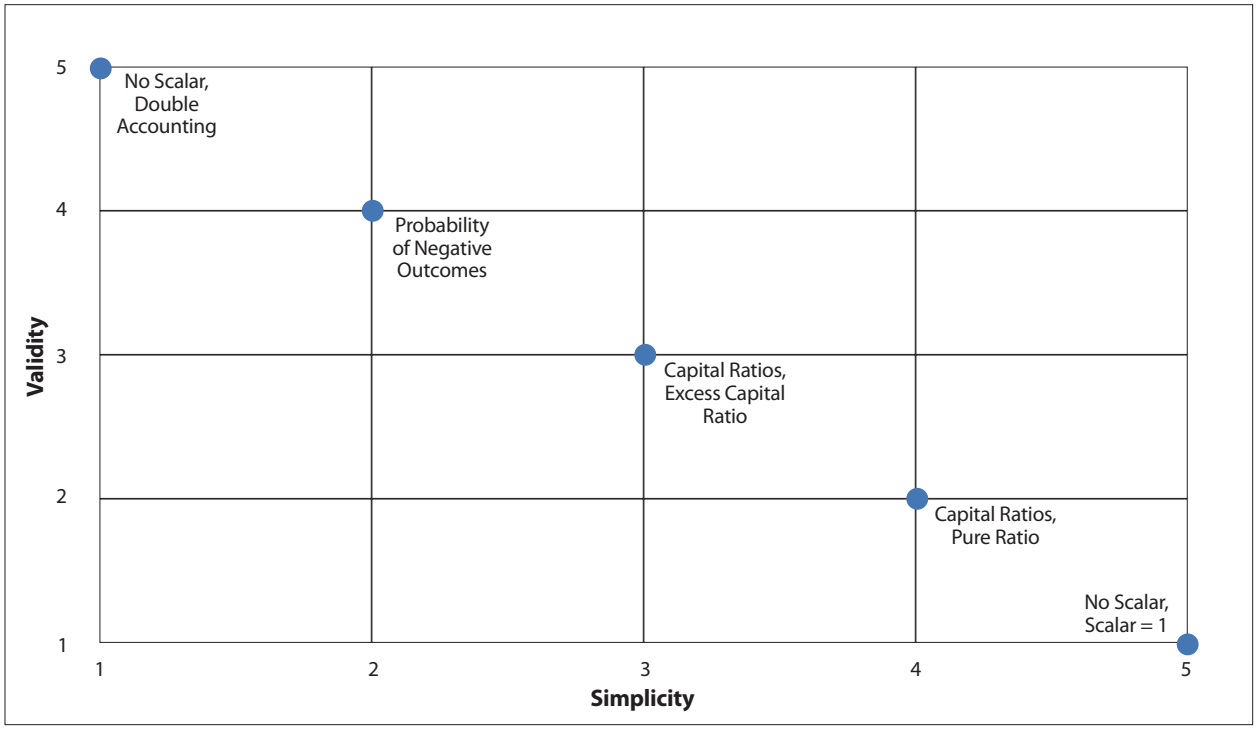
As this analysis examines possible scalar methodologies, four independent general criteria for assessment are introduced: validity, reliability, ease of implementation, and stability of parameters. Translating these criteria to explicitly apply to scalars and elaborating on specific factors that might be assessed under each of these four general criteria make the report's assessments more comparable and more useful.

Four families of methodology for estimating scalars are assessed: No Scalars, Capital Ratios, Equivalence of Two Points, and Probability of Negative Outcomes. One of these families—Equivalence of Two Points—turns out to be a generalization of two other families. Each of the three distinct families include multiple variants. Two variants from each of two families are specifically assessed and the variants of the third family are assessed as a group. The evaluation of these methodologies by the criteria just suggested presents issues to consider, sometimes applying to all branches of a family and sometime applying to one branch but not others.

The assessments presented here suggest not only that any scalar methodology will be imperfect; they also suggest that the extent to which the results produced will vary from the "ideal" is itself variable, depending on the circumstances (e.g., how much of a company's business is accounted for by entities in other jurisdictions). As a result, a final determination on preferred scalar methodologies likely will vary due to circumstances.

To summarize roughly the assessments of the five methodologies which are assessed in detail, it is useful to conceptualize two dimensions based on our four criteria of assessment: 1) validity; and 2) simplicity. Validity includes both conceptual validity as discussed in the paper and the lack of validity that follows from a lack of reliability. Simplicity includes both conceptual simplicity (discussed as part of validity) as well as ease of implementation. The best scalar methods would be very simple and highly valid. Unfortunately, none of the methods assessed here fit that description. Indeed, there is an ordinally inverse relationship between validity and simplicity, as can be seen in Figure A.

Figure A: Validity and Simplicity of Scalar Methodologies



Four issues arise to a greater or lesser extent for all of the methodologies assessed, and it seems prudent to highlight them before concluding. Those issues are:

1. *The application of these methodologies to entities in different industries:*
   Jurisdictions differ by geography and/or by industry. The regulatory regime in a given geographic unit defines a jurisdiction. Most of the comments in this paper apply to scalars for entities in different jurisdictions, whether the basis for the difference is geography, industry, or both. However, it is true for all methodologies (with the exception of one of the No Scalar methods) that when the entities are in different industries, a second scalar element is required.

2. *The dependence of the anchors for these methodologies on regulatory actions and company responses (the "problem of endogeneity")*:
   For all methods discussed in this paper (with the exception of one of the two No Scalar approaches), the anchors of these methods (e.g., the Capital Adequacy ratio, or the Probability of Default), are the result, in part, of companies acting under regulatory requirements. As illustrated in this paper, scalars may adjust for the differences in those requirements. However, anchors also reflect the actions of regulators within the various regulatory systems, and the responses of companies to those actions. The anchors then are products both of the different requirements (for which scalars aim to adjust) and the responses of regulators and companies to those anchors.

3. *The dependence of stability and validity of results on jurisdictional regime stability:*
   For all methods discussed here, and likely for any other methods that might be contemplated, the validity of the results, and their stability over time, depends on regime stability.

4. *The value of sensitivity testing in selecting a most desirable method:*
   In discussing the role of sensitivity testing throughout this paper, two different dimensions of sensitivity have been implied: 1) sensitivity of results to changes of parameters within a model; and 2) sensitivity of results to differences in methods of calculating scalars.

This paper provides a discussion of these issues in more detail as well as possible responses. As with scalars themselves, there are no perfect solutions.

While the Academy offers the considerations presented in this paper to be taken into account by regulators as they consider adoption of scalars as part of the group capital regulation process, the Academy does not make any specific recommendations in favor of or against any particular methodology. However, three conclusions do seem to follow from the analysis presented here:

1. Methodologies based on observable data are preferable to methodologies based on assumption, other things being equal. Only the approaches discussed under the Probability of Negative Outcomes are defined by reference to the analysis of observable data, and thus deserve heightened attention in any regulatory environment. However, as discussed, with the advantage of reliance on data come several challenges—many of them directly related to the reliance on available data. As such, regulators should consider whether adoption of this methodology, the Probability of Negative Outcomes, is advisable especially after careful consideration.

2. Almost all methodologies will be prone to increased imperfection if regulatory regimes change in a manner affecting capital adequacy standards after scalars have been estimated. While there might be attempts to develop methods by which to calculate adjustments to scalars based on the changes observed, the optimal way to adjust scalars for regime change and other changes in relevant conditions is to recalculate the scalars periodically. Hence, it may be advisable for a periodic recalculation to be made as an intrinsic element of any methodology adopted.

3. All of the methodologies discussed here are and will be imperfect. While factors that might be addressed to reduce some of those imperfections have been identified, it is impossible to find perfect solutions given the criteria of validity, reliability, ease of implementation, and stability of parameters and results. The question facing regulators then involves balancing degrees of validity (i.e., how imperfect the measures are, given what they would be if ideally conceptualized and measured) against degrees of reliability, ease, and stability. The only reliable way in which to regard those degrees, and to provide meaningful information with which to select a methodology based on some optimization of the criteria, is through the application of sensitivity testing as described. Hence, it may be advisable that the information required to examine the impact of each selected methodology under varying parameters, and to compare the impact of differing methodologies, be collected by regulators in order to allow them, at least initially, to rely on sensitivity testing to determine the best scalars in a particular jurisdiction.

Section 1

Background and Introduction

Insurance companies are regulated in the United States by regulators operating at the state level, scrutinizing the entities which offer insurance in their state. This regulatory regime has a long history and offers many advantages. However, given that the majority of insurance policies issued in the U.S. are offered by companies consisting of multiple entities in multiple states, the traditional review of individual entities but not of groups to assure their financial soundness poses a challenge. If the financial soundness of one entity might be affected by the strength or weakness of other entities in the same group, or by the strength or weakness of the parent company, how might regulators incorporate this potential into their view?

Especially since the financial crisis of 2007–08,[2] regulators in the U.S. and around the world have recognized that the solvency of insurance groups as well as that of their individual legal entities needs to be examined.[3] Efforts toward global regulatory convergence were launched by the International Association of Insurance Supervisors (IAIS), in conjunction with the Financial Stability Board (FSB). These efforts include the development of a group solvency capital standard for all Internationally Active Insurance Groups (IAIGs): Insurance Capital Standard 2.0 (ICS 2.0). ICS 2.0 is a market-based approach, relying on a consolidated balance sheet and assessing risk through the application of shocks. The approach the IAIS has taken with the International Capital Standard has been largely resisted by regulatory and industry stakeholders in the United States (and some other countries) based on the nature of its current regulatory structures, relying as it does on book values and factor-based assessment of risk. The IAIS has agreed to consider an alternative approach based on its comparability with ICS 2.0—referred to as the aggregation method (AM).

The AM was born of practical necessity. In the United States, the Dodd-Frank Wall Street Reform and Consumer Protection Act (Dodd-Frank), requires the Federal Reserve Board (FRB) to regulate holding companies, which include banks and insurance companies. In 2016, the FRB proposed a building block approach (BBA) to regulate the capital of these mixed entities. As banks and insurance companies do not "share any common capital assessment methodology,"[4] the FRB proposed relying on the existing methodologies for each

2 This background is intentionally abbreviated, and does not mention many prior relevant moments. These would include, for example, the development of Solvency II and the U.S.-E.U. Covered Agreement.
3 In hearings and reports in the United States (1990), the European Union (2002), and Australia (2003), problems that escaped the view of regulators because they occurred in other parts of the corporate parents to affected entities were brought into sharp focus. See Dingell(1990); Sharma (2002); and Owen (2003).
4 Board of Governors of the Federal Reserve System (2019), page iii.

sector and to aggregate capital requirements across regulatory frameworks with the use of a "translating mechanism" called a scalar.[5]

In the same timeframe, the National Association of Insurance Commissioners (NAIC) charged its Group Capital Calculation (E) Working Group with defining a group capital calculation by the AM that would be useful for all insurance groups in the United States, whether they would be covered by the IAIS standard or not. The development of the AM became not just a U.S. effort as other foreign jurisdictions and the IAIS itself joined in the effort. The IAIS is presently conducting field tests of both the ICS and the AM with a goal of assessing by 2024 whether the AM provides outcomes comparable to the ICS.

Currently, the Federal Reserve Board, the National Association of Insurance Commissioners, and the IAIS do not have an abundance of published, independent, academic, or expert actuarial/guidance available to them on how to scale for aggregation. As the Federal Reserve Board noted, "Scaling has not previously been the subject of academic research, and industry practitioners don't agree on the best methodology."[6] This paper aims to contribute to filling that gap.

This paper is intended to clarify as much as possible the objectives, both conceptual and practical, of a scalar methodology. It assembles an inventory of possible methodologies, both from methodologies that have been tried and/or assessed by the NAIC, the FRB, the IAIS or others, and from methodologies suggested by academic literature addressing adjacent issues. It derives a set of criteria for the evaluation of methodologies from existing discussions of possible methodologies and from standard statistical principles. It evaluates each of several relevant methodologies according to the specified criteria.

The Academy provides independent, objective information to assist policymakers in making informed decisions. Thus, the Academy offers assessments of several major possible methods without recommending a method for scalars. The assessments address both theoretical and practical considerations. The intention is to assist regulators and staff seeking to create group capital standards by the AM by providing information as they seek to choose the best methodology for deriving scalars for their purposes. This paper is also intended to more widely educate the actuarial community about scalars and to engage both the actuarial and academic communities in this issue. The Academy's assessments are clearly designed to address scaling for insurance entities across jurisdictions, while also being relevant to other uses for scalars.

5 Ibid., page iii.
6 Ibid, page 1. That paper began the process of filling the gap for a particular context; this paper continues to fill the gap with applicability to broader contexts.

Section 2

The Purpose of Scalars

From Entity Capital Adequacy to Group Capital Adequacy

Scalars are designed to allow regulators in a jurisdiction[7] to have access to a metric of the capital adequacy of an insurance group—or more generally, of a financial services group—based on the capital adequacy metrics of its individual components, including those entities regulated in other jurisdictions. While scalars might be developed for all kinds of entities, the focus of this paper is on scalars for entities regulated by jurisdictions that specify a measure of capital adequacy based on the ratio of some measure of available capital to some measure of the risk inherent in their operations. This measure of inherent risk (which is also referred to as "required capital" in this paper) might vary: for insurance, it might express the capital required to account for asset, interest rate, underwriting and/or other risks; for banking, it might express a risk-weighted measure of assets. However, as long as an entity has a regulatorily mandated capital adequacy measure of this form, then scalars might be conceptualized as having the following two specific purposes:

- To make the measure of inherent risk in a second jurisdiction comparable to the measure of inherent risk in the first jurisdiction.
- To make the measure of available capital in a second jurisdiction comparable to the measure of available capital in the first jurisdiction.

With scalars satisfying these purposes in place, it should be possible to achieve the ultimate purpose of group capital assessment:

- To create a measure of group capital adequacy comparable to the measure of capital adequacy for individual entities in the originating jurisdiction.

Specifying that the group capital adequacy measure is comparable to that for individual entities recognizes that the group measure will incorporate the strengths and the weaknesses of the measures for individual entities. Specifying that the measures will be comparable recognizes that their construction will not be identical; for example, scalars are not required to build capital adequacy measures at the individual entity level. Further, at the individual entity level one need not have concerns over double-counting assets or capital that might

7 A jurisdiction is defined herein as a geographic unit and an industry such that all entities in that location in that industry must produce a solvency metric by the same rules. By this definition, insurance entities in different states within the United States are part of the same jurisdiction, as all states rely on statutory accounting and the NAIC's Risk-Based Capital (RBC) for Insurers model law. However, banks in the United States or insurance companies in other countries would lie in jurisdictions distinct from the United States insurance industry jurisdiction.

occur when looking at individual entities and their corporate parent. Finally, specifying that the measures are comparable, and not identical, allows that the metrics might be fitted to different safety levels. For example, regulators might be comfortable with entity level metrics calculated at the 99% confidence level but might think it more appropriate to calculate group metrics at the 99.5% level.

'Ideal' Form of Scalars: Constructed at the Entity Level

Consider a hypothetical illustration. Assume there is an insurance group with insurance entities in two jurisdictions: Entity A1 in the originating jurisdiction, country A, and Entity B1 in another jurisdiction, country B. In each jurisdiction, there is a prescribed process for creating a capital adequacy measure, a ratio of available capital to some measure of the risks to capital inherent in the holdings and/or operations of the entities in that jurisdiction (the measure of inherent risks to capital shall be denoted as required capital).[8]

In order to create a group capital adequacy measure from the two entities, the available capital of the two entities must be combined, as must the required capital measures of the two entities. In doing so, ideally the capital and risk measures from country B need to be modified in such a way that if that entity operated within the originating jurisdiction, it would produce the same estimates of available capital and required capital under country A's rules and procedures as the modified estimates from country B.[9]

To illustrate this "ideal," assume that Entity A1 from country A has available capital of $1 billion, and required capital of $100 million, with a capital adequacy ratio of 10. Assume further that Entity B1 from country B has available capital of $500 million and required capital of $125 million, with a capital adequacy ratio of 4. Finally, assume that if Entity B1 operated in country A, and used the accounting practices and prescribed methods for calculating the capital adequacy ratio of country A, that its available capital would be $750 million and its required capital would be $100 million. For Entity B1's inclusion in a group capital calculation with Entity A, scalars of 1.5 for available capital ($750/$500) and 0.8 for required capital ($100/$125) would be required. For the group including Entity A1 and Entity B1, available capital would be treated as $1.75 billion and required capital as $200 million, producing a capital adequacy ratio of 8.75.

8 In the U.S., for insurance, the inherent measure of risk in the construction of the RBC ratio is a required minimum of capital, accounting for a broad set of risks that vary somewhat between life and health insurers, on the one hand, and property and casualty insurers, on the other. In the U.S., for banks, risk-weighted assets serve as the measure of inherent risk. In each case, regulators have defined intervention levels based on the ratio of available capital (defined somewhat differently) to the respective inherent risk measures.

9 This "ideal" form of scalars implicitly assumes the comprehensiveness of regulatory regimes. If, for example, the regime in a "home" insurance jurisdiction, focusing on the kinds of policies most common there, does not provide for the calculation of required capital for an uncommon policy, then the recalculation by an entity in a foreign jurisdiction in which this uncommon policy is common might understate the required capital when it converted the calculation to one based on the home jurisdiction's regime.

This "ideal" form of scalars—where an entity in one jurisdiction calculates its available and required capital as if it operated in the originating jurisdiction—creates coherent and consistent estimates of a group capital adequacy metric *as long as all other things are equal.*[10] If the objective of the aggregation method is to create a metric indicating the safety of a group's operations from a policyholder and/or shareholder perspective, other factors not captured in the capital adequacy ratio need to be taken into account. One such factor would be reserves for future losses; if different jurisdictions require different levels of reserves for the same book of business, then entities operating in the two jurisdictions with equivalent capital adequacy ratios would represent different levels of overall safety. Another such factor would be the stability of the macroeconomic environment; if different jurisdictions face different likely futures of interest rates, for example, then entities operating in the two jurisdictions with equivalent capital adequacy ratios would represent again different levels of overall safety.[11]

This recognition of the role of forces beyond the capital adequacy ratio in affecting that which the capital adequacy ratio seeks to indicate requires a restatement of an "ideal." The idealized form of scalars is one where an entity in one jurisdiction calculates available and required capital as if they operated in the originating jurisdiction while adjusting (or controlling for) other factors that might affect the safety of the group's ongoing operations.

Of course, this conceptual "ideal" may be practically impossible—requiring, as it would, each entity with ownership in a different jurisdiction to maintain two sets of books: one with accounting principles and solvency measures calculated according to local requirements and a second one aligning with the principles and practices of the jurisdiction of their ownership. It would also require adjusting for all other relevant factors, and doing so in a manner that recognizes the possibility that different accounting practices and/or different levels of safety inherent in calculations of required capital might already reflect awareness by jurisdictional regulators of some or all of these other factors.

Further, this conceptual "ideal" also raises an additional question. Capital adequacy measures—whether for individual entities or for groups—are but one metric among several used by regulators and others to gauge the safety of ongoing operations. In the U.S. insurance industry, reserve levels and, for larger companies, Own Risk and Solvency Assessments (ORSAs) are two such additional measures.[12] In current practice for entities,

10 "Other things" may never be equal; the definition of the "ideal" scalar methodology is that if an entity operated the same business identically in a different jurisdiction, then adjustment by scalars would make the adjusted measures of available and required capital equal to the home jurisdiction. For entities doing different business, this would translate to mean that the risk metrics derived would also be "ideal."

11 With a wide range of entity types potentially included in the range of this paper's discussion, some comments may apply more directly to certain types (e.g., insurance) than others (e.g., banking).

12 Reserves that include a margin clearly provide information for capital adequacy. Even required reserve levels provide an indication of risks that might stress capital. While ORSAs may be completed on many different bases, almost any basis would provide additional indications of the risks which might stress capital and, thus, the adequacy of capital.

each of these measures is constructed independently, and they are viewed as a portfolio which, using judgment to balance and combine them, reflect the safety of the entities. The same practice seems to be the intention of regulators with respect to group capital adequacy measures.

The question then becomes whether scalars—reflecting the relative safety of entities in other jurisdictions—should solely reflect safety as indicated by capital adequacy or whether it should capture the influence on safety of other factors as indicated in the revised "ideal?" Consistency might argue for restricting scalars to considerations of capital adequacy; completeness might argue for expanding the scope of scalars to include other factors.

It might be helpful to illustrate "ideal" scalars for entities within the same industry (e.g., insurance) but where at least one entity in a group operates outside the home jurisdiction (e.g., United States). To restate, scalars are designed to allow the available and required capital of an entity in a foreign jurisdiction to be added to the available and required capital of their group in the home jurisdiction, adjusting appropriately for differences in the risk levels embedded explicitly or implicitly in the rules and procedures of the distinct jurisdictions. In order to isolate the impact of differences in rules across jurisdictions, it may also be important to recognize differences in the relative riskiness of the books of business of entities across jurisdictions.

In general, the "ideal" scalar could be identified as a multiplier for required capital (or, perhaps, multipliers for required and available capital) which, when used to adjust the required and/or available capital of an entity in a foreign jurisdiction, would produce the same capital ratio for the foreign entity as that entity would have exhibited had it operated in exactly the same way in the home jurisdiction.

To begin an illustration (as represented in Figure 1), a hypothetical insurance entity operating in the United States (U.S.), the home jurisdiction is posited. The company, A, has available capital of $15,000, and required capital of $2,000. This produces a capital adequacy ratio, in the narrow sense discussed above, of 7.5. Company A has reserves of $7,500 required under local regulations. To measure capital adequacy in the broader sense described above a ratio of available capital to the sum of required capital and reserves is defined. This is comparable to the total asset requirement as used by many life insurers in their internal capital frameworks. For current purposes, it stands as a simple indicator of the difference in capital adequacy ratios when factors beyond the available and required capital are taken into account. For Company A, the capital adequacy ratio in a broad sense is 1.58.

One way to conceptualize "ideal" scalars is to assume that an entity identical to one in the home jurisdiction operated in a foreign jurisdiction. Its available capital would be identical (assuming away issues related to exchange rates).[13] However, its required capital and reserves might differ due to different regulatory frameworks, even if the underlying business is identical. In the illustration, the same entity, Company A, is considered operating in three foreign jurisdictions: 1, 2, and 3.

Figure 1: 'Ideal' Scalars, One U.S. Company

JURISDICTION	U.S.	Foreign 1	Foreign 1	Foreign 2
COMPANY	A	A1	B1	A2
Reserves	$7,500	$7,500	$8,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,000	$2,000	$3,000
Capital Adequacy Ratio (Narrow)	7.5	5	7.5	5
Implied Scalar (Narrow)		0.67	1.00	0.67
Capital Adequacy Ratio (Broad)	1.58	1.43	1.43	1.58
Implied Scalar (Broad)		0.90	0.90	1.00
		Same Reserves	Higher Reserves	Lower Reserves
		Higher Req Cap	Same Req Cap	Higher Req Cap

Narrow = Avail/Req
Broad = Avail/Total Asset Req = Avail / (Reserves + Req)

In jurisdiction 1, Company A1 is required to maintain the same reserves as in the U.S., but the required capital is higher, reflecting a higher safety level. Under the specific parameters of the illustration, the narrow capital adequacy ratio would decrease from 7.5 in the U.S. to 5.0 in jurisdiction 1. If an "ideal" scalar for Company A1 were to be identified, defining the scalar as a multiplier for required capital that restores the narrow capital adequacy ratio of the entity in a foreign jurisdiction to the same level as the entity would manifest in the U.S., the narrow scalar implied would be 0.67. Dividing the available capital of Company A1 by 0.67 times the required capital of A1 produces a narrow capital adequacy ratio of 7.5, identical to the original ratio of Company A operating in the U.S. Similarly, in jurisdiction 1, the broader capital adequacy ratio declines from 1.58 to 1.43; an implied scalar of 0.90 restores the broader capital adequacy ratio to the same level as the company when it operates in the U.S.

13 At this point, it is assumed that available capital would not be modified by different jurisdictional rules. Later in this paper, this assumption is relaxed.

Entities identical to Company A operating in two other jurisdictions are also examined: In #2, reserves are higher while required capital remains the same as in the U.S.; and in #3, reserves are lower than in the U.S. while required capital is higher. These examples do not exhaust the possibilities qualitatively nor quantitatively. They serve as points illustrating some of the possibilities that might arise when considering "ideal" scalars in the narrow and broad sense. Three principal observations occur from these simple illustrations:

1. Assuming available capital remains the same, if required capital does not vary, then the narrow capital adequacy ratio will not vary, even if the safety of entities might be different due to other factors (such as different levels of reserves);

2. In the broader sense, the capital adequacy ratio does not vary unless the sum of reserves and required capital varies. That is, the broader ratio is indifferent to the origins of the requirements that serve as a baseline against which to measure available capital; and

3. Either the narrow adequacy ratio or the broader one might differ more across jurisdictions. For example, comparing Company A in the U.S. to Company A1, the narrow ratio declines substantially (by 50%) while the broad ratio declines slightly (by ~10%). However, comparing Company A and Company A2, the narrow ratio remains unchanged while the broad ratio declines slightly once again. Both then qualitative and quantitative aspects of the differences in jurisdictions will determine whether the ratios differ similarly or differently.

The variation in capital adequacy ratios can be extended, with similar results, with consideration of two companies in the U.S., similar in size but differing in the risks associated with the businesses. Company A remains the same. Company B, also operating in the U.S., maintains the same reserves and has identical available capital. However, because of its higher levels of risk, the required capital for Company B is significantly higher than that of Company A. This leads to lower capital adequacy ratios, both broad and narrow, for Company B relative to Company A, reflecting the lower level of safety provided by the same available capital. When entities identical to Company B join those identical to Company A operating in foreign jurisdictions 1, 2, and 3, the results show a wider range of variation consistent with the same observations as earlier. Importantly, the adequacy ratio of the relatively riskier company, whether narrow or broad, is lower (reflecting less safety) compared to the ratio of the relatively safer company, in every jurisdiction.

Figure 2: 'Ideal'" Scalars, Two U.S. Companies

JURISDICTION	U.S.	U.S.	Foreign 1	Foreign 1	Foreign 2	Foreign 2	Foreign 3	Foreign 3
COMPANY	A	B	A1	B1	A2	B2	A3	B3
	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier
Reserves	$7,500	$7,500	$7,500	$7,500	$8,500	$8,500	$6,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,500	$3,000	$4,500	$2,000	$3,500	$3,000	$4,500
Capital Adequacy Ratio (Narrow)	7.50	4.29	5.00	3.33	7.50	4.29	5.00	3.33
Implied Scalar (Narrow)			0.67	0.78	1.00	1.00	0.67	0.78
Capital Adequacy Ratio (Broad)	1.58	1.36	1.43	1.25	1.43	1.25	1.58	1.36
Implied Scalar (Broad)			0.90	0.92	0.90	0.92	1.00	1.00
			Same Reserves	Same Reserves	Higher Reserves	Higher Reserves	Lower Reserves	Lower Reserves
			Higher Req Cap	Higher Req Cap	Same Req Cap	Same Req Cap	Higher Req Cap	Higher Req Cap

In the illustration above, factors beyond available capital and required capital have been accounted for by creating a broad ratio that includes reserves. Another way in which other factors could be incorporated, if so desired, would be to rely on an external benchmark for the safety of entities and/or groups. Whether looking at the probability of default, or the distance to insolvency, or the distance to intervention—three possible external benchmarks—using an external benchmark to create scalars would implicitly (or explicitly) reflect the impact of both capital adequacy and other factors. Hence, if inclusion of factors beyond capital adequacy is desired, the reliance on an external benchmark might well be "ideal," if it is practical.

Beyond the practical challenges of the "ideal" scalars suggested above, conceptually designing "ideal" scalars when entities are in different industries poses additional challenges. To say that a bank, for example, should recalculate its available capital and measure of inherent risk by the rules governing insurance companies may not only not be ideal, it may not be useful at all. For example, intervention in insurance occurs when the capital adequacy ratio falls below 300% (or 200%); for banks, the equivalent intervention threshold is 8%. Recalculating a bank's available capital and required capital by insurance standards misses the difference in the businesses involved—differences that may account for a significant portion of the difference between thresholds of 8% and 300%. An "ideal" scalar to convert bank-available and required capital must somehow account for the difference in the businesses involved. It is unclear whether that is possible, even in an ideal sense, by looking solely at the operations of an individual entity. If it is possible, a method relying on

an external benchmark, as just discussed, might serve the purpose. Otherwise, in addition to multipliers for available capital and required capital, some method would be required to convert the ratios from one kind of business to another kind entirely.

Hence, "ideal" scalars may be defined when considering entities in the same industry operating in different jurisdictions, although the exact specification depends on the definition of specific purpose. However, when entities operate in different industries (and thus, by definition, in different jurisdictions), the definition of an "ideal" scalar, while it may still exist, is certainly more complex.

Ideal Approximation: Aggregate Adjustments for Differences in Accounting, Safety, and Industry

Given the practical difficulties and/or impossibility of defining "ideal" scalars at the level of individual entities, most efforts to define scalars aim to identify characteristics of the entities within a jurisdiction as a basis for comparison to other jurisdictions. For example, one could look at the average capital adequacy ratios in country A and country B and adjust the required capital measure for entities from country B to make the average ratio in country B equal to that in country A. This is but one example, and this shall be considered along with others in subsequent sections of the paper.

To define a conceptually "ideal" approximation for scalars, with adjustments based on the totality of experiences of entities in the different jurisdictions, one would want to root the approximation in the defining purpose of scalars, namely the construction of a group capital adequacy measure comparable to measures already constructed for entities. Those existing measures are used as an early warning sign for inadequate capital that might lead to insolvency and/or bankruptcy, affecting the claims of customers, creditors, and/or shareholders.

Hence, an "ideal" approximation for scalars might begin with a description of the experience of a jurisdiction with its entities avoiding the problems that flow from inadequate capital. For example, one might look at the average default rate within one jurisdiction, compared to another. Yet, the search for an "ideal" yardstick raises a host of questions, some of which are:

1. What is the best outcome to consider? Defaults can refer to many different consequences, which might distinguish the effects on customers, creditors, and shareholders. And would it be better to look at problems prior to default, and if so, is there a uniform definition that could apply across financial services jurisdictions?[14]

2. Is there a robust relationship between capital adequacy ratios and specified outcomes (for example, the probability of default)? While ratios are set by legislators and/or regulators on the assumption that higher ratios (up to some limit, perhaps) provide more safety, they are not generally set based on systematic examination of the relationships. Moreover, there seems to be clear recognition that other factors, beyond capital adequacy, affect these outcomes. Again, one could choose either to control, or not to control, for some or all of those other factors in examining the relationship between capital adequacy and a given outcome.

3. Is there a way to disentangle the effects of intervention from an analysis of capital ratios and undesirable outcomes? Is it possible that two entities in different jurisdictions with comparable and identical adequacy ratios proceed differently—one continuing as a healthy entity, the other disappearing in default—based on more effective early intervention in one jurisdiction and not the other? Should these effects be disentangled, or should the nature and quality of interventions be incorporated into the characterization of the relative safety of different jurisdictions as yet another factor beyond capital adequacy?

This paper does not aim to answer these questions fully at the conceptual level. However, as specific possibilities are raised, this paper will return to these questions, examining the answers to them implied by the different approaches to scalar construction.

14 A reminder that this section is not talking about data availability, but rather considering whether there is a conceptual definition which, assuming unlimited access to required information, could be specified.

Section 3

Criteria for the Assessment of Scalers

The purpose of scalars is to translate available capital and required capital of an entity in one jurisdiction into values that are appropriate for addition to those of other entities in another jurisdiction. As possible scalar methodologies are examined, by what criteria shall they be assessed? This section of the paper will begin by introducing appropriate criteria at a general level before proceeding to elaborate more specifically the derived criteria that will guide the assessments of specific potential scalar methodologies.

To begin, it is worth noting that any proposed methodology must meet criteria which are both theoretical and practical. As described in a noteworthy article on accounting: "Criteria is used here to mean the standards by which something is judged. More particularly, conceptual criteria for accounting measures are standards by which we judge whether the proposed goal for the accounting process is or is not acceptable. Feasibility criteria for accounting measures are standards by which we judge whether a particular method of measurement is practicable, given the goals for the accounting process."[15] In these terms, both conceptual criteria (theoretical) and feasibility criteria (practical) are required.

Theoretical criteria arise from the theory of measurement developed in the social sciences largely in the late 1940s–1950s. "[T]he purpose of a theory of measurement in the social sciences is to state the objectives of the measurement process, describe how measurement should be established and the standards against which measurements can be compared. …" Caws (1959:3) also states: 'Measurement presupposes something to be measured, and, unless we know what that something is, no measurement can have any significance.'[16]
"The objective of the measurement process for scalars was discussed in the prior section of the paper. Next, this paper will examine the processes by which measurement might be established; i.e., what are the "standards against which measurements can be compared"?

15 McDonald (1967),"Feasibility Criteria for Accounting Measures,"page 662.
16 Musvoto (2011), "The Role of Measurement Theory in Supporting the Objectives of the Financial Statements," page 2.

Across the social sciences, from economics to public health, from politics to policy evaluation research, two criteria are generally held to be the keys to effective measurement: validity and reliability. "Reliability describes how far a particular test, procedure or tool, such as a questionnaire, will produce similar results in different circumstances, assuming nothing else has changed. Validity is a subtler concept. It is about the closeness of what we believe we are measuring to what we intended to measure."[17]

In moving from the theoretical criteria of validity and reliability to practical criteria, we look to the Federal Reserve Board's research on scaling, which provides the following perspective: "There are at least three considerations of importance in assessing the scaling methods. We identify these as the reasonableness of the assumptions, ease of implementation, and stability of the parameterization."[18]

The first of these criteria—the reasonableness of assumptions—is the basis on which validity often rests (defined as "construct validity"). The second and third of these criteria define practical grounds for assessment. If a methodology cannot be implemented, it is not useful. If it is more difficult than another methodology of comparable reliability and validity, then it should not be preferred. Parameter stability is another potentially important practical criterion. If the metrics derived with the use of scalars are to be used for periodic review of a group's financial condition, then it would be more useful if it were known that the measure observed at one moment would be unlikely to be wildly different if the measure were constructed shortly before or shortly after the actual moment of measurement. Even if the measures are to be reviewed continuously, significant fluctuations in the values over time make it more difficult to determine the direction of motion. Hence, even for continuous measures, the stability of parameters is useful.[19]

Four independent general criteria are described below: validity, reliability, ease of implementation, and stability of parameters. Translating these criteria to specifically apply to scalars and elaborating on specific factors that might be assessed under each of these four general criteria will make the assessments more comparable and more useful.

17 Roberts and Priest (2006). "Reliability and Validity in Research." This concept of reliability, drawn from measurement theory as developed in the social sciences, covers ground related to the actuarial concept of credibility. In this paper, reliability refers to all of the steps in the process which might cause variation in the results when there is no variation in the relationships or quantities being measured.
18 Board of Governors of the Federal Reserve System, "Comparing Capital Requirements in Different Regulatory Frameworks."
19 Of course, instability might reflect real, meaningful instability in the underlying conditions affecting entities in different jurisdictions. This would be more likely seen in market-based metrics, such as the ICS. Nonetheless, other things equal, stability of parameters remains valuable if the resulting calculations are to be useful for periodic, and not continuous, review.

Validity: As applied to scalars, validity requires that the selected methodology generate values for available capital and required capital for an entity in a foreign jurisdiction that can appropriately be added to the values of available capital and required capital of those entities within the same group located in the home jurisdiction. To the extent that appropriateness requires consideration for factors beyond capital adequacy, then the measures should incorporate those factors. A restatement of validity might be that a valid scalar is an "ideal" scalar. As with research in the social sciences, the "ideal" may well not exist. Nonetheless, minimizing the distance from the ideal is a crucial criteria There are two common ways in which validity is evaluated: the reasonableness of assumptions, and the correlation of the measure with other known measures of similar quantities. Just as the Federal Reserve Board did, and given the absence of work on other scalar methodologies, or on similar quantities, this paper will rely on the reasonableness of assumptions.

Reliability: As applied to scalars, reliability implies a set of process characteristics. Reliability requires a process where any entity or group calculating a scalar will know with confidence that they are using the same information which any other entity or group would use.[20] This implies that the definition of scalars must be:

- transparent,
- unambiguous, and
- based on broadly available and understood data.

To the extent these characteristics are not present in a given methodology, the measures derived will be less reliable.

Ease of implementation: While many features of a scalar methodology might affect the ease of implementation, two stand out:

- Availability of data: While some methods depend on easily available data, others do not. To the extent that data is unavailable, or the available data is of lesser quality for the required purposes, that will limit the ease of implementation. Pre-existing data would be easier to implement than data requiring new processes to collect.
- Compatibility with existing procedures: Where the calculation and implementation of scalars requires significant changes in the way in which regulators and companies operate, this will produce limits on the ease of implementation. This includes both the calculation of the scalars and the ways scalars are incorporated into the group capital adequacy calculation.

20 Scalars might be calculated and embedded in the group capital adequacy metrics in at least two ways: 1) entities might calculate the scalars following directors from their regulator. That is the method contemplated in this discussion; or 2) entities could provide the necessary information on their entities to their regulator, and the regulator would do the required calculations. In this second process, reliability requires knowing that the same information is being provided to regulators by all groups.

Stability of parameters: Scalars may be built from underlying parameters; they represent parameters themselves, and they produce resultant values for available and required capital. While the resultant values could be unstable due to the instability of local and foreign jurisdiction calculations of available and required capital, the stability of the underlying parameters and of the scalars themselves is important if they are to be useful. This does not mean that they must be invariant; changes in the rules governing a jurisdiction ought to change scalars for those jurisdictions if the rules changes imply a change in the safety level of the new calculations. Other changes—for example, in the macroeconomic environment—might cause instability in the parameters that might be inappropriate. Depending on the purposes for which the derived metrics are used, more or less sensitivity to changing conditions might be appropriate. Hence, in assessing scalar methodologies for stability, both assessing stability when conditions remain essentially unchanged and assessing the sensitivity of the measures to changing conditions can be done.

Section 4

Assessments of Scalar Methodologies

In this section of the paper, four families of methodology for estimating scalars are assessed: No Scalars, Capital Ratios, Equivalence of Two Points, and Probability of Negative Outcomes. Each of these families includes multiple variants. The discussion of these methodologies by the criteria just suggested presents issues to consider—sometimes applying to all branches of a family and sometime applying to one branch but not others.

A Federal Reserve Board white paper, *Comparing Capital Requirements in Different Regulatory Frameworks* (September 2019), presents several other approaches that might be considered. The section "Review of Other Scaling Methods," outlines several methods and discusses the advantages and disadvantages in a manner consistent with the discussion here. For those interested, please refer to that paper for discussion of those other methods. Most of those methods appear to have sufficient challenges identified in the FRB paper to be unlikely options for the most appropriate method.

No Scalar

A good place to begin is an examination of No Scalar—a default category in which regulators do not specify a particular scalar for each jurisdiction. In the non-default categories, regulators select a methodology that generates a scalar[21] for groups to use for any entities which operate in particular foreign jurisdictions. They might specify, for example, that for U.S. groups, any entities operating in a particular country shall use a scalar of 0.25. In this current default category, regulators do not specify a particular scalar for use in each foreign jurisdiction. This does leave two options available within this category, and each shall be assessed in turn.

Scalar Equal to 1

Perhaps the simplest possibility is for regulators to specify that all groups should use a scalar equal to 1 for all entities in the same industry in foreign jurisdictions. In December 2020, that was the option selected by the National Association of Insurance Commissioners when

21 A scalar might consist of a single quantity, normally a multiplier for required capital. However, a scalar might consist of multiple factors; for example, a scalar might include one multiplier for available capital and one multiplier for required capital. The use of the singular term scalar applies to any scalar, whether it consists of a single multiplier or more than one.

it finalized the initial instructions for group capital calculations.[22] While the discussion of it indicated this decision remains subject to change, it is worth beginning the assessments by examining this simplest of options.

Validity: The only problem—but it is a serious one—with the option of setting scalars equal to 1 is that it is strictly invalid. As discussed in the background and introduction of this paper, different jurisdictions vary in their accounting process and in the setting of capital adequacy standards in such a way that they incorporate explicitly or implicitly different safety levels in their measures. Yet, setting scalars equal to 1 implies that safety levels are the same in both the home and foreign jurisdictions. While this might be true sometimes, it is certainly not always true. This makes the assumption underlying this option unreasonable—and must be cause to view the option as invalid.

This is the beginning, not the end of the discussion of the validity of this option. If there were other available metrics routinely calculated for entities and/or groups that conceptually ought to be highly correlated with scalars (or the derived group capital adequacy metrics which rely on the scalars), the correlation of the results of using this option with that other metric could be examined. However, that option does not exist in any simple form.[23] However, one could consider an alternative approach to assessing how far from valid are the products of this option.

Sensitivity analysis offers an opportunity to assess how invalid this option for scalars might be. If, for example, one used a scalar of 1 but examined the resulting group capital adequacy ratios with scalars ranging from 0 to 2, one would get a sense of how much difference varying the scalar would make. If, for example, the size of a foreign entity (or all foreign entities) is small relative to the size of the group, then varying the scalar over quite a large range could indicate that the group metrics would not vary significantly. If this were the case, this option would be judged as sufficiently valid to consider further.[24]

Reliability: This option is completely reliable; it is transparent, unambiguous, and requires no data. Every group will know that for every foreign entity they will use a scalar of 1, and that any other group would do the same.

22 National Association of Insurance Commissioners (November 17, 2020), page 45.
23 In Section 4(D), when the Probability of Negative Outcomes is discussed, it will include the possibility that existing metrics, such as credit or financial strength ratings, might be considered as conceptual cousins of scalars and their derived adequacy metrics.
24 While there has been discussion at the NAIC of sensitivity analysis of the scalars, it is unclear whether a simple variation of the constant scalar was intended as opposed to a comparison of results of the constant scalar and those in which other methodologies contemplated by the U.S. insurance regulators—such as excess capital ratios—were introduced. Both forms of sensitivity testing could demonstrate the approximate validity of the option assessed here. If differences in scalars do not change results, then the argument for the simplest possibility becomes quite strong.

Ease of implementation: There could not be an easier option to implement. No data—beyond that already used to calculate capital adequacy measures for individual entities—is required. Similarly, no efforts beyond that already undertaken for individual entities is required to implement this option.

Stability of parameters: The constant scalar is as stable as a parameter can be. And the resultant group capital calculations are as stable as the underlying measures of available and required capital.

Scalar identified by double-accounting

A second option in which regulators choose not to specify particular scalars for particular jurisdictions would require groups to approximate the "ideal" scalar discussed in Section 2 of this paper. For any entity operating in a foreign jurisdiction, groups would be required to calculate the available and required capital for that entity as if it were operating in the home jurisdiction. While this would not account for other factors affecting the safety of the foreign entity (such as differential reserve requirements) and would not apply if the entity were in a different industry, but within these limits, this method would seem to produce scalars worth considering.

Validity: The assumptions underlying this option, discussed in the introductory section of this paper, makes this option essentially an operationalization of the definition of the scalar's objective (putting aside the factors beyond the capital adequacy metrics themselves, which can affect the safety of an entity and/or group). As such, and with that caveat, this option would be valid on its face. However, this option would only be valid if every jurisdiction specified the rules for all operations as they occur in every other jurisdiction (or, at least in the jurisdictions relevant to a particular selection of scalar methodology). For example, if automobile insurance policies in the home jurisdiction do not include catastrophic claim coverage, but such policies in a foreign jurisdiction include such coverage, then accounting for the entity in the foreign jurisdiction by home jurisdiction rules would require that the home jurisdiction specified rules for the calculation of required capital for policies as they are commonly issued in the foreign jurisdiction. If all such rules exist, double accounting would be valid on its face. If some of those rules do not exist, then methods would have to be developed to approximate the appropriate values, reducing the validity of the method.

Reliability: This option would require groups to produce accounts for foreign entities that satisfy the requirements of the home jurisdiction. These accounts would exist alongside those needed to meet local requirements. In one sense, the data required for groups would be very familiar, transparent, and well known to the groups and their regulators. In another sense, however, it is possible that some data required for home jurisdiction accounting would be obscure in the accounts maintained according to foreign jurisdictional rules. This might require foreign entities to create new processes not just in their accounting but in their operations as well, allowing them to capture data required by home jurisdiction rules.

Ease of implementation: This option would require companies to produce available and required capital in two forms for any entity operating in a foreign jurisdiction. If the information required by the home regulatory regime is identical to the information collected pursuant to the demands of the foreign regulatory jurisdiction, then this option requires only (although this may be quite an undertaking) that the foreign entity reproduce the processes in place in the home jurisdiction to create the comparable numbers. If the information requirements between the two jurisdictions differ significantly, then efforts to collect the needed additional information (i.e., that which is required by the home jurisdiction but not by the foreign jurisdiction) would also need to be put in place.

Stability of parameters: The relevant parameters for this option would depend on the requirements of the home and foreign jurisdictions. To the extent that regulatory regimes are stable, usually changing incrementally, the resultant scalars implied by this option would be relatively stable. Of course, if any jurisdiction did significantly alter its requirements, the calculations under this option would also have to change significantly. This would be likely to produce significant change in parameters and might produce significant changes in results.

Capital Ratios

The next widely discussed possibility is using relative average solvency ratios to scale required capital originating in non-home jurisdictions. The beginning point for this category of methods is the assumption that the average solvency ratio in a jurisdiction provides a summary of the differences in regulatory treatment of both available capital and required capital. By relying on the relationship of those averages, one might scale the values from a foreign jurisdiction to be equivalent to those from the home jurisdiction. Again, two variants of this methodology are assessed (although others could certainly be imagined).

Pure Ratio

The most straightforward application of this methodology, sometimes referred to as the "Pure Ratio" approach, scales the required capital of a foreign entity by the ratio of the average foreign jurisdiction solvency ratio to the average home jurisdiction ratio. If the average ratio in the home jurisdiction were 3.0, and the average ratio in the foreign jurisdiction were 6.0, then an entity in the foreign jurisdiction with $100 million in available capital and $10 million in required capital would report to the home jurisdiction, for group capital calculation, $100 million in available capital and $20 million in required capital. In principle, if this scalar were applied to all entities operating in the foreign jurisdiction, the resultant adjusted average solvency ratio in the foreign jurisdiction would equal that of the home jurisdiction. In this way, the values transferred to the home jurisdiction are arguably comparable.

Validity: This method succeeds in making the values associated with foreign entities comparable. However, the comparability is meaningful only under quite restrictive assumptions. If differences in average solvency ratios reflect solely differences in the construction of the two metrics—available and required capital—then, assuming other factors, such as reserves, are the same, this method will produce meaningful if not perfect compatibility with the home jurisdiction. The comparability might be imperfect in the sense that the method will make the ratios of available to required capital which are transferred to the home jurisdiction comparable, but the levels might not be appropriately adjusted. Examining solely the averages of the ratios does not provide information on the extent to which differences in the ratios are the result of differences in available capital, or in required capital, or in both. By applying the scalar to the required capital, one is forced to make the further assumption that any differences between the two jurisdictions (home and foreign) are due to differences in required capital alone.

If differences in average solvency ratios reflect differences in factors beyond the construction of the two metrics then the validity of the measure is challenged. If one considers an "ideal" case, this might be seen clearly. Assume, as immediately above, that the average solvency ratio in a foreign jurisdiction is 6.0, while the average ratio in the home jurisdiction is 3.0. Add to that the assumption that reserves are identical between the two jurisdictions. Finally, assume that the methods of calculating both available capital and required capital are also identical. In other words, the higher average solvency ratio in the foreign jurisdiction reflects a real difference in the capital available to entities. The higher level of safety represented in this average foreign entity would be diminished in transferring values to the home jurisdiction for group capital calculation if the Pure Ratio methodology were the basis for scalars.

Beyond this fundamental issue with the validity of the Pure Ratio (although one that might be of limited importance in practice), there is another issue which arises from applying a jurisdictional average to every entity. The impact of the averaging effect is evident in illustrations based on the illustrative model introduced in considering the "ideal" scalar. Recall that in the "ideal" illustration, entities in foreign jurisdictions are assumed to be identical to those in the home jurisdiction. As a result, their available and required capital, properly translated, are known to be equal to that reported by the entity in the home jurisdiction. Figure 3 introduces three new elements to the illustrations in Figures 1 and 2 in order to demonstrate possible impacts of the Pure Ratio scalar. The first element is the mix of safer and riskier entities in each jurisdiction. For this illustration, assume that all entities in all jurisdictions are identical to one of the two archetypes: the relatively safer and the relatively riskier entities. In Figure 3, it is assumed that the three foreign jurisdictions share an identical mix of firms—50% safer, 50% riskier—as in the U.S., the home jurisdiction.[25] Based on the mix of entities, the second new element—the calculation of the average solvency index for each jurisdiction—is introduced. This index is calculated both on the narrow basis (excluding reserves) and on the broader basis (including reserves). Finally, based on the average ratios of the jurisdictions, narrow and broad scalars based on the Pure Ratio method are calculated.

25 In Figures 4 and 5, the industrial mixes of the foreign jurisdictions will be varied. Note: For simplicity, it is assumed that all entities of the same safety level ("safer," "riskier") in each jurisdiction are identical.

Figure 3: Pure Ratio Scalars in Foreign Jurisdictions With the Same Mix of Safety of Entities

JURISDICTION	U.S.	U.S.	Foreign 1	Foreign 1	Foreign 2	Foreign 2	Foreign 3	Foreign 3
COMPANY	A	B	A1	B1	A2	B2	A3	B3
	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier
INDUSTRY PROPORTION	50%	50%	50%	50%	50%	50%	50%	50%
Reserves	$7,500	$7,500	$7,500	$7,500	$8,500	$8,500	$6,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,500	$3,000	$4,500	$2,000	$3,500	$3,000	$4,500
Capital Adequacy Ratio (Narrow)	7.50	4.29	5.00	3.33	7.50	4.29	5.00	3.33
Implied Scalar (Narrow)			0.67	0.78	1.00	1.00	0.67	0.78
Capital Adequacy Ratio (Broad)	1.58	1.36	1.43	1.25	1.43	1.25	1.58	1.36
Implied Scalar (Broad)			0.90	0.92	0.90	0.92	1.00	1.00
Avg Capital Adequacy Ratio (Narrow)	5.89		4.17		5.89		4.17	
Implied Scalar Avg (Narrow)			0.71		1.00		0.71	
Avg Capital Adequacy Ratio (Broad)	1.47		1.34		1.34		1.47	
Implied Scalar Avg (Broad)			0.91		0.91		1.00	
			Same Reserves	Same Reserves	Higher Reserves	Higher Reserves	Lower Reserves	Lower Reserves
			Higher Req Cap	Higher Req Cap	Same Req Cap	Same Req Cap	Higher Req Cap	Higher Req Cap

In Figure 3, the averaging effect is obvious. Entities A1 and B1 would ideally (in a narrow sense) have scalars of 0.67 and 0.78. In the Pure Ratio approach, they would both apply a scalar of 0.71; this means that entity A1 is applying a larger scalar than necessary to accurately adjust its required capital, and entity B1 is applying a smaller scalar than necessary. Unless all entities share identical "ideal" scalars, this averaging effect will always occur. Of course, the differences between the "ideal" and the calculated scalars are not large (e.g., 0.67 compared to 0.71), and sensitivity analysis in particular circumstances might reveal this effect to be of minimal importance.

Figure 4 replicates the situation constructed in Figure 3 with one difference: The mix of entities in the three foreign jurisdictions is now assumed to be safer than in the home jurisdiction, with 75% of the entities relatively safer as opposed to 50% in the U.S. Results are similar except that there are now more pronounced differences between the "ideal" and calculated scalars. For example, entity A1, with an "ideal" scalar of 0.67, would now have a calculated scalar of 0.78. Note that in jurisdiction 1, entity B1 would experience a

match between its "ideal" and its calculated scalar. In other words, once the mix of entities in jurisdictions is allowed to differ, larger potential differences in the scalars implied are observed; that some entities will have little or no distortion in the scalars implied for their use is also noted.

Figure 4: Pure Ratio Scalars in Foreign Jurisdictions With a 'Safer' Mix of Entities

JURISDICTION	U.S.	U.S.	Foreign 1	Foreign 1	Foreign 2	Foreign 2	Foreign 3	Foreign 3
COMPANY	A	B	A1	B1	A2	B2	A3	B3
	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier
INDUSTRY PROPORTION	50%	50%	75%	25%	75%	25%	75%	25%
Reserves	$7,500	$7,500	$7,500	$7,500	$8,500	$8,500	$6,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,500	$3,000	$4,500	$2,000	$3,500	$3,000	$4,500
Capital Adequacy Ratio (Narrow)	7.50	4.29	5.00	3.33	7.50	4.29	5.00	3.33
Implied Scalar (Narrow)			0.67	0.78	1.00	1.00	0.67	0.78
Capital Adequacy Ratio (Broad)	1.58	1.36	1.43	1.25	1.43	1.25	1.58	1.36
Implied Scalar (Broad)			0.90	0.92	0.90	0.92	1.00	1.00
Avg Capital Adequacy Ratio (Narrow)	5.89		4.58		6.70		4.58	
Implied Scalar Avg (Narrow)			0.78		1.14		0.78	
Avg Capital Adequacy Ratio (Broad)	1.47		1.38		1.38		1.53	
Implied Scalar Avg (Broad)			0.94		0.94		1.04	
			Same Reserves	Same Reserves	Higher Reserves	Higher Reserves	Lower Reserves	Lower Reserves
			Higher Req Cap	Higher Req Cap	Same Req Cap	Same Req Cap	Higher Req Cap	Higher Req Cap

Figure 5 presents the situation when the foreign jurisdictions are "riskier" than the home jurisdiction—i.e., with a larger percentage of relatively riskier entities. While broadly similar to Figure 4, there is one novel phenomenon represented in the results here: The implied scalar calculated based on the average ratios across jurisdictions is not bound by the range of "ideal" scalars among the entities in the jurisdiction. In jurisdiction 1, entity A1 has an "ideal" scalar of 0.67 while entity B1 has an "ideal" scalar of 0.78. Yet, the implied scalar based on average ratios is 0.64. This phenomenon, where the implied scalar may lie outside the range of the "ideal" scalars, suggests a disconnect between the Pure Ratio methodology and "ideal" scalars as defined here. In principle, this is a problem.

It is worth noting that in all of the illustrative results presented here, some entities will have scalars that are larger than "ideal," some will have scalars which are smaller than "ideal," and some will have scalars equal to their "ideal." Not only will some be larger and some smaller than "ideal," but the differences between actual and "ideal" can vary—some entities might be slightly smaller than "ideal," while others might be significantly larger than "ideal." The distribution of impacts will depend both on the averages for the jurisdiction as well as the particulars of the individual entities. This observation will be true for all methods that rely on jurisdictional averages.

Finally, it is worth noting that the same results that have been discussed with respect to narrow scalars apply to broad scalars with the following caveat: The difference between "ideal" broad scalars and calculated broad scalars is less than the difference seen in narrow scalars The larger, more inclusive base of the broad scalar (including reserves as well as required capital) produces smaller differences when conditions vary in the ways illustrated here.

Figure 5: Pure Ratio Scalars in Foreign Jurisdictions With a 'Riskier' Mix of Entities

JURISDICTION	U.S.	U.S.	Foreign 1	Foreign 1	Foreign 2	Foreign 2	Foreign 3	Foreign 3
COMPANY	A	B	A1	B1	A2	B2	A3	B3
	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier
INDUSTRY PROPORTION	50%	50%	25%	75%	25%	75%	25%	75%
Reserves	$7,500	$7,500	$7,500	$7,500	$8,500	$8,500	$6,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,500	$3,000	$4,500	$2,000	$3,500	$3,000	$4,500
Capital Adequacy Ratio (Narrow)	7.50	4.29	5.00	3.33	7.50	4.29	5.00	3.33
Implied Scalar (Narrow)			0.67	0.78	1.00	1.00	0.67	0.78
Capital Adequacy Ratio (Broad)	1.58	1.36	1.43	1.25	1.43	1.25	1.58	1.36
Implied Scalar (Broad)			0.90	0.92	0.90	0.92	1.00	1.00
Avg Capital Adequacy Ratio (Narrow)	5.89		3.75		5.09		3.75	
Implied Scalar Avg (Narrow)			0.64		0.86		0.64	
Avg Capital Adequacy Ratio (Broad)	1.47		1.29		1.29		1.42	
Implied Scalar Avg (Broad)			0.88		0.88		0.96	
			Same Reserves	Same Reserves	Higher Reserves	Higher Reserves	Lower Reserves	Lower Reserves
			Higher Req Cap	Higher Req Cap	Same Req Cap	Same Req Cap	Higher Req Cap	Higher Req Cap

All of the prior discussion of the validity of the Pure Ratio method applies whether the entities are in the same industry or not. However, if they are in different industries, then an additional layer of concerns arises. If either available capital or required capital (or both) are calculated in such a way that the level of values systematically differs across industries, then some adjustment for these differences must be incorporated into the Pure Ratio approach to produce meaningful comparability. In addition to adjustments to required capital based on the relationship between average solvency ratios, one might have to adjust the level of required capital and available capital by the ratio of average levels of required and available capital, respectively, in the two industries. This additional adjustment will make the values transferred to the home jurisdiction more nearly comparable but introduces additional possibilities for distortion, analogous to the averaging effects described above.

Reliability: The elements that serve as inputs for the Pure Ratio approach—available capital, required capital, possibly reserves—are generally well defined in each jurisdiction, as is, by definition, the solvency ratio.[26] The principal challenge to reliability would arise from the existence of multiple relevant ratios in some jurisdictions. In that instance, different selections of the most appropriate ratio might introduce variability in the scalars produced. Defining criteria for the selection of the metric from available choices would help in limiting variability. Sensitivity testing could be used to assess the extent to which scalars based on different selections of metrics produce different group capital results.

Ease of implementation: Data required for this methodology are generally available. In most jurisdictions, reports on solvency conditions are publicly available either from the individual entity, or from the group to which they belong, or from the regulatory authority. Averages for an industry are often reported by the regulatory authority. However, if a jurisdiction does not report—or require public disclosure of entity-level solvency ratios—it may be difficult to establish an entity-level average solvency ratio. In this case, group-level ratios might be substituted. To the extent that group solvency ratios are the weighted average of the ratios of the component entities, the group average is not a bad approximation. However, to the extent that intergroup operations modify the group ratio from the average of its entity ratios, the group average for a jurisdiction may be misleading.

Stability of parameters: To the extent that average solvency ratios are stable, the scalars calculated by this method and the results derived from the application of these scalars will also be relatively stable. Of course, events can alter ratios relatively quickly—a major

26 This is true by definition because this paper only considers jurisdictions in which the country regulates the industry by reference to a ratio of available capital and required or required capital.

recession, a series of catastrophic events—but only if those events cause differential impact on the average ratios of both the home and foreign jurisdictions will there be an impact on scalars based on the Pure Ratio method. Basing scalars on longer-term averages would reduce instability due to variability in these external conditions, if instability is a problem. It is also possible that more variability in the scalars might be expected if the home jurisdiction relies on book values while a foreign jurisdiction relies on market valuation, which might produce more variability in results, as well.

Excess Capital Ratio

The Pure Ratio method rests fundamentally on the assumption that at average levels of capital adequacy in each jurisdiction, all jurisdictions reflect comparable levels of safety. In the narrow approach, the assumption relies solely on available and required capital; in the broader approach, the assumption is expanded to include reserves. However, both broad and narrow approaches to the Pure Ratio approach continue to assume that available capital may be compared across jurisdictions without any adjustment. Yet, available capital may also reflect differences across jurisdictions both in implied safety levels and adaptations to other conditions within the jurisdiction. Hence, a modification of the Pure Ratio, sometimes referred to as the Excess Capital Ratio method, has been discussed. That modification exists in two comparable variants.

In the first variant of the Excess Capital Ratio method, in place of the ratio of available capital to required capital that anchors the Pure Ratio method, the anchor is the excess of available capital above and beyond the level of required capital. Hence, scalars are based on the average ratios of the difference between available capital and required capital, in the numerator, and required capital, in the denominator. By focusing on the excess of capital, one might expect to capture some of the differences in available capital across jurisdictions due to factors other than required capital.

In the second variant of the Excess Capital method, a second step is added to the Pure Ratio method prior to calculation of the available and required capital, which would be recorded in the home jurisdiction for an entity from a foreign jurisdiction. In the first step, identical to the Pure Ratio, the required capital of an entity in a foreign jurisdiction is multiplied by the ratio of the average solvency ratio in the foreign jurisdiction to the average solvency ratio in the home jurisdiction. In the second step, the difference is calculated between the originally reported required capital of the foreign entity and its level after adjustment by the scalar. That difference is then subtracted from the originally reported available capital of the foreign entity. The result is an adjusted available and an adjusted required capital. This also produces an adjusted capital adequacy ratio for the foreign entity.

Validity: If the primary virtue of the Pure Ratio method is its simplicity in producing comparability, the Excess Capital Ratio by either variant adds one more step, complicating the metric in the interest of increasing its validity—the extent to which the comparability it produces are more meaningful. By adjusting both required and available capital, taking into account more potential differences between jurisdictions in a still quite straightforward fashion, would seem to be more likely to produce valid results. There are several caveats to this conclusion.

As a first caveat, it is clear that the simple methods proposed in the two variants of this methodology are not the only ways in which available capital might be adjusted in a second-step procedure. Indeed, at least two other ways immediately suggest consideration. One could adjust available capital by the same scalar calculated in the Pure Ratio method to adjust required capital. This approach would follow from an assumption that the factors which lead required capital to be larger or smaller than it would be if calculated in the home jurisdiction are the same as those which affect available capital.[27] This adjustment would produce required and available capital values transferrable to the home jurisdiction in a comparable form. It would, however, leave the capital adequacy ratio of the entity in the foreign jurisdiction unchanged, hence, failing to bring it into line with the capital adequacy ratio that the entity would produce in the home jurisdiction. If the definition of the "ideal" scalar remains tied to matching the ratio after scaling to the home jurisdiction, then this would fail. However, in many ways, the attempt to include other factors in the Excess Capital Ratio approach seems to aim more nearly to match the broader capital adequacy ratio of the home jurisdiction, one which accounts for reserves as well as available and required capital. Whether it achieves that goal (or approaches it more closely than the Pure Ratio approach, for example), shall be examined shortly with an analysis of illustrative scenarios.

Alternatively, as suggested for the Pure Ratio applied to entities in different industries, one could adjust available capital by examining the ratio of average levels of available capital in the home and foreign jurisdictions. This method applied to all entities, not just entities in different industries, assumes that the factors affecting available capital might differ from those affecting required capital, and would allow for independent adjustments. Sensible values for both available and required capital would be generated in two independent steps rather than sequentially. The resulting capital adequacy ratios, as with the original method

27 For example, if regulators in a jurisdiction are relatively conservative in the safety levels they wish to establish, that conservatism might affect their designated procedures for determining both available and required capital. This might include decisions such as which assets to admit as available capital.

and the first proposed alternative, would likely differ more from the "ideal" ratio, because it would add the independent changing of available capital to the "averaging effects" described earlier. However, as with the earlier approaches, it might yield ratios that are closer to the broad ratios in the home jurisdiction.

As a second caveat, the procedure outlined here relies on two steps that might be viewed as one iteration of a repeatable process. Once one has adjusted both available and required capital by the Excess Capital method (whether using the original proposal or one of the alternatives), one could repeat the process, calculating the average adjusted capital adequacy ratio in the foreign jurisdiction and comparing it to the ratio in the home jurisdiction. One could then use this ratio to adjust the once-adjusted required capital, and then adjust the once-adjusted available capital by the same method as used in the first iteration. This process could be repeated until immaterial changes are produced by additional iterations. This repeated iteration method might produce something akin to equilibrium levels for comparability. The cost of achieving these levels would be significantly more complexity.

As a third and final caveat, the validity of this method continues to rely, in part, on the assumption underlying the Pure Ratio: namely, that at average levels of capital adequacy in each jurisdiction, all jurisdictions reflect comparable levels of safety. While this assumption seems contrary to at least one major reason for introducing scalars—i.e., adjusting for differing safety levels implicitly or explicitly incorporated into different jurisdictions' rules and procedures—it does adjust for other differences, and broadly, allows comparison of the values transferred from foreign to home jurisdictions. The addition of variability in available capital to the pure ratio method almost certainly improves validity.

The existence of alternatives to the specific method described initially as the Excess Capital Ratio method does not undermine its validity, per se. It does raise questions about whether the superiority of one alternative over another could be established conceptually or empirically. While this paper does not explore the alternatives proposed in its illustrative scenarios, one could do so. Rather, the illustrative scenarios serve to examine some of the outcomes possible when applying the Excess Capital Ratio method as described.

Figure 6: Excess Capital Ratio Scalars (2nd Variant) in Foreign Jurisdictions With the Same Mix of Safety of Entities

JURISDICTION	U.S.	U.S.	Foreign 1	Foreign 1	Foreign 2	Foreign 2	Foreign 3	Foreign 3
COMPANY	A	B	A1	B1	A2	B2	A3	B3
	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier
INDUSTRY PROPORTION	50%	50%	50%	50%	50%	50%	50%	50%
Reserves	$7,500	$7,500	$7,500	$7,500	$8,500	$8,500	$6,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,500	$3,000	$4,500	$2,000	$3,500	$3,000	$4,500
Capital Adequacy Ratio (Narrow)	7.50	4.29	5.00	3.33	7.50	4.29	5.00	3.33
Implied Scalar (Narrow)			0.67	0.78	1.00	1.00	0.67	0.78
Implied Capital Adequacy Ratio (Narrow)			7.00	4.00	7.50	4.29	7.00	4.00
Capital Adequacy Ratio (Broad)	1.58	1.36	1.43	1.25	1.43	1.25	1.58	1.36
Implied Scalar (Broad)			0.90	0.92	0.90	0.92	1.00	1.00
Implied Capital Adequacy Ratio (Broad)			1.47	1.27	1.47	1.27	1.58	1.36
Avg Capital Adequacy Ratio (Narrow)	5.89		4.17		5.89		4.17	
Implied Scalar Avg (Narrow)			0.71		1.00		0.71	
Implied Capital Adequacy Ratio based on Avg (Narrow)			6.66	4.30	7.50	4.29	6.66	4.30
Avg Capital Adequacy Ratio (Broad)	1.47		1.34		1.34		1.47	
Implied Scalar Avg (Broad)			0.91		0.91		1.00	
Implied Capital Adequacy Ratio based on Avg (Broad)			1.47	1.27	1.47	1.27	1.58	1.36
			Same Reserves	Same Reserves	Higher Reserves	Higher Reserves	Lower Reserves	Lower Reserves
			Higher Req Cap	Higher Req Cap	Same Req Cap	Same Req Cap	Higher Req Cap	Higher Req Cap

In Figure 6, the Excess Capital Ratio method (2nd variant) is applied to the scenarios with three foreign jurisdictions. In this set of scenarios, the relative safety of the mix of entities remains the same as in the home jurisdiction in each of the foreign jurisdictions. The implied scalar for each entity is defined by the ratio of the capital adequacy ratio in the foreign jurisdiction to that in the home jurisdiction. Based on that implied scalar, and applying the Excess Capital Ratio method, an implied capital adequacy ratio is determined based solely on the characteristics of the individual entity and its home jurisdiction comparable. Note that, unlike the Pure Ratio, the Excess Capital Ratio method produces implied capital adequacy ratios for the foreign entities that differ from the ratio of the entity in the home jurisdiction (recall that the entities are assumed identical—e.g., A and A1—

except for their compliance with the mandates of different jurisdictions). Using the average capital adequacy ratios allows for the definition of scalars for a jurisdiction. When applied to each entity, there is again evidence of the extent to which some entities end up with larger implied capital adequacy ratios than in the home jurisdiction, and some with smaller ratios. In the case of Foreign 2, both safer and riskier entities produce adjusted ratios identical to the home jurisdiction ratios, "ideal" as defined earlier. Turning to the Excess Capital Ratio method applied to the broad capital adequacy ratio, in two scenarios the implied ratios for foreign entities are lower than they would have been in the home jurisdiction, while in one scenario, they match exactly.

Figure 7: Excess Capital Ratio Scalars (2nd Variant) in Foreign Jurisdictions With a 'Safer' Mix of Entities

JURISDICTION	U.S.	U.S.	Foreign 1	Foreign 1	Foreign 2	Foreign 2	Foreign 3	Foreign 3
COMPANY	A	B	A1	B1	A2	B2	A3	B3
	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier
INDUSTRY PROPORTION	50%	50%	75%	25%	75%	25%	75%	25%
Reserves	$7,500	$7,500	$7,500	$7,500	$8,500	$8,500	$6,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,500	$3,000	$4,500	$2,000	$3,500	$3,000	$4,500
Capital Adequacy Ratio (Narrow)	7.50	4.29	5.00	3.33	7.50	4.29	5.00	3.33
Implied Scalar (Narrow)			0.67	0.78	1.00	1.00	0.67	0.78
Implied Capital Adequacy Ratio (Narrow)			7.00	4.00	7.50	4.29	7.00	4.00
Capital Adequacy Ratio (Broad)	1.58	1.36	1.43	1.25	1.43	1.25	1.58	1.36
Implied Scalar (Broad)			0.90	0.92	0.90	0.92	1.00	1.00
Implied Capital Adequacy Ratio (Broad)			1.47	1.27	1.47	1.27	1.58	1.36
Avg Capital Adequacy Ratio (Narrow)	5.89		4.58		6.70		4.58	
Implied Scalar Avg (Narrow)			0.78		1.14		0.78	
Implied Capital Adequacy Ratio based on Avg (Narrow)			6.14	4.00	6.72	3.89	6.14	4.00
Avg Capital Adequacy Ratio (Broad)	1.47		1.38		1.38		1.53	
Implied Scalar Avg (Broad)			0.94		0.94		1.04	
Implied Capital Adequacy Ratio based on Avg (Broad)			1.46	1.27	1.46	1.27	1.56	1.35
			Same Reserves	Same Reserves	Higher Reserves	Higher Reserves	Lower Reserves	Lower Reserves
			Higher Req Cap	Higher Req Cap	Same Req Cap	Same Req Cap	Higher Req Cap	Higher Req Cap

Figure 8: Excess Capital Ratio Scalars (2nd Variant) in Foreign Jurisdictions With a 'Riskier' Mix of Entities

JURISDICTION	U.S.	U.S.	Foreign 1	Foreign 1	Foreign 2	Foreign 2	Foreign 3	Foreign 3
COMPANY	A	B	A1	B1	A2	B2	A3	B3
	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier	Relatively Safer	Relatively Riskier
INDUSTRY PROPORTION	50%	50%	25%	75%	25%	75%	25%	75%
Reserves	$7,500	$7,500	$7,500	$7,500	$8,500	$8,500	$6,500	$6,500
Available Capital	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000	$15,000
Required Capital	$2,000	$3,500	$3,000	$4,500	$2,000	$3,500	$3,000	$4,500
Capital Adequacy Ratio (Narrow)	7.50	4.29	5.00	3.33	7.50	4.29	5.00	3.33
Implied Scalar (Narrow)			0.67	0.78	1.00	1.00	0.67	0.78
Implied Capital Adequacy Ratio (Narrow)			7.00	4.00	7.50	4.29	7.00	4.00
Capital Adequacy Ratio (Broad)	1.58	1.36	1.43	1.25	1.43	1.25	1.58	1.36
Implied Scalar (Broad)			0.90	0.92	0.90	0.92	1.00	1.00
Implied Capital Adequacy Ratio (Broad)			1.47	1.27	1.47	1.27	1.58	1.36
Avg Capital Adequacy Ratio (Narrow)	5.89		3.75		5.09		3.75	
Implied Scalar Avg (Narrow)			0.64		0.86		0.64	
Implied Capital Adequacy Ratio based on Avg (Narrow)			7.29	4.67	8.53	4.80	7.29	4.67
Avg Capital Adequacy Ratio (Broad)	1.47		1.29		1.29		1.42	
Implied Scalar Avg (Broad)			0.88		0.88		0.96	
Implied Capital Adequacy Ratio based on Avg (Broad)			1.49	1.28	1.49	1.28	1.60	1.38
			Same Reserves	Same Reserves	Higher Reserves	Higher Reserves	Lower Reserves	Lower Reserves
			Higher Req Cap	Higher Req Cap	Same Req Cap	Same Req Cap	Higher Req Cap	Higher Req Cap

In Figures 7 and 8, results for a wider range of scenarios applying the Excess Capital Ratio method (2nd variant) are displayed. In general, they reveal the same range of possibilities as in Figure 6, even as the mix of "safer" and "riskier" entities varies. Sometimes the method produces higher ratios than in the home jurisdiction, sometimes it produces lower ratios, and sometimes it produces exactly the same ratio. Sometimes the mix of safer and riskier entities in a foreign jurisdiction varies results, and sometimes it does not. Only analysis of a much larger number of scenarios would clearly reveal the range of outcomes possible, dependent on the interaction of jurisdictional requirements, entity characteristics, and the mix of entities in a jurisdiction.

Reliability: Because the data requirements for the Excess Capital Ratio method, as initially specified, are the same as those required for the Pure Ratio method, the reliability would be identical. If one pursued the second alternative—using the averages of available capital within a jurisdiction—then additional data would be required. While the data required appears to be available from data vendors, there would be some room for uncertainty as the data passes through an intermediary. It is possible that regulators might obtain the required information directly from regulators in the foreign jurisdiction, removing concerns about the reliability of this extended data need.

Ease of implementation: As discussed under the Pure Ratio method, data here are generally available, although there are questions needing to be addressed when different jurisdictions define the needed quantities differently, or with options. The added complexity of the Excess Capital Ratio method does not significantly decrease its ease of implementation—unless, as discussed under reliability, additional data is required.

Stability of parameters: The stability of the parameters identified and the resulting group capital calculations depend, as with the Pure Ratio, on the stability of average capital adequacy ratios. As described above, to the extent they are stable, the results will be stable. To the extent they change—and especially to the extent they change differentially in different jurisdictions—the parameters and results of the Excess Capital Ratio method will change as well.

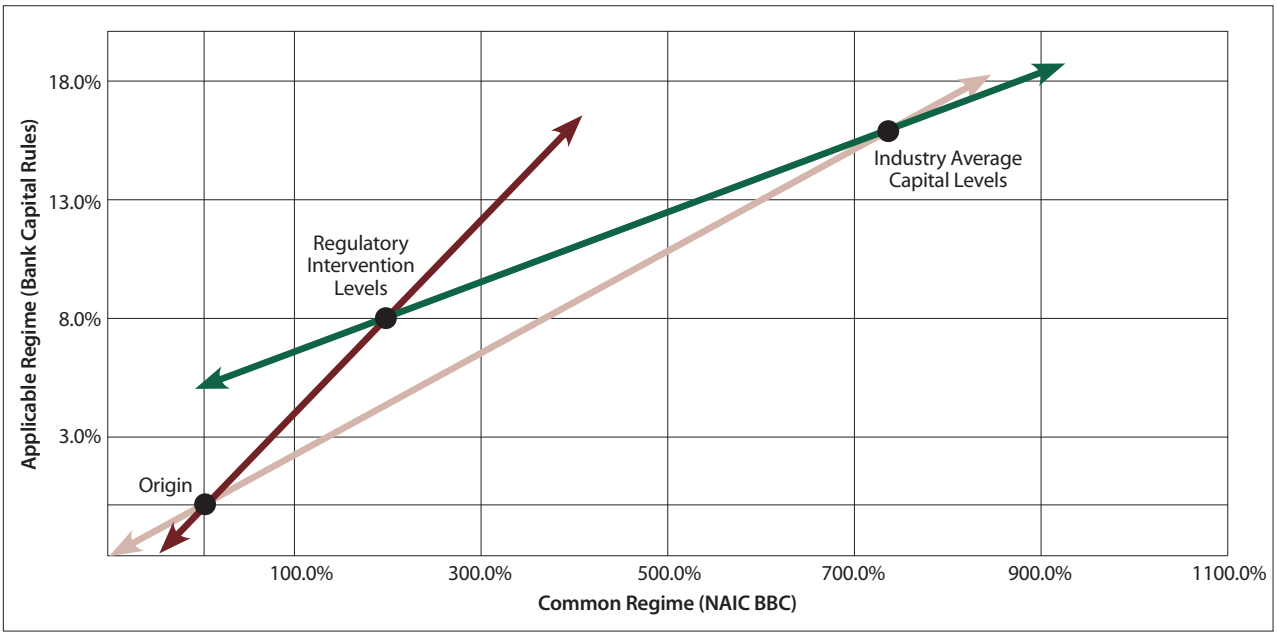
Equivalence of Two Points

In the FRB paper, a method identified as Scaling by Interpolating between Assumed Equivalent Points is presented. "Most commenters on the ANPR [Advance Notice of Proposed Rulemaking] suggested one of these methods."[28] Given this observation, it seems prudent to comment on this approach. Rather than relying on the equivalence of a single average ratio across jurisdictions (such as the capital adequacy ratio in the Pure Ratio method), this method assumes the equivalence of two points. The FRB identifies three possible points, any two of which might be used. Depending on the combination selected, this method produces scalars comparable to those we have discussed in prior categories, illustrated in Figure B. The line A—which assumes only that the absence of available capital

28 Board of Governors of the Federal Reserve System (2019), p. 18

has equal significance for capital adequacy in both jurisdictions and that levels of regulatory intervention may be matched—corresponds in many ways to the No Scalar, Scalar = 1 method. The line B—which assumes that average capital levels represent equivalent levels of capital adequacy—corresponds to the Capital Ratios, Pure Ratio method. The line C—which assumes comparable capital adequacy at both average capital ratios and at matched regulatory intervention levels—corresponds to the Capital Ratios, Excess Capital Ratio method.

Figure B: Interpolation Methods Illustrated



[Source, FRB (2019), Figure 5, page 18]

Validity: The Equivalence of Two Points method requires assumptions of equivalence for two points rather than just one. Yet, two of the three points presented (available capital at 0, and regulatory intervention levels) are largely assumed equal for all of the methods we have examined (with the exception of No Scalars, Double Accounting and Probability of Negative Outcomes). Hence, in some ways, these methods can be reduced to assumptions about a single point. However, even where they may be equivalent to other methods that focus on a single point as an anchor, recognizing reliance on a second point might be useful. It might be a disadvantage because it makes explicit that a second assumption of equivalence is required. However, it might also be an advantage, as errors or biases in one ratio might be

compensated for in the other, making the combination nearer to the "ideal." If, for example, the average capital ratios understates the safety of one jurisdiction, that might create a bias in the Pure Ratio approach. However, if the regulatory intervention point also underestimates the safety of that jurisdiction, the combination of the two underestimations might be closer to an accurate, ideal estimation than either ratio on its own. Of course, the biases could also create less ideal metrics.

Nonetheless, as with the Pure Ratio and the Excess Capital Ratio methods, the quality of the metrics depend on the validity of the assumed equivalences, which must be accepted without confirmation from data. The assumed characteristics of the two equivalent points (along with a third point of zero available capital) are well described in the FRB paper. To the extent that the assumptions of equivalence are correct, then the method would generate reasonably valid results, with the discrepancies due to jurisdictional averaging remaining, as described in the Excess Capital Ratio method.

Reliability: Data for the Equivalence of Two Points is broadly available, with one caveat. The point of regulatory intervention must be at an equivalent level of intervention in each jurisdiction. While this might be easy to identify at times, there might also be times when it is less obvious and more difficult. If the nature of first interventions varies, for example, across jurisdictions, it would raise the question of whether those interventions are equivalent. This possibility seems especially likely if the jurisdictions include different industries, but it is possible even within the same industry across different geographic regulatory regimes. Hence, the selection of appropriate regulatory intervention points might be a challenge to reliability, at least in some circumstances.

Ease of implementation: This method would be straightforward to implement, depending only on a particular method for translating the interpolated values from the line of equivalence of the two points into appropriate scalar quantities. If it is done in a manner comparable to the Excess Capital Ratio method, 2nd variant, it would be straightforward.

Stability of parameters: In the FRB analysis, some points are relatively stable (e.g., regulatory intervention) and some are less stable (e.g., capital ratios). The stability of scalars and derived group capital adequacy measures would depend on the relative stability of these two points. Sensitivity testing could determine whether the instability is minimal or material.

Probability of Negative Outcomes

The final method considered herein, the Probability of Negative Outcomes approach, is a generalization of a method widely discussed and recommended in a report by the Federal Reserve Board, based on the probability of default. While default is, in one sense, a natural outcome to use as an anchor for scalars, it raises issues which can be usefully considered in light of alternative negative outcomes as the anchor. One such possibility is a first intervention level.

If the aim of solvency metrics, such as a group capital calculation, is to avoid negative outcomes (such as default), it makes sense to root the metrics and the scalars that are used to build them in the probability of those negative outcomes. Beginning with the available and required capital and the derived capital adequacy ratio for each entity, and with information on the experience of each entity with the defined negative outcome (i.e., has it experienced that outcome or not), the relationship between capital adequacy ratios and the probability of negative outcomes can be identified. With that relationship known, scalars can be built that allow the addition of available and required capital values adjusted for the equal probability of negative outcomes.

While one might treat variants of this method separately, the variants (defined by the different outcomes which might serve as anchors) differ relatively little, except perhaps with regard to the reliability of data. In the discussion that follows, distinctions will be noted and discussed where they are relevant.

Validity: As a construct, this methodology begins with an assumption closely linked to the objective that scalars are intended to serve; if scalars are intended to adjust capital values of entities in different jurisdictions for differences in the safety levels of those jurisdictions, then using the observed absence of safety (i.e., a negative outcome) as the basis for calculating scalars intuitively appeals. While this is true, as soon as one begins to consider elaboration of this construct to create a full methodology, problems arise—even before one turns to those problems which arise from data limitations.

It is useful to begin with the definition of a negative outcome. If default is an ultimate measure of failure for an entity, different definitions of that failure emerge from the perspective of different parties. For regulators and consumers of financial services, a relevant default is one in which customers' claims cannot be satisfied. Even this definition raises many questions. Insolvency, when the net present value of liabilities exceeds that of assets, might be defined as a default; in this circumstance, not all claims created by liabilities can

be expected to be met. Currently available assets might be sufficient to meet liabilities for enough time that measures could be taken to make sufficient assets available. In this event, no customer would ever see an unmet claim on the entity. Alternatively, assets might be insufficient to meet all current liabilities, but adequate to meet some of them. While this circumstance certainly should fall within the definition of default, it raises the question of degree: Does it matter whether an entity can meet 98% of its obligations to its consumers rather than 8% of those obligations? Is any default of any degree an equally negative outcome?

Assuming agreement on a definition of default—in practice, this is likely to be driven by the availability of data—there is a problem that lies at the intersection of concept and data, and which might cause a consideration of alternative definitions of negative outcomes. Defaults of financial service companies, both insurers and banks, in the contemporary world and in the principal jurisdictions of interest, are relatively rare. This is especially true if the definition involves a significant shortfall in the ability to meet current claims.

Why does this matter? It matters because this methodology, at its root, depends on identifying relationships between capital adequacy ratios and the probability of a negative outcome. If that outcome occurs infrequently enough, it makes it difficult if not impossible to establish the difference between the capital adequacy ratios of companies unlikely to experience a negative outcome and the ratios of companies likely to experience such an outcome. Without such a difference, it becomes impossible to estimate the variation in the probability of a negative outcome associated with a given variation in a capital adequacy ratio.

The limited numbers of defaults might be mitigated by one of four options. First, one could expand the time horizon for defaults. In effect, one would look at the relationship between an entity's capital adequacy ratio and its probability of default within a certain amount of time. Conventionally, relationships are examined within the same year (i.e., the ratio at the end of one year is compared to default experience either in the prior year or in the following year). Instead, for example, one could examine the relationship between the capital adequacy ratio at the end of one year and the default experience over the next few years. While this would increase the number of entities with default experiences, it does so by introducing variable time lags between capital adequacy and the default. This variation in lags would conflate ratios that foreshadow imminent default with those that indicate future difficulties. This imprecision would yield inefficient estimates, as multiple generating processes are treated as one.

Second, one could expand the geographic scope for defaults, examining the experience of several jurisdictions as one. The aim would be to increase the number of defaults by combining the experience of similar but distinct jurisdictions, perhaps grouped geographically. Yet this too suffers from the same problem as that of an expanded time horizon, resting as it does on the assumption that different jurisdictions would yield the same relationship between capital adequacy and default.

Third, one might try to avoid the limits of defaults experiences by changing the anchor outcome from default to some other negative outcome, such as the level of first intervention. There are two general advantages to shifting the anchor for negative outcomes. By moving to a first intervention level, or something similar, one finds many more entities experiencing that level of capital inadequacy, a much larger number than those that experience default. Additionally, by moving to a first intervention level one might reduce the impact of endogeneity on the results.[29] The problem of endogeneity occurs when the actions of regulators and companies, in response to capital adequacy levels, predictably modify their behavior. That is, once a company reaches a first intervention level, the probability of default depends on the nature and extent of intervention by regulators and on the responses to those interventions by companies. Hence, using defaults as anchors for the calculation of scalars implies that both safety levels and intervention processes and procedures characteristic of different jurisdictions are captured in the scalars. By moving to a first intervention level, one refocuses the scalars on the characteristic differences across jurisdictions in implied safety levels.

Of course, relying on a first intervention level carries with it challenges of its own. If one relied on each jurisdiction's first intervention level, then scalars would continue to incorporate intervention processes in the calculation. One approach that would avoid this entanglement (if it is an entanglement to include intervention processes and procedures in the scalars calculation) would be to define a first intervention level in the home jurisdiction (e.g., a capital adequacy ratio of 3.00 for the United States) and apply that to all other jurisdictions. Rather than examining the relationship between capital adequacy ratios and negative outcomes (which would be tautological in this case, unlike in the case of anchoring with defaults), one might base scalars directly on the probability in different jurisdictions of reaching that intervention level. However, it would likely be necessary, if one adopted this approach, to adjust the capital adequacy ratios for foreign jurisdictions by a preliminary scalar before calculating whether the comparable first intervention level had been reached.

29 See more on endogeneity in the concluding section of this paper.

The idea here is to make a ratio of 3.00 in foreign jurisdictions as comparable as possible to that ratio in the home jurisdiction before creating scalars based on the anchor of first interventions.

Fourth and finally, one might try to avoid the limits of default experiences by examining some form of transition processes. If the data is sparse (conceptually) for the estimation of a relationship between capital adequacy and default, perhaps it would be easier to first identify the relationship for something akin to a first intervention level, as described above. One could begin by estimating the probability of an entity reaching that first intervention level within one year given its capital adequacy ratio. One could then estimate the probability of reaching a second intervention level within a year given both having reached the first level (or not) and the current capital adequacy ratio. Finally, one could estimate the probability of reaching default within a year given both having reached the second level (or not) and the current capital adequacy ratio. If estimated independently, the set of transition probabilities could be multiplied to produce an estimated probability of default associated with a given current level of capital adequacy.[30]

Transition process methodologies suffer from the same problems as the original probability of default methodologies if they follow the transitions all the way to default. The final estimation, in that instance, from a capital adequacy level above default to a default level, will be based on the same default experiences which were noted at the outset of this discussion as rare. Hence, the advantage of this methodology lies most likely in following the process to levels closer to default levels than first intervention levels but not all the way to default. One could empirically examine the data to define the lowest levels of adequacy which are manifest by sufficient numbers of entities for robust estimation of the parameters required for the calculation of scalars.

Which leads to the final issue challenging the validity of this methodology—namely, how the probabilities of default (or other negative outcomes) are employed to create scalars. The simplest approach, analogous to some other approaches, would employ the average probability of default (or alternative negative outcome) for a jurisdiction as the basis for scalars. For example, one could adjust required capital from a foreign jurisdiction by the ratio of the average probability of default in that jurisdiction to the average probability of default in the home jurisdiction. Alternatively, one could assume a certain distribution,

30 An equivalent transition process method could use externally defined markers in place of intervention levels, such as levels of financial soundness reported by credit reporting agencies. This approach would likely not change the validity of the methodology but would raise issues of reliability arising from the reliance on proprietary calculations by private sources, not subject to full transparency and subject to alteration without public control.

and determine the adjustment based on where each probability of default appears on that distribution. Available capital would be transferred in its original form. This would create an adjustment comparable to the Pure Ratio approach, but with probabilities of a negative outcome substituted for the respective capital adequacy ratios. Recall that the purpose of scalars is to adjust the available and required capital from a foreign jurisdiction to be comparable to values in the home jurisdiction. If probabilities of negative outcomes are directly correlated with the differences in safety levels implied by the respective calculations of capital adequacy (narrowly or broadly), then the use of ratios of probabilities of negative outcomes makes sense.

However, if probabilities of default are related to capital adequacy ratios only after controlling for the effects of other elements, then a more elaborate approach for the construction of scalars is required. In the absence of strong theory or practice relating the two concepts, there is no single, best approach. The Federal Reserve Board has developed a simple and plausible approach, estimating two linear relationships between default probabilities and available and required capital, respectively. This approach not only produces a scalar for required capital, but also produces one for available capital. As mentioned previously, this method allows the application of the derived scalars to entities not only in different jurisdictions but to entities in different industries, as well. Yet, the sensitivity of the scalars and the resultant group capital calculations to the particular specification of the relationships remains untested.

In summary, the probability of negative outcomes approach is intuitively appealing and offers relatively valid possibilities for the construction of scalars. However, the challenges to that validity—even before turning to issues of reliability—are significant.

Reliability: This method suffers more difficulties with reliability than do other methods. That is largely due to the requirement that regulators must have access to information on the probability of defaults for entities in every jurisdiction in which home companies control entities. While the information on default experiences is relatively easily available in certain jurisdictions, in many jurisdictions it is more difficult to find. Even when it is available, it

usually exists in one form. For example, for U.S. insurance entities, it is relatively easy to obtain systematic data on entities that had policies covered by state insurance guarantee funds. While this might or might not be precisely the definition of default one might select,[31] if other jurisdictions have data available on a distinct basis, the creation of scalars would involve the comparison of "apples to oranges."

The variability in the data (i.e., lack of reliability) arising from the need to identify negative outcomes is compounded if one aims to associate the probability of default (or another negative outcome) with financial conditions, both micro- and macroeconomic, beyond the elements of the capital adequacy ratio. Controlling for more factors in the estimation of the core relationship between capital adequacy and default produces more robust estimates. This practice allows for more validity. However, this extension of data needs produces challenges, both to validity and reliability. The challenge for reliability is simple: The more detailed the data needed for all entities in all jurisdictions, the more likely it will be that some of that data will not exist or will be defined differently in some jurisdictions. This will again produce an "apples to oranges" comparison.

The challenge to validity might emerge if one aims to examine narrow capital adequacy ratios, and yet, in controlling for factors beyond those, includes factors which reflect responses, at least in part, by entities to the interventions of regulators. If the desire is to adjust required capital, for example, based on the relative safety of capital standards in different jurisdictions, incorporating into those estimates—by modifying scalars—features in the regulatory process beyond the setting of required capital benchmarks muddy the result. It is no longer clearly an aggregation of available and required capital, adjusted for differences in the safety levels of the jurisdictions in establishing rules and procedures for the assessment of those capital levels. While this might be less problematic if one's aim is to assess capital adequacy ratios more broadly defined, that is not the way in which the objective is conventionally identified.

31 Whether the definition of default should be restricted only to entities which failed to meet their policyholders' claims was raised earlier in the paper. If an entity would have been unable to meet its current obligations but was acquired by a company able to do so, should that count as a default? The answer might depend on the extent to which one treats the acquisition process as an extension of the financial condition of the entity (i.e., if an entity was acquired, its financial condition must not have been too dire) or somewhat independent of it. If the acquisition of near-default entities is serendipitous, unrelated to the immediate adequacy of its assets to meet current obligations, then failing to identify entities that were near default and then acquired may understate the degree of duress in a particular jurisdiction.

An alternative to the direct estimation of probabilities of default for each entity in each jurisdiction would be to find a place where that has already been done. Were that possible, the probabilities of default could be employed directly to related to capital adequacy metrics, thus producing the basis for scalars. In order for such a dataset to be useful, several criteria would or might apply:

1. Organized and controlled by experts who are independent of control by any particular company, industry, or jurisdiction;
2. Generate estimates of probability of default (or negative outcomes) based on a publicly transparent methodology that has been vetted in appropriate scholarly and/or professional publications;
3. Generate estimates for all financial service companies in all countries in the world;
4. Produce estimates for entities, not groups, if the results are to be useful in generating scalars at the entity level; and
5. Reason to expect that the site will continue to produce these estimates for the foreseeable future.

While there might be several datasets satisfying, or nearly satisfying, these criteria, one that is known will be discussed illustratively. The Risk Management Institute of the National University of Singapore hosts the Credit Research Initiative (CRI), which produces probability of default estimates that nearly satisfy the criteria posted above.[32] Based on the extensive, distinguished academic work of J.C. Duan, director of the initiative, the CRI website provides estimates of the probability of default over various time horizons (for example, 1 month, 3 months, 1 year, 2 years) for public companies, for industries within countries, and for countries. One can relatively easily (and without charge) view and download certain default categories (for example, the mean probability of default over the following 12 months for insurance companies in the United States, or Japan, etc.). If one wished to download the estimated probabilities of default for each company included in the national samples, one could then use those estimates to identify relationships with capital adequacy metrics.

The principal limitation of this dataset is that the calculations are presented only for publicly traded companies; this would not yield estimates for most individual insurance entities, many of which are structured as mutual or fraternal entities. This limitation leads to two possible paths forward. If one were comfortable relying on ratios of average probabilities of

32 The Academy is not endorsing the CRI site, but rather recognizing it as the closest found to meeting the specified criteria and discussing it in a way that would largely apply to any other such site.

default for jurisdictions to create scalars directly, then one might use the ratios for publicly traded companies as a surrogate for the ratios for all entities within the jurisdiction. This approach might introduce biases, as publicly traded companies are larger in size, generally, than private entities, if, at least in certain ranges of capital adequacy ratios, smaller companies are more susceptible to default than larger companies. Hence, before turning to this simplifying assumption and practice, it would be worth comparing estimates based on these public companies directly to estimates based on individual entities, public and private, to identify any biases that exist.

Another alternative arises from Duan's work. Recognizing that the techniques he developed to assess the probability of default for public companies could not be applied directly to private companies, he elaborated a method based on the same principles, and relying on many similar steps, to calculate the probability of default of private companies. While this method might well yield more robust estimates for the probabilities of default compared to the simpler, approaches illustrated by the Federal Reserve Board's effort, the extensive data required for Duan's approach—while available from credit reporting agencies and financial data companies—returns us to the same reliability issues we touched on earlier: needing both default experience data and detailed financial information for all entities in all jurisdictions.

Ease of implementation: The probability of negative outcomes represents a family of methods that vary from simple to complex implementation. The simplest variant might be to use the ratio of the average probability of default of publicly traded companies for an industry within a foreign jurisdiction to the average probability of default for public traded companies within the home jurisdiction as a scalar to adjust required capital. While simple and easy to implement, it raises validity issues and implicit reliability issues. The most complex variant might be to use the Duan approach to estimate the probabilities of default for private entities in each jurisdiction. This approach would raise serious reliability issues, as default experience and financial data for private entities may be available but may not be complete or strictly comparable. In general, the simpler variants will tend to be more reliable but less valid, while the more complex variants will tend to be more valid but less reliable. The optimal selection among these variants, or between these variants and other methodologies for scalars, likely should depend on sensitivity tests in which ease of implementation is decreased—i.e., options should be made more complicated until they reach an acceptable tolerance—to the point where changes in the resultant group capital calculations fall below an acceptable tolerance level.

Stability of parameters: The stability of parameters derived from the probability of default methodology will depend to some extent on the variant selected. However, in general, and if one focuses on default as opposed to an alternative negative outcome, there is a greater likelihood of both internal and external variability of parameters from this methodology compared to others. Internal stability refers to the extent to which results vary (or, better, do not vary) when small changes are made in the data or methods used. External stability refers to the extent to which the results vary over time and/or across jurisdictions. In both senses, stability is likely less than for alternative methodologies due to the relative infrequency of defaults. For a given jurisdiction, the inclusion of one or two more defaults—whether due to changes in the definition of relevant data, or due to changes over time—might change the estimated probabilities much more than small changes in more frequent or continuous values. If one selected an alternative negative outcome precisely to have more occurrences of that outcome, then the results would be more stable.

Section 5

Conclusion

Constructing a method for aggregating the available and required capital of different financial entities within a corporate group is necessary if group capital adequacy is to be assessed by a method that preserves information generated by the regulatory process governing those entities. If the entities operate in different jurisdictions—whether that is distinct industries within the same geographic, legal regime, or entities in the same industry in different geographic, legal regimes—a requirement for aggregation is a method of adjusting values drawn from distinct jurisdictions. Those adjustments are referred to in this paper as scalars.

The initial discussion in this paper of "ideal" scalars suggests some of the complexity in creating such adjustments and illustrates why any method based on national averages will invariably be imperfect.[33] The assessments of various possible methodologies seem to indicate clearly that there is no perfect method, not even necessarily a best method for all circumstances. Validity, reliability, ease of implementation, and the stability of parameters—all must be assessed in selecting an appropriate method for a given purpose.

The qualitative assessment presented in this paper best captures many of the most important issues of validity and reliability of the various methodologies. Ease of implementation and stability of parameters and results, while discussed, are much more difficult to assess in the abstract, without specific implementation decisions and concrete data.

The assessments presented here suggest not only that any scalar methodology will be imperfect. They also suggest that the extent to which the results produced will vary from the "ideal" is itself variable, depending on the circumstances (e.g., how much of a company's business is accounted for by entities in other jurisdictions). Therefore, as is discussed further below in point 4, a final decision on preferred scalar methodologies not only may vary due to circumstances but also might depend on various forms of sensitivity testing. To the extent that testing reveals small differences in results as one compares simpler and more complex varieties of methods, confidence in simpler methods would increase.

33 This statement is true unless all entities in a jurisdiction are identical in their levels of available and required capital.

Four issues arise to a greater or lesser extent for all of the methodologies assessed, and it seems prudent to highlight them before concluding. Those issues are:

1. *The application of these methodologies to entities in different industries:*
   Jurisdictions differ by geography and/or by industry. The regulatory regime in a given geographic unit defines a jurisdiction. Most of the comments in this paper apply to scalars for entities in different jurisdictions, whether the basis for the difference is geography, industry, or both. However, it is true for all methodologies (with the exception of one of the No Scalar methods) that when the entities are in different industries, a second scalar element is required. For all entities in different jurisdictions, scalars adjust the foreign jurisdiction required capital to make it comparable to the home jurisdiction. In some instances—most notably certain implementations of the Probability of Negative Outcomes approach—scalars may adjust both required capital and available capital. However, when entities differ by industry it will most likely be required to adjust the available capital as well as the required capital. This follows from the likely differences in the definitions under different industrial practices and regulatory requirements.

   This paper has suggested ways in which this might be accomplished both in the Capital Ratio and Probability of Negative Outcomes families of methods. It is likely possible for other methods that might be considered. However, the additional adjustment (for available capital) raises competing additional issues. On the one hand, whenever available capital definitions differ across jurisdictions (whether based on industry or geography), using scalars to adjust for those differences (in addition to differences in required capital) increases the validity of the metrics derived. On the other hand, a second estimation process yields a second set of possibilities for errors in assumptions, data, and/or derived metrics. Hence, it is likely that scalars across industries will be less accurate (farther from the "ideal") than scalars within an industry across geographies. Whether they are accurate enough leads to sensitivity testing for answers.

2. *The dependence of the anchors for these methodologies on regulatory actions and company responses (the "problem of endogeneity"):*
   For all methods discussed in this paper (including one of the two No Scalar approaches), the anchors of these methods (e.g., the Capital Adequacy ratio, or the Probability of Default), are the result, in part, of companies acting under regulatory requirements. As illustrated earlier in this paper, scalars may adjust for the differences in those

requirements. However, anchors also reflect the actions of regulators within the various regulatory systems, and the responses of companies to those actions. The anchors then are products both of the different requirements (for which scalars aim to adjust) and the responses of regulators and companies to those anchors.

One attempt to mitigate this problem—defining a negative outcome at an arbitrarily high level, a level high enough that regulatory intervention is unlikely—fails on two counts. If the level is high enough (or low enough, for example, for probability of default) then it is no longer a negative outcome and thus does not serve as an appropriate anchor for comparison of entities and/or jurisdictions. A second approach—defining a more complex system of simultaneous equations to describe the interactions among anchors, regulatory action and company responses—would make implementation much more difficult and raise additional questions about the model specification and the availability of needed data.

3. *The dependence of stability and validity of results on jurisdictional regime stability:*
For all methods discussed here, and likely for any other methods that might be contemplated, the validity of the results, and their stability over time, depends on regime stability. If one jurisdiction, for example, materially changes its required capital prescription, then scalars for that jurisdiction would require recalculation if they are to remain as valid as they were previously. While it may be possible to qualitatively assess changes in regulatory regimes to determine when material changes have occurred, it might also prove difficult to know whether an apparently modest change in a regime might produce substantial changes in the scalars and their derived results. There seem to be two paths to assuring stability and validity of scalars in light of regime change: 1) define a test for material change in regulatory regimes, and recalculate relevant scalars whenever a regime undergoes such a change; or 2) routinely recalculate scalars at some regular time interval—whether that is annually, or biannually, or some other time frame—to be sure to capture the impact of all changes in regimes, large and small.

4. *The value of sensitivity testing in selecting a most desirable method:*
In discussing the role of sensitivity testing throughout this paper, two different dimensions of sensitivity have been implied: 1) sensitivity of results to changes of parameters within a model; and 2) sensitivity of results to differences in methods of calculating scalars. Initially and periodically, it makes sense for regulators to collect sufficient information to be able to perform both kinds of sensitivity tests.

For the first branch of testing, the input would be some range of values for the derived scalar, and the output would be the calculated group capital adequacy metrics for groups in the home jurisdiction. If, for example, a scalar for a particular jurisdiction were estimated at 0.8, one might assess the impact on all groups of varying the scalars from 0.4 (i.e., 50% of its estimated value) to 1.6 (i.e., 200% of its estimated value). If, with that degree of variation in the scalar, 90% of group capital adequacy metrics for groups in the home jurisdiction varied by less than 1%, one could rely on that degree of confidence.

For the second branch of testing, the input would be the scalars derived from more than one method, perhaps from the two leading possibilities. The output again would be the calculated group capital adequacy metrics for groups in the home jurisdiction. If the distributions of results are, for example, within 1% of each other at each defined point in the distributions, then one could rely on that degree of confidence that either method might be selected. If they are sufficiently close, one might select that which is easiest to implement. If they differ, then one would select the one more likely to be more valid, closer to the "ideal."

Both forms of sensitivity are useful—not only in selecting a method, but in interpreting results. If a selected method displays substantial variability in group capital adequacy results when scalars are varied, one might rely less on those results.

Finally, while both forms of sensitivity make sense to assess initially, once a determination of a "best" method is made, then future recalculations could focus solely on the sensitivity to variations within that method. However, whenever material changes occur to a regime, it might make sense to re-examine sensitivity in both senses. Parallel to the discussion on stability of regimes, it might make sense periodically (although not necessarily every time that scalars are recalculated) for sensitivity across methods to be re-assessed. If changing circumstances increase the gap, for example, between a relatively simple and a relatively more complex method, it might become prudent to shift from relying on the simpler method to reliance on the more complex one.

While the American Academy of Actuaries offers the considerations presented in this paper to be taken into account by regulators as they consider adoption of scalars as part of the group capital regulation process, the Academy does not make any specific recommendations in favor of or against any particular methodology. However, three conclusions do seem to follow from the analysis presented here:

1. Methodologies based on observable data are preferable to methodologies based on assumption, other things being equal. Only the approaches discussed under the Probability of Negative Outcomes are defined by reference to the analysis of observable data, and thus deserve heightened attention in any regulatory environment. However, as discussed, with the advantage of reliance on data come several challenges—many of them directly related to the reliance on available data. As such, regulators should consider whether adoption of this methodology, the Probability of Negative Outcomes, is advisable, especially after careful consideration.

2. Almost all methodologies will be prone to increased imperfection if regulatory regimes change after scalars have been estimated.[34] While one might attempt to develop methods by which to calculate adjustments to scalars based on the changes observed, the surest way to adjust scalars for regime change and other changes in relevant conditions is to recalculate the scalars periodically, which can be accomplished by incorporating such periodic recalculation be made as an intrinsic element of any methodology adopted.

3. All of the methodologies discussed here are and will be imperfect. While factors have been discussed herein that might be addressed to reduce some of those imperfections, it is impossible to find perfect solutions, given the criteria of validity, reliability, ease of implementation, and stability of parameters and results. The question facing regulators then involves balancing degrees of validity—i.e., how imperfect the measures are, given what they would be if ideally conceptualized and measured—against degrees of reliability, ease, and stability. The only reliable way in which to judge those degrees, and to provide meaningful information with which to select based on some optimization of the criteria, is through the application of sensitivity testing as described. Hence, it may be advisable that the information required to examine the impact of each selected methodology under varying parameters, and to compare the impact of differing methodologies, be collected by regulators in order to allow them, at least initially, to rely on sensitivity testing to determine the best scalars in a particular jurisdiction.

34 This might not be true for No Scalars, Constant Value, where the scalars do not depend on estimates from current regimes. Changes in regime, and other changes (such as the proportion of business done by entities in foreign jurisdictions) may increase or decrease the imperfections inherent in this method.

References

Altman, Edward. "Revisiting Credit Scoring Models in a Basel 2 Environment." *Credit Rating: Methodologies, Rationale and Default Risk*, edited by M. Ong. 2002.

Atkeson, Andrew; Eisfeldt, Andrea; Weill, Pierre-Olivier. "Measuring the Financial Soundness of US Firms, 1926–2012." National Bureau of Economic Research. 2013.

Barnes, Michelle L; Bohn, James; Martin, Cynthia L. "A Post-Mortem of the Life Insurance Industry's Bid for Capital during the Financial Crisis." *Journal of Insurance Regulation*. 2016.

Bharath, Sreedhar; Shumway. "Forecasting Default with the Merton Distance to Default Model." *The Review of Financial Studies*. 2008.

Board of Governors of the Federal Reserve System. "Capital Requirements for Supervised Institutions Significantly Engaged in Insurance Activities." Advance Notice of Proposed Rulemaking. *Federal Register*. Volume 81, #114. June 14, 2016.

Board of Governors of the Federal Reserve System. "Comparing Capital Requirements in Different Regulatory Frameworks." Board of Governors of the Federal Reserve System. 2019.

Chan-Lau, Jorge; Sy, Amadou. "Distance-to-Default Banking: A Bridge too Far?" International Monetary Fund, Monetary and Financial Systems Department. 2006.

Dangl, Thomas; Lehar, Alfred. "Value-at-Risk vs. Building Block Regulation in Banking." *Journal of Financial Intermediation*. 2004.

Dingell, John. "Failed Promises: Insurance Company Insolvencies: a Report." Subcommittee on Oversight and Investigations, Committee on Energy and Commerce, U.S. House of Representatives. 1990.

Duan, Jin-Chuan; Kim, Baeho; Kim, Woojin; Shin, Donghwa. "Default Probabilities of Privately Held Firms." *Journal of Banking and Finance*. 2018.

Duan, Jin-Chuan; Sun, J; Wang, T. "Multiperiod Corporate Default Prediction—A Forward Intensity Approach." *Journal of Econometrics*. 2012.

Gan, Vincent. "Two Sides of the Same Coin: Insolvency Risk Management and Capital Adequacy Rules for Basel III." Graduate School of Management, Universiti Putra Malaysia. 2017.

Gnabo, Jean-Yves; Bernal, Oscar; Guilmin, Gregory. "Assessing the Contribution of Banks, Insurance and other Financial Services to Systemic Risk." *Journal of Banking and Finance*. 2014.

Herring, Richard; Schuermann, Til. "Capital Regulation for Position Risk in Banks, Securities Firms and Insurance Companies." *Capital Adequacy beyond Basel*, edited by Hal S. Scott. 2005.

Li, Xiping; Tripe, David; Malone, Chris. "Measuring Bank Risk: An Exploration of Z-Score." Massey University, New Zealand. 2017.

McDonald, Daniel. "Feasibility Criteria for Accounting Measures." *The Accounting Review*. Volume 42, #4. 1967.

Moody's Investors Service, Global Credit Research. "RiskCalc for Private Companies: Moody's Default Model." Moody's Investors Service, Global Credit Research. 2000.

Munch, Patricia; Smallwood, Dennis. "Theory of Solvency Regulation in the Property and Casualty Insurance Industry." *Studies in Public Regulation*, edited by Gary Fromm. 1981.

Musvoto, Saratiel. "The Role of Measurement in Supporting the Objectives of the Financial Statements." *International Business & Economics Research Journal*. Volume 10, #8. 2011.

Na, H.S.; Couto, Miranda L.; van den Berg, Jan; Leipoldt, M. "Data Scaling for Operational Risk Modeling". Erasmus Research Institute of Management, Erasmus University, Rotterdam, The Netherlands. 2005.

National Association of Insurance Commissioners. *NAIC Group Capital Calculation Instructions*. Adopted November 17, 2020.

National Association of Insurance Commissioners Staff. "Summary of Relative Ratio Approach to Scalars for Non-U.S. Insurers." National Association of Insurance Commissioner, Group Capital Calculation (E) Working Group. 2017.

Owen, The Honorable Justice Reville. *The Failure of HIH Insurance: Report of the HIH Royal Commission*. HIH Royal Commission, Australia. 2003.

Pezier, Jacques. "Application-Based Financial Risk Aggregation Methods." University of Reading, United Kingdom. 2003.

Roberts, Paula and Priest, Helen. "Reliability and Validity in Research." *Nursing Standard*. Volume 20, #44. 2006.

Sharma, Paul. "Prudential Supervision of Insurance Undertakings." Conference of Insurance Supervisory Services of the Member States of the European Union. 2002.

Tyrrell, Ned. "Aggregation Method Update." Executive Committee, International Association of Insurance Supervisors. 2019.

Tyrrell, Ned. "Latest Developments in Group Capital." ERM Symposium. 2020.

American Academy *of* Actuaries

Objective. Independent. Effective.™

AMERICAN ACADEMY OF ACTUARIES
1850 M STREET NW, SUITE 300, WASHINGTON, D.C. 20036
202-223-8196 | **ACTUARY.ORG**