GOES Model Governance Framework Comments:

- American Council of Life Insurers
- Risk & Regulatory Consulting, LLC
- Connie Tang
- Mark Tenney
- John Hancock

Brian Bayerle
Chief Life Actuary
202-624-2169
BrianBayerle@acli.com

Colin Masterson
Policy Analyst
202-624-2463
ColinMasterson@acli.com

November 21, 2024

Mike Yanacheak
Chair, NAIC Generator of Economic Scenarios (GOES) (E/A) Subgroup

      Re: Draft GOES Model Governance Framework

Dear Chair Yanacheak:

The American Council of Life Insurers (ACLI) appreciates the opportunity to provide our feedback on the recently exposed draft GOES Model Governance Framework. While the comments reflect the current views of industry broadly, they are not an exhaustive list and are instead meant to encourage continued discussions between regulators, NAIC staff, Conning, and other interested parties.

ACLI's commentary has been split below between more general feedback and responses to specific sections of the draft Framework.

General Comments:

- Scenario statistics will play a key role in monitoring the appropriateness of the scenarios. The framework discusses the governance related to production and review of statistics but does not define those statistics themselves or who owns them. There needs to be a clearly defined list of statistics to validate against the criteria. Further, the guidance should also cover how NAIC validates the model statistics to the criteria without an explicitly defined range of acceptance.
- We would appreciate discussion on drawing distinction between the governance applicable for different types of updates. For example, the governance process for recalibration, monthly updates, annual updates, off-cycle model changes, and structural model improvements would be similar, but each should be tailored to the risk and significance associated with each change.

- We request that Conning produce scenarios across different starting economic environments (most recent year end, low rate, high rate, normal yield curve) when changes are made to the generator to ensure the calibration still meets the criteria in these situations.
- We would like to better understand the escalation process, particularly in the following situations:
  - In what situations would NAIC pause the release of scenarios? How would the process be handled after escalation to reach resolution?
  - How should companies handle unintuitive scenarios or reserve or capital impacts? How would that escalation process look?
- In certain cases, the separation of duties is unclear (such as ownership/review of statistics). We think this should be more specific, especially in cases where there is ambiguity of duties between Conning and NAIC.
- To strengthen governance, additional detail and clarification could be added on how certain aspects of the framework will be applied. For example, the following would be helpful:
  - Defined process for how the models will be validated/reviewed, both by Conning and by the NAIC.
  - Defined methodology for determining the model risk rating and clarification on how governance requirements will vary by rating or by complexity/materiality of a model change.
  - Defined methodology for determining a finding's risk classification and controls to ensure that the finding is corrected appropriately and in a timely manner.
  - Standards for what information should be included in documentation. Since model changes can have a significant impact to model users, transparency of communication/documentation and timely disclosure to users is important.
- ACLI members have also identified questions due to the proprietary nature of certain aspects of the model, particularly the Corporate Model.
  - It is common practice for companies to replicate models to help manage their business (e.g., projecting future reserves / capital requirements for capital / risk management). We are concerned that an NDA would restrict this ability; we would be comfortable if the NDA explicitly prohibits the documentation from being used for any purpose external to the company or for commercial purposes.
  - Further, it is unclear how ACLI could have discussions related to aspects of the generator that are proprietary. If not all of our members have signed an NDA, it would seem we would not be able to discuss those items at all. This would also be an issue for any public discussions.
- While not specifically related to governance, we would appreciate a future opportunity to discuss whether proprietary models that comport with the stylized facts and are within the thresholds for targeting criteria and evaluation statistics facts would be acceptable for valuation purposes. We note that developing these thresholds is something ACLI and our team of subject matter experts are currently working so this is a topic we would be willing to present on in the coming weeks.

II.A. (Governance Roles):

- Overall, this table does not seem fully applicable to all models in the Model Inventory (particularly, the "ancillary tools").
  - For the models that produce the Basic and Robust Data Sets, as well as the API tool, Conning serves as the "First Line of Defense": they develop the models, create documentation, and perform independent peer review. Given Conning develops and owns the model, we need "Second Line of Defense" to perform some technical review and/or substantiate testing for reasonableness or unintended consequence

check, not just control review. This role is typical for a company with a sound and well-defined risk management framework.

- o These roles are not clear for the other tools in the Model Inventory File. If the NAIC owns and develops those tools, then there is no clear delineation between the first - and second-line functions. Who provides oversight? Independent review?
- Regarding model stewardship, Conning should have some role for ancillary roles, such as model developer.

II.B. (Sign Off-Protocols):

- Conning Sign-Off Responsibilities:
    - o Regarding attestation, how is this performed and documented? We would support a checklist that gets initialed for each reviewed item and any commentary associated with the review.
    - o Are there clearly defined specifications detailing how the statistics are calculated? If not, this should be defined.
- NAIC Staff Sign-Off Responsibilities:
    - o Is this review sufficient for the NAIC to be confident that the model is fit for use?
    - o Who produces the stats, the NAIC or Conning? And if Conning produces them, how does NAIC validate that the stats are correct?
    - o NAIC should develop the inventory of statistics. We suggest interested parties have a say in the development of those statistics.
    - o How will sign off occur based on the statistics?
    - o Will there be publication of controls publicly?
    - o As noted in Section V.A.2, judgement is involved in determining whether scenario sets are acceptable or need to be revised. Absent clear rules for determining whether scenario sets are acceptable, the GOES subgroup should also be involved in the decision.
- GOES (E/A) Subgroup Sign-Off Responsibilities:
    - o How will responsibility #1 ("All material non-routine updates to the model, such as model recalibrations") be communicated widely?
    - o With all three responsibilities listed in this section, would there be an exposure and comment period for these items after new GOES is implemented?

III.D.3. (Monthly Production of Scenarios, Scenario Statistics, and Validation Reports):

- The draft states that "The process of producing and reviewing all monthly deliverables, including execution of controls, will be tested and practiced before the GOES scenarios are adopted and become effective." ACLI recommends at minimum a three-month trial period.
- Validation reports need to show how well the model performs against acceptance criteria and stylized facts. It may be helpful to provide more detail on the process / thresholds to determine whether a scenario set is acceptable, while still allowing for appropriate use of judgment.
- ACLI members would appreciate the posting all of the scenarios picker tools, values, and scenario subsets.
- Regarding the course of action if there will be a delay in posting scenarios, up to a one-day delay would be acceptable. If there is a significant issue identified after scenarios are posted, then there is a larger discussion to be had beyond having a contingency plan such as allowing companies to revert back to the previous month's scenarios with any appropriate adjustments for starting conditions on the valuation date, e.g. replacing prior period initial yield curve with the current period. Another aspect to consider is that quarter end, month end, and year end also all have different levels of importance to companies so

it will be crucial for there to be a detailed and pre-determined contingency plan if we cannot get scenarios in a timely manner.

<u>III.E (Subject Matter Experts and Interested Parties):</u>

- Because of the substantial impact GOES will have on all life insurance activities, it is critical that the Subgroup provide clear communications and rationale behind its decisions. We would request the following to be included in the formal written governance and guidance:
    - The Subgroup and Conning should document decisions and rationale behind technical modifications to GOES.
    - Formal discussions and decisions on technical GOES issues should be conducted on public calls so industry can provide meaningful and useful feedback the regulators may want to consider in those discussions.
    - There may be times when it is appropriate to rely on the vendor for feedback without engaging the industry, and we would encourage the regulators to develop clear guidance on when that might be appropriate.

<u>IV.A-C (Model Risk Rating):</u>

- ACLI agrees with the note from regulators that it would be prudent to start out with all models listed in the Model Inventory File ranked as high risk.
- Regarding the posed question, the model governance framework should extend to optional, additional items that are available for a fee.

<u>V.A (Acceptance Criteria):</u>

- The latest set of acceptance criteria includes "targeting criteria" and "evaluation statistics." These should be defined in the governance framework to clarify how they will be used in determining whether scenario sets are acceptable.
- Prior to making sure model statistics are able to meet the stylized facts and/or acceptance criteria, it should define what is the intended purpose and how the model fits for purpose.
- Who is responsible for determining if a particular scenario set is acceptable? Would this process include interested parties such as ACLI and the Academy? Having more detail on this part of the process may be helpful, acknowledging that judgment will be needed to determine whether scenario set(s) as a whole are appropriate for use in this context.
- Regarding the implementation of material model updates, ACLI notes that depending on the change, some items may not need any formal testing, some could require review from the NAIC model office, and some updates could require full field testing or an off-cycle update across the board in line with section four. The nature of the GOES model changes and limitations of the model offices should also be considered when determining whether model office testing is preferrable to industry field testing.

<u>V.B. (Model Validation):</u>

- The Governance framework should make clear who specifically is responsible for this process.
- Will validation procedures be performed on all models in the model inventory? How frequently (e.g., for every monthly update)? Performed by whom? Independent of model developer? Does the scope of validation vary depending on the extent of the change or the risk of the model?
- Model validation should also consider including, as applicable:

- o Implementation into production (e.g., checking that there are no breakdowns or unintended consequences as the model is moved from the development environment to the production environment)
  - o Assessment of limitations
  - o Adequacy of documentation
- Model replication procedures or a sample prototype should be shared publicly for transparency in-line with V.B.2.
- For output validation, industry would request more specifics on the validation steps and criteria. At minimum, validation should be compared to stylized facts and acceptance criteria, and the validation should be made public. Such validation should also contemplate how the model will perform in different economic environments.

VI (Model Updates and Review):

- Regarding whether model documentation should be included as appendices in the document so that governance and documentation are all in one place, or if it is preferable to keep them separate, the items should at least be linked but the specific format does not matter as long as it is easily accessible and clearly identified.
- Regarding annual model updates, how should industry contribute to these?
- The draft notes as an example the mean reversion parameter (MRP) could be updated. We are unaware of any methodology being discussed or exposed, so we would appreciate clarity around any updates to this component and other components/parameters of the model.
- There should be a defined quarter for annual to avoid unnecessary volatility. A clear update process for off-cycle updates should be established.
- ACLI would suggest regularly scheduled meetings for discussion about whether there is a need for model or calibration updates. Such discussions could also make it easier to identify items for the 5-year recalibration and model revisions (or sooner if deemed necessary) and off-cycle model updates as described in the draft framework.

VII.B. (Risk Classification):

- One of the questions for consideration posted in this section asks, "What criteria will be used to evaluate the materiality of a finding?". As a starting point, ACLI believes that items such as financial impact, reputational impact, and operational efficiency (including documentation inefficiency) should be considered.
- Given Conning develops and owns the model, in addition to relying on the GOES subgroup and interest parties to identify the issues/model findings, we suggest NAIC form a smaller/independent technical group to review Conning's technical update for reasonability or unintended consequences.

Thank you once again for the opportunity to provide this feedback and ACLI looks forward to continuing discussions with NAIC staff, regulators, and other interested parties as the process of creating a robust GOES Governance framework moves forward.

Sincerely,

B. Banfordi Colin Masterson

cc: Scott O'Neal, NAIC

Memo

To:	Mike Yanacheak, ASA, MAAA, Chair of Generator of Economic Scenarios ("GOES") (E/A) Subgroup
From:	Patricia Matson, FSA, MAAA, Partner, RRC Lynn Manchester, FSA, MAAA, Director, RRC Janine Bender, ASA, MAAA, Supervisor, RRC
Date:	December 6, 2024
Subject:	RRC Comments Regarding GOES (E/A) Subgroup's GOES Model Governance Framework Draft Exposure

Background

The Generator of Economic Scenarios ("GOES") (E/A) Subgroup ("Subgroup") is requesting comments on the GOES Model Governance Framework Draft ("the Exposure").

RRC appreciates the opportunity to offer our comments on the Exposure. Should you have any questions, we would be glad to discuss our comments with you and Subgroup members.

We appreciate the work that the Subgroup has undertaken to address what we believe is a critical industry issue, namely a model governance framework for the GOES model which is intended to mitigate risk by providing governance and controls for scenarios generated for use within the industry.

Comments on I. Background

Regarding the importance of a model governance framework for the GOES model, detailed in Section I.B, we believe that systemic risk should be mentioned along with the material financial impact since the GOES model will be used industry-wide.

While Section I.C.9 mentions access controls, we suggest that Section I.C also cover storage, i.e., where models are stored, perhaps referencing the three separate modeling environments used by Conning, described in Section VIII.D.

We also suggest that the model governance framework include a requirement to create backup copies of the current and previous version of the model, in case of model corruption or data loss.

Comments on II. Governance Roles and Sign-off Protocols

In addition to the roles mentioned in Section II.A, we recommend the addition of the role of Model Designer. We believe that the NAIC/LATF Committee would be assigned this role and would be responsible for requesting specific changes or enhancements to the model to meet desired regulatory purposes. The Model Designer should be independent of the Model Developer. This role could also be mentioned in Section I.C component #1 and the first paragraph of Section II.A.

Responsibilities of the Model Steward role should include accuracy, quality, and fitness of the model, in addition to the governance of the model. We would expect that the Model Steward would be responsible for collecting input from the Model Users (i.e., Industry and State Insurance Regulators) on necessary upgrades.

The table in Section II.A states that the Model Owner (Conning's Professional Services Team) "will perform user-acceptance testing of any new code required for software to meet NAIC model specifications…". We suggest that user acceptance testing ("UAT") also include Model Users (i.e., Industry and State Insurance Regulators), even if from an oversight perspective.

We also recommend that the high-level responsibilities found in the table in Section II.A include the following items. Note that some relate to incorporating information from subsequent sections of the Model Governance Framework to ensure internal consistency.

- **Model Developer** –
    - o We suggest that the Model Developer will incorporate change requests **from the Model Steward** into the GEMS© software rather than "incorporate NAIC requirements", as all requirements should flow through the Model Steward.
    - o We recommend that the high-level responsibilities include model validation (as described in Section V.B) and managing the modeling environments, conducting testing, and completing change documentation to meet governance requirements (as described in Section VIII.D).
    - o We also recommend that the Model Developer be the owner of any new code that is required for the software to meet NAIC model specifications.
- **Model Owner** - We recommend adding the following responsibility:
    - o Explains model results to the Model Steward and recommends adjustments to parameterization and calibration (to the Model Developer) based on input from the Model Steward.
- **Model Steward** – We recommend that Model Selection (as described in Section V.A) be included in the high-level responsibilities and that all NAIC requirements to be incorporated into the GEMS© software flow through the Model Steward.
- **Model User** – We suggest adding that they would also assist with UAT.

Regarding Section II.B, as part of the sign-off responsibilities for Conning, we recommend that an auditing process be included. This may include a System and Organization Controls 1 ("SOC 1") report as part of the attestation provided to NAIC staff. We would recommend that it be provided at inception and every two to three years. This could also be included as part of the sign-off protocols in Section III.D.

It may also be helpful to include a graphical representation of the roles and responsibilities, for example in a process flow format.

Comments on III. Stakeholder Responsibilities

To link the stakeholders in Section III to the governance roles in Section II, we recommend that reference to the Model Steward role be mentioned at the end of the first paragraph in Section III.B. For example, "*As the Model Steward*, the Subgroup will direct NAIC Staff as necessary to effectuate aspects of the Framework."

As part of NAIC staff responsibilities, we believe they would act under the direction of the GOES (E/A) Subgroup **to support the implementation of the economic scenario generator** as well as implement and monitor the model governance, and we recommend that the **bolded** language be added to responsibility #1. Additionally, we assume that NAIC staff would not only develop the scenario review process but also perform a review of the statistics each time scenarios are produced. We recommend that this be clarified within the NAIC staff responsibilities section.

We suggest clarification be provided regarding the delivery method to be used by Conning to provide training materials to Users (e.g., the materials will be posted with the scenarios, sent to the Model Users, etc.). We also suggest clarifying whether Section IX is intended to include training materials in addition to documentation.

The Robust Data Set is mentioned in Section III.D as having additional data fields, but this section does not mention what additional fields are available for a fee. We recommend adding this.

We believe that Subject Matter Experts and Interested Parties would bring any **model or** governance issues to the GOES (E/A) Subgroup for consideration and recommend that the **bolded** language be added to activity #1 in Section III.E.

Comments on IV. Models Subject to the GOES Model Governance Framework

Section B (Model Risk Rating) discusses the assignment of a risk rating and notes that all models listed in the Model Inventory File are currently ranked as high risk. The Exposure draft does not mention who is responsible for determining the risk rating on an ongoing basis, or the frequency at which the rating should be reviewed. We recommend that the appropriate governance role be assigned this responsibility. We also recommend including the model risk rating responsibility in the governance roles in Section II.A.

Regarding whether the Model Governance Framework should be extended to optional items available for a fee (e.g., Robust Data Set, API tool), we agree that the Model Governance Framework should be extended to all optional items related to the economic scenario generator.

Comments on V. Model Selection and Validation Process

In the Model Selection section, the process and criteria for model selection are described. We recommend a requirement that the model be reviewed and recalibrated at a minimum every five or so years to confirm continued appropriateness and fit of the model.

As part of the Model Validation section, we would recommend clarification of who would be performing the model validation along with the frequency at which the model validation is performed and how this would be related to the model risk rating mentioned in Section IV. These appear to be items that should be part of the Model Developer responsibilities.

Pertaining to the independent UAT performed by the Model Owner, we recommend that the description of this testing be clarified as the Model Owner would not necessarily be considered independent.

Comments on VI. Model Updates and Review

We do not have any specific comments.

Comments on VII. Process for Handling Model Findings

We do not have any specific comments.

Comments on VIII. Model Change Management

For "emergency" model findings and fixes, we recommend that an escalation process be created such that critical model fixes can be implemented in a timely manner, when the normal NAIC approval process may not be fast enough.

Comments on IX. Documentation Requirements

We suggest including clarification of a vendor's access to Conning's Software Documentation Library if a company outsources the work to a vendor and the vendor signs Conning's Nondisclosure Agreement.

Comments on X. Access Controls

Regarding the people identified as having access to models and documentation, we recommend that Conning and the NAIC consider mitigants to key person risk and clarify any succession plans in place to ensure that there will be appropriate resources to update the models.

Thank you for the opportunity to provide comments on this important topic. We can be reached at 860-305-0701/tricia.matson@riskreg.com, 813-506-7238/lynn.manchester@riskreg.com or 860-324-4951/janine.bender@riskreg.com if you or other members have any questions.

November 19, 2024

Michael Yanacheak, ASA, MAAA
Chair, NAIC Generator of Economic Scenarios (E/A) Subgroup
National Association of Insurance Commissioners

Re: Draft GOES Model Governance Framework

Dear Chair Yanacheak:

Thank you for the opportunity to comment on the Draft GOES Model Governance Framework.

I agree with your statements stressing the importance of model governance, and I applaud the NAIC staff's efforts and GOES Subgroup's focus on this issue.

GOES governance is critical but challenging because it involves multiple disciplines and complex modeling and assumption setting processes.

Developing and calibrating economic scenario models for life and annuity statutory valuation assumptions is an interdisciplinary exercise requiring collaboration between specialized and often distinct skill sets. Economic scenario modeling requires quantitative finance expertise while valuation assumption setting requires knowledge of life and annuity products and principle-based reserve (PBR) frameworks.

The draft framework references Actuarial Standard of Practice (ASOP) 56 and incorporates concepts from the Academy of Actuaries' (AAA's) Model Governance Practice Note and Principle-Based Reserves (PBR) Model Governance Checklist, and those are excellent starting points. However, unlike PBR cash flow projection models that are more "mechanical" in nature (e.g., are contractual product features or decrements implemented correctly?), GOES also represents a highly complex assumption setting process (e.g., analogous to calibrating sophisticated dynamic behavior or mortality improvement models) – with structural and methodology judgments and statistical calibration techniques that go well beyond those required to implement cash flow projection models.

Therefore, GOES governance efforts should consider items in the Governance, Models, and Assumptions sections of the AAA's Model Governance Checklist as well as actuarial assumption standards and best practices. The Federal Reserve's Supervisory Letter SR 11-7 on Model Risk Management[1] and the AAA's Model Risk Management Practice Note may also be helpful references.

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[1] Links to Fed SR 11-7 documents:
https://www.federalreserve.gov/supervisionreg/srletters/sr1107.htm
https://www.federalreserve.gov/supervisionreg/srletters/sr1107a1.pdf
https://www.fdic.gov/bank-examinations/model-governance

Good governance requires well-defined policies, comprehensive documentation, and effective review and challenge.

The draft appropriately highlights the importance of independent review and validation. However, it focuses primarily on implementation / process validation and should be expanded to include the first and most fundamental element of model validation – the evaluation of conceptual soundness (e.g., of the model, data and methodologies used in calibration) and suitability for purpose.

Key prerequisites for effective review and challenge include:

- In-depth documentation of all model components (e.g., the *rationale* for data, model, and calibration methodology selection as well as all actual inputs, mathematical formulas, standard and exception handling algorithms, pre-/post-processing) and end-to-end processes and controls

- People with sufficient expertise, resources, and influence.

For example, the persons or teams performing the reviews must have

- sufficient information for a substantive review (e.g., not hindered by incomplete documentation or inaccessible proprietary information)

- expertise on interest rate, equity, and credit models and calibration techniques *and* their implications for life and annuity valuation (so assertions and documentation are not automatically accepted as givens or collected as a "check the box" exercise)

- adequate time and budget

- the influence / authority to effect change (e.g., material findings are escalated and implemented vs. dismissed due to contractual constraints or commercial inconvenience).

A "GOES Governance Drafting Group" may expedite and enhance the governance process.

I have attempted to provide feedback on specific sections of the governance exposure draft in the attachment to this letter. However, real-time feedback and collaboration may be more effective.

The effort needed to establish a governance framework and initial GOES documentation is at least as substantial as drafting a new Valuation Manual chapter. The GOES process may benefit from a similar drafting group approach that brings regulators, Academy members, industry / ACLI members, and other interested parties together for in-depth framework discussions and timely vetting of GOES documentation for content and clarity.

I can be reached at c.w.tang@comcast.net if you have any questions or would like to discuss these comments further.

Sincerely,
Connie Tang, FSA, MAAA, CFA

ATTACHMENT 1: Detailed Feedback / Comments by Section

Section II:

Section II.A: Governance Roles

In my experience, the model owner is typically a leader in the area that relies on the model for business outcomes (i.e., the person who uses the model for decision making and cares about its results). The model owner has overall *accountability* for the model and is the decision maker on intended purpose, strategy, priorities, usage, etc., including initiating the selection of new vendors and/or models. LATF or the GOES Subgroup would be the natural candidates for this role.

The model steward typically has more of a compliance and day-to-day implementation role (i.e., making sure that strategies, frameworks, policies set by the model owner or other authorities are followed).

While Conning's Professional Services Team may be the product owner for GEMS software development and "own" the running of the model / generation of the model output, I would not expect them to be the GOES model owner unless we are adopting a more colloquial definition of "model owner" (i.e., the point of contact or person *responsible* (i.e., "hands on keyboard") for implementing and running the model).

Some of the confusion may stem from software development life cycle (SDLC) vs. model development life cycle (MDLC) terms and considerations, so we may need to be careful about the context in which we use terms like "developer" or "owner."

Elaborating on roles and responsibilities (e.g., through tools such as a RACI matrix) may alleviate potential terminology confusion. Examples of activities to explicitly identify include:

- Roles, responsibilities, and sign-off processes for initial (and future) vendor review and selection since vendor selection is a key part of the GOES process and may be a de facto and highly consequential actuarial modeling and assumption decision if the vendor only supports one particular model form.

- Defining intended purpose, priorities, stylized facts, acceptance criteria, and other requirements (e.g., for ancillary tools)

- Identifying, recommending, approving, and implementing a model form / structure; relevant calibration data, methodologies, and targets; SERT scenario definitions and methodologies; scenario selection counts, dimensions, methodologies; diagnostic and summary metrics; etc.

This additional detail would also address a fundamental question and clarify professionalism responsibilities (e.g., around expertise and potential conflicts of interest): Is the GOES vendor a software vendor acting at LATF's direction or a consultant providing Actuarial Services by

recommending material valuation assumptions? Clear divisions of labor and expectations are critical when two parties (i.e., LATF, Conning) are fulfilling three conceptual roles: regulator / sponsor, actuarial consultant / PBR economic assumption expert, and software vendor.

Section II.B: Sign-Off Protocols

The Sept. 25, 2024 GOES Subgroup call noted that Conning's attestation in Section II.B is consistent with Sarbanes-Oxley (SOX) / Model Audit Rule (MAR) requirements. SOX/MAR attestations are usually provided *after independent testing* (e.g., by an auditor). Will such testing be required for GOES, or will this be a self-attestation (i.e., no independent testing)?

If a company had developed or were running an economic scenario generator for material GAAP / statutory balances, the generator would likely be in scope for periodic independent testing. Companies outsourcing work affecting financial reporting often require service providers to have a third party audit and report on their controls (e.g., Service Organization Control (SOC 1) reports).

Conning should have standard operating procedures, appropriate controls, and risk assessments for all its GOES-related processes. Given the importance of GOES and its more "black box" scenario production process, best practice would include formal review and/or testing of end-to-end processes and controls, an assessment / summary of results, and attestation.

Section III:

Feedback on Discussion Questions:

- Scenario subsets:

  The GOES scenarios will be used for products with different risk profiles and sensitivity to one *or more* market risks. Therefore, the scenario selection tool should have the functionality to stratify on multiple dimensions (i.e., rates and equities). (The posted GOES tool stratifies on only one or the other.)

  Posting all scenario subsets companies might use is not practical, so posting the scenario selection tool is a good alternative. It may also be helpful to post

  - The scenarios or selected scenario numbers for a few key stratifications. (E.g., the scenario numbers for a 1,000 scenario interest rate-only set, 1,000 scenario equity-only set, and a 1,000 interest rate / equity set)

  - Scenario statistics *tools* so that companies can calculate and compare statistics for their subsets to the full 10,000 scenario set.

- Sensitivities:

Typical sensitivities may include up and down shocks on all key initial market inputs. This will require a complete inventory of the initial market conditions used in the GEMS interest rate, equity, and corporate models.

For interest rates, the sensitivities could include both parallel and key rate shocks. We will need to understand and assess how well GEMS accommodates non-parallel sensitivities given initial curve fitting issues and the material, persistent impact of initial state variable selection / fitting on GOES scenarios.

- Unexpected production issues:

    There should be a well-defined communication, escalation, and fallback plan if something unexpected occurs during scenario generation (as well as a business continuation plan for other potential disruptions). Year-end and quarter-end valuations are typically the most critical and require tighter recovery / resolution times.

Section IV:

Section IV.B: Model Risk Rating

Typically, a model governance policy establishes quantitative and qualitative criteria (and other considerations) for high-, medium-, and low-risk classifications. Each classification is associated with risk-based testing and review requirements.

This document provides the rationale for a "high" classification without defining "low" and "medium" because the GOES model is clearly high-risk overall. However, not every model component or tool within GOES may be high risk, so establishing explicit classification criteria may facilitate more efficient, risk-based activity.

Section IV.C: Model Inventory

For large and complex models like GOES, a more detailed model *component* inventory may be helpful. For example, a "Treasury Model" may include the GEMS engine that generates projected rates given initial state variables and model parameters, the tool used to fit the initial state variables from the initial rate curve, a Generalized Fractional Flooring tool, other pre-/post-processing tools, calibration tools (for determining or updating parameters from calibration data), etc.

Identifying models and model components at a more granular level can help ensure that we have not overlooked an item (e.g., an undocumented change in initial state variable fitting methodology / tools) and are applying the appropriate risk-based scrutiny to each.

Note that the same underlying models are used to produce different levels of output detail for the Basic and Robust Data Sets, so it would be more natural to identify Treasury, Equity, and Corporate models instead of a "Basic Data Set Model" and "Robust Data Set Model."

Feedback on Discussion Question – Optional Items:

All aspects of GOES, including (but not limited to) items such as the API tool and generation of the additional elements in the Robust Data Set, should be covered by the model governance policy. There are no other means of establishing governance over these items, and GOES objectives and appropriate statutory reporting will not be achieved if the API is incorrect or Basic and Robust data sets are inconsistent.

Section V:

Section V.A: Process and Criteria for Model Selection

This section should be expanded to include vendor selection, model selection, and model calibration / parameter selection.

A policy document should provide guidance on when model office testing, impact analysis, and/or full field testing would generally be applicable (vs. discussing recent model office runs or field tests).

Section V.B: Model Validation

The model validation section focuses on implementation / process testing. However, model validation must also include confirming the conceptual soundness and suitability of the selected model form and calibration[2].

Section VI:

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[2] A liability assumption analogy:

- Implementation / process validation would be confirming that the dynamic lapse assumption is implemented according to specifications. E.g., Testing that the single specified linear function, calibrated from in-surrender period lapses and depending only on a nominal definition of in-the-moneyness, has been implemented according to the model documentation.

- Validation of conceptual soundness and suitability would be checking how well the dynamic lapse formula and parameters align with experience, expected relationships, and best practices and satisfy the intended purpose. E.g., Reviewing company experience, industry studies, behavioral research, product features, and sensitivities to determine that the functional form should be an S-curve; have separately calibrated parameters for in-surrender period, shock year, and ultimate lapses; and depend on an actuarial present value definition of in-the-moneyness as well as withdrawal status.

Section VI.A: Monthly Model Updates

There should be a complete inventory of all initial market inputs, their data sources, and update frequency for the Interest Rate, Equity, and Corporate models. This information would normally be maintained in the model documentation (and not the model governance framework document).

Feedback on Discussion Question – Governance and Model Documentation Structure:

The draft document appears to be a hybrid document that establishes policy and documents compliance with policy. However, separate documents stored in a well-cataloged, version controlled, and searchable repository may be easier to understand and maintain – particularly if there are multiple models, model components, or tools and multiple responsible parties.

- Typically, a board or oversight group owns the model risk / governance framework and policies. The framework and policy documents define scope (e.g., models and model components covered), roles and responsibilities, materiality and risk rating thresholds / considerations, and activities required (e.g., documentation, inventories, validation, testing) by materiality / risk rating. Frameworks and policies are subject to periodic review and revision (e.g., every 1-2 years or if regulatory requirements change). The documents tend to be relatively stable, with updates primarily to elements such as materiality or risk rating thresholds.

- Separately, there are documents demonstrating compliance with the policy (e.g., model and model component inventories; detailed technical documentation on data, models, and tools; validation reports and findings; change logs; test plans, results, and signoffs; risk and control assessments and attestations; list identifying the people serving in each role). These documents are updated frequently (e.g., as personnel change or model components are updated).

Section VI.B: Annual Model Updates

The annual update might be better characterized as an "Annual Review and Update (if necessary)."

Automatic / formulaic parameter updates may not be necessary for the interest rate and equity models and calibrations. The long-term (steady state) interest rate target appears to have been set as a means-to-an-end (i.e., to make the calibration perform better on criteria such as low- and high-for-long) vs. calculated from or strongly tied to historical data. The long-term equity assumption was constrained at "8.75%" based on a long-standing judgment (from 2005 and reaffirmed during GOES) and not directly tied to historical data. Neither of these items seem likely to change meaningfully in a year or with an additional of 12 months of data. (Note: There is insufficient model and calibration information to opine on potential Corporate model updates.)

Nevertheless, there should be a formal annual *review* process. It is an assumption best practice to regularly assess whether there are trends that may be indicative of a change in long-term expectations; review accumulated findings and/or items flagged by ongoing or off-cycle monitoring; and confirm whether updates are warranted. Updates may be needed in some years but not others. However, not making a change is still an actuarial decision, and explicitly affirming that prevents accidental neglect of an assumption ("set-it-and-forget-it until it's too late").

Section VI.C: 5-Year Model Recalibration

The 5-year review should be a <u>*comprehensive model review*</u> and include assessing the continued suitability of the model form/structure (which may include evaluation of vendor limitations) and not limited to the recalibration of the existing model.

The 5-year review process should commence well before 5 years has elapsed. (Starting the process in 5 years would delay any update significantly beyond 5 years.)

Special considerations may apply for our initial implementation. If findings related to model limitations and soundness are open / deferred from the initial implementation, it may be advisable to continue exploring enhancements and actions in the coming years (vs. waiting until the formal kickoff of the 5-year review in a few years).

Section VI.D: Off-Cycle Model Updates

Feedback on Discussion Question:

Potential drivers of off-cycle model changes and/or recalibration may include:

- New uses / products / risks that require additional economic outputs or make existing scenario values or characteristics more material

- Changes / enhancements to stylized facts or acceptance criteria

- Conditions that may be indicative of a change in long-term expectations – including but not limited to persistent trends in actual data, Fed / monetary policy changes, fiscal policy changes, market structure changes, global economics

- Conditions the model was not designed to handle or does not handle well occurring more frequently or persistently (e.g., conditions that stress a known model/calibration limitation or simplification beyond what's acceptable, distributions or sensitivities that no longer make sense because of previously unidentified model/calibration limitations)

- Regime changes not adequately reflected in the ranges of the existing distribution

- Failing and/or worsening performance (e.g., trending towards failure) on acceptance criteria

- Other model findings (e.g., correcting errors, removing an approximation / simplification, enhancements for conceptual improvements and evolving best practices)

Errors or market conditions materially "breaking" the existing model/calibration would be more likely to trigger more "immediate" actions. Most other cases would tend to be incorporated into an upcoming annual review / update, and some could even be slated for the next 5-year review. However, there should be regular monitoring and escalation procedures.

Section VII:

Section VII.A: Tracking and Communications of Model Findings

It is unclear how the Model Findings (Section VII) and Model Change (Section VIII) processes will work if the items involved are subject to a non-disclosure agreement. (E.g., Will interested parties be able to ask questions and obtain sufficient information to log a finding or request? How will the findings or changes be posted and discussed?)

Section VII.B: Risk Classification / Section VII.C: Remediating Findings

The handling and utility of the proposed classification system (Material, Complex; Material, Simple; Immaterial) is unclear.

In my experience, findings are typically classified as errors or refinements and assessed on a several dimensions. The classification and assessment then lead to an explicit recommended action (e.g., address immediately, address at the next scheduled [annual, 5-year] review / update, monitor and address at some pre-defined trigger).

Error vs. Refinement

The first distinction is whether a finding is an error or refinement (e.g., changes to address previously documented model limitations, simplifications, approximations or reflect emerging situations, advancements, best practices).

Errors should be "addressed immediately" while refinements are typically scheduled over longer time frames. Addressing an error may mean fully implementing the correction, implementing a workaround / topside / adjustment that reduces the impact below an immateriality (de minimus) threshold, or potentially documenting and having an implementation plan (with appropriate monitoring in the interim) if the error is already under an immateriality threshold.

Errors also trigger reviews to identify root causes and any control deficiencies requiring remediation. (We must fix the error *and* make sure that controls are adequate to mitigate the risk of similar future errors.)

Assessment

Each finding may be assessed on several dimensions, e.g,

- Materiality / significance: potential dollar or percentage impact on reserves, surplus, or RBC ratios for representative model office blocks and estimated company results

- Likelihood: number of companies affected, how frequently the finding may have an impact (e.g., possible but rare, intermittent, often in the current or specifically identifiable environment, all the time)

- Complexity and effort / resources required to address.

Findings should be evaluated both individually and in aggregate to make sure that smaller (seemingly immaterial) items do not add up to something material in aggregate.

Prioritization and Taking Action

The error / refinement determination and impact assessment result in the assignment of an actionable rating (e.g., address immediately, as soon as practicable, at the next annual update, at the next 5-year review). Findings with more material and/or likely impacts would generally receive the highest prioritization and timeliest implementation. Practical considerations (e.g., complexity, effort, logical grouping of related changes) may influence the exact timing / scheduling, but critical or high priority items (e.g., high severity and frequency) would still be addressed with urgency.

The shared and "closed" / proprietary nature of GOES may complicate prioritization decisions and remediation activities. For example, an error or refinement that is immaterial or only moderately impactful at the industry level may be very material for a small company or a company with a particular product or asset strategy. The PBR Actuary will need detailed and timely information about the issue and its potential remediation to determine if additional actions may be required in the interim (e.g., building or using other generators/models to assess impacts, adjusting reserves/capital[3]). Ideally, scenario sets with the corrections/refinements and/or prototype models implementing or approximating the proposed changes would be provided as part of the GOES assessment process.

Note that using a prior version of the generator would be an option only if the finding is a newly introduced error, and the prior version happens to be correct. (This should not be a common occurrence in an effective control environment.)

Section VIII:

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[3] If an unremediated GOES error understates reserves, the PBR Actuary could address the understatement by increasing reserves. However, if an unremediated GOES error overstates reserves, whether a reduction in reserves for the overstatement is permissible may depend on whether the unremediated (i.e., currently implemented) or remediated GOES is deemed the prescribed economic scenario generator in the Valuation Manual.

Section VIII.A: Model Change Categories

A governance policy should define what "full governance" might entail for each type of finding and regular update type (i.e., monthly, annual, 5-year) – including the testing, validation, documentation, and approvals required and when model office testing, impact studies, and full field testing would apply.

"Routine (monthly) changes" that trigger some sort of exception handling should require notification / tracking. (E.g., Substituting or not updating for an unavailable or questionable input data element, deviating from the publicly documented algorithm for setting initial state variables because a valid or acceptable solution could not be found, altering credit model adjustments because they no longer work well)

Section VIII.B: Model Change Requests and Tracking

The policy should identify how often model change requests will be reviewed and prioritized. (Avoids having requests that languish.)

Section VIII.D: Modeling Environments

Information about development, test, and production IT environments would more commonly be found in testing and/or controls documentation and not a model governance *framework* or *policy* document. (However, the current draft appears to be a hybrid document and not purely a framework/policy document.) A policy document would establish expectations for types of testing, test plans, and documentation (potentially by change type and/or risk level) instead of leaving testing to "the discretion of the model developer and owner."

The use of development, test, and production environments is standard in both software and model development, but the process described for storing, tracking, and promoting models appears to deviate from standard software development practice and insurance company modeling best practices / IT control requirements. Formal version control / library management software and processes should be used to store, track, and promote all model components (e.g., source code, Excel tools, pre-/post-processing tools) as well as inputs (e.g., initial market, calibration parameter, and projection parameter files) through the different IT environments. (For example, development of the next version should start from the "gold copy" of the production model in the repository instead of copied from whatever may reside in the production environment.)

The current draft mentions developer testing. However, it is unclear if or how other standard software and model testing processes (e.g., integration testing, user acceptance testing) are being performed.

November 21, 2024

Honorable Rachel Hemphill
Chair, Life Actuarial (A) Task Force (LATF)
Honorable Mike Yanacheak
Chair, GOES committee, Life Actuarial (A) Task Force (LATF)
Re: GOES Model Governance Exposure.

Dear Dr. Rachel Hemphill and Mr. Mike Yanacheak,

Please accept this comment on the exposure for GOES model governance.

The members of LATF, GOES, the NAIC staff, Conning, the Academy, ACLI and many interested parties have contributed a great deal and produced a high quality model ready for release. Moving forward rapidly with this framework as it exists is the best for all stakeholders.

For regulatory purposes, there needs to be a reliable established model like the GOES system. The regulators and NAIC have developed a good framework to go forward.

Together with a strong fixed model and delivery system goes the art of using the model. In the art of the model one deals with what is not in the model or what is rapidly changing. Any model system has to have this separation of mindsets. Here the regulators, companies and other stakeholders use the model but with an understanding of the changing context.

This comment focuses on model calibration to fundamental economic data. This is longer range in nature. This is concerned with the art of using the model as we adjust to dealing with a joint economic climate system reality that is different than the 20th century. In the 20th century we had economic and financial models to manage, but we did not have a physical system telling us we were wrong from time to time. That makes the art of the model different for the 21st century. This comment goes towards that art of the model in the 21st century.

Sincerely yours,

Mark S. Tenney

1 The Lucas Paradox and GOES

The GOES model is almost purely a financial variable model. It does not have some of the fundamental economic variables that connect to the situation of people who are not doing well.

In the last few years of protests, during the election of 2024, at the IMF and World Bank meetings in 2024, at UN COP29 and elections Europe many ordinary people have expressed that things are not working for them. Some of this is in strong emotional terms.

The economic fundamentals and the widely used Cobb Douglas production function connect to these strong emotions that things are not going well for many groups.

The Lucas Paradox in particular picks up on these strong emotions of discontent and expresses them in terms of economic fundamentals for parts of the US economy and the global economy. The Lucas Paradox is that in the Global South and in parts of the economies of the Global North, investments don't work out fully or as often as desired because the labor multiplier is too low for many groups. Private investors are reluctant to take on these risks in many cases. For these investments, winning may be just a small win in profit terms. So risks are not compensated by upside.

The Lucas Paradox is not unbeatable, but it is the main reality of investments in the Global South and some segments of economies in the Global North. The discussion here is on the pessimistic side. An effort has been made to tone it back from deeply pessimistic, but this has not always succeeded. The meetings of the UN COP29 and IMF and World Bank are on the optimistic side. So they provide different sides of these issues. There are many optimistic voices there, but also a few pessimistic or cautious ones.

Climate change and the Lucas Paradox interact to deepen these separate crises. In particular, climate mitigation requires large investments in all parts of the Global North and Global South. However, the Lucas Paradox says that for many groups in both places these investments will fail too often for private investors to take the risk. This is because their labor multiplier is too low relative to the average in the US. The low labor multipliers means the investments will fail too often for private investors. If they succeed, the profit will be slim.

The UN COP29 and IMF and World Bank meetings have partly ignored the Lucas Paradox. An exception is Ajay Banga, president of the World Bank. Banga is pushing innovative arrangements to create multilayered risk taking to bring in more private market investment.

Nonetheless, the IMF has agreed to capital flow management measures and macroprudential measures for most countries in the world that limit their capital inflows to current levels. The Lucas Paradox says that the investments the World Bank and regional development banks are planning above current levels allowed by the IMF controls will have too high a failure rate. This is why the IMF has agreed to redlining most countries to get no more than their current external investment levels. The capital flow control measures and macroprudential measures of the IMF imply that the planned climate investments by the World Bank will not work in practice enough for private investors to take up the bulk of investments. This is required for the scale of investments needed.

Parts of the Global South have made impressive progress on green energy, higher than the US as a percentage in many cases. But this is offset by the fact that their total capacity is low.

The US economy is dependent on cheap prices for Global South goods. These includes coffee, tea, chocolate, spices, minerals and agricultural goods. These low cost Global South raw materials are turned into cheap manufactured goods in China and other low cost producers. They then come to the US at doubly cheap prices reflecting cheap manufacturing prices and cheap raw material prices.

These low prices are unsustainable if uncontrolled climate change is the reality for the Global South regions that produce raw materials or transform them into manufactured goods. Even if parts of the Global South have a high percentage of green energy, what matters is the total world output of carbon.

This means the backward looking parameters in GOES are not going to work out in practice if climate mitigation fails. Instead, financial market returns will be much lower. This can include much higher default rates on home mortgages and corporate bonds. For companies purchasing tail tranches of CMOs and CDOs, this can mean payout rates close to zero as the 21st century plays out.

In addition, demographic changes in the US, Canada and other advanced countries may result in substantially lower labor multipliers in the US and those countries. This can be for larger segments of the US or the US as a whole. The strong emotions of discontent expressed in the US reflect that for parts of the US economy, these lower labor multipliers are already reality. This means that despite its enormous capital stock, the US is not investing money in sufficient size in parts of its economy that are not doing well. Neither the government nor private investors can do this if the investments fail because of the low labor multipliers in those segments of the workforce and economy. This includes many young adult groups and those nearing retirement.

The reason the US can't invest in these low labor multiplier groups adequately is that the lower labor multiplier in them means that investments will fail too often for private investors. The scale of investment is too great for government to do most of the investments by itself. The reason the government is so financially burdened is the low labor multiplier groups. This forms what is sometimes called a doom loop for cities like Detroit. There is high labor multiplier flight leaving the low labor multiplier groups behind. The city then has to raise tax rates on those left. That causes further flight of the remaining high labor multiplier groups. So the city spirals down. Suburban communities can suffer this as well.

Immigration expands the size of the doom loop sector and thus swallows the rest of the economy. Young adults and those nearing retirement expressed their view that they are in the doom loop during the elections. So did many veterans.

That's the message of the Lucas Paradox whether it is internal to parts of the US not doing well or to the Global South or parts of Canada and other advanced countries experiencing these low labor multipliers. Neither the government nor the private markets can fix them easily, because the low labor multiplier means investments in them don't succeed sufficiently or often enough. It doesn't matter if the source of funds is private markets or government expenditures. The Lucas Paradox says the low labor multiplier makes the investment fail too often and not produce enough gain in the cases that do succeed. Governments can do only a small part of the total investment. Most has to come from the private capital markets. But they don't like the risk of failure from low labor multipliers or the low profits in winning scenarios.

If the overall average labor multiplier in the US falls to half its current level, then the effect on capital markets and prices will be to divide prices in those markets by 4. This assumes a capital exponent of $1/3$ and a labor exponent of $2/3$. To move the labor multiplier from under the labor exponent of $2/3$ to be under the capital multiplier of $1/3$, the labor multiplier has to be squared.

This scenario of a $1/2$ labor multiplier means home prices will be divided by 4 in most of the US. This will result in deep defaults on mortgage securities. This will be beyond the capacity of FNMA and FHLMC. The US government won't be able to intervene because the amounts will be too large. In addition, the US government will be unable to make good on Social Security, Medicare, Medicaid and veterans benefits. So it won't be able to extend itself to home mortgages.

There will be similar defaults in corporate bonds. This means that tail tranches of collateralized debt and loan obligations will have payouts close to zero.

As global temperatures rise, parts of the Global South will be too hot to sleep comfortably at night during the hot months of the year. Coffee, tea, chocolate and spices require care in growing and processing to keep them safe and healthy. The workers will find it hard to do this when they can't sleep for 3 or more months each year. In addition, their motivation to keep these products tasting good for us may be mixed. On the one hand, they will need to keep our business even though the prices are higher. On the other hand, they will feel abandoned by us and this will reduce their motivation.

Even in the US, many groups will experience the same situation and emotions. Their output effort may degrade

further because of this. This will contribute to the average labor multiplier for the US reaching 1/2 or lower.

To recapitulate, most of the population of the Global South and much of the Global North have labor parameter values that mean that climate mitigation investments will fail too often for private market investors to take the risk. The World Bank is trying to use mechanism design to overcome this, but this is not proven yet.

Climate mitigation can't succeed by the efforts of just a few people or a few countries. Although the IMF has most of the world redlined to current investment levels because it can't absorb any more external capital, this is ignored by many but not all at the UN COP29 and some parts of the World Bank portion of IMF and World Bank meetings.

China can not switch to high cost green energy if the Global South and parts of the population of the US and the Global North can't pay higher prices than China's current prices. Large parts of the US public in the 2024 election said and voted they have no money to pay for higher prices for green energy produced goods. They can't even pay a dollar more for green energy costs for an item manufactured in China or other parts of Asia or Latin America. China has listened to this and is building coal capacity to run its entire economy on cheap coal. India is doing the same. Although, India has built a substantial percentage of its economy as green and China is the world's largest green energy producer.

The Global South has even less ability to pay a dollar more an item for goods manufactured in China or India from more expensive green energy. There are some who claim lower costs for green energy. If this was easy to do, there would be more of a rush by private investors to fund green energy. It is however, part of the mix of scenarios on green energy costs.

Advocates for the Global South claim that the US, Canada and other advanced countries have taken 60 trillion dollars from the Global South since 1960. A substantial part of this calculation is lower wage rates for workers in the Global South. That is not sustainable with higher temperatures in the Global South. The yields of agriculture and the output of factories in the Global South will be lower under the conditions of global warming, which will be more intense in the Global South.

This will result in much lower profits in the US for corporations, higher prices for consumers, and the inability of consumers to continue to pay for new housing or high prices for old housing. It will also mean that workers in the US who depend on transforming cheap raw material or agricultural imports or cheap manufactured imports into higher priced goods in the US will be squeezed. That means home prices will fall in the US. The people won't have the wages to pay for it.

Default rates of mortgages and corporate bonds will be much higher than a backward looking calibration will produce. Goldman Sachs and others are predicting much lower equity market returns already.

As to negative interest rates, the US public believes it voted for price level mean reversion not inflation rate mean reversion. Both parties in effect promised the public price level maintenance. Another election in which the party that wins is the one that promised price level maintenance and this will become policy. That means during recessions, the federal reserve may have to go to deep negative interest rates.

As global temperatures rise, the IMF, World Bank, US Treasury, UN, EU and others will become desperate to fund investment in climate mitigation. Low labor multipliers in the Global South and segments of the US and Global North will require deep negative interest rates to make them viable in some scenarios. The pressure of unmitigated climate change if that materializes will be so extreme that the US and other central banks will try deep negative interest rates for very long sustained periods of time. This will be a tool of desperation, but other choices will seem worse. Before trying those, the governments will try a prolonged period of deep negative interest rates. This could easily last over 10 years or become the equivalent of year long daylight savings time.

This period of deep negative interest rates to fund climate mitigation investments could start as soon as they think of it. That could be at next springs World Bank and IMF meetings. Or it may have been ten years ago and they will revive it now. Trump wanted negative interest rates in his first presidency. Many who have influence on his views are already advocating replacing the Fed chairman and pursuing a lower interest rate policy.

They may try deep negative interest rates and price controls to contain inflation. They may be willing to keep this combination going for a long time. Initially, deep negative interest rates for the Global South to invest in climate mitigation could help keep Global South products at cheap prices. If so, the IMF and World Bank and US Treasury will want deep negative interest rates to continue until they make something else get so bad that it has blowback on low prices from the Global South. That might be a long time. If the only way to keep the Global South producing at low prices is deep negative interest rates, the IMF, World Bank and US Treasury may decide to keep deep negative interest rates going for the rest of the 21st century.

2 Solvency, Advocacy, Factor Share, anti-Corruption

In a corrupt society, solvency does not happen by itself in a separate silo marked solvency. Instead, solvency is linked to advocacy that your company, industry, group gets its fair factor share. Corruption is when you don't get your factor share. Justice is when you do.

The World Bank and IMF focus on corruption as part of every meeting. As the world becomes integrated, everyone has to do this.

India has a labor multiplier of $1/5$ compared to the US. It is popular at World Bank and IMF meetings to attribute this to corruption. If corruption means the top 1 percent, then $1/100$ cause the entire work force to come out as $1/5$. So a simple way to measure corruption is $1/5$ times $1/100$ so $1/500$. This means the top 1 percent in India are 500 times more corrupt than the average person in America. If the World Bank and IMF are right on corruption, then one comes up with such a number.

If the top 1 percent are the ones who come to America or Canada or Germany, then we have to face the reality of corruption from this source. We also have our own home grown corruption.

The Magnificent Seven tech companies have a stock market value at times of 17 trillion dollars. At times, the S and P market cap is 45 trillion dollars. All 7 magnificent seven tech stocks are in the S and P 500. So the rest of the S and P 500 is worth 28 trillion dollars. The Magnificent 7 have no debt, so life insurance companies don't invest in them.

If there is an unfair net transfer of fair factor share return from the rest of the world to the Magnificent 7 and the life insurance industry invests in the rest of the world, then the life insurance industry has a problem. This is not just a profits problem, but a solvency problem.

Corporations that issue debt to the public are not in the Magnificent 7. They may not even be in the Mag 7 also rans. They may be way down in the corporate pecking order.

How do low status corporations transfer wealth to high status corporations? One is a failure in factor share justice. They don't get their fair factor share. This can come from market power by higher status corporations. It can come from unpaid know-how transfer. This could be outright theft of trade secrets, but that is difficult to prove in court.

So we can consider it a flow. This can come from a network flow. The best employees move up from middle of the pack companies that issue debt on the corporate bond market to top tier companies that don't or don't issue much. Those employees take know-how with them.

Sales between corporations may reflect bargaining power. So high status or bargaining power companies get an unfair share from low status or low bargaining power companies. Part of a companies status or bargaining power is ability to keep employees. The cheapest way to get know-how from a low status companies is to hire their top engineers, managers and sales people. This is cheaper than a deal.

The Magnificent 7 sit on top of this food chain and drain out STEM know-how, managerial skill, sales ability from the lower status companies. This may be global as well as within the US.

The Frankfurt stock exchange has a market cap of 2 trillion dollars. Germany has 80 million people, about 1/4 of the US. So scaling that 2 trillion up, we get 8 trillion compared to the S and P 500 of 45 trillion. This suggests that Germany is losing factor share returns to the Magnificent 7 and some of the also rans to it. Networks of people transfer this know-how. So Germany's IP investment is lost to the Magnificent 7 in part. One could say Germany has a brain drain, possibly in place, to the Mag 7 and its alternates.

Developing countries face the same STEM brain drain to the Magnificent 7. Their best people end up working for the Mag 7 or suppliers or customers of the Mag 7.

Another way the Mag 7 gain advantage is that other people pay the cost of their capital. If you own a computer that you use to look at Google advertisements, then you are paying the capital cost of the computer. Google gets the ad revenue without paying for the capital cost of your computer. In a sense, Google's capital includes your computer, but you pay all the cost and they get all the ad revenue.

The Mag 7 are a drain on the rest of the world. Since they are in the US, we can expect that they drain more from the US than anywhere else. So the sectors they interact with, like corporations that issue bonds, will transfer profits to the Mag 7.

The transfer from the sector of corporations that issue bonds in size to the high status sector may be lumpy instead of smooth. So instead of a constant fee per year drain, the drain can come in the form of corporate defaults by bond issuing companies. That is in the lane of life insurance regulators.

If these defaults can come in a huge correlated spike, then the life insurance industry can't just price it. The spike comes in the form of solvency failure at a specific time for the life insurance industry. So regulation of life insurance solvency includes identifying and exposing how corporate default spikes build up and how to stop them ahead of time. Most of that involves better measurement by federal statistical agencies, BEA, BLS and the Fed.

The federal statistical agencies are focused on the business cycle, inflation and unemployment. The life insurance industry has a stake in long term growth. The federal statistical agencies need to do more to measure variables key to long term growth.

One such group are young adult workers who are struggling. This group also has a dip in mortality improvement relative to others. More measurement of this group is in the lane of life insurance regulators and the industry.

Regulators and the life insurance industry need to practice see something, say something. Young adult workers and those nearing retirement have these dips in mortality improvement. That is because these groups have economic problems, not some mystery virus that targets people in their 20s and early 60s.

The economic problems of those in their 20s and early 60s are not from the business cycle. It isn't inflation or short term unemployment. These are long term growth problems. There needs to be a balance between focus on the business cycle and long term growth by the federal statistical agencies. Currently, that balance is off, and the federal focus is too much on the business cycle and too little on long term growth.

Most of advocacy happens in Washington D.C. If you rule out interacting with the federal government, then you have disarmed yourself. In a corrupt world, you can't get your fair factor share without advocacy. To get your tiny little sliver of fair factor share, you have to make alliances with your customers and suppliers and employees. You need to be part of a bigger group for advocacy for your tiny slice to succeed.

The Authoritarian Left and Oligarchic Right types (ALORTs) are happy to split DC between them. We have had an election in which power was transferred from the Authoritarian Left to the Oligarchic Right. Low status corporations will not get the lions share of that transfer. Corporations that issue a lot of bonds are low status in American society. So are the life insurance companies that buy them. They both may even lose factor share from that transfer. For life insurance companies that transfer can take the form of correlated default spikes.

The Magnificent 7 are in charge of the reform hen house. That will mean deep cuts in the regulatory apparatus and statistic apparatus for trying to keep their excessive grab of factor share in line. That regulatory and statistical apparatus is what keeps down correlated default spikes in corporate bonds.

3 Recommendations for GOES Justice

1. Calibrate all the models forward to economic and climate fundamentals. This includes scenarios where the Lucas Paradox dominates efforts to get around it. This is not all scenarios but many.

2. The Cobb Douglas production function, the Lucas Paradox and scenarios of deep declines in the labor multiplier in segments or the overall US economy must be part of forward calibration to economic fundamentals.

3. The expected trend in default rates on home mortgages and corporate bonds should have a rising trend for the rest of the 21st century.

4. There should be some scenarios with deep negative interest rates for the rest of the 21st century. The median of interest rates should be shifted downward. But there may be scenarios of high interest rates if inflation takes over. This is to reflect a collapse of the Global South because of a complete failure of climate mitigation.

5. Climate variables and scenarios should be part of the forward calibration process. There is substantial uncertainty on these. Many observers think that the global average temperature change now can't be contained from reaching 2.5 to 3 degrees C above pre-industrial levels.

6. The situation of young adults and those nearing retirement should get extra attention. These groups, as I understand the material presented, are experiencing low mortality improvement relative to other groups. This is likely linked to low labor multipliers for those segments of the work force. This means neither the government nor private markets can save these groups because the low labor multiplier means investments in these groups will fail. It doesn't matter if the investments are public or privately funded, the low labor multiplier means the investments will fail.

7. The NAIC should have a permanent member of the Federal Economics Statistics Advisory Committee (FESAC). This should be to get very disaggregated data on the labor multiplier of different groups and ages. We also need to know if the capital multiplier is going up while the labor multiplier is going down. This may have started as early as the 1960s.

8. It is critical to understand what is happening to the labor multiplier of young adults. The mortality data presented indicate that many young adult subgroups have a low labor multiplier and can't easily be helped by investments, private or public. If the labor multiplier is low for even parts of the young adult group, that will indicate we are in for a bad 21st century. That means rising default rates on home mortgages and corporate bonds for the rest of the 21st century. It also means the Fed and US Treasury will want deep negative interest rates as a way to reduce deep default rates. It is hard to default on a negative interest rate mortgage. Mortgage rates may not reach negativity but they may be low.

9. The Lucas Paradox is taught in graduate level textbooks in economics used from Berkeley to Cambridge and Oxford. It is admitted to by the IMF and World Bank as well as by India and China. As the Lucas Paradox is more widely understood and its implication that climate mitigation is more difficult than is admitted to for both the Global North and South, the central banks and finance ministries will be willing to try going into the Looking Glass world of negative interest rates more and more deeply. The GOES model needs to both partly anticipate this and be able to adapt to it as it comes to pass.

10. It is important to be able to include as part of calibration of GOES climate events like a shift in the Gulf Stream. This could lead to less rain over North and Central America in some scenarios. It could also lead to flooding parts of the East Coast. A water pipeline system from the Greenland icecap could be built in North and Central America to try to prevent such a shift happening. Longer oil or gas pipelines under the sea already exist.

It could be used to remove all the ice on the edge of Greenland to prevent it going into the sea.

The water being lost into the ocean now is actually quite valuable. It is 10 percent of the world's freshwater reserves. It would also boost agriculture in the US and Canada. If the East Coast was flooded, this would give them a place to go in the West.

Climate change could lead to contamination of New York City's water supply. A pipeline system from the Greenland icecap would mitigate that. Infrastructure outside large cities can be damaged by wildfires outside urban cores. This can cause smoke requiring evacuation of an urban core. The water can be used to keep vegetation surrounding urban cores becoming dry during a drought.

The water would also help deal with wildfire insurance. Parts of Colorado already have difficulty getting fire insurance. This might happen in any part of the country from global warming.

The water pipeline extension to Mexico and Central America would help avoid migration into Texas, New Mexico, Arizona, and California if climate mitigation fails in those countries. It could also be used as an incentive for Mexico to stop illegal immigration across its border. Water flows south when migrants don't flow north and vice versa.

This would help keep the labor multiplier up in the US which is a critical part of calibrating an economic or financial model over the 21st century. Such a pipeline system would provide jobs to those in the coal, oil and gas industry.

LATF could request that FESAC study such a pipeline system and it's economic benefits. We need to get that water before the do-gooders at the World Bank think of getting it for the Sahara Desert. Let them build their own pipeline under the sea to Antarctica. If climate mitigation fails in the Global South that fresh water is essential for the US to provide its own agricultural needs year round.

The West and Midwest have large aquifers that are already being drained to low levels without climate change. Climate change is an additional burden on the West's water. This includes California's agriculture. With the Greenland water, the desert could bloom, providing agriculture to supply the country's food needs as the population has to shift around.

Homeowners won't be able to make their mortgage payments without water. Nor will the stock market go up 8 percent a year forever without it. Nor a lot of other things assumed in the GOES model calibration.

At the current pace, climate mitigation is failing. This means the calibrated parameters in GOES are over optimistic. This is especially true on defaults. People who lose their jobs or have lower income are not going to be able to pay their mortgages. If the house price collapses in their area from lack of water, then the default will be severe. This will mean tail tranches get nothing. Even mid-tier tranches will be hit. If the CMO is concentrated in one area, all the tranches can go down. Corporations will find it difficult to meet bond interest payments if their employees don't have water or their factory burns down. This will hit tail tranches of collateralized debt and loan obligations and go through to hit mid-tier tranches.

11. China's leaders are building coal capacity for China to run its entire economy for the rest of the 21st century on coal alone. China's leaders study the US carefully. They see an alliance of the Authoritarian Left Oligarchic Right Types (ALORTs) that has an iron grip on American immigration. That means that the Lucas Paradox will be reinforced with the drain of young adult workers, STEM workers and capital from the Global South.

It takes 400,000 dollars of capital for each immigrant worker to bring them up to the US level. For 2.5 million a year of green cards, temp workers, students and illegals that is a trillion dollars a year of capital. Three-fourths of that is on buildings. There is not one problem the US Treasury has or the World Bank has or any state has whose answer is spend 3/4 trillion dollars a year on buildings for immigrants to the US. This use of money means that the US can't bring its capital stock up to the standards of green energy for climate mitigation.

China's leaders know that. They know it proves the ALORTs have effective control on US capital spending. That

means the US can never get out of its debt problems, because it borrows money from abroad, much of it from China to pay for buildings for immigrants to the US each year. Those immigrants have a lower labor multiplier than American workers. So America digs itself deeper into debt and the inability to bring up its average labor multiplier to take care of its many groups who are in difficulty, including young adults and adults near retirement as shown by the adverse relative mortality statistics of these groups. If America can't provide capital for its young adults or adults approaching retirement, then it can't provide capital for climate mitigation in the Global South.

That makes climate mitigation in the Global South mathematically out of reach. It means the Global South can't pay an additional dollar an item for goods made in China from green energy if green energy costs more. In theory green energy can be cheaper, but in practice people who have money to invest still prefer a substantial investment in conventional fuels. There wouldn't be protests from young adults if this was not the case.

The GOES model has to incorporate what China knows about corruption US style. Immigration to the US from a global viewpoint is a major part of global corruption preventing saving the climate system. China's leaders understand the Lucas Paradox better than American ones do. China's leaders also understand how America spends its capital better than do American leaders.

The microfoundations of GOES are how the US gets and spends capital. China's leaders study that. America's leaders don't even know the ballpark numbers on America's capital stock. It is 100 trillion dollars not including land according to BEA.gov, see fixed assets by type.

The US capital stock is divided into government, residential and corporate. For each category, structures i.e. buildings, roads, etc. are the majority and overall structures are 3 out of every 4 dollars of US capital stock. Immigration requires 3/4 of a trillion dollars a year for buildings. From a global point of view, this spend is irrational compared to spending it on climate mitigation in the US and Global South. If the US spent this money on its own climate mitigation first, it could change to green energy for itself first and then help the Global South. China's leaders know that and know it is why climate mitigation is not happening.

That needs to be in the GOES calibration. Studying this and reporting on it should be a request from the NAIC to FESAC.

12. Request to FESAC. What will be the impact of artificial intelligence, AI, on future financial market returns? AI may have an important role in reducing defaults in home mortgages and consumer debt. It may also apply to corporate debt default rates. The IMF Statistics Forum this year is on measuring AI for the national economic accounts of countries.

If climate mitigation fails, then the national authorities may decide to push AI on the human population the way that they did the covid vaccine during the pandemic. They may require accepting the AI to get benefits that didn't require it before. What impact will that have? Can the AI raise the labor multiplier of groups who have low labor multipliers? In the US? In the Global South? What if the AI can't make people with low labor multipliers behave the way it wants on climate mitigation or raise their labor multiplier? If the AI can't raise up the groups with low labor multipliers to make climate mitigation work, what will happen?

13. Request to FESAC and US Treasury. Adding all data needed for calibration of bank and insurance risk models to the national economic accounts. This was a project that several actuaries were working on before the pandemic. That included Steve Strommen, Hal Pedersen, Geoff Hancock, Max Rudolph, Dave Sandberg and others. We made progress with FESAC and BEA including Brian Moyer of BEA and his staff. Christine Lagarde of the IMF agreed to add this data to the IMF database. The statistics department of the IMF told me that they needed a request from the US Treasury not from Mark Tenney. USAID was interested, but this got lost in the pandemic. This is even more timely with climate mitigation capital flows needed of a trillion dollars a year of external financing. This data should include fundamental economic data needed. That includes the labor multiplier of groups of young adults. That is key data for climate mitigation capital flows and for capital budgeting and planning for the US economy as a whole as well as the federal government and the states. If young adult groups in the US have labor multipliers below one that means that all government units in the US

will have to make deep cuts in benefits and programs. It also means educating Americans that they won't have much retirement from public or private sources.

By making this part of the IMF's mission, all countries would contribute this data to the IMF data base. That would be public for all. That would allow comparing Solvency II in Europe to the NAIC's GOES model. It would allow comparing risk requirements of offshore reinsurance countries to that of GOES. This would help in compliance on international agreements on reinsurance. It would also help if there was fraud in a reinsurance treaty. The investigators for government or even accounting or actuarial firms could use this data to understand the differences in risk model calibrations.

14. Request to FESAC. FESAC needs to get all the data needed to understand all the doom loops in the US economy into the national economic accounts. If adults nearing retirement and young adults are in these doom loops, then that needs to be explicit in the national economic accounts. The dips in mortality improvement curves indicate that many young adults and adults nearing retirement are in doom loops. Many younger candidates for office in the election said they were stuck in these doom loops, even though they did not use that term. High interest student debt or consumer debt is another type of doom loop people are stuck in. This interacts with the high cost of housing near or in urban cores. This is particularly a problem if they are in a low labor multiplier group.

15. Request to FESAC and US Treasury. Add the following to the core mission of the IMF. These problems require the broad expertise of the IMF staff. They see these problems in many countries and have know-how needed from seeing these problems in all countries, including the US, to solve them.

1. All the data including fundamental economic, labor and climate data needed to calibrate bank and insurance risk models in each country to the IMF's public database.

2. Long term growth for each country and the planet as a whole.

3. Climate capital budgeting for each country and the entire planet.

4. Climate capital flows from the Global North to the Global South needed to fund climate mitigation. These are primarily private market investments.

5. The state of young adult workers in each country and the planet as a whole. What are the labor multipliers for different groups of young adult workers? Why are young adults in Canada sleeping on mattresses several to a room in Canada? Is the underlying cause a problem already in the US?

6. Immigration from the Global South to the Global North. Does this need to be halted until global average temperatures return to pre-industrial levels. Do capital markets need to have the expectation that the only access they have to young adult workers in the Global South is to send their capital to the Global South? Are STEM workers the most important to keep in the Global South?

7. Solving corruption in the Global South. One idea would be independent Hong Kongs in the Global South. These could be one hundred miles by one hundred miles. They could have self-government. They could avoid corruption in the Global South this way. They would be able to receive returning workers or others from the Global North. This would expand the ability of the Global South to absorb private market capital from the Global North. It would allow the IMF to increase the limits on external capital to Global South countries under capital flow management measures and macroprudential measures. The Hong Kongs could focus on STEM workers and be called STEM Kongs.

8. Incentives for voluntary remigration with capital from the Global North to the Global South. This would be part of expanding the Global South's ability to absorb capital and for the IMF to increase the limits on external capital flows to Global South countries in capital flow management measures.

9. The role of the US as steward of the world's capital stock. The US has acquired approximately 1/3 of the world's capital stock. American politicians think this is found money to spend on current costs. Does this prevent the solution of climate capital budgeting and climate capital flow problems? Similar questions for Europe, Canada, Australia, New Zealand, China and East Asian countries.

10. Studies by advocates of the Global South say that the Global South has lost 60 trillion dollars of capital to the Global North since 1960. Immigration to the US since 1960 is 75 million people. At 400,000 dollars of capital per immigrant that is 30 trillion dollars. If Canada, Australia, New Zealand and Europe have 30 trillion dollars of capital for immigrants it adds up to another 30 trillion. So the sum matches the 60 trillion lost by the Global South. Are these numbers the same or should they be added? So the total capital drain or diversion away from the Global South from the combination of immigration to the US and Europe and lower wages and other drains in the Global South is 120 trillion dollars?

    Did the 60 trillion dollars of capital diversion from the Global South to build buildings for immigrants in the Global North cause the 60 trillion dollars reduction of wages in the Global South since 1960? The workers in the Global South didn't have the 60 trillion dollars of capital they needed, so their wages were 60 trillion dollars less?

    Is this why 1 billion people in the Global South don't have electricity? The total cost of the US electric grid is 1.5 to 2 trillion dollars and the replacement cost is 5 trillion dollars. Is this why the Global South needs an external trillion dollars a year for climate? Is this why the IMF has redlined the Global South to its current capital inflows which are far below the trillion dollars a year of external cash flow it needs for climate mitigation?

11. When does the Global South get back on track? Now? Or do they have to wait until the end of the 21st century when temperatures have gone much higher for the US Treasury and IMF to admit this has happened.

12. The US and other advanced countries have had a slow down in the growth of total factor productivity, wages, pension coverage and other measures of well being starting in the 1970s. Is this caused by lower labor multipliers from immigration from the Global South? Is this why Canadian young adults sleep on mattresses several to a room in Canadian cities? Is this why Detroit turned into ruins?

13. According to some sources, the US has more abandoned buildings and parts of cities than other countries. Is this caused by the low labor multipliers from immigration? From drains of capital in building buildings for immigrants instead of fixing blighted cities? Are these blighted cities Lucas Paradox Zones? Are they expanding as immigration from the Global South continues?

14. When does the Global North get back on track? It got off track in the 1970s. Is that why it doesn't have the money to do climate mitigation? Does the Global North have to wait until the end of the 21st century as well to get back on track? What happens to young adults today while the world waits until the end of the 21st century to get back on track?

15. Is immigration to the US, Canada, Australia, New Zealand, and Europe the advanced world's version of corruption? Has it harmed both the Global South and Global North? It is the reason why climate mitigation is a crisis for the rest of the 21st century instead of a problem that was solved already? Should it be classified as the main elite corruption in the world today?

16. All of these items and anything necessary to make them work would be part of the Article IV consultation between the IMF and the US as well as other member countries. The statistical support for the Article IV consultations would be part of the IMF's public database.

17. FESAC request. IMF request. If the top 1 percent in India are corrupt as the World Bank and IMF say, and they are responsible for India's labor multiplier being 1/5 of the US, then one way to measure corruption is the top 1 percent in India are 500 times more corrupt than the average American. Does this make sense? Should this be adjusted for low human capital, etc.? What is the role of cooperative behavior? Does the 1/5 measure coordination failure not just individual effort or corruption? How do we measure corruption in the US? Do developing world STEM workers bring high corruption with them? If so, are they worth it? How much of the Magnificent Seven tech companies success is from corruption? Or from network effects that are shortchanging fair factor shares to other parts of the US economy?

18. FESAC. IMF. We need to measure corruption in the national economic accounts of the US, India, China, etc. Partly this is to measure fair factor shares at a micro level. This needs to be part of the national economic accounts.

19. FESAC. Bond Market Justice. Do companies that issue bonds tend to lose out to the Magnificent 7 and other companies at the top of the corporate food chain that don't issue much debt? Can this be measured?

16. If the Global South and Global North spend the 21st century off track like they have been since the 1960s, how does climate mitigation happen? Assuming they stay off track and climate mitigation doesn't happen, what does that imply for the calibration of GOES? Is GOES way off track in its predictions for the 21st century? The GOES calibration is a backward looking calibration that doesn't make any sense for the rest of the 21st century?

17. Why is educating foreign students in STEM a priority of American universities? While Americans get trained in dead end liberal arts degrees? Only 20 percent of degrees at American universities in STEM. Many of those are foreign, especially at the Ph.D. level. Some departments in some years have only foreign students receiving Ph.D.s in STEM. When does that change? The GOES model is calibrated to the 20th century. That was a time when Americans were educated in STEM at American universities. That no longer is the case. This is another reason that the calibration of GOES is way off track.

18. High rise office and residential buildings are a major part of the US capital stock. Anything that undermines public acceptance of these buildings could cause a huge reduction in the capital stock. Some examples are the following. Smoke from fires near urban cores that require evacuation. Vacancy rates that lead to crime. Migrants or homeless who hide in the buildings during the day and harm people after hours.

A perception could grow that the office high rises are not safe for women employees after hours or on weekends. This can include inside the building, in its approaches or garages, or in commuting to and from the building in the dark in winter months. That can include unsafe garages at the end of commuter lines in winter months.

It could include urban prosecutors who don't prosecute cases which causes the police not to do much to investigate complaints. This can cause high rise office or residential buildings to become known as easy cribs. Voters have this perception already. Workers and voters overlap.

The pandemic showed we don't need these buildings. This could cause employee groups to become more vocal in no longer tolerating this type of risk as something to accept in exchange for a job.

19. FESAC request. Anything that goes wrong in the BEA capital table can undermine the GOES calibration. FESAC could be requested to do an exhaustive analysis of everything that can go wrong in the capital table.

20. Noticing. The two people in charge of the so-called department of government efficiency come from the sectors indicated as being most corrupt. Will they cut regulation of corruption? Cut statistical agencies that now or could measure their corruption?

4 US Capital Table

Most of the approximately 100 trillion US capital stock is buildings.

Table 1.1. Current-Cost Net Stock of Fixed Assets and Consumer Durable Goods

[Billions of dollars; yearend estimates]

Last Revised on: October 2, 2024

Line		2016	2017	2018	2019	2020	2021	2022	2023
1	**Fixed assets and consumer durable goods**	**62,369.0**	**64,930.3**	**68,251.8**	**70,987.8**	**74,223.6**	**84,594.7**	**94,344.6**	**96,792.8**
2	**Fixed assets**	**57,232.2**	**59,662.6**	**62,780.2**	**65,316.4**	**68,205.4**	**77,603.6**	**86,709.1**	**88,932.3**
3	Private	43,394.9	45,255.4	47,621.6	49,625.5	51,906.2	59,313.0	66,405.1	68,096.2
4	Nonresidential	23,162.0	24,066.9	25,227.3	26,423.9	27,023.0	30,069.4	33,702.3	34,847.7
5	Equipment	6,523.0	6,767.0	7,086.5	7,315.4	7,442.1	8,020.9	8,629.8	8,998.9
6	Structures	13,703.4	14,142.9	14,773.9	15,513.6	15,636.2	17,795.4	20,414.7	20,806.1
7	Intellectual property products	2,935.6	3,157.0	3,366.9	3,594.9	3,944.8	4,253.0	4,657.8	5,042.7
8	Residential	20,233.0	21,188.5	22,394.3	23,201.6	24,883.1	29,243.6	32,702.8	33,248.5
9	Government	13,837.3	14,407.3	15,158.5	15,691.0	16,299.3	18,290.6	20,304.1	20,836.2
10	Nonresidential	13,421.8	13,978.9	14,709.6	15,229.0	15,808.2	17,718.4	19,667.6	20,199.2
11	Equipment	996.4	1,014.2	1,045.3	1,075.6	1,111.5	1,188.4	1,258.9	1,302.2
12	Structures	11,278.0	11,770.4	12,419.3	12,883.4	13,352.4	15,089.0	16,855.7	17,256.5
13	Intellectual property products	1,147.4	1,194.4	1,244.9	1,270.0	1,344.2	1,441.0	1,553.1	1,640.4
14	Residential	415.5	428.4	448.9	462.0	491.1	572.3	636.4	637.0
15	**Consumer durable goods**	**5,136.7**	**5,267.6**	**5,471.6**	**5,671.3**	**6,018.2**	**6,991.1**	**7,635.5**	**7,860.4**
	Addenda:								
16	**Private and government fixed assets**	**57,232.2**	**59,662.6**	**62,780.2**	**65,316.4**	**68,205.4**	**77,603.6**	**86,709.1**	**88,932.3**
17	Nonresidential	36,583.8	38,045.8	39,936.9	41,652.8	42,831.2	47,787.7	53,369.9	55,046.9
18	Equipment	7,519.5	7,781.2	8,131.8	8,390.9	8,553.6	9,209.2	9,888.7	10,301.2
19	Structures	24,981.4	25,913.3	27,193.3	28,397.0	28,988.6	32,884.5	37,270.4	38,062.6
20	Intellectual property products	4,083.0	4,351.4	4,611.8	4,864.9	5,289.0	5,694.0	6,210.8	6,683.1
21	Residential	20,648.5	21,616.8	22,843.3	23,663.6	25,374.2	29,815.9	33,339.2	33,885.4
22	**Government fixed assets**	**13,837.3**	**14,407.3**	**15,158.5**	**15,691.0**	**16,299.3**	**18,290.6**	**20,304.1**	**20,836.2**
23	Federal	3,325.2	3,422.7	3,547.2	3,626.7	3,773.1	4,116.1	4,454.7	4,594.5
24	State and local	10,512.1	10,984.6	11,611.3	12,064.3	12,526.1	14,174.5	15,849.3	16,241.7

Using year 2023, 96.7 trillion dollars is fixed assets and consumer durables. Of this 88.9 trillion is fixed assets. Of these, private non-residential structures are 20.8 trillion. These are commercial buildings primarily. Residential is 33.2 trillion, which is buildings primarily. Consumer durables are separately accounted in this table. Government structures are 17.2 trillion. So the structures are 20.8 + 33.2 + 17.2 trillion dollars. This is 71.2 trillion dollars. If we take the 71.2 trillion of structures over the 88.9 trillion of fixed assets, we get .80, so 80 percent. If instead, we divide by 96.8 trillion, we get .735 or 73.5 percent. So at least 3/4 of the 100 trillion is structures.

If you assume a US population of 300 million or 333 million, of whom 170 million are working, one gets 200,000 dollars of capital per worker. This is taking the 34.8 trillion non-residential and dividing by 170 million workers. The other 62 trillion or so, divided by 300 million people gives 200,000 dollars per person of residential and government. Adding these, for a working immigrant, the number is 400,000 dollars per immigrant. The benefits of immigration are touted for young adult immigrants, so the 400,000 dollar figure is appropriate. For 2.5 million total immigrants including students, temps, and illegals, we get 1 trillion dollars a year. Of this, 735 billion dollars is buildings.

From a capital budgeting point of view, immigration is about building buildings for immigrants. This is not the answer to any problem facing the United States, any state, any city, any school system, Mexico, Latin America, the billion people without electricity in the Global South, the Global South's climate need of a trillion dollars a year, the IMF or World Bank, the US Treasury, or the climate system. The global economic system's free capital is mostly controlled and spent by the US. Cows in India are not readily redeployable to Africa for electrification for the 600 million without electricity there.

However, the trillion dollars the US spends on capital for immigrants is redeployable to any other problem at

any spot on the globe. If one combines Canada, Australia, NZ, and Europe a similar figure might be arrived at. But it would not be as easily controlled as by the US. The US controls free capital of one trillion a year. It spends it on buildings for immigrants. This prevents solving all other problems of the United States, North America, Latin America and the climate system.

China and India are betting this never changes. So they have abandoned counting on climate mitigation to happen. They are building coal plants with 75 year lifetimes because they believe the US will never stop spending the world's free capital of one trillion dollars a year on buildings for immigrants.

This means climate change will be unmitigated in the 21st century. That means the rise in temperature will likely reach 4 degrees centigrade by the end of the century. That will cause massive economic damages resulting in a large loss in output for the global economy and the US. The US has chosen that the purpose of the 21st century is to build buildings for immigrants to the US. It has decided to subordinate all other global projects to this one goal. Even other species will be wiped out by this decision. Others will suffer harm.

5   The Redlining Formula

What is the formula for redlining an entire country? Or part of a country? Now it can be told. Actually, it was told in 1990 by Robert Lucas. "Why Doesn't Capital Flow from Rich to Poor Countries?"

https://www.jstor.org/stable/2006549

It is part of textbooks in advanced macroeconomics. The Romer textbook on Advanced Macroeconomics is widely used. For example, it is used at Berkeley, U Colorado Boulder and Colorado Springs, Oxford and Cambridge and many points in between.

IMF terminology for capital flow management measures and macroprudential measures is here.

https://www.imf.org/-/media/Files/Data/2022/
2022-update-of-imf-taxonomy-of-capital-flow-management-measures.ashx#:~:
text=CFMs%20comprise%20two%20types%20of,by%20residency%20but%20are%20nonetheless

The following version of the Cobb Douglas production function is used here.

$$Y = A_g(K)^{1/3}(A_L L)^{2/3} \tag{1}$$

Y is output of a country, region or sector. A_g is the gross total factor productivity. Here A_L is the labor multiplier.

The net total factor productivity is as follows.

$$A_n = A_g(A_L)^{2/3} \tag{2}$$

This is not the standard notation or terminology but it is consistent with the standard and useful for both math and verbal explanations.

5.1   So how do you use this formula to redline?

$$Y = A_g(K)^{1/3}(A_L L)^{2/3} = A_g(A_L^2 K)^{1/3}(L)^{2/3} \tag{3}$$

Suppose that

$$A_L = \frac{1}{5} \tag{4}$$

This is the value for India used in Robert Lucas's original 1990 paper.

$$Y = A_g(K)^{1/3}(\frac{1}{5}L)^{2/3} = A_g(\frac{1}{25}K)^{1/3}(L)^{2/3} \tag{5}$$

So working under the exponents, multiplying the labor input by 1/5 is the same as dividing the capital input by 25.

So if you invest 100 dollars in India, you divide it by 25 to 4 dollars. Now try to get back to 100.

Is this how it really works? The true blue Lucas derivation uses calculus. It is a little more work and harder to explain afterwards. This is the elevator version of the Lucas Paradox. Even my local candidates for Congress can understand it.

You can invest a small amount of money in India and get a normal return. But if everyone tries to do it at once, you end up with this. This is the average version. It isn't calculus correct at the margins, but deep in the average territory of large investments it is accurate enough for development economics work.

So what is happening to Canada? The average has rotted and this is catching up with the margins? Something like that.

If you think about India, deep in the country the average investment has a low return like the average version indicates. In the big cities near a top university and large banks the marginal investment in India can be reasonable.

So in reverse, Canada has declined from the inside out. The average labor multiplier has gone down and now the marginal good opportunities are few. There might still be a good startup near U Waterloo, but a lot of even those are in the cash cow phase of letting the capital run off and taking profits. This is especially true of acquisitions of once rising stars of high tech near U Waterloo or other high tech incubators.

6   Reference material on climate negative interest rates

Google AI likes negative interest rates for climate financing.

> A negative interest rate policy could potentially be used to fund climate mitigation investments by incentivizing banks and investors to lend money at a low cost, thereby making it more attractive to finance green projects and technologies that might otherwise be considered too risky due to their upfront costs, ultimately encouraging a shift towards a low-carbon economy;
>
> however, this approach has limitations and potential drawbacks that need careful consideration.
>
> How it could work:
>
> Lower borrowing costs:
>
> When interest rates are negative, it becomes cheaper for businesses and governments to borrow money, making it easier to finance large-scale climate mitigation projects like renewable energy infrastructure, carbon capture and storage, or energy efficiency upgrades.
>
> Stimulating investment:
>
> By lowering the cost of capital, negative interest rates can encourage businesses to invest in green technologies and innovations that might not be financially viable at higher interest rates.
>
> Directing capital towards green projects:
>
> Central banks could implement targeted policies to further incentivize lending specifically to climate-friendly projects through mechanisms like green bonds or preferential regulations.

Potential concerns:

Economic uncertainty:

Negative interest rates can distort economic behavior and create uncertainty in financial markets, potentially leading to unintended consequences.

Disincentivizing savings:

When people are penalized for saving money, it can discourage individuals from putting aside funds, potentially affecting economic growth.

Impact on banks:

Negative interest rates can put pressure on banks' profit margins, potentially limiting their ability to lend money.

Effectiveness debate:

Some economists argue that negative interest rates may not be effective in stimulating large-scale climate investment, particularly if other factors like regulatory barriers or market uncertainty are present.

Key points to remember:

Targeted approach:

To maximize the effectiveness of a negative interest rate policy for climate mitigation, it is crucial to design targeted mechanisms that direct capital towards specific green investments.

Coordination is key:

Implementing such a policy would require coordinated efforts between central banks, governments, and the private sector to ensure efficient allocation of funds towards climate mitigation projects.

Consideration of other tools:

Negative interest rates should be considered alongside other policy instruments such as carbon pricing, subsidies for clean energy, and regulatory frameworks to effectively address climate change. Generative AI is experimental.

So are climate negative interest rates.

"Does negative interest rate policy impact carbon emissions? Evidence from a quasi-natural experiment" Jianhui Ni, Jia Ruan "

https://www.sciencedirect.com/science/article/abs/pii/S0959652623027828

Highlights

Negative interest rates can reduce carbon emissions.

Exchange rate channel can mitigate carbon emissions while credit channel is blocked.

Heterogeneity in the impact of negative interest rate policy on carbon emissions across countries.

There is a relationship between unconventional monetary policy and carbon emission

Highlights for some are lowlights for others.

7 Canada compared to the US

Canada is already experiencing disinvestment in the form of lower capital to labor ratios. The Canadian government has announced it will slow down immigration. The Lucas Paradox tells us the low investment in

capital in Canada is because new workers in Canada have low labor multipliers. This includes immigrants and recent graduates. Canada's immigration system tends to favor skilled workers more than the US. Its schools also have higher test scores on international comparisons to the US. This implies that the disinvestment in Canada may be happening already in some segments of the US.

We see this in indoor malls being demolished. We see it in so called "Urban Prairies" in many cities. This is where parts of the city go back to nature. We see it in ruins of Detroit and other cities. We see it even in large box stores not parts of malls that are closed or demolished even in the suburbs. Much of new construction is of low quality. Ugly buildings and low quality materials go together. They spring from the same cost saving mentality of the development community. That cost savings mentality is because they think that American consumers have no extra money to spend on nice looking houses or even office buildings. This low investment in buildings by developers is an indication according to the Lucas Paradox that Americans already are experiencing low labor multipliers.

This reinforces the view that starting as early as the 1960s, capital effectiveness improvements such as computers have masked labor effectiveness going down for many groups. This is one of the things we need FESAC to work on finding out and exposing more clearly. We have to know this in order to plan for the 21st century. This includes for climate mitigation as well as long term investments.

There is a wealth of information on Youtube where theory's tires can hit the road. From the BEA fixed assets by type table we discover that America's capital stock is 3/4 buildings. Looking at Youtube videos is a good way to understand what can go wrong with America's building capital stock. One channel I have benefited from the most is Chris Harden.

https://www.youtube.com/c/ChrisHarden

He covers many cities and their problems. He also does suburbs. He has a good mix of video tours, statistics and narration. It isn't isolated facts, you build up a picture from him. This is the Lucas Paradox Road Show. When the labor multiplier goes down for a city, the city follows it and goes down.

8   Ajay Banga World Bank President Climate Leader

The closest person to being the leader on climate is Ajay Banga, president of the World Bank. He is the son of a lieutenant general in the Indian army. He is a Sikh warrior. He is a born leader. He is like a general himself in the battlefield on horseback. He is making it up from the seat of his pants.

Yet he has problems to deal with. His subordinate commanders don't listen to him. Several are in open rebellion. He can't fire them. He can't fully rely on his troops in the Global South or North. He has certain funding at one level, but the real level needed depends on the whims of the capital markets.

The 21st century will require quick footed adaptivity by economists, models, vendors, regulators, and model users. There isn't going to be any time where it settles down. The change is speeding up. No one sees it all. Not even any specialty profession sees it all.

Economists are still learning. The interaction of the Lucas Paradox and climate change is still cutting edge. Although the online AI have a lot to say about it, it is not really part of the conversation in economics meetings or climate meetings. Yet, once one understands it, it changes everything.

The world may not make it the way it thinks it will for the 21st century because of the interaction of the Lucas Paradox and climate change. The Lucas Paradox may prevent climate change mitigation from working. That means the climate doesn't get fixed, it gets worse. That carries over to capital markets.

The US has deep long term problems besides just climate. but climate interacts with each of them. So does the open global economy that the US is part of. The US is important but it can't dictate the answer by itself. This

especially applies to climate. The US has passed the torch on climate leadership. It is unlikely to get it back on this watch.

9 Climate is a physical system telling us our economics is wrong

In the 20th century, we had economic and financial models. Economic or financial data would tell us the model was wrong. Then we would have to update the model.

In the 21st century, economic, financial and climate models are linked. The climate is a physical system. It tells us we are wrong at least a little bit each year. In the last year it has told us we were wrong a lot. We can't talk back to it.

The interaction of the Lucas Paradox and climate mitigation capital cashflows is the climate telling us we were wrong on our models. Although the AI chats know this, no one else is saying it publicly. This is possibly the first public written discussion of it.

How often will the physical climate system tell us our economic and financial models are wrong? When it is pleased to. It doesn't make sense to ignore this reality. The climate system won't let us if we try.

Flexibility in the model especially applies with a leader in the field uncertain of his next move or who will follow him. The models will have to switch back and forth as much as our leader on horseback does. And as much as his whimsical subordinates. In a few years, we will have a new leader no matter the victories or defeats of our current one.

But our opponent is not a human leader and a human army. It is a physical system. We may be impressed with our leader. Or we may be persuaded by a rebellious commander. But in the end, the climate system decides if our moves were correct. Each time the climate system moves, we have to reorganize ourselves and go in a new direction. The models will have to do that too.

10 UN COP 29 failure

The big failure of UN COP 29 was to promise money first and not even discuss corruption and reform. The World Bank and IMF learned by experience that they had to put reform first and money second.

Most of the money for climate mitigation in the Global South has to come from the private markets. The role of governments is to negotiate reforms. The international groups need to strengthen the hand of local reformers in each country. This is done by insisting on reform first and money second. It is also done by making most of the money be private capital market investments not government to government grants.

https://www.imf.org/en/Topics/climate-change/COP29

Mohamed Jameel Al Ramahi CEO, Masdar spoke at one of the IMF World Bank sessions. He is an investor. Al Ramahi said the money is there if the opportunity to invest is there. The problem is that the opportunity to invest is not there. He has dealt with governments in Sub-Saharan Africa he said. The problem is getting them to make projects work. It is the corruption and apathy problem. My nominee for hero of the UN COP 29 meeting is Al Ramahi. There is no climate justice without investor justice. Climate investments have to succeed and pay out profits just like ordinary investments that have no cheer leaders.

The World Bank has streamlined its approval process for loans and grants. This shortens the period to insist on reforms before money. This may be a mistake. The primary role of the World Bank and IMF and UN COP meetings is to insist on reforms first and money second.

Some principles for investment in climate mitigation capital in the developing world are as follows.

1. Reform first, money second.

2. Strengthen local reformers.

3. Most of the money has to be voluntary capital market investments.

4. The public capital markets have to be part of the formula. It can't be private company foreign direct investment without a capital market component.

5. Capital markets shine a spotlight on problems.

6. The infrastructure of capital markets includes honest accounting, securities regulation, fair and honest tax collection, etc.

7. The best warning of a project's problem is a falling stock price on a public traded capital market. Even inside information gets into public markets this way.

8. The Lucas Paradox is the elephant in the room of climate mitigation investment in the developing world. The low labor multiplier of the Global South means projects in the Global South need extra care to work. Without the extra care, the projects will fail.

9. If the money is wasted, the climate system won't change. The climate system doesn't care about good intentions or shouting climate justice in front of or inside the meetings.

10. The capital markets have to be told firmly that until climate is solved in the developing world there will be no more immigrants to the developed world. The indicator this is achieved is not a government agency, it is the climate. When the climate says the global average temperature is back to pre-industrial levels is when the capital markets can have immigrants to the developed world. Until then, they get none.

UN COP29 was a failed meeting. The advocates of climate justice need to focus on corruption, reform, honest accountants and actuaries, securities market regulators in the developing world, transparency,and publicly traded stocks for large investment projects. There needs to be a capital market component to all large climate investments. Ajay Banga is on the right track with his work in this direction. Publicly traded bonds and stocks are essential to avoiding the Lucas Paradox for climate mitigation in the developing world.

The IMF plays a critical role in making capital markets work. Climate capital flows have to be part of the IMF's core mission. That includes being able to criticize advanced countries in their annual Article IV consultations for draining STEM talent and capital from the developing world by immigration.

11   Labor multiplier for young adults is key for calibration

We have to know how far down the labor multiplier has already gone for young adults. That number will tell us the future of default rates and of whether health care and retirement for Americans have to be reduced to middle income country levels. The middle income boundary for countries is 14,000 dollars a year according to the World Bank. So shifting down to middle income status for large groups of American workers is something we have to incorporate into our planning. This downward shift is because of lower labor multipliers.

The Lucas Paradox tells us you can't easily fix lower labor multipliers by investment because the lower labor multiplier makes investments fail for these groups too often. It doesn't matter if the investment is public or private. The low labor multiplier makes the investment fail at a high rate. Being in a low labor multiplier group is thus a type of doom loop. The same applies to low labor multiplier cities, close in suburbs, rural areas or countries.

If this low labor multiplier new reality includes many subgroups of young adults in America, that means those groups have no easy or automatic way out for the 21st century to come. Young adults are stuck in a Lucas Paradox low labor multiplier doom loop. This is what has happened to them in Canada. They are sleeping on mattresses on the floor, several to a room in Canadian urban cores.

These Lucas Paradox doom loops mean dialing down expectations on health care and retirement for these young adults. Young adults will have to be counseled to think of themselves as being part of the middle income countries for the rest of the 21st century. Young Americans should be told that if the coffee still tastes good come mid-century, that they're ahead of the curve.

John Hancock

John Hancock Life Insurance Company (U.S.A.)
Ann Delaney
AVP & Regulatory Actuary
adelaney@jhancock.com

October 28, 2024

To: Mike Yanacheak, Chair, Generator of Economic Scenarios (E/A) Subgroup
        Peter Weber, Vice Chair, Generator of Economic Scenarios (E/A) Subgroup

Re**:**   GOES (E/A) Subgroup Exposure 9/25/24: Sensitivity Scenario Questions

Dear Chair Yanacheak and Vice Chair Weber,

John Hancock Life Insurance Company (U.S.A.) appreciates the opportunity to provide feedback on the recently exposed GOES Sensitivity Scenario Questions. We are grateful for all the effort the GOES Subgroup members and staff have put forth so far and for your willingness to consider additional sensitivity scenarios as part of this effort. We have answered the exposure questions in the appendix.

While we believe that it may be possible to incorporate additional sensitivity scenarios that will satisfy most of the requests from regulators and rating agencies, we remain concerned about scenarios needed for both financial conditions testing and for making timely financial decisions, without having to compromise on the timing and amount of information available. We believe we will need to continue to use our internal generator for these purposes.

We would also like to take this opportunity to remind you of a fundamental concern we have with the black box nature of the GEMS Corporate Bond model. We have much better control over a process that uses our own internal generator than a process that relies on a black box. It is also a more efficient and flexible process to have one source of economic scenarios for managing our business, a source that we understand and can use on demand. Today we are able to test our own internal scenario generator against the fully transparent AIRG model to ensure that the scenarios generated from our internal model do not result in a TAR that is materially lower than the TAR resulting from the use of the prescribed generator, consistent with the requirements of VM-21. From our conversations with Conning, we understand that we will not be allowed to replicate their Corporate Bond Model for the purposes of testing our internal model, even if we sign an NDA. This raises serious concerns and is inconsistent with the requirements of VM-21 and with messages we heard at various LATF meetings that sufficient documentation would be released.

We thank you for considering our comments and ask that you discuss options for ensuring that sufficient documentation of the GEMS Corporate Bond Model be available with an NDA so that companies can continue to support their business using internal generators. We are happy to answer any questions you may have.

Sincerely,

Ann Delaney

cc: Scott O'Neal, NAIC; Judy Weaver, Senior Deputy Director, MI DIFS

Appendix: Responses to the Sensitivity Scenario Exposure Questions

1. What is needed with each posting of sensitivity scenarios?

    a. 10k scenarios or subset(s)

       Yes, ideally, we need 10,000 scenarios, but absolutely need the picking data in c along with these 10,000 scenarios.

    b. Reports/Statistics

       We don't need these for sensitivities.

    c. Scenario picking data

       Yes.

    d. SERT Scenarios

       Would be good to have all 16, but at a minimum, we need Scenario 12 (DR).

    e. Etc.

2. How frequently are sensitivity scenarios needed (monthly, quarterly, once a year, etc.)?

    Quarterly

3. What specific sensitivities are needed? The issue here is coming up with a common set that would work for wide range of companies.

    Quarterly sensitivities:
    - +/- 50bps interest rate
    - +/- 100bps interest rate

    Additional year-end sensitivities:
    - Equity Geometric Mean -100bps
    - Equity Volatility +100bps
    - NY7 and NY Special Considerations Letter scenarios

    For Financial Conditions Testing, annually, we run different shocks that change every year based on the economic environment. Annually, we need the ability to ask for nonparallel shocks to the yield curves, and inverted yield curves. With the current AIRG model today, we can shift any point on the curve by any amount. Not having the ability to do this is a big step backwards. There are an infinite number of possible combinations of shocks we would need for FCT purposes.

4. Please provide any other information you think would be helpful for this purpose.