Institutional Risk Scoring Methodology

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1 Introduction

Institutional analysis represents a fundamental pillar in country risk assessment, as it measures the quality of governance, state effectiveness, and institutional stability. In the reinsurance sector, these dimensions play a critical role in maintaining regulatory stability, legal predictability, and investor confidence. Several international databases and indicators provide valuable tools to quantify and compare countries' institutional performance (see Figure **??**).

1. **Worldwide Governance Indicators (WGI)** – ***World Bank***
   Available since 1996, the WGI dataset groups six key dimensions of governance: *Voice and Accountability*, *Political Stability and Absence of Violence/Terrorism*, *Government Effectiveness*, *Regulatory Quality*, *Rule of Law*, and *Control of Corruption*. These indicators provide a comprehensive view of a state's capacity to ensure transparent, stable, and predictable governance. For reinsurance markets, regulatory quality and political stability directly affect the legal security of contracts and market solvency.
2. **Corruption Perceptions Index (CPI)** – ***Transparency International***
   The CPI annually measures perceived corruption in the public sector. High corruption weakens the effectiveness of public policy, increases regulatory uncertainty, and elevates operational risk for reinsurance companies. Countries with low CPI scores are considered riskier due to higher transaction costs and limited legal protection.
3. **Freedom in the World** – ***Freedom House***
   This report assigns an overall score (0–100) based on two sub-dimensions: *Political Rights* and *Civil Liberties*. For reinsurers, a high score reflects stronger institutional stability and better judicial predictability, whereas a low score indicates greater fragility and higher institutional risk.
4. **Index of Economic Freedom** – ***Heritage Foundation***
   Covering around 180 countries since 1995, this index measures several institutional components, such as *Property Rights*, *Judicial Effectiveness*, and *Government Integrity*. These dimensions are directly related to the legal security of reinsurance contracts: weak property rights protection or limited judicial efficiency increase litigation risks and reduce market attractiveness.
5. **Doing Business** – ***World Bank***
   This index measured the ease of doing business, investor protection, contract enforcement, and tax payment processes. These factors are critical for reinsurance companies, as they influence market entry costs, investment security, and dispute resolution speed. Although discontinued in 2021, the dataset remains relevant for historical comparisons.

2 Institutional Risk Analysis by Category

The purpose of this subsection is to propose a rigorous methodology to evaluate, for each country, institutional risks derived from multiple databases and grouped into five categories (see Figure **??**). Each category may include several variables, requiring a combination of quantitative modeling and qualitative expertise to construct a reliable, transparent, and operational institutional risk profile that supports strategic decision-making in reinsurance.

1. **Inventory and Preprocessing:**
   - Identify variables x_j belonging to category c.
   - Harmonize variable direction (e.g., reverse if higher values indicate greater risk).
   - Handle missing values using robust imputation methods.
2. **Robust Normalization:** Each variable is normalized to allow comparison:
$$\tilde{x}_{i,j} = \frac{x_{i,j} - Q_{0.05}(x_{\cdot,j})}{Q_{0.95}(x_{\cdot,j}) - Q_{0.05}(x_{\cdot,j})}, \quad \tilde{x}_{i,j} \in [0,1].$$
3. **Intra-category Weighting:** Three approaches are proposed:
   (a) **Statistical approach (PCA-based):** For each variable j, compute its weighted contribution to the first (or several) components:
$$w_j^{(stat)} \propto \sum_{k=1}^{K} |\ell_{j,k}| \cdot \lambda_k$$
   where $\ell_{j,k}$ is the loading of variable j on component k, λ_k the variance explained by component k, and K the number of retained components. Normalize the $w_j^{(stat)}$ so that $\sum_j w_j^{(stat)} = 1$.
   (b) **Informational approach (Entropy method):** Weights are assigned based on each variable's **information dispersion degree** — the more variability or diversity it provides, the higher its weight.
$$E_j = -k \sum_i p_{ij} \ln(p_{ij}) \quad \text{and} \quad w_j^{(ent)} = \frac{1 - E_j}{\sum_j (1 - E_j)}$$
   where p_{ij} is the normalized value of indicator j for unit i, E_j measures the informational content, and k ensures $0 \leq E_j \leq 1$.
   (c) **Expert approach (AHP or professional judgment):** The *reinsurance industry* prioritizes some institutional dimensions (e.g., rule of law, corruption control, contract enforcement) over others. Expert-based

weights $w_j^{(exp)}$ (sum = 1) are obtained via internal consultation (actuaries, legal experts, underwriters).

A hybrid scheme is recommended:

$$w_j = \alpha\, w_j^{(stat)} + (1-\alpha)\, w_j^{(exp)}, \quad \alpha \in [0,1],$$

with $\alpha = 0.6$ suggested to prioritize data-driven weighting while retaining expert correction. Normalize w_j afterward.

4. **Category Score:** For each country i and category c, the aggregated score is:

$$S_{i,c}^{*} = \sum_{j \in c} w_j\, \tilde{x}_{i,j}$$

where $\tilde{x}_j$ are normalized variables (0 = best, 1 = worst). To obtain a *risk score* (0 = maximum risk, 100 = low institutional risk):

$$S_{i,c} = 100 \times S_{i,c}^{*}$$

5. **Probability Estimation:** The probability of an institutional shock depends on both the level and volatility of the score:

$$P_{i,c} = \min\left(1,\ \gamma_1 \frac{S_{i,c}}{100} + \gamma_2 \frac{\sigma_t(S_{i,c}^{*})}{\sigma_{\max}} + \gamma_3 \mathbf{1}_{S_{i,c}>T}\right).$$

The temporal component (volatility, trend) is critical in reinsurance as it captures rapid institutional deterioration (e.g., coups, judicial crises) often missed by static indicators.

6. **Impact Estimation:** Combined evaluation of exposure and vulnerability determines the potential impact of an institutional shock:

$$I_{i,c} = EXPO_i \times VULN_c \times f(S_{i,c}),$$

where EXPO_i is exposure, VUL_c is sectoral vulnerability, and $S_{i,c}$ is the institutional score. Alternatively:

$$I_{i,c} = \mathrm{EXPO}_i \times VUL_c \times \left(\kappa_1 + \kappa_2 \frac{S_{i,c}}{100}\right),$$

where κ are calibration parameters.

Exposure (EXPO): reflects the market size or importance of a country or sector. Main approaches include:

- **Economic proxy:** Use global economic indicators (GDP, market capitalization, local premiums).
- **Sectoral data:** Measure exposure by reinsurance branch (life, non-life, health, etc.).
- **Normalization/Scoring:** Transform indicators to a common scale, e.g., $EXPO_i = (value_i - min)/(max - min)$.
- **Historical approach:** Average or volatility of premiums/contracts over several years.
- **Professional expertise:** Manual weighting based on market strategic importance.

Vulnerability (VULN): represents the sensitivity of a country or sector to institutional shocks. Common methods include:

- **Inverse score:** Transform institutional scores to reflect vulnerability, e.g., $VULN_c = 1 - score_c/100$.
- **Weighted average of indicators:** Combine multiple institutional variables, e.g., $VULN_c = 0.4\,\mathrm{WGI} + 0.3\,\mathrm{CPI} + 0.3\,\mathrm{FH}$.
- **Factor analysis:** Use PCA to create a synthetic vulnerability factor normalized between 0 and 1.
- **Qualitative expertise:** Classify based on international reports or expert opinion (low, medium, high vulnerability).
- **Econometric modeling:** Estimate institutional shock impacts on losses or premiums using statistical or ML models.

In this study:

- **Exposure:** estimated using an economic proxy approach based on GDP.
- **Vulnerability:** assessed through a composite method combining three complementary techniques:
  - inverse scoring,
  - factor analysis,
  - weighted average of indicators.

7. **Risk Score by Category:** Institutional risk for category c is obtained as:

$$R_{i,c} = P_{i,c} \times I_{i,c}^{*}, \qquad R_{i,c} \in [0,100].$$

8. **Multi-category Aggregation:** The overall institutional risk index for country i is:

$$\mathrm{SRI}_i = \sum_{c=1}^{7} W_c\, R_{i,c}, \qquad \sum_{c=1}^{7} W_c = 1.$$

9. **Validation and Interpretation:**
   - Sensitivity analysis of parameters $(\alpha, \gamma, \kappa, W_c)$.
   - External validation using market indicators (CDS spreads, payment delays).
   - Production of a country × category risk map identifying key vulnerability areas.