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Does external vulnerability predict sovereign rating-at-risk?

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ABSTRACT

Sovereign ratings are persistent, so rating-level regressions may miss changes in downside credit risk. We propose rating-at-risk: the probability and magnitude of future rating deterioration conditional on the inherited rating. In a panel of 68 emerging and developing economies, external vulnerability predicts 1- and 2-year downgrade risk and multi-year notch losses, with the signal concentrated in the upper tail of the vulnerability distribution. Macroeconomic controls attenuate pooled binary estimates but leave the within-country and cumulative notch-loss evidence intact. External vulnerability improves country-blocked validation modestly but not temporal validation over 2018–2023, so we interpret rating-at-risk as a transition-risk summary rather than a forecasting rule.

KEYWORDS

Sovereign ratings; downgrade risk; external debt; fiscal vulnerability; rating-at-risk

JEL CLASSIFICATION

F34; G24; H63; C53

I. Introduction

Sovereign-rating studies usually estimate rating-level regressions (Afonso, Gomes, and Rother 2011; Cantor and Packer 1996). Yet ratings are persistent states: the surveillance question is not only which variables explain rating levels, but also which predict future deterioration conditional on the rating in place. We develop a rating-at-risk framework: the conditional probability or expected magnitude of future rating deterioration, analogous to downside-risk measures in finance but with a credit-assessment transition as the outcome.

The framework sits between rating-level and ordered-response models, which mix the determinants of the inherited grade with those of its revision, and transition-matrix studies (Alsakka and Ap Gwilym 2010; Hill, Brooks, and Faff 2010; Hu, Kiesel, and Perraudin 2002), which characterize unconditional grade dynamics without asking which fundamentals shift downgrade intensities conditional on the current state. Rating-at-risk fixes the inherited grade as a conditioning state, defines forward-looking downside outcomes over explicit horizons, and asks whether a parsimonious fundamentals signal shifts them. The outcome is deliberately an agency decision rather than a market event, because rating transitions carry regulatory and contractual consequences (Almeida et al. 2017; Borensztein, Cowan, and Valenzuela 2013; Gande and Parsley 2005). Our fundamentals signal is an external vulnerability index (EVI) built from external debt/GDP, debt service/exports, and short-term external debt/reserves, motivated by sovereign-default theory (Arellano 2008; Eaton and Gersovitz 1981). We do not claim that external debt causes downgrades; the narrower claim is that external vulnerability contains incremental transition-risk information after conditioning on inherited ratings and common year shocks. All robustness and diagnostic material referenced below is in the Online Appendix at the end of this document.

II. Data and empirical framework

The panel combines annual sovereign ratings, mapped to a common notch scale (higher = stronger), with World Bank International Debt Statistics indicators. The EVI sample therefore covers 68 emerging and developing economies (26 in Africa, 18 in Asia, 14 in the Americas, 8 in emerging Europe, and 2 in the Pacific), with a median of 22 annual observations per sovereign; roughly one

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Table 1. Multi-horizon rating deterioration.

	1y downgrade	2y downgrade	3y downgrade	1y net loss	2y net loss	3y net loss	3y gross loss
EVI (equal weight)	0.038** (0.018)	0.052* (0.028)	0.050 (0.034)	0.099*** (0.031)	0.147*** (0.057)	0.158** (0.071)	0.212*** (0.082)
Inherited rating	0.003 (0.003)	0.006 (0.005)	0.008 (0.007)	−0.001 (0.004)	0.001 (0.007)	0.004 (0.010)	−0.003 (0.010)
N	1403	1402	1336	1403	1402	1336	1336
Countries	68	68	68	68	68	68	68
Years	1993–2024	1993–2024	1993–2023	1993–2024	1993–2024	1993–2023	1993–2023
R^2	0.052	0.061	0.049	0.071	0.070	0.061	0.083

Notes: Downgrade columns are binary outcomes. Net loss is the maximum inherited rating minus the future rating, zero otherwise. Gross loss cumulates annual downward movements within the horizon. Standard errors are clustered by sovereign.

quarter of sovereign-years are at or above investment grade. Unconditional downgrade probabilities are 15.1% over 1 year and 26.0% over 2 years – the benchmarks against which effects should be judged (Appendix Table A1).

Let R_{it} be the inherited rating at the end of year t. The binary h-year outcome is

$$D_{it}^{(h)} = \mathbf{1}\{\exists s \in \{1,\ldots,h\} : R_{i,t+s} < R_{i,t+s-1}\}. \quad (1)$$

Net and gross notch losses are

$$L_{it}^{net,(h)} = \max\{R_{it} - R_{i,t+h}, 0\}, \quad (2)$$

and

$$L_{it}^{gross,(h)} = \sum_{s=1}^{h} \max\{R_{i,t+s-1} - R_{i,t+s}, 0\}. \quad (3)$$

EVI winsorizes each component at the 1st/99th percentiles, standardizes to pooled z-scores, averages equally over at least two available components, and re-standardizes; PCA, alternative winsorization, and leave-one-out variants give similar results (Appendix B, Table A5). Institutional quality is not included: governance indicators merge poorly with the debt sample, so country effects absorb its level while its time variation remains a candidate omitted variable (Appendix B).

The benchmark transition equation is

$$Y_{it}^{(h)} = \alpha_h + \beta_h EVI_{it} + \gamma_h R_{it} + \tau_t + u_{it}^{(h)}, \quad (4)$$

with country fixed effects, nonlinear inherited-rating controls, and agency panels as richer variants, standard errors are clustered by sovereign. The coefficients are predictive, not causal: expected deterioration can raise EVI before any rating action, and omitted fundamentals can drive both (Appendix C discusses these caveats and the choice of this design over ordered-response, hazard, and Markov alternatives). The mechanism is balance-sheet fragility: high rollover needs and thin reserve buffers shrink the sovereign's option set under stress, so a given grade becomes more vulnerable to adverse revision – implying that the tail of the vulnerability distribution should matter more than its centre, a prediction we test.

III. Results

Table 1 is the central result. EVI predicts 1- and 2-year binary downgrade risk (3.8 % and 5.2% points per standard deviation – one quarter and one fifth of the respective base rates), while net and gross notch losses remain significant through 3 years. The strongest multi-year evidence thus concerns the magnitude of deterioration: external vulnerability generates cumulative adverse actions rather than one immediate downgrade, which matters because gross losses affect market access and investor mandates even when partly reversed. Figure 1(a) summarizes the horizon structure. EVI is also negatively related to rating levels (Appendix Table A2); 1-year estimates are robust to logit/probit forms and country effects (7.9 points; Table A3), and to nonlinear inherited-rating controls, which show the signal is strongest when fragility is not yet capitalized into a low grade (Table A4).

Table 2 addresses omitted macroeconomic fundamentals with real GDP growth (Maddison Project; Bolt and van Zanden 2024) and World Bank CPI inflation, covering 65 of 68 sovereigns. Growth predicts downgrades with the expected negative sign, and adding the controls attenuates the pooled 2-year binary coefficient (0.044 to 0.026) – part of the cross-sectional signal overlaps the growth cycle. But the within-country estimates strengthen: with country and year effects plus macro controls, one standard deviation of EVI

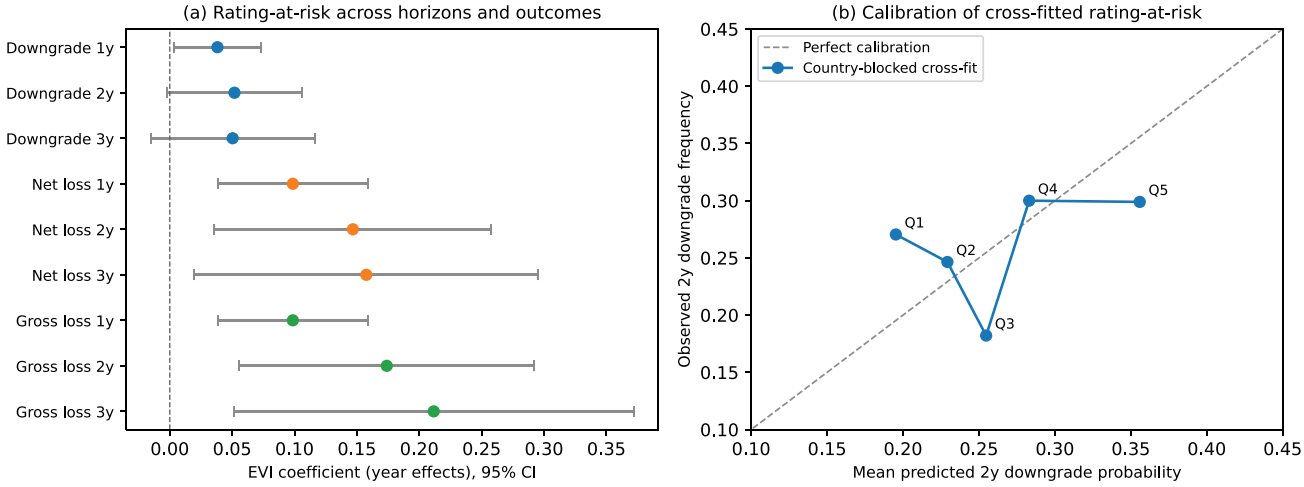


Figure 1. Horizon structure and calibration of rating-at-risk. Notes: Panel (a): EVI coefficient and 95% confidence interval, year-effects specification, by outcome and horizon (Table 1). Panel (b): mean cross-fitted country-blocked 2-year predictions vs. realized downgrade frequencies, by predicted-risk quintile; dashed line indicates perfect calibration.

Table 2. Rating-at-risk with macroeconomic controls.

	Downgrade risk, 2y			Gross notch loss, 3y		
	Baseline	+ Macro	+ Macro, C+Y FE	Baseline	+ Macro	+ Macro, C+Y FE
EVI (equal weight)	0.044 (0.029)	0.026 (0.029)	0.087* (0.049)	0.191** (0.081)	0.161** (0.081)	0.365** (0.151)
Real GDP growth		−0.010** (0.004)	−0.013*** (0.004)		−0.025** (0.011)	−0.034*** (0.011)
Inflation (log)		0.021 (0.021)	−0.003 (0.016)		−0.026 (0.072)	−0.087 (0.072)
Inherited rating	0.006 (0.005)	0.008 (0.005)	0.059*** (0.021)	−0.004 (0.010)	−0.004 (0.011)	0.197*** (0.060)
N	1215	1215	1215	1214	1214	1214
Countries	65	65	65	65	65	65
Years	1993–2022	1993–2022	1993–2022	1993–2022	1993–2022	1993–2022
R2	0.059	0.068	0.216	0.083	0.092	0.308

Notes: The sample is restricted to sovereign-years with non-missing real GDP growth and CPI inflation, so the baseline columns re-estimate the corresponding specification on the macro subsample. Real GDP growth is computed from Maddison Project real GDP levels (available through 2022); inflation is World Bank CPI inflation transformed as $\text{sign}(\pi)\log(1+|\pi|)$ to bound hyperinflation observations. All specifications include year effects; C+Y FE adds country fixed effects. Standard errors are clustered by sovereign. *, **, and *** denote 10%, 5%, and 1% significance.

implies an 8.7%-point higher 2-year downgrade probability and 0.37 additional gross notches over 3 years, and the pooled gross-loss estimate stays significant.

Table 3 tests the tail prediction and regional heterogeneity. The top EVI quintile carries a 9.8%-point higher 2-year downgrade probability – two fifths of the base rate – and the piecewise slope

Table 3. Threshold effects and regional heterogeneity (2-year downgrade risk).

	Top quintile	Piecewise	Region interactions
EVI top quintile (0/1)	0.098* (0.050)		
EVI (slope below mean)		0.003 (0.052)	
EVI (added slope above mean)		0.080 (0.075)	
EVI × Africa			0.060* (0.035)
EVI × Americas			0.122* (0.069)
EVI × Asia–Pacific			0.034 (0.037)
EVI × Europe			0.226** (0.103)
Inherited rating	0.005 (0.005)	0.005 (0.005)	0.006 (0.005)
N	1402	1402	1402
Countries	68	68	68
Years	1993–2024	1993–2024	1993–2024
R2	0.062	0.063	0.085

Notes: The dependent variable is downgrade risk within 2 years. Column 1 replaces the linear EVI with an indicator for the top EVI quintile. Column 2 estimates a piecewise-linear specification with a kink at the (zero) sample mean of the standardized index. Column 3 interacts EVI with UN M49 regions; the two Pacific sovereigns are grouped with Asia. A Wald test does not reject equality of the regional slopes ($p = 0.29$). All specifications include year effects; standard errors are clustered by sovereign. *, **, and *** denote 10%, 5%, and 1% significance.

below the sample mean is essentially zero: the signal lives in the upper tail. Regional slopes are positive everywhere, largest in emerging Europe and Latin America, but a Wald test does not reject equality, so we read the pattern as suggestive. Agency-level panels confirm that the signal is not an aggregation artefact (Appendix Table A6).

Out-of-sample diagnostics limit the interpretation (Appendix Table A7). Against the persistence benchmark (rating-only models), EVI adds modest value in country-blocked validation, especially in precision-recall terms, but not in temporal validation over 2018–2023 – a short window dominated by the COVID shock and unusual agency practice, though genuine parameter instability cannot be ruled out (Appendix E). Figure 1(b) shows that cross-fitted predictions are imperfectly calibrated and are best used as ordinal risk tiers. Consistent with market relevance, higher EVI and rating-at-risk predict higher CDS spreads conditional on the rating (Table A8), and the baseline is stable in pre-2020 and long-coverage samples (Table A9).

IV. Concluding remarks

Creditworthiness is not only a level but a state-contingent risk of revision: sovereigns with identical grades face different transition risks when their external balance sheets differ. Because the signal is concentrated in the vulnerability tail and in cumulative notch losses, a natural application is an internal grading mechanism for debt-management offices and surveillance institutions: track rating-at-risk alongside the headline rating, and let entry into the upper tail trigger pre-specified reviews of maturity structure, reserve adequacy, and rollover exposure before any agency action. Investors can likewise differentiate transition risk among identically rated sovereigns, which CDS pricing suggests markets partly do.

The estimates are predictive associations, not causal effects; time-varying institutional quality is uncontrolled; forecasting gains do not extend to 2018–2023, and predictions are imperfectly calibrated; and the sample excludes advanced economies. Future work could evaluate whether debt-management reforms, IMF programs, or reserve accumulation reduce rating-at-risk in causal designs, and extend the signal with institutional indicators, market-based conditions, or machine-learning aggregation.

Author contributions

CRediT: **Mauricio G. Villena:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing; **María J. Quinteros:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

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Data availability statement

The data and replication materials supporting the findings of this study are available from the corresponding author upon reasonable request. The macroeconomic controls are constructed from publicly available sources: Maddison Project real GDP (Bolt and van Zanden 2024) and World Bank WDI CPI inflation. The Online Appendix below contains all supplementary tables and discussion and is intended for online publication as supplementary material.

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