INTERNATIONAL MONETARY FUND

How to Assess Country Risk: The Vulnerability Exercise Approach Using Machine Learning

Approved by Sanjaya Panth

Prepared by an interdepartmental team led by Kevin Wiseman, and comprising Pranav Gupta and Andrew Tiffin (AFR), Andrew Swiston (APD), Juliana Gamboa Arbelaez, Klaus Hellwig, Andrew Hodge, Paulo Medas, Marialuz Moreno Badia, Roberto Perrelli, and Yuan Xiang (all FAD), Maksym Ivanyna (ICD), Sean Simpson (iLab), André Leitão Botelho and Wan Li (ITD), Silvia Iorgova (MCM), Suman Basu (RES), Chuqiao Bi, Jorge Chan-Lau, Sandile Hlatshwayo, Chengyu Huang, Lamya Kejji, Agustin Roitman, Weining Xin, Harry Zhao, and Yunhui Zhao (all SPR), Le Xu (SPR Summer Intern), and Daria Ulybina (STA); under the supervision of Daria Zakharova and Wojciech Maliszewski (SPR). Sharon Eccles (SPR) provided excellent administrative assistance.

ACKNOWLEDGMENTS

We are grateful for the support of this project by the iLab through the AI/ML Innovation Challenge and Catalyst series. We would also like to gratefully acknowledge the support from and the discussions with Michal Andrle, Alberto Behar, Angana Banerji, Fabian Bornhorst, Eugenio Cerutti, Marcos Chamon, Kirpal Chauhan, Qianying Chen, Mali Chivakul, Federico Diaz Kalan, Florence Dotsey, Aquiles Farias, Vikram Haksar, Yuko Hashimoto, Niko Alfred Hobdari, Plamen Iossifov, Tetsuya Konuki, Miguel Lanza, Emilia Magdalena Jurzyk, Maxym Kryshko, Nan Li, Sandra Lizarazo, Albert Touna Mama, Jimmy McHugh, Alexis Meyer Cirkel, Chifundo Moya, Nkunde Mwase, Rajesh Nilawar, Liam O'Sullivan, Marijn Otte, Mamoon Saeed, Jasmin Sin, Shannon Staley, Fabian Valencia, Tristan Walker, Hans Weisfeld, Jason Weiss, and Weijia Yao.

Cataloging-in-Publication Data
Joint Bank-Fund Library
Names: International Monetary Fund.
Title: How to Assess Country Risk: The Vulnerability Exercise Approach Using Machine Learning
Other titles: Technical Notes and Manuals (International Monetary Fund)
Series/volume #: TNM/21/03
Description: Washington, DC : International Monetary Fund | Periodic | Some
issues also have thematic titles.
Classification: LCC HC10.W79
HC10.80

ISBN: 978-1-51357-421-9

JEL Classification Numbers:	C14, C36, C38, C52, C53, E32, E37, F32, F47, G01, H63
Keywords:	Risk Assessment, Supervised Machine Learning, Prediction, Sudden Stop, Exchange Market Pressure, Fiscal Crisis, Debt, Financial Crisis, Economic Crisis, Economic Growth
Corresponding Authors' E-Mail Addresses:	Daria Zakharova (DZakharova@imf.org) Wojciech Maliszewski (WMaliszewski@imf.org) Kevin Wiseman (KWiseman@imf.org) Andrew Tiffin (ATiffin@imf.org) Roberto Perrelli (External Sector) (RPerrelli@imf.org) Klaus Hellwig (Fiscal Sector) (KHellwig@imf.org) Jorge Chan-Lau (Real Sector) (JChanLau@imf.org)

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EXECUTIVE SUMMARY

The IMF's Vulnerability Exercise (VE) is a cross-country exercise that identifies country-specific near-term macroeconomic risks. As a key element of the Fund's broader risk architecture, the VE is a bottom-up, multi-sectoral approach to risk assessments for all IMF member countries. Assessments reflect the judgement of country teams informed by consistent, cross-country quantitative models as well as country-specific context.

The VE modeling toolkit is regularly updated in response to global economic developments and the latest modeling innovations. Earlier models evolved organically, assessing advanced economies, emerging markets, and low-income countries separately and looking at different types of risks. The new generation of models presented here closes gaps in risk and country coverages from previous models, while improving consistency and comparability of risk assessments across countries.

The new generation of VE models presented here leverages machine-learning (ML) algorithms. Macroeconomic risk assessment is a challenging task: crises are infrequent and almost always involve some elements of surprise. They tend to feature interactions between different parts of the economy and non-linear relationships that are not well measured in ”normal times.” ML tools can often better capture these relationships. They can also be more robust to outliers, noise, and the diversity of experiences across countries.

The performance of machine-learning-based models is evaluated against more conventional models in a horse-race format. The models assess the near-term risk of a crisis in the external, financial, fiscal, and real sectors. In each sector, rigorous performance metrics are used to compare new tools against traditional approaches. It turns out that random forest-based models, which are popular modern ML methods that average over many decision trees, outperform other options in most cases. In other cases, the signal extraction approach, a robust non-parametric method designed for macro-crisis detection, performs best. These winning models represent a new generation of models at the core of the VE.

The paper also presents direct, transparent methods for communicating model results. ML techniques can sometimes appear to be a black box due to their complexity and infrequent (though rapidly growing) use in economics. Communication tools, developed to inform country teams about the model assessments, help take the last step from predicting to informing.