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Education

2021–Present **University of Maryland** College Park, MD
Doctor of Philosophy in Economics
Master of Arts in Economics awarded in spring 2023

2018–2020 **Harvard University, Harvard Extension School** Cambridge, MA
Non-degree graduate student in mathematics and statistics

2014–2018 **University of Richmond** Richmond, VA
Bachelor of Science in Mathematical Economics

Experience

2022–Present **University of Maryland** College Park, MD
Research Assistant to John Haltiwanger
Census Bureau Special Sworn Status researcher

2018–2021 **Board of Governors of the Federal Reserve** Washington, DC
Research Assistant to Vice Chair Clarida (2020–2021)
Research Assistant (2018–2021)

Summer 2017 **Federal Reserve Bank of Chicago** Chicago, IL
Economic Research Intern

2015–2018 **University of Richmond** Richmond, VA
Writing Consultant (2016–2018)
Economic Research Fellow (Summer 2016)
Economic Research Assistant (2015–2018)

Technology (See GitHub for projects and packages)

Skills

Primary Tools: Git, Julia, LaTeX, Linux, Python, R, SQL

Additional Tools: Matlab, Microsoft Office, SAS, Stata

Software

1. **OOS** for out-of-sample time series forecasting
   The OOS package introduces a structured and automated approach to out-of-sample time series forecasting, a common, important, and subtle task. In many ways, this package is merely a wrapper for the excellent extant time series forecasting routines on CRAN - including both traditional econometric time series models and modern machine learning techniques. However, this package additionally provides a modern and comprehensive set of forecast combination techniques and forecast analysis tools.
   GitHub ◦ Website ◦ CRAN

2. **sovereign** for state-dependent empirical analysis
   The sovereign package introduces a set of tools for state-dependent empirical analysis through both VAR- and local projection-based state-dependent forecasts, impulse response functions, historical decompositions, and forecast error variance decompositions. Tools are also available for the estimation and analysis of Proxy-SVARs.
   GitHub ◦ Website ◦ CRAN

Research (See website for details and updates)

Publications

1. "Out-of-sample performance of recession probability models" with Francisco Vazquez-Grande
   FEDS Note (2019)

Works in Progress

1. Getting in all the Cracks: Monetary Policy, Financial Vulnerabilities, and Macro Risk
   Coauthored with Andrea Ajello
   We estimate the effect of monetary policy on financial vulnerabilities and the implications for macroeconomic tail risk. We first extract a small set of common factors from a large dataset of financial vulnerability indicators, estimating a factor-augmented proxy SVAR to study the response of aggregate economic activity, inflation, and financial vulnerabilities to monetary policy shocks. We then estimate the effect of changes in the financial vulnerability factors on macroeconomic tail risk via quantile regressions. We find that an unexpected monetary policy tightening can lower asset valuation vulnerabilities in the short term and slow down credit growth in the medium term. As tighter monetary policy reduces asset valuation pressures, it does so at a cost of a sizable increase in macro tail risk in the short term that is only partially offset by a modest reduction in tail risk in the medium term, induced by a slowdown in credit growth.

2. Estimation and Inference of Impulse Responses with Random Forests
   Coauthored with Francisco Vazquez-Grande
   Abstract: This paper introduces methods to estimate and conduct inference on impulse responses without specification and estimation of the underlying system, which are particularly suited in the presence of a nonlinear structure. We use flexible machine learning techniques to estimate response

values at each horizon of interest, as it is done with local projections. The advantages of our tree-based method over traditional available methods to estimate impulse responses are the following: (1) they automatically estimate nonlinear specifications without having to postulate a specific nonlinear model; (2) they allow for the inclusion of a large number of covariates that far exceed the limits of linear models; (3) they are more robust to model misspecification; (4) they can estimate asymmetric impulses based on the sign and magnitude of a shock. We present Monte Carlo evidence and applications to a simple models that make these advantages apparent.

3. Credit Supply Shocks and the Macroeconomy: The Predictive and Causal Role of Bank Lending Standards
   Coauthored with Elijah Broadbent and Horacio Sapriza
   Abstract: We construct bank credit supply indicators for the four major loan categories in the United States using changes in lending standards from bank-level responses to the Federal Reserve's Senior Loan Officer Opinion Survey on Bank Lending Practices, adjusted for macroeconomic and bank-specific factors that affect loan demand. We evaluate the ability of these indicators to predict economic activity and estimate the effect of unit shocks to these indicators on economic activity and monetary policy rates. First, we find that credit supply indicators for business loans generally provide more out-of-sample predictive information for economic activity than the indicators for household loans. Second, we find that negative shocks to the credit supply indicators decrease economic activity and monetary policy rates, particularly when applied to the commercial and industrial lending category. Third, we find that the magnitude of these effects strongly depends on the stance of monetary policy and broad financial conditions, whereas a negative shock leads to monetary policy easing and declines in economic activity when either financing conditions or the monetary policy stance are tight, but has little impact otherwise.

Pre-Doctoral Research

1. Combining forecasts: Can machines beat the average?
   Coauthored with Francisco Vazquez-Grande
   Abstract: Yes. This paper documents the benefits of combining forecasts using weights built with non-linear models. We introduce our tree-based forecast combinations and compare them with benchmark equal weight combination as well as other nonlinear forecast weights. We find that nonlinear models can improve consistently upon the equal weight alternative–breaking the so-called "forecast combination puzzle"–and that our proposed methods compete well with other nonlinear methods.

2. Bottom-up leading macroeconomic indicators: An application to non-financial corporate defaults using machine learning
   Coauthored with Horacio Sapriza, and Tom Zimmermann
   Abstract: This paper constructs a leading macroeconomic indicator from microeconomic data using recent machine learning techniques. Using tree-based methods, we estimate probabilities of default for publicly traded non-financial firms in the United States. We then use the cross-section of out-of-sample predicted default probabilities to construct a leading indicator of non-financial corporate health. The index predicts real economic outcomes such as GDP growth and employment up to eight quarters ahead. Impulse responses validate the interpretation of the index as a measure of financial stress.

Presentations

- “ Getting in all the Cracks: Monetary Policy, Financial Vulnerabilities, and Macro Risk” 53rd Annual Conference of the Money, Macro and Finance Society. Canterbury, UK (2022)
- “Bank Credit Supply Shocks and Economic Activity: The Role of Lending Standards” Macro-Financial Analysis Seminar. Washington, DC (2020)
- “The Fast and Frugal Tree and Recession Probabilities” Macro-Financial Analysis Seminar. Washington, DC (2020)
- “Determinants of bank lending standards in the United States”
    - International Finance and Banking Society Conference. Medellin, Colombia (2019)
    - Macro-Financial Analysis Seminar. Washington, DC (2019)
- “Bottom-up leading macroeconomic indicators: An application to non-financial corporate defaults using machine learning” Macro-Financial Analysis Seminar. Washington, DC (2019)
- “Building a Statistical FCI Using Partial Least Squares” Macro-Financial Analysis Seminar. Washington, DC (2019)
- “Technology, Distance, and Bilateral Remittance Flows”
    - University of Richmond Research Symposium. Richmond, VA (2018)
    - Federal Reserve Bank of Dallas’ Economic Scholars Conference. Dallas, TX (2018)

Awards, Fellowships, & Grants

2022 Jacob K. Goldhaber Travel Grant

International Conference Student Support Award

2021 University of Maryland Graduate Fellowship

(Federal Reserve Board) Division Director’s Award for Excellence

Professional Activities

Referee for Macroeconomic Dynamics