Research Statement

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My research advances macroeconomic analysis by developing econometric methods, particularly Bayesian techniques and machine learning, that improve forecasting, structural inference, and policy evaluation. The overarching goal is to make economic analysis *more predictive, more structural, and ultimately more policy-relevant*. I pursue this through four interrelated themes: forecasting and predictive analytics, structural macroeconometrics and policy analysis, Bayesian moment-condition models, and machine-learning applications to economics.

Across these areas, I combine methodological innovation with policy relevance. On the forecasting side, I study how to combine, evaluate, and apply forecasting models in real time and across high-dimensional and uncertain environments. For example,

- "On the Aggregation of Probability Assessments: Regularized Mixtures of Predictive Densities for Eurozone Inflation" (with Francis X. Diebold & Boyuan Zhang). *Journal of Econometrics*, 2023.
- "Machine Learning for Regularized Survey Forecast Combination: Partially-Egalitarian LASSO and Its Derivatives" (with Francis X. Diebold). *International Journal of Forecasting*, 2019.

On the structural side, I develop identification and inference methods for vector autoregressions and dynamic stochastic general equilibrium models, with applications to monetary policy, uncertainty shocks, and non-pharmaceutical interventions during the COVID-19 pandemic. For example,

- "Inference Based on Time-Varying SVARs Identified with Sign Restrictions" (with Jonas E. Arias, Juan F. Rubio-Ramírez & Daniel F. Waggoner). *Review of Economic Studies*, forthcoming.
- "The Causal Effects of Lockdown Policies on Health and Macroeconomic Outcomes" (with Jonas E. Arias, Jesús Fernández-Villaverde & Juan F. Rubio-Ramírez). *American Economic Journal: Macroeconomics*, 2023.

A third strand extends Bayesian inference to moment-condition environments, providing robust tools for model comparison and endogeneity testing. For example,

- "Bayesian Estimation and Comparison of Conditional Moment Models" (with Siddhartha Chib & Anna Simoni). *Journal of the Royal Statistical Society: Series B*, 2022.
- "Bayesian Estimation and Comparison of Moment Condition Models" (with Siddhartha Chib & Anna Simoni). *Journal of the American Statistical Association*, 2018.

Finally, I apply modern machine-learning methods to both econometrics (e.g., penalized forecast combination, optimal-transport metrics) and to questions of fairness and access in credit markets. For example,

- "Constructing Applicants from Loan-Level Data: A Case Study of Mortgage Applications" (with Hadi Elzayn & Simon Freyaldenhoven). Philadelphia Fed Working Paper, 2025.
- "Probability Forecast Combination via Entropy-Regularized Wasserstein Distance" (with Ryan Cumings-Menon). *Entropy*, 2020.

Together, these contributions provide a coherent agenda that integrates methodological advances with real-world applications. By building bridges between statistical theory, machine learning, and macroeconomic practice, my work aims to equip policymakers with sharper predictive tools, stronger identification strategies, and fairer evaluation metrics for credit markets. The detailed sections below illustrate this agenda through specific publications and ongoing projects.

Comprehensive Research Overview

What follows is a thematic overview of my research, grouped into four pillars. Each section summarizes representative contributions and demonstrates the interplay between theory, methods, and applied policy work.

Theme 1: Forecasting and Predictive Analytics

I develop new tools to combine, evaluate, and improve forecasts in high-dimensional, nonlinear, and uncertain environments. These contributions span forecast combination, forecast evaluation, and forecasting models and applications in macro-financial settings.

Forecasting Combination. Methods that shrink, transport, and regularize information across forecasts and models.

- On the Wisdom of Crowds (of Economists) (with Francis X. Diebold & Aaron Mora). Working paper, 2025.
- On the Aggregation of Probability Assessments: Regularized Mixtures of Predictive Densities for Eurozone Inflation (with Francis X. Diebold & Boyuan Zhang). *Journal of Econometrics*, 2023.
- Probability Forecast Combination via Entropy-Regularized Wasserstein Distance (with Ryan Cumings-Menon). *Entropy*, 2020.
- Machine Learning for Regularized Survey Forecast Combination: Partially-Egalitarian LASSO and Its Derivatives (with Francis X. Diebold). *International Journal of Forecasting*, 2019.

Forecasting Evaluation. Metrics and principles to compare point, interval, and density forecasts in a decision-relevant way.

- Measuring Disagreement in Probabilistic and Density Forecasts (with Ryan Cumings-Menon & Keith Sill). *JSM Proceedings (ASA, Business and Economic Statistics Section)*, 2020.
- On the Comparison of Interval Forecasts (with Ross Askanazi, Francis X. Diebold & Frank Schorfheide). *Journal of Time Series Analysis*, 2018.
- Assessing Point Forecast Accuracy by Stochastic Error Distance (with Francis X. Diebold). *Econometric Reviews*, 2017.
- Assessing Point Forecast Accuracy by Stochastic Loss Distance (with Francis X. Diebold). *Economics Letters*, 2015.

Forecasting Models and Applications. Applications that stress-test models out-of-sample and in real time; design choices that matter for predictive density performance.

- Macroeconomic Forecasting and Variable Ordering in Multivariate Stochastic Volatility Models (with Jonas E. Arias & Juan F. Rubio-Ramírez). *Journal of Econometrics*, 2023.
- DSGE-SVt: An Econometric Toolkit for High-Dimensional DSGE Models with SV and t Errors (with Siddhartha Chib & Fei Tan). *Computational Economics*, 2021.
- Real-Time Forecast Evaluation of DSGE Models with Stochastic Volatility (with Francis X. Diebold & Frank Schorfheide). *Journal of Econometrics*, 2017.
- Does Realized Volatility Help Bond Yield Density Prediction? (with Molin Zhong). *International Journal of Forecasting*, 2017.

Theme 2: Structural Macroeconometrics and Policy Analysis

I develop identification and computation for structural time-series models—especially sign-identified VARs and time-varying parameter models—and apply them to policy questions around monetary policy, uncertainty, and non-pharmaceutical interventions.

- Inference Based on Time-Varying SVARs Identified with Sign Restrictions (with Jonas E. Arias, Juan F. Rubio-Ramírez & Daniel F. Waggoner). *Review of Economic Studies*, forthcoming.
- A Gibbs Sampler for Efficient Bayesian Inference in Sign-Identified SVARs (with Jonas E. Arias & Juan F. Rubio-Ramírez). Working paper, 2025.
- The Causal Effects of Lockdown Policies on Health and Macroeconomic Outcomes (with Jonas E. Arias, Jesús Fernández-Villaverde & Juan F. Rubio-Ramírez). *American Economic Journal: Macroeconomics*, 2023.
- A New Approach to Identifying the Real Effects of Uncertainty Shocks (with Molin Zhong). *Journal of Business & Economic Statistics*, 2020.

– Measuring International Uncertainty: The Case of Korea (with Boyuan Zhang, Molin Zhong & Dong Jin Lee). *Economics Letters*, 2018.

Theme 3: Bayesian Moment Condition Models

I extend Bayesian methods to settings defined by moment conditions, with robust large-sample theory and practical computation. This work covers misspecification, model comparison via marginal likelihoods, and testing for endogeneity.

– Testing for Endogeneity: A Moment-Based Bayesian Approach (with Siddhartha Chib & Anna Simoni). Under revision at *Econometric Theory*, 2024.
– Bayesian Estimation and Comparison of Conditional Moment Models (with Siddhartha Chib & Anna Simoni). *Journal of the Royal Statistical Society: Series B*, 2022.
– Bayesian Estimation and Comparison of Moment Condition Models (with Siddhartha Chib & Anna Simoni). *Journal of the American Statistical Association (Theory & Methods)*, 2018.
– Bayesian GMM. Dissertation, University of Pennsylvania, 2015.

Theme 4: Machine Learning Applications to Economics

I apply machine learning both to econometric methodology (e.g., penalized forecast combination, entropy-regularized optimal transport, Wasserstein metrics, clustering) and to policy-relevant applications in credit markets using ideas from algorithmic fairness.

ML Methods for Forecasting and Evaluation. Regularization and transport-based approaches to improve and assess predictive distributions.

– On the Aggregation of Probability Assessments: Regularized Mixtures of Predictive Densities (with Francis X. Diebold & Boyuan Zhang). *Journal of Econometrics*, 2023.
– Measuring Disagreement in Probabilistic and Density Forecasts (with Ryan Cumings-Menon & Keith Sill). *JSM Proceedings (ASA)*, 2020.
– Probability Forecast Combination via Entropy-Regularized Wasserstein Distance (with Ryan Cumings-Menon). *Entropy*, 2020.
– Machine Learning for Regularized Survey Forecast Combination: Partially-Egalitarian LASSO and Its Derivatives (with Francis X. Diebold). *International Journal of Forecasting*, 2019.

Algorithmic Fairness and Credit Markets. Applicant-level data construction using ML and fairness analysis using definitions from ML (statistical parity, equalized odds, predictive parity) to evaluate credit market outcomes.

– Measuring Fairness in the U.S. Mortgage Market (with Hadi Elzayn, Simon Freyaldenhoven & Ryan Kobler). Philadelphia Fed Working Paper, 2025.
– Constructing Applicants from Loan-Level Data: A Case Study of Mortgage Applications (with Hadi Elzayn & Simon Freyaldenhoven). Philadelphia Fed Working Paper, 2025.

Other Applications

I have also worked on applied topics that fall outside the main four pillars but underscore the breadth and policy relevance of my research.

– Failure of Silicon Valley Bank Reduced Local Consumer Spending but Had Limited Effect on Aggregate Spending (with Edmund Crawley & Taeyoung Doh). *Federal Reserve Bank of Kansas City, Economic Bulletin*, 2023.
– A Statistical Learning Approach to Land Valuation: Optimizing the Use of External Information (with David Albouy). *Journal of Housing Economics*, 2022.
– Metropolitan Land Values (with David Albouy & Gabriel Ehrlich). *Review of Economics and Statistics*, 2018.
– Capital-Based Corporate Tax Benefits: Endogenous Misallocation through Lobbying (with Tanida Arayavechkit & Felipe E. Saffie). Under revision at *Journal of the European Economic Association*, 2018.