

## PhD course: Macroeconomic Forecasting and Structural Analysis in Big Data Environment

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### Topic 1: Forecasting in data-rich environment

- Part 1
  - Introduction to time series econometrics (if needed)
  - Introduction to theory of forecasting
  - Standard time series forecasting models
  
- Part 2
  - Introduction to data-rich environment
  - Data-rich predictive modeling
    - Sparse modeling: regularized regressions
    - Dense modeling: factor models and principal component analysis
  - Variable selection
  - Cross-validation for time series
  - Examples of *linear* data-rich forecasting models (Kotchoni, Leroux and Stevanovic, 2019)
    - Dynamic factor models
    - Regularized predictive regressions
    - Regularized data-rich model averaging
    - Simulation and empirical applications
  
- Part 3
  - Introduction to Machine Learning
  - Approximating nonlinearity in predictive regressions
    - Polynomials
    - Kernel trick
    - Regression trees
    - Neural networks

- Examples of *nonlinear* data-rich forecasting (Goulet Coulombe, Leroux, Stevanovic and Surprenant, 2022)
  - Kernel ridge regressions
  - Random forest
  - Boosted trees
  - Neural networks
  - Support vector regressions
  - Simulation and empirical applications

## Topic 2: Structural empirical macroeconomic analysis in data-rich environment

- Part 1
  - Specification and estimation of vector autoregressions (VAR)
  - Identification of structural shocks and estimation of impulse response functions
  - Link between dynamic stochastic general equilibrium (DSGE) and VAR
- Part 2
  - Problems with small-scale VAR
  - Impulse response analysis in data-rich environment
    - Structural dynamic factor modeling
    - Identification of structural shocks and estimation of dynamic effects
  - Example (Boivin, Giannoni and Stevanovic, 2020)
    - Estimation of dynamic effects of monetary and credit shocks

## References

Boivin, J., Giannoni, M. & D. Stevanovic (2020), Dynamic Effects of Credit Shocks in a Data-Rich Environment, *Journal of Business and Economic Statistics*, 38(2), 272-284.

Goulet Coulombe, P., Leroux, M., Stevanovic, D. and S. Surprenant (2022). How is Machine Learning Useful for Macroeconomic Forecasting? *Journal of Applied Econometrics*, 37(5), 920-964.

Goulet Coulombe, P., Leroux, M., Stevanovic, D., & Surprenant, S. (2021). Macroeconomic data transformations matter. *International Journal of Forecasting*, 37(4), 1338-1354.

Kotchoni, R., Leroux, M. and D. Stevanovic (2019). Macroeconomic Forecast Accuracy in a Data-Rich Environment, *Journal of Applied Econometrics*, 34(7), 1050-1072.

## Exam (for students who wish to be awarded 4 ECTS credits)

Upon completing all course activities (attendance throughout the course and doing the assignment), participants will be awarded 4 ECTS credits.