- **The BIAS-FD Tool.**
  - Tool to calculate the quality of a banknote to determine whether it is usable (FIT-UNFIT) using supervised Machine Learning algorithms.
- **The Minijourney.**
  - Six NCBs perform extraction of information of banknotes (S/N + 12 properties) using banknotes processing machines.
  - Storage in a Hadoop cluster at the ECB for analysis.
- **Neurometrics.**
  - Applied to the design of banknotes and their security features.
  - Neurometrics measured on participants performing a visual and physical evaluation of different banknotes.

- **New economic policy uncertainty index for Spain (EPU), and Latam**

- **Extraction of structured data from mortgage loan agreements.**

- **Semi-Automated review of certain aspects in consumer credit.**

- **Extraction of Climate-related disclosures from financial reports.**

- **Sentiment analysis of Bank of Spain's Quarterly reports.**

- **Sentiment analysis of Financial Stability Reports.**

- **Text mining of press bulletin to aid weekly economic situation report.**

- **Topic modelling of Statements and press conferences of Central Banks.**

- **Detecting faults & outliers in CBSO questionnaires.**

    - Detect alternative patterns to assess data quality and perform data imputation of missing values via machine learning for questionnaires sent by corporations to the Central Balance Sheet Data Office.

- **Data Analytics on Basel III reports to improve data quality.**

    - Detect anomalies, quality problems and inconsistencies not covered by the XBRL validations in the COREP and FINREP reports.

- **"Financial Frictions and the Wealth Distribution". Fernández-Villaverde, J.; Hurtado, S.; Nuño, G. (2019).**

- **"The effects of tax changes on economic activity: a narrative approach to frequent anticipations". García-Uribe, S. (2018).**

- **"Nowcasting private consumption: traditional indicators, uncertainty measures, and the role of internet search query data". Pérez, J.J.; Urtasun, A. (2017).**
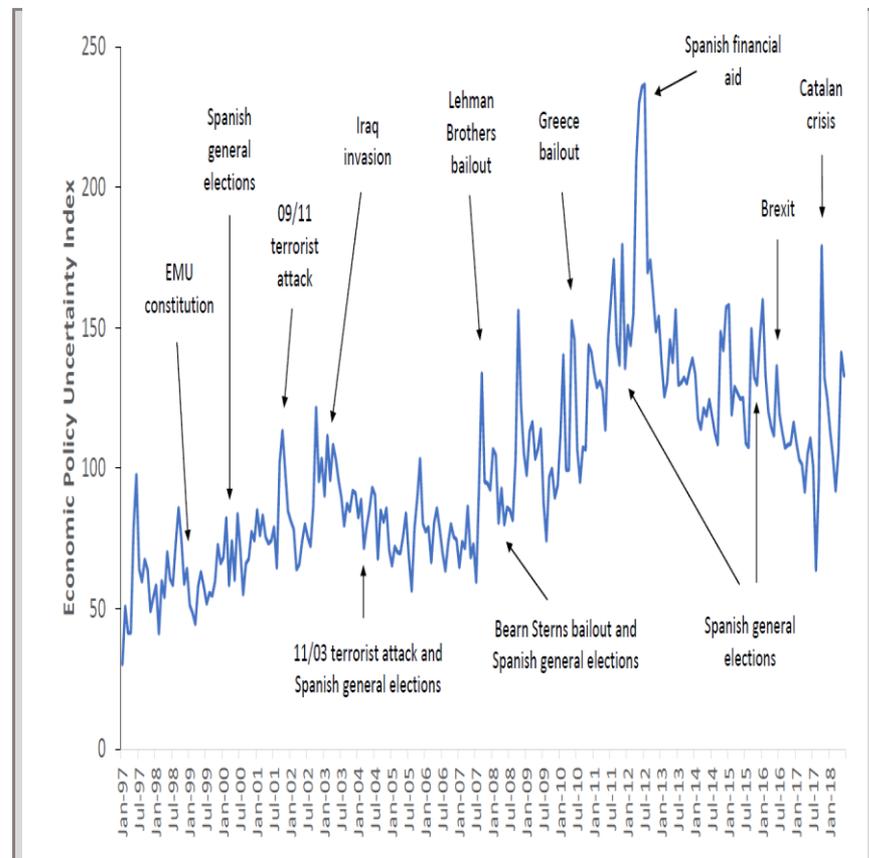
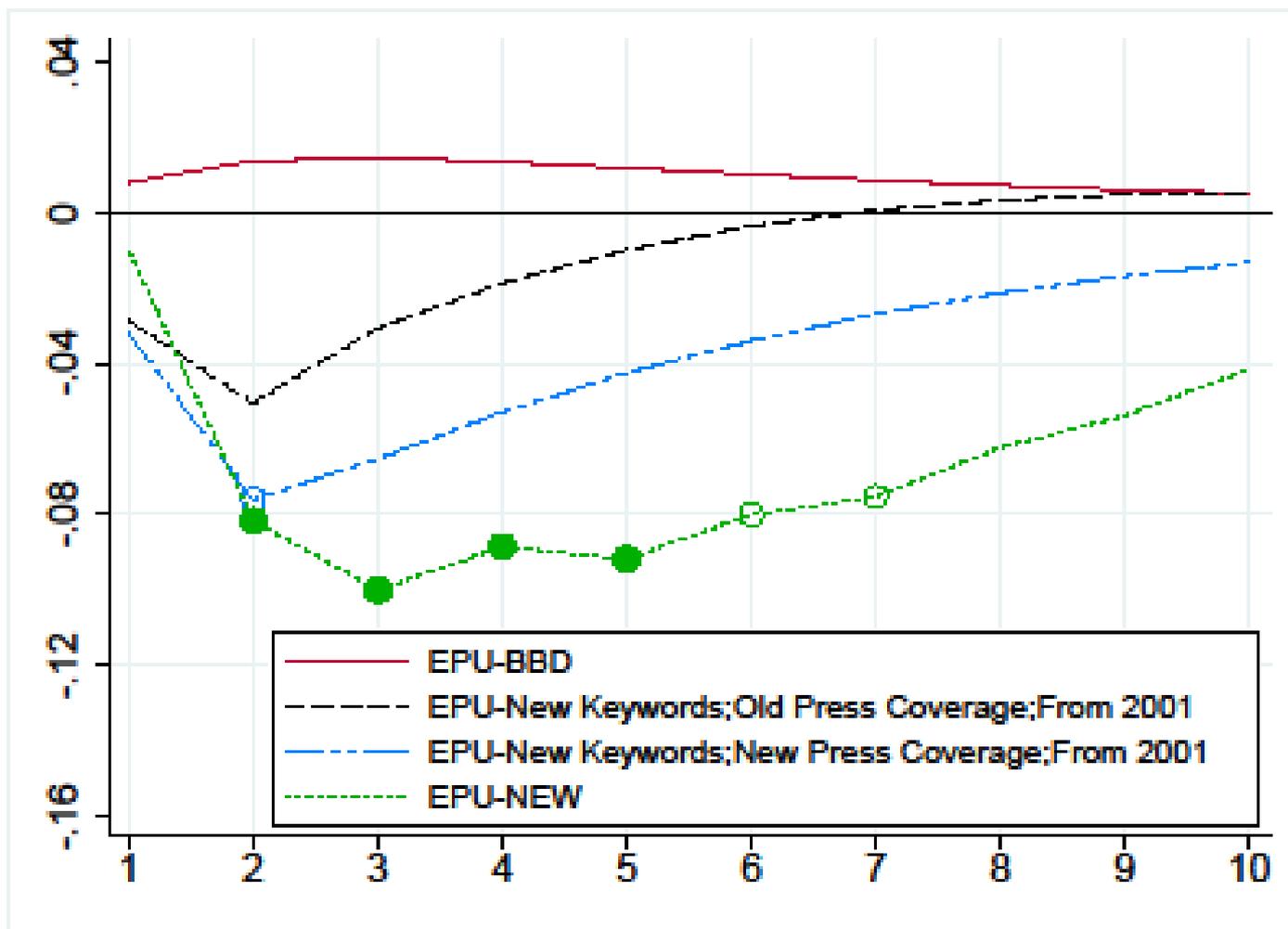# APPENDIX

BANCO DE ESPAÑA
Eurosistema

- **Banknote Image Analysis in the Spatial and Frequency Domains (European Patent EP2911123B1).**

- **Tool to calculate the quality of a banknote to determine whether it is usable. Fitness classification:**
  - FIT for recirculation.
  - UNFIT for recirculation.

- **Supervised Machine Learning algorithms based on spatial and frequency information.**
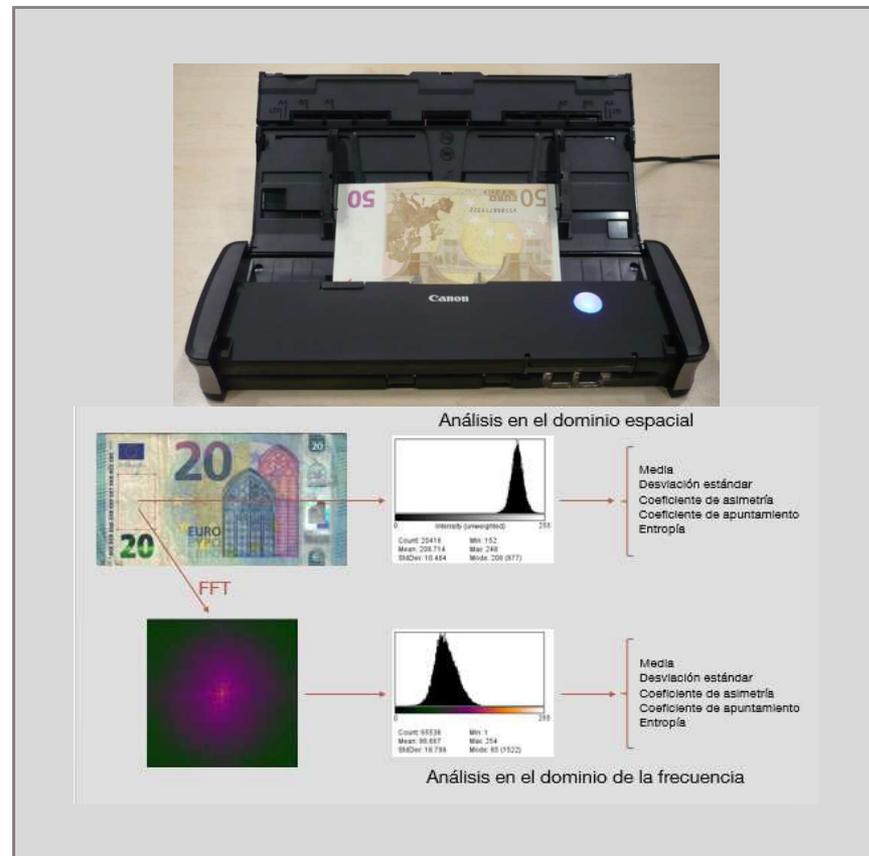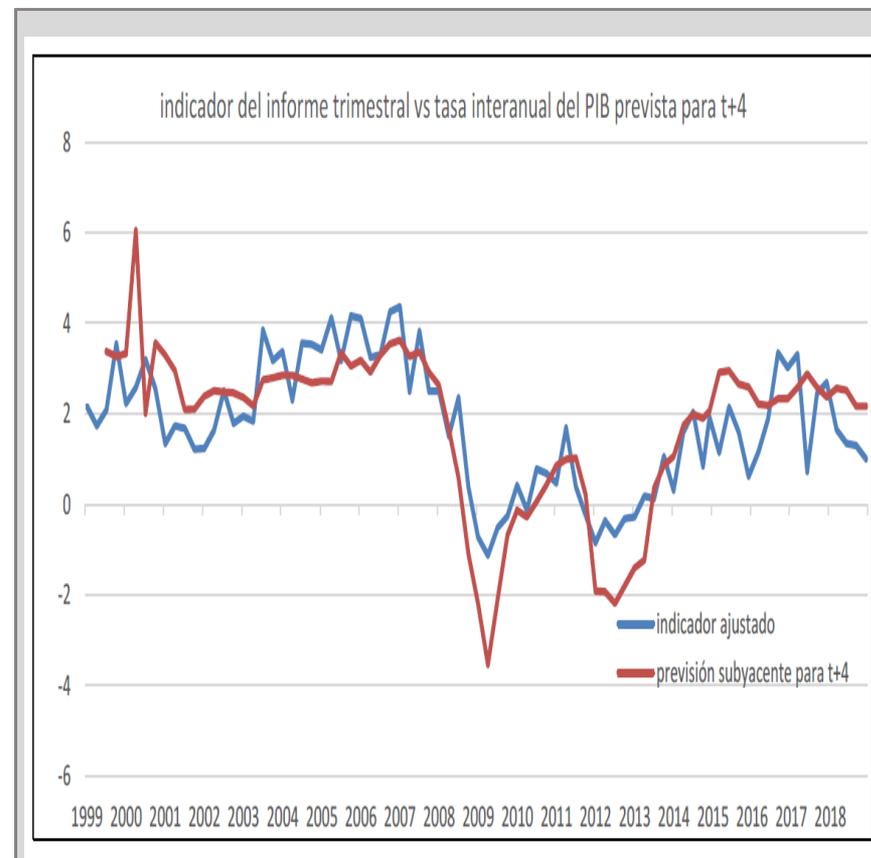
- **Refines the Economic Policy Uncertainty (EPU) index (Baker et al., 2016) for Spain.**
- **Fine-tunes richness of expressions and newspaper coverage.**
- **Based on 7 relevant Spanish national newspapers from January 1997 to the present.**
- **New EPU shows more consistent chronology of relevant events.**
- **Available at: http://www.policyuncertainty.com/spain_GPU.html**

Relative contribution of keywords, press, and time coverage: GDP responses

Legend:
- EPU-BBD
- EPU-New Keywords;Old Press Coverage;From 2001
- EPU-New Keywords;New Press Coverage;From 2001
- EPU-NEW

- **Study on sentiment evolution in Quarterly Reports on the Spanish Economy (mainly in the Overview section).**

- **Creation of dictionary of positive and negative terms (90 + variants) in Spanish.**

- **Evaluation of evolution of sentiment and the PIB since Q1 1999.**

- Some recent related literature: Clements and Reade (2016); Stekler and Symington (2016); Hollrah, Sharpe, Sinha (2017); Catalfamo (2018); Jones, Sinclair and Stekler (2018)

indicador del informe trimestral vs tasa interanual del PIB prevista para t+4

— indicador ajustado
— previsión subyacente para t+4

Quarterly Reports on the Spanish economy published online (PDF) since 1999Q1

Since 1999: description of the economic situation and qualitative risk assessment

As of 2007: quantitative projections published once per year (in March)

As of 2014: quantitative projections published four times per year

Qualitative index vs. Forecasts ("shadow" and published)
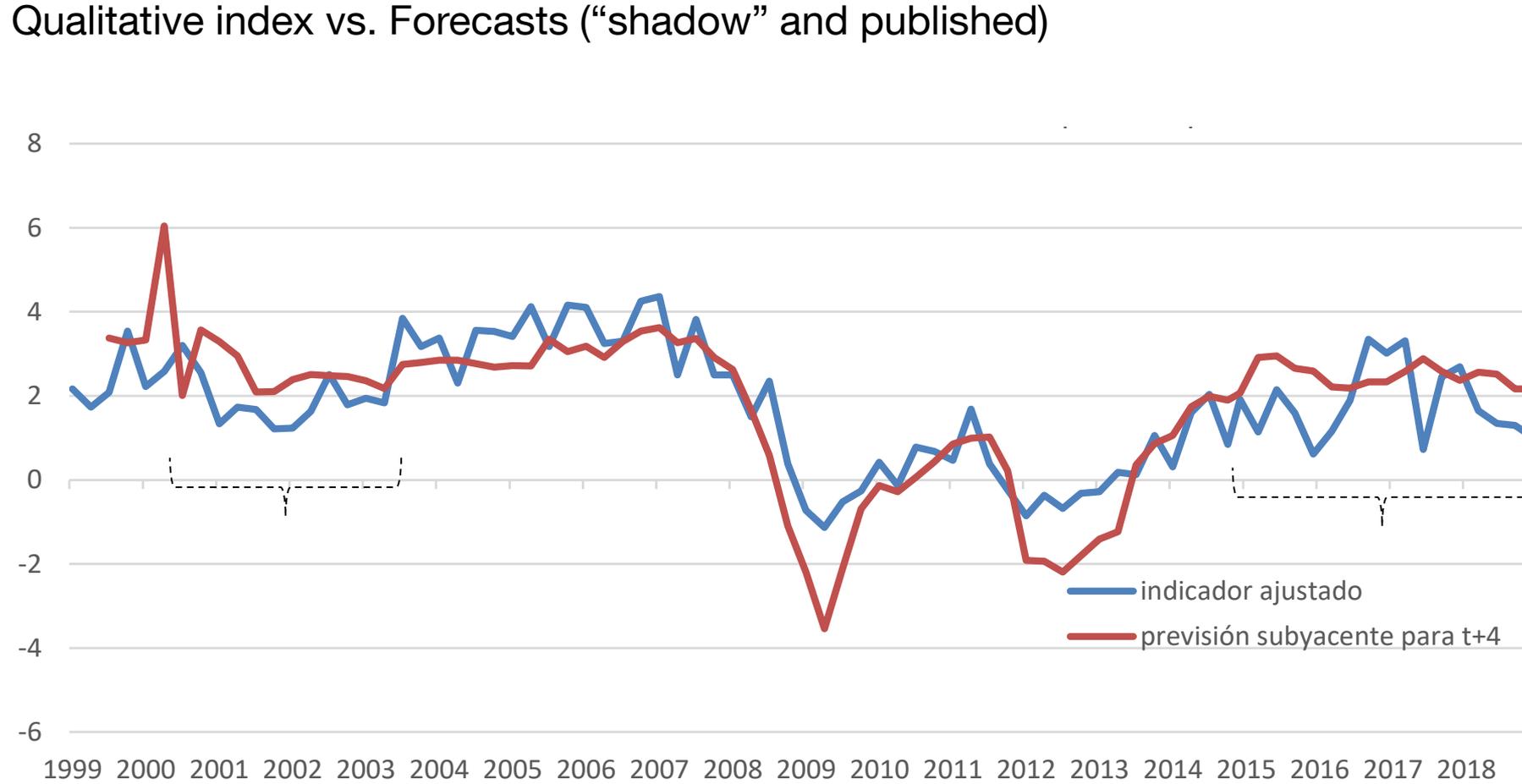
Legend:
- indicador ajustado
- previsión subyacente para t+4

Financial Frictions and the Wealth Distribution. **Fernández-Villaverde, J.; Hurtado, S.; Nuño, G. (2019).**

- **Dynamic stochastic general equilibrium modeling (DSGE) is a method in macroeconomics that attempts to explain economic phenomena through models based on general equilibrium theory and microeconomic principles.**

- **This paper shows how these models can be computed through neural networks on simulated data.**

- **Allows model estimation using micro-data.**
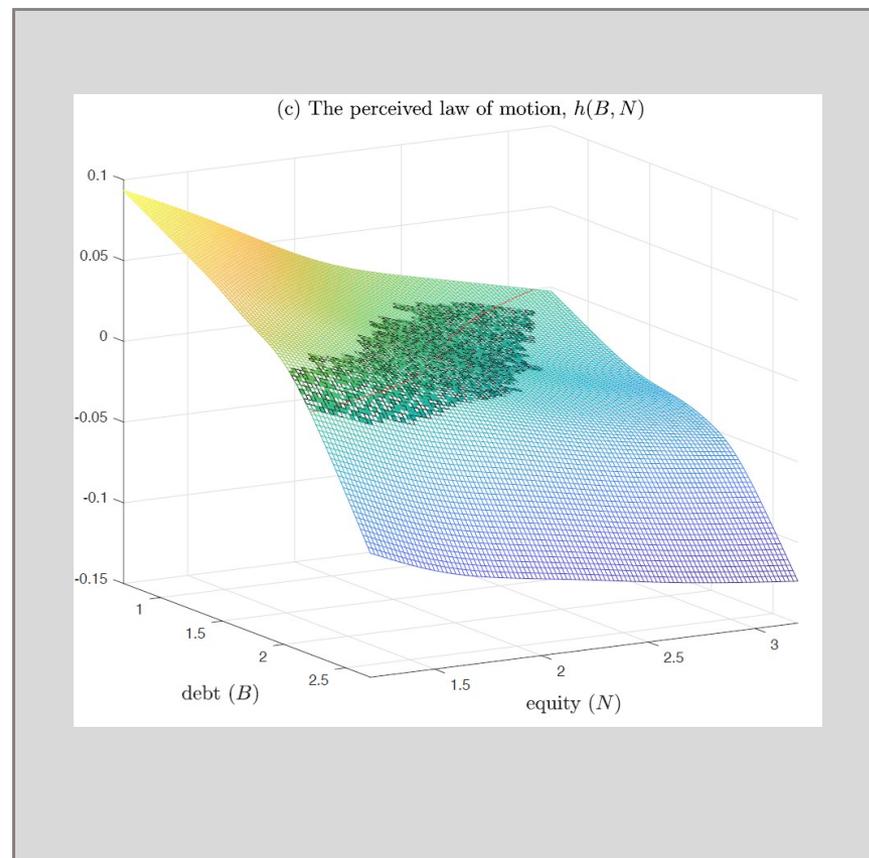
(c) The perceived law of motion, $h(B, N)$

The effects of tax changes on economic activity: a narrative approach to frequent anticipations. **García-Uribe, S. (2018)**

- **Uses summaries of TV news from 1968 to 2007 to create a new information measure on potential tax policy reforms in the USA.**

- **Applies Random Forests and Fuzzy Forests algorithms.**

- **Results reveal that one-month-ahead anticipations of tax approvals significantly stimulate current economic activity.**

- **Figure: predicted probability for tax bill approvals one month ahead based on new media measure.**
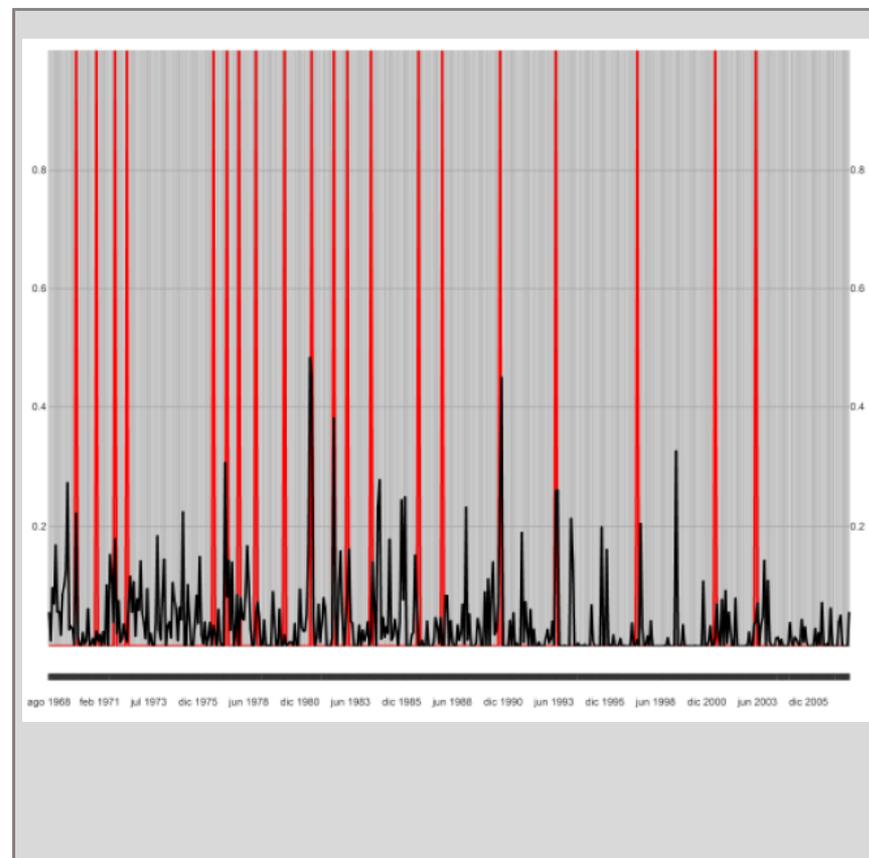
Nowcasting private consumption: traditional indicators, uncertainty measures, and the role of internet search query data. **Pérez, J.J.; Urtasun, A. (2017)**

- **Focuses on nowcasting and forecasting quarterly private consumption.**

- **Uses proxy indicators of economic and policy uncertainty indicators such as consumption-related search queries.**

- **Google-based and uncertainty indicators perform notably when combined with traditional ones at estimation horizons beyond the nowcasting one, consistent with capturing information about future consumption decisions.**