Firmin Ayivodji

Office Contact Information

University of Montreal (UdeM)
Department of Economics
3150 Jean Brillant Street, C6070-10
Montreal (Quebec), H3C 3J7
Canada

Personal Contact Information

Phone (cellular): +1 (514) 448-9572
Email: firmin.ayivodji@umontreal.ca
Homepage: firminayivodji.github.io
Citizenship: Benin

Research Interests

Primary: Econometrics, Macroeconometrics, Big Data, Machine Learning/NLP, Causal Inference.

Secondary: Climate Finance, Real Estate, Housing Economics, Household Finance, ESG Investing.

Education

2017-present: PhD Candidate in Economics, University of Montreal (UdeM), Canada.

2014–2017: MSc in Statistics and Economics, Ecole Nationale de la Statistique et de l'Analyse Economique (ENSAE), Senegal.

2010–2013: BSc in Statistics, Ecole Nationale d'Economie Appliquée et de Management (ENEAM), Benin.

Research and Publications

Working Papers

"*Identification of Common Factors in Group Factor Models*".

"*Regional and Sectoral News-Based Indicators for Macroeconomic Forecasting*".

"*Food Security and the COVID-19 Employment Shock in Nigeria: Any Ex-Ante Mitigating Effects of Past Remittances?*", with A., Akim, and J., Kouton (**R&R at Food Policy**).

"*Economic Government Support and the COVID-19 Lockdown-Compliance in Africa*", with A., Akim, and M., Amba (**Submitted**).

Work in Progress

"*Deep Dynamic Factor Models in a Data-Rich Environment*".

"*Global Housing Price Forecasting with Economic Narratives and Machine Learning*".

"*High-Frequency Inflation Expectations from Big Data: A Natural Language Approach*".

"*How Media Narratives Influence Canadian Regional Housing Markets*".

Policy Papers

2022 "*Network Effects and IMF Program Review Teams*", with Jochen Andritzky, and Heiko Hesse.

2021 "*More Than Words: A Textual Analysis of MEFP*", with Jochen Andritzky, and Heiko Hesse.

2019: "*Fiscal Vulnerabilities and the Role of Fiscal Policy in Commodity-Exporting Countries*", World Bank, MTI discussion paper, with Christine Richaud, Sebastian Essl, Arthur Mendes, and Samer Matta.

Pre-Doctoral Publications

2019: "*Analysis of Determinants of Export Diversification in Franc Zone: A comparative study between UEMOA and CEMAC countries*", [Journal of Economics and Public Finance Vol. 6, No. 1, 2020], with Remy Hounsou.

2018: "*Threshold Effects of Health on Economic Growth in Sub-Saharan African Countries: Evidence from a Dynamic Panel Threshold Model*", [Journal of Economics and Development Studies, 2018, vol. 6, no 4, p. 19-37], with Jeffrey Kouton, and Coffie José N'guessan.

Research Grants, Scholarships, & Fellowships

2022: First International Workshop on Interactive Causal Learning, Travel grant.

2022: IVADO/Fin-ML, Mitacs, and Borealis AI Fellowship (declined).

2022: Canadian Economics Association, Travel grant.

2020: World Bank Group Fellowship, Africa Region, shortlisted.

2020-2023: FRQSC - Doctoral Research Scholarships.

2017-2023: PhD Fellowship of CIREQ and Department of Economics, University of Montreal.

2014-2017: MSc. in Statistics, Excellence Scholarship.

Teaching and Academic experience

Instructor, University of Montreal (UdeM)

- Econometrics I for undergraduate degree, Winter (2023).
- Econometrics II for undergraduate degree, Winter (2020).

Instructor, Ecole Nationale de la Statistique et de l'Analyse Economique (ENSAE)

- Big Data, Machine Learning and Econometrics, Graduate, Guest speaker, Fall (2021).
- Econometrics of Panel Data and Quantile Regression, Guest speaker, Winter (2016).

Teaching Assistant, University of Montreal (UdeM)

- Advanced Econometrics for graduate degree, Fall (2021), Fall (2020), Fall (2019).
- Macroeconometrics for graduate degree, Winter (2021).
- Econometrics II for undergraduate degree, Winter (2022), Fall (2021), Winter (2021).
- Introduction to Macroeconomics for undergraduate degree, Fall (2019).
- Principles of Economics for undergraduate degree, Summer (2022), Summer (2021).

Research and Work Experience

July 2023 – present: **Research Economist**, *Bank of Canada*, Model Development Division, Ottawa, Canada

April – June 2023: **Research Economist**, *Observatoire de la Francophonie Économique*, Montreal, Canada

March – May 2023: **AI Research Scientist**, *PMGS Inc.*, Montreal, Canada

October 2022 – February 2023: **Lead Advisor - AI Scientist**, *AI Global Pros Inc.*, Montreal, Canada

October 2021 – October 2022: **Research Assistant** for Prof. *Karim Chalak*, University of Montreal, Canada

June – August 2021: **PhD Intern**, *International Monetary Fund (IMF)*, Strategy, Policy, and Review Department, Washington, US

December – January 2021: **Research Assistant** for Prof. *Benoit Perron*, University of Montreal, Canada

November 2020 – January 2021: **Research Assistant** at *Observatoire de la Francophonie Économique (OFE)*, Montreal, Canada

August 2019 – September 2019: **Economic Researcher** at *Macroeconomics, Trade and Investment (MTI) Global Practice*, World Bank, Washington, USA

August 2019 – present: **Co-founder & Chairman** at *KiDs A.I. Inc.*, Canada

August 2018 – August 2019: **Research Assistant** for Prof. *Christopher Rauh*, University of Montreal, Canada

January – June 2018: **Economic Researcher** at *Macroeconomics, Trade and Investment Global Practice*, World Bank, Washington, USA

August – October 2016: **Research Officer**, *International Monetary Fund (IMF)*, Dakar, Senegal

2013-2016: **Co-Founder STATEC**, *Lead Data Scientist*, Cotonou, Benin

May 2015: **Data Scientist Intern**, *ENSAE-United Nations Industrial Development Organization (UNIDO) Cooperation*, Dakar, Senegal

August – November 2013: **Data Scientist Intern**, *Direction of Forecasting and Business Cycle*, Cotonou, Benin

Seminar and Conference Presentations (* scheduled, $^{+}$co-author)

2023:

17^{th} International Conference on Computational and Financial Econometrics (Berlin, 2023)*, Department of Mathematics and Statistics (UdeM, Montreal), Recent Developments in Econometrics, CIREQ (Montreal); 57^{th} Annual Meetings of the Canadian Economics Association (Winnipeg-Manitoba); 1^{st} CIREQ Interdisciplinary Conference on Big Data and Artificial Intelligence (Montreal); 62^{th} Congress - Societé Canadienne de Science Economique (Quebec); 18^{th} CIREQ PhD Students' Conference (Montreal).

2022:

6^{th} Annual Toronto Machine Learning Summit (TMLS), Toronto, Canada; IVADO Digital October, MIL Campus, Montreal, Canada; CIREQ Montreal Econometrics Conference in Honor of Eric Renault (Montreal, poster); 56^{th} Annual Meetings of the Canadian Economics Association, Carleton University; 61^{st} Congress of the Canadian Society of Economic Sciences, Montreal; 17^{th} CIREQ PhD Students' Conference, Montreal, Canada; CSAE Conference 2022:

Economic Development in Africa^{+}, Virtual conference; International Conference on Development Economics (ICDE), Clermont-Ferrand, France^{+}; Quebec PhD workshop in Economics, Statistics and Finance.

Conference organization:

- Co-organizer of 1st CIREQ Interdisciplinary Conference on Big Data and Artificial Intelligence, Summer 2023.

- Volunteer of 61st congrès annuel Société Canadienne de Science Economique (SCSE), Summer 2022.

- Volunteer of International Association for Applied Econometrics (IAAE) Annual Conference, Summer 2018.

Selected Additional Training

March 05-June 30, 2022: "***Statistical Learning***", *Stanford University*, taught by Trevor Hastie and Rob Tibshirani.

April 17- May 10, 2022: "***Macroeconomics of Climate Change: Science, Economics, and Policies***", *IMF*, taught by James Roaf, Augustus Panton, Irene Yackovlev.

October 02-December 04, 2020: "***Empirical Household Finance***", *New York University Leonard N. Stern School of Business*, taught by Theresa Kuchler and Johannes Stroebel.

August 14-December 14, 2018: "***Machine Learning***", *Georgia Tech*, taught by Charles Isbell.

August 21-December 21, 2018: "***Artificial Intelligence (AI)***", *Columbia University, Department of Computer Science*, taught by Ansaf Salleb-Aouissi.

August 15-December 18, 2018: "***Machine Learning Fundamentals***", *California-San Diego University, Computer Science and Engineering Department*, taught by Sanjoy Dasgupta.

Memberships and Research Affiliations

Econometric Society, International Association for Applied Econometrics, American Economic Association, Canadian Economics Association, American Statistical Association, CIREQ, Mila – Quebec AI Institute, Black in AI, Waterloo AI Group, Society for Financial Econometrics (SoFiE).

Skills and Languages

Programming: Python, MATLAB, STATA, R, SAS, Git, ArcGIS,VBA, LaTeX.

Statistics and Machine Learning: Natural Language Processing, Causal Inference (Experiments, IV, DiD, RDD, Synthetic Control Methods), Deep Learning, Predictive Modeling, Machine Learning for Causal Inference, Unsupervised Learning, Recommender Systems, Reinforcement Learning, etc.

Other: Tableau, Bloomberg, Datastream.

Alternative data manipulation: social media, newspaper text, text data, etc.

Languages: English (proficiency), French (native).

Summary of working papers/work in progress

Identification and Estimation of Common Factors in Group Factor Models

This paper examines the comovement among factors extracted from two distinct large panels (or groups) of variables. We show that estimating factors introduces a bias in the estimated correlation between factors, which disappears if the factors are estimated from panel data sets containing many cross-sectional series. We show that a modified version of the wild bootstrap algorithm proposed by Gonçalves and Perron (2014) can correct the bias and provide reliable inference on the correlation of interest. Additionally, we apply our modified wild bootstrap method to analyze the influence of institutional factors on economic growth, as examined in Deniz et al. (2018), and the degree of synchronization of business cycles in developed and emerging economies, as explored in Kose et al. (2013) and Aastveit et al. (2015).

Regional and Sectoral News-Based Indicators for Macroeconomic Forecasting

This paper proposes an approach to measure real-time economic conditions using newspaper narratives. First, we apply deep learning and lexical-based techniques to construct new high-frequency measures of sentiment indices embodied in a vast news corpus covering economic and financial articles in Canada from January 1977 to October 2022. These sentiment indices are constructed at the sectoral (or 6-digit NAICS), provincial, and national levels. Second, we document that the sentiment indices capture the business cycle and the movement of contemporaneous key economic and financial measures such as GDP, inflation, housing prices, and unemployment. Third, we use an advanced machine learning method to isolate information about future, current, and past sentiments. Finally, this paper provides novel evidence of how news sentiment tracks current and future economic and financial conditions at sectoral, regional, and national levels and significantly enhances predictive power in forecasting models using shrinkage methods (LASSO, Ridge, Elastic net) and nonlinear machine learning techniques (Random Forest, Gradient Boosting, Artificial Neural Network), ensembles of linear and nonlinear models.

High-Frequency Inflation Expectations from Big Data: A Natural Language Approach

In this study, we leverage advanced computational techniques, including textual analysis and machine learning, on a comprehensive dataset of more than 2 million newspaper articles and 40 million tweets across Canadian provinces to build novel high-frequency and real-time indicators of consumer inflation expectations at both the national and subnational levels. To achieve this, we first identify news articles and tweets related to inflation or prices, then construct daily measures of text-based inflation expectations which is the difference between the number of news articles or tweets about inflation and the number of tweets about deflation through a combination of state-of-the-art techniques like Latent Dirichlet Allocation (LDA), transformer text classification, and a dictionary-based approach. Our findings indicate a high correlation between the resulting text-based inflation expectations indices and consumers' survey-based inflation expectations and official inflation data. Subsequently, we use a mixed-frequency machine learning approach to generate nowcasts/forecasts of quarterly inflation expectations based on large sets of text indicators and Google Trends search volume data for inflation-related terms. The predictions are based on linear models estimated via the LASSO, Ridge, and Elastic net, nonlinear models based on Random Forests, Extreme Gradient Boosting, and Artificial Neural Networks, and ensembles of linear and nonlinear models. The results demonstrate that news and social media data contain valuable information regarding inflation dynamics, and our newly developed indicators effectively anticipate consumer expectations. Moreover, we show that random forests and neural networks are very competitive models, and their superiority, although stable across most of the time period considered. The findings suggest that newspaper and social media data can serve as a timely source for eliciting beliefs on inflation.

How Media Narratives Influence Canadian Regional Housing Markets

Housing price prediction is a big challenge. The 2008 Global Financial Crisis (GFC) showed that even the most sophisticated traditional macro-financial models failed to foresee the crisis. In this paper, I investigate whether information from Canadian local newspaper articles about housing market narratives could improve local housing price predictions. We build separate future and past topic indexes to capture prior and posterior media narratives about the housing market. I use the mixed-frequency machine learning approach to generate a sequence of nowcasts/forecasts of monthly housing prices based on a vast local newspapers corpus related to the housing market. The predictions are based on linear models estimated via the LASSO and elastic net, nonlinear models based on artificial neural networks, ensembles of linear and nonlinear models. The results indicate that news data contain valuable information about the housing market's direction.

Power Blackout 'Pandemic' and Social Media Voice, joint with J., Agossa

The energy crisis in South Africa has become a major concern for governments, businesses, and consumers. While conventional survey methods to gauge public opinion on power blackouts are costly and time-consuming, Twitter has emerged as a useful tool for collecting data on the crisis, providing a more efficient and cost-effective way to gauge public sentiment through tweets. This study explores the use of Twitter to assess public sentiment on the energy crisis in South Africa, analyzing all tweets related to the issue from January 2010 to February 2023. By doing so, the study identified significant variations in sentiment across different cities and provinces, highlighting Twitter's value in understanding public sentiment and gaining insights into the issue. Furthermore, the study used machine learning techniques, such as Latent Dirichlet Allocation (LDA), to identify key topics discussed in the data, which could inform policy decisions to address the country's energy crisis. Additionally, the study found that the energy crisis has increased people's interest in renewable energy. Finally, the dynamic responses of macro variables to the identified energy crisis sentiment are consistent with the theoretical consensus.

Global Housing Price Forecasting with Economic Narratives and Machine Learning

In this paper, we apply economic narratives to housing price forecasting for a vast panel of countries using a unique large dataset of multilingual tweets and advanced machine learning algorithms. We measure economic narratives quantitatively from more than 30 million tweets related to the housing market and home price expectations and represent them as interpretable social media topics. The results indicate that narrative-based forecasts are more accurate than the benchmarks both in-sample and out-of-sample, which perform well, especially during recession periods. We show that random forests and neural networks are very competitive models, and their superiority, although stable across most of the time period considered. Narrative-based forecasts perform better in long-run forecasting, suggesting that narratives help to capture the slowly-varying trend housing price markets directions. Overall, we provide a novel representation of economic narratives and highlight the important role of economic narratives in housing price forecasting for different countries. Additionally, it sheds light on the interconnectedness of housing markets among major economies, facilitating the examination of shock transmission.