

Curriculum Vitae

Mahdi Ebrahimi Kahou

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PERSONAL INFORMATION

Citizenship: Canadian, Iranian
Contact Info: mekahou@alumni.ubc.ca, [Website](#).

RESEARCH INTERESTS

Macroeconomics, Machine Learning, Econometrics, and Computational Economics.

EDUCATION

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- Doctor of Philosophy in Economics, [University British Columbia](#). 2017-
Committee: [Dr. Jesse Perla](#) (UBC), [Dr. Jesús Fernández-Villaverde](#) (UPenn),
[Dr. Hiroyuki Kasahara](#) (UBC), [Dr. Vadim Marmer](#) (UBC)
 - Visiting scholar at Federal Reserve Bank of Minneapolis. October 2022
 - Doctor of Philosophy in Economics, [University of Minnesota](#).
Voluntary withdrawal due to the U.S. travel ban after finishing the first year.
 - Master of Science in Physics,
[Institute for Quantum Science and Technology](#), [University of Calgary](#).
Thesis Topic: [Spatial search via non-linear quantum walk](#)
Supervisor: [Dr. David Feder](#)
 - Bachelor of Science in Physics, [Sharif University of Technology](#).

WORKING PAPERS

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- **Job market paper:** “[Exploiting Symmetry in High-Dimensional Dynamic Programming](#)”,
NBER Working Paper, 2021.
With Jesús Fernández-Villaverde, Jesse Perla, and Arnav Sood.
“We propose a new method for solving high-dimensional dynamic programming problems and recursive competitive equilibria with a large (but finite) number of heterogeneous agents using deep learning. We avoid the curse of dimensionality thanks to three complementary techniques: (1) exploiting symmetry in the approximate law of motion and the value function; (2) constructing a concentration of measure to calculate high-dimensional expectations using a single Monte Carlo draw from the distribution of idiosyncratic shocks; and (3) designing and training deep learning architectures that exploit symmetry and concentration of measure. As an application, we find a global solution of a multi-firm version of the classic Lucas and Prescott (1971) model of investment under uncertainty. First, we compare the solution against a linear-quadratic Gaussian version for validation and benchmarking. Next, we solve the nonlinear version where no accurate or closed-form solution exists. Finally, we describe how our approach applies to a large class of models in economics. ”

- “Spooky Boundaries at a Distance: Exploring Transversality and Stability with Deep Learning”.

With Jesús Fernández-Villaverde, Sebastian Gomez Cardona, Jesse Perla, and Jan Rosa.

“In the long run, we are all dead. Nonetheless, even when investigating short-run dynamics, models require boundary conditions on long-run, forward-looking behavior (e.g., transversality and no-bubble conditions). In this paper, we show how deep learning approximations can automatically fulfill these conditions despite not directly calculating the steady state, balanced growth path, or ergodic distribution. The main implication is that we can solve for transition dynamics with forward-looking agents, confident that long-run boundary conditions will implicitly discipline the short-run decisions, even converging towards the correct equilibria in cases with steady-state multiplicity. While this paper analyzes benchmarks such as the neoclassical growth model, the results suggest deep learning may let us calculate accurate transition dynamics with high-dimensional state spaces, and without directly solving for long-run behavior.”

- “Optimal Entry Decision with Correlated Variable Cost and Output Price”.

“In models with irrecoverable investment and uncertainty in the output price it is a well-established result that uncertainty increases the output price that a firm starts investment. This paper studies a model of irrecoverable investment (entry) where the variable cost and output price are characterized by two correlated geometric Brownian motions. The numerical results indicate that in the presence of high levels of correlation the impact of uncertainty in output price is ambiguous and depends on the level of variable cost. Specifically, increasing uncertainty in output prices increases the entry output price for low levels of variable cost and the reverse happens for high levels of variable cost. Therefore, in the presence of high levels of correlation the conventional result does not hold anymore. Moreover, this study establishes that increasing the correlation level decreases the entry output price.”

WORK IN PROGRESS

- “Solving Equilibrium Economic Models with Deep Learning”.

With Jesús Fernández-Villaverde and Jesse Perla.

“The success of deep learning in a variety of applications is leading economists to explore its potential for orders of magnitude increase in the size of the state-space and the complexity of models we can solve. In this paper, we provide a clear mental picture of what deep learning is, how it relates to existing solution methods, how to encode economic insights and domain knowledge, and where the methods are likely to be revolutionary. In answering those questions, we demystify these methods, explain the core concepts with simple, however, insightful examples, and debunk some “folk wisdom” commonly held, while elaborating on places where we should proceed with caution.”

PUBLICATIONS

- “Quantum Search with Interacting Bose-Einstein Condensates”, Physical Review A, 2013. (With David L. Feder)
- “Macroprudential Policy: A Review”, Journal of Financial Stability, 2017. (With Alfred Lehar)

SCHOLARSHIPS, AWARDS AND HONOURS

- Selected for 71st Lindau Nobel Laureate Meeting on Economic Sciences.
- Social Sciences and Humanities Research Council (SSHRC) Doctoral Fellowship.
- Four Year Doctoral Fellowship (UBC).
- Faculty of Graduate Studies Award (University of Calgary).
- Institute for Quantum Science and Technology “Top-Up Students Award” (University of Calgary).
- Bronze medal in National Physics Olympiad.

PRESENTATIONS

- University of Colorado Boulder, Scheduled for December 2022.
- University of Minnesota, Scheduled for October 2022.
- “Spooky Action at the Boundary: A Note on Transversality Condition and Stationarity”. Society For Economic Dynamics, Madison, June 2022.
- “Spatial Search by Non-Linear Quantum Walk”. Southwest Quantum Information and Technology, Albuquerque, February 2012.
- “Non-linear Quantum Walk”. Canadian Association of Physicists, Calgary, June 2012.

REFERENCES

- Dr. Jesse Perla
Associate Professor of Economics
University of British Columbia
6000 Iona Drive, Vancouver, BC Canada V6T 1L4.
Phone: +1 604 822-5721
E-mail: jesse.perla@ubc.ca.
- Dr. Jesús Fernández-Villaverde
Professor of Economics
University of Pennsylvania
The Ronald O. Perelman Center for Political Science and Economics
133 South 36th Street, Philadelphia, PA 19104.
Phone: +1 215 573-1504
E-mail: jesusfv@econ.upenn.edu
- Dr. Hiroyuki Kasahara
Professor of Economics
University of British Columbia
6000 Iona Drive, Vancouver, BC Canada V6T 1L4.
Phone: +1 604 822-4814
E-mail: Hiroyuki.Kasahara@ubc.ca
- Dr. Vadim Marmer
Professor of Economics
University of British Columbia
6000 Iona Drive, Vancouver, BC Canada V6T 1L4 .
Phone: +1 604 822-8217
E-mail: Vadim.Marmer@ubc.ca

TEACHING EXPERIENCE

- TA for Computational Economics with Data Science Applications, UBC. 2019
- TA for Information and Incentive (graduate), UBC. 2019
- TA for PhD Econometrics Theory, UBC. 2018
- TA for honor level macroeconomics and microeconomics, UBC. 2019-2020
- TA Economic Growth, University of Minnesota. 2016

- TA for Phys 211/221, Phys 259 and Phys 369, University of Calgary. 2010-2012
- TA for Analytical Mechanics I&II, Sharif University of Technology. 2007-2008

COMPUTER
PROGRAMMING

- MATLAB, Mathematica, Julia, Python.