Essay on current research, future research, and reason for applying

Current Research

My PhD dissertation examines the interaction between technological innovation, transition policies, and macroeconomic dynamics in the context of the green transition. The first chapter modifies a granular task-based model [1] calibrated to US data to quantify the effectiveness and welfare implications of current green input subsidies. The key takeaway of this project is that production subsidies as a policy to boost innovation and productivity are effective only if the new technology is able to mitigate the productivity gap between the existing technology. Findings also suggest that subsidies are only welfare-improving if the positive externalities from green inputs are substantial (equivalent to a 3% increase in consumption) and lump-sum taxes are identified as the least welfare-distorting financing method. In the second chapter, I empirically investigate how market structure affects innovation across "clean" and "dirty" sectors. My preliminary results confirm an inverted-U relationship between competition and innovation, consistent with the broader macroeconomic literature [2]. However, this relationship dampens when I control for coordinated R&D investment in clean energy. This suggests that while competition initially fosters innovation, in general equilibrium, greater competition may weaken coordinated investment, reducing overall technological progress. I am currently refining the empirical framework by constructing a more comprehensive dataset on sectoral R&D investments and innovation outcomes, which could directly benefit from the BootCamp.

Future Research

For my job market paper, I am developing a microfounded macroeconomic model that integrates elements of Coordination, Cooperation, and Competition (CoCoCo) within a game-theoretic framework. In this model, firms strategically allocate resources between small, incremental innovations and larger, breakthrough innovations—the latter's success rate being endogenously linked to the cumulative rate of incremental innovations. The computational analysis of the game theoretical equilibrium shows how competition intensity, cooperative incentives, and coordination mechanisms jointly influence innovation investment, yielding non-linear responses to parameter shifts. I will calibrate this model using R&D and innovation outcomes data, thereby directly addressing bottlenecks in green technology development. This project could benefit directly from the sessions and insights from this boot camp.

Reason for Applying

Innovation dynamics are central to my research on the green transition, where the pace and direction of technological progress shape macroeconomic feasibility. My work explores how strategic interactions among firms influence innovation incentives, but robust measurement and empirical validation of these mechanisms remain challenging. The boot camp offers an unparalleled opportunity to engage with cutting-edge research on innovation policy, market structure, and technology diffusion, equipping me with the analytical tools to enhance both my theoretical modeling and empirical strategies. By integrating insights from leading scholars and collaborating with researchers tackling similar questions, I aim to refine my measurement and empirical approach to linking firm-level decision-making with macroeconomic outcomes. Strengthening this connection would enable me to provide policy-relevant research insights to design effective policy interventions that accelerate green technology development and drive the economic transformation needed for a sustainable future.

References

[1] Daron Acemoglu and Pascual Restrepo. The race between man and machine: Implications of technology for growth, factor shares, and employment. *American Economic Review*, 108(6):1488–1542, 2018.

[2] Philippe Aghion, Nick Bloom, Richard Blundell, Rachel Griffith, and Peter Howitt. Competition and innovation: An inverted-u relationship. *The quarterly journal of economics*, 120(2):701–728, 2005.

Cover Letter

February 6, 2025

Subject: Application for NBER Innovation Research Boot Camp 2025

Dear Review Committee,

I am excited to apply for the NBER Innovation Research Boot Camp 2025, as my research directly engages with the economics of innovation in the context of the green transition. My work examines how market structure and policy shape firms' incentives to develop clean technologies, with a particular focus on the role of coordination and strategic interactions in driving technological progress. While my theoretical and empirical research highlight key mechanisms influencing innovation dynamics, the challenge of measuring these effects rigorously and calibrating them within macroeconomic models remains a key obstacle. The boot camp presents an invaluable opportunity to refine my approach by engaging with experts at the frontier of innovation research.

One major difficulty in studying innovation within macroeconomic frameworks is the lack of standardized methods for linking firm-level innovation choices with broader economic outcomes. I am particularly interested in exploring alternatives to patent data and R&D expenditures as measures of innovation, as traditional metrics often fail to capture the full scope of technological progress, particularly in emerging clean energy sectors. Moreover, firm-level R&D investment data frequently lacks the granularity needed to distinguish between clean and dirty technologies, making it difficult to assess the true impact of policy incentives on green innovation. Identifying alternative proxies that better reflect technological diffusion and innovation outcomes is critical for improving the empirical foundation of my research and informing more effective policy interventions.

My research would greatly benefit from exposure to advanced methodologies in innovation measurement, firm-level data analysis, and policy evaluation, particularly in understanding how market frictions shape technological adoption. The interdisciplinary perspective of the boot camp—integrating insights from industrial organization, public economics, and innovation policy—aligns closely with my objective of developing a structurally grounded approach to modeling innovation in the green transition. I look forward to the opportunity to engage with leading scholars and peers who are tackling similar questions, which will help refine my theoretical and empirical strategies.

I have attached my CV and a list of my PhD coursework as requested. A letter of recommendation will be submitted separately by my advisor, Prof. **Athanasios Geromichalos** (UC Davis). Thank you for your time and consideration—I look forward to the opportunity to participate in this program.

Sincerely,
Shisham Adhikari
PhD Candidate, Department of Economics
University of California, Davis (UC Davis)

Shisham Adhikari

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EDUCATION

University of California, Davis (UC Davis) — Davis, CA
Ph.D. in Economics — 05/2026
M.S. in Economics, *Awarded Best First-Year Student Award* — 09/2022
Research Areas: Intersection of climate change and macroeconomics

Reed College — Portland, OR
B.A. in Mathematics and Economics (Top 5 % with GPA 3.89) — 05/2021
Thesis: Inequality in Ramsey Growth Model with Heterogeneous Rates of Return

PHD COURSES AND TECHNICAL SKILLS

Courses: Microeconomic Theory series, Macroeconomic theory series, Econometric foundations series, International trade series, International Macroeconomic series, Advanced Time Series Analysis
Programming: Python, R, MATLAB, Stata, SQL
Tools: RStudio, Jupyter, Git, Microsoft Office, LaTeX, GitHub, UNIX/Linux, Spark, GIS tools.

RELEVANT EXPERIENCES

University of California, Davis — Davis, CA
Graduate Researcher | R, Stata, MATLAB, Python — 09/2021 - Present

- **Ongoing JMP:** Developing a quantitative macroeconomic model to analyze how market structure (competition, cooperation, and coordination) influence innovation, with a focus on clean technology innovation.
- **Emissions Forecasting Under Uncertainty**: Built time-series models for uncertainty-guided predictive forecasting for Green House Gas emissions at scale with dimensionality reduction techniques.
- **How Much Work Experience for a First Job?** *(With Prof. Athanasios Geromichalos and Prof. Ioannis Kospentaris)*: Analyzed macroeconomic implications of entry-level job market frictions and compared interventions to identify optimal solutions for reducing barriers faced by inexperienced workers.
  Latest version: Revise and Resubmit, Review of Economic Dynamics (RED)
- **Green Subsidies and Skills Training** (Draft): Developed a quantitative framework using a DMP search-match labor market model to identify the optimal strategy for scaling green jobs to meet climate targets.
- **A Task-Based Model for Targeted Green Subsidies** (Draft): Developed and calibrated a task-based model highlighting the role of relative productivity in designing effective clean input subsidies.
- **Monetary Policy for Climate**: Developed a New-Keynesian model to assess climate impacts on price indices and suggest optimal monetary policy adjustments that account for climate risks.

RStudio PBC — Remote
Data Science Educator — Sept 2021 - December 2022

- Designed, developed, and delivered educational content to help professionals learn data science with R.
- Oversaw the creation of instructional materials and courses for data science education.

Software Developer (Intern) — May 2021 - August 2021

- Developed an R package (shinymodels) for interactive model exploration to facilitate model deployment.

Reed College — Portland, OR
Undergraduate Researcher | Python, R, MATLAB — 08/2018 - 05/2021

- Analyze heterogeneous investment returns across wealth distributions. (with Prof. Jasmine Jiang)
- Examined wealth inequality trends in large-scale survey data (SCF 1983–2016) (with Tristan Nighswander).
- Assessed firm-level inequality using U.S. Multi National Enterprises (MNE) data (with Prof. Kimberly Clausing).

CERTIFICATIONS AND AFFILIATIONS

Climate Change and AI (CCAI) Summer School — Virtual, 2024
Journal of International Economics (JIE) Summer School — Crete, 2023
Phi Beta Kappa Honor Society — Reed College, 2021
Commendation for Academic Achievement — Reed College, 2017-2021
Foundations of Investment Management — Wharton Online, Jan 2020
Accounting, Analyzing Financial Reports, and Excel Training — Wall Street Prep, Oct 2019
Girls Who Invest Online Intensive Program — Girls Who Invest, Oct 2019
The Investment Foundations Program — CFA Institute, Oct 2019
Public Policy and International Affairs (PPIA) Fellowship — Carnegie Mellon University, Aug 2019

LEADERSHIPS AND INVOLVEMENTS

Reed College Peer Services — Portland, OR
Peer Career Advisor, Housing Advisor, Peer Mentor — September 2018 - May 2020

- Provided leadership and guidance on career advising, on-campus housing, and peer mentorship to students.

PERIOD. — Remote
Data and International Policy Analysis Intern — May 2020 - August 2020

- Applied machine learning to classify global menstrual health policies and support policy recommendations for a non-profit.

CFA Institute Research Challenge — Portland, OR
Team Leader — March 2019 - May 2019

- Led a 4-member team to analyze Nike's financials and presented a buy-side report using a DCF model.

Reed College Finance and Investment Club — Portland, OR
President — December 2018 - December 2019

- Managed a $75K investment portfolio, achieving a 15% increase during tenure.

TEACHING EXPERIENCES

University of California, Davis — Davis, CA
Graduate Teaching Assistant: Econometrics, Game Theory,Intermediate Macroeconomics, Intermediate Microeconomics, Principles of Microeconomics, Principles of Macroeconomics

Reed College — Portland, OR
Undergraduate Teaching Assistant: International Monetary System, International Trade, Behavioral Finance, Econometrics, Data Science, Probability, Math Statistics, Calculus, Analysis, Linear Algebra, Vector Calculus

SCHOLARSHIPS, GRANTS, HONORS AND ACHIEVEMENTS

Department Research/Travel Award ($\$2,200$) — UC Davis 2023
Best First-Year Student Award ($\$500$) — UC Davis 2021
Carl Burgdorfer CFA Scholarship ($\$2,000$) — CFA Society of Portland 2021
Evan Rose Research Fund ($\$6,500$) — 2021
Gerald M. Meier Award for Distinction in Economics ($\$500$) — 2021
Public Policy and International Affairs (PPIA) Fellowship ($\$3,000$) — Carnegie Mellon University 2020
Summer Internship Award ($\$4,000$) — 2020
Collaborative Research Grant ($\$2,488$) — 2020
Economics Summer Research Award ($\$4,900$) — Reed College 2019
Girls Who Invest Online Intensive Program Scholarship — 2019
Career Advancement Fund ($\$1,265$) — 2019-2020
Student Opportunity Subsidy (SOS) Grant ($\$700$) — 2019
Davis Projects for Peace Award ($\$10,000$) — 2018

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SANTA BARBARA • SANTA CRUZ

Athanasios Geromichalos
Associate Professor
Department of Economics
University of California, Davis

February 6, 2025,

Dear colleagues,

This is a letter of recommendation in support of Shisham Adhikari, who has applied for the 2025 NBER Economic Innovation boot camp. Shisham is a student in good standing at our PhD program, and she is in her fourth year. I know Shisham very well. As the Graduate Chair of the PhD program I admitted her (in Spring 2021) in our program with full financial support. Shisham took two Macroeconomics courses with me, she is my coauthor in a paper, and I am one of her main advisors.

Shisham is an amazing student with a bright and promising future in research in the field of Macroeconomics (defined in the broader sense, i.e., including Labor topics, International topics, and Environmental Macroeconomics topics.) In Fall 2022, she was awarded the "Best first-year student award", an award which (as the name reveals) we give every year to the first-year student who has the best performance in the core first-year courses. It is quite remarkable that Shisham won this award being a student who came to our program only with an undergraduate degree, while the vast majority of her cohort (her "competitors" for this award) had a Master's degree, and some of them had already seen a big part of the material covered in the first year. While Shisham was still a first-year student, I realized that she is a much deeper thinker than the average graduate student: when I would teach a new model and most of her classmates would be trying to understand the math on the board, Shisham was looking deeper into the model trying to grasp the mechanism that delivers the model's main results. And while most of her class mates were only thinking about passing the prelims, Shisham came to my office a few times to pitch ideas for papers that I found extremely interesting.

It was for these reasons that I decided to ask Shisham to join me as a coauthor in an ongoing project. I should point out that I asked her to become my coauthor a few days after the prelim exam grades were released, i.e., she had just finished the first year, and she had not taken any second year courses yet. Nevertheless, I still believed that Shisham was the best Macro student in the whole department, thus, she was my first choice. Our joint paper now has a Revise and Resubmit at the *Review of Economic Dynamics.* I would love to tell you more about this very exciting paper, and some of the other papers that Shisham has been working on (she is also extremely prolific), but I understand that this letter is meant to be

short, so I will only focus on her project that will benefit the most from a possible participation at the NBER boot camp.

Shisham has been developing a research agenda that examines how market forces shape innovation dynamics, with a particular focus on the green transition. In her ongoing project, she uses a game-theoretical model—CoCoCo (Coordination, Cooperation, and Competition)—to analyze how firms balance investments between incremental ("small") innovations, which are less costly with higher arrival rates, and breakthrough ("big") innovations, which, though riskier and slower to emerge, offer higher payoffs. Her model intriguingly shows that the success rate of breakthrough innovations is influenced by investments in small innovations, with the equilibrium levels of investment depending non-linearly on the dynamics of competition, cooperation, and coordination. She is currently working to embed this micro-founded game into a broader macroeconomic framework to assess how market structure and policy interventions shape long-term innovation outcomes, especially for a successful green transition. By calibrating the model using available data, she aims to pinpoint the key bottlenecks in the innovation process.

I believe that the NBER Innovation Research Boot Camp would provide her with valuable methodological and empirical insights, making this opportunity directly relevant to the next steps in her research. **I recommend her for this event in the strongest possible terms.**

If you have additional questions, please feel free to email me at ageromich@ucdavis.edu.

Sincerely,
Athanasios Geromichalos

