Akhil Rao

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Citizenship: USA

Research and Teaching Interests:

Environmental and Resource Economics, Computational Economics, Econometrics

Education:

PhD Economics, University of Colorado Boulder, expected 2019

MA Economics, University of Colorado Boulder, 2016

BS Business Administration, University of California Riverside, 2012

Dissertation:

Title: The Economics of Orbit Use: Theory, Policy, and Measurement

Adviser: Dr. Daniel Kaffine

Additional committee members: Dr. Jonathan Hughes, Dr. Martin Boileau, Dr. Miles Kimball, Dr. Matthew Burgess

Working Papers (abstracts below):

Economic Principles of Space Traffic Control, latest draft (job market paper)

Cost in Space: Debris and Collision Risk in the Orbital Commons (with Giacomo Rondina) latest draft

Elicitation and Corrective Taxation (with Brennan McConnell) mimeo

Works in Progress

Good Guesses (with Alessandro Peri)

To solve the space junk problem, address economic incentives (with Matthew Burgess and Daniel Kaffine)

Conference publications:

The CENKI Space Economic Simulator: Analytical Verification of an Agent-Based Modeling Engine, with Trevor Bennett, Charles Cain, Nicholas Campbell, Andrew Gemer, John Marino, and Tobias Niederwieser, in *2018 IEEE Aerospace Conference Proceedings*

The CENKI Space Economic Simulator: Demonstrating Agent-Based Modeling on Satellite Market Data, with Trevor Bennett, Charles Cain, Nicholas Campbell, Andrew Gemer, John Marino, and Tobias Niederwieser, in *2018 IEEE Aerospace Conference Proceedings*

Research Abstracts:

Economic Principles of Space Traffic Control

Open access to Earth's orbits presents a unique regulatory challenge. Technical solutions to space traffic control tend to emphasize launch restrictions or public funding of debris removal technology development and use, but often ignore that current and prospective orbit users dissipate rents under open access. In this paper, I derive economic principles governing the choice of space traffic control policies. I show that policies which target satellite ownership, such as satellite taxes or permits, achieve greater expected social welfare than policies which target satellite launches, such as launch taxes or permits. Price or quantity policies can achieve equal expected social welfare due to the symmetry of uncertainty between regulators and firms. I also show that active debris removal can reduce the risk of runaway debris growth no matter how it is financed, but can only reduce the risk of satellite-destroying collisions if satellite owners pay for it or if competition from removal-induced entry reduces the returns to satellite ownership. My results show that attempts to control orbital debris growth and collision risk through launch fees or debris removal subsidies may be ineffective or backfire.

Cost in Space: Debris and Collision Risk in the Orbital Commons

As Earth's orbits fill with satellites and debris, the probability of collisions between orbiting bodies increases. Runaway debris growth, known as Kessler syndrome, may cause Earth's orbits to become unusable for millennia. We present the first long-run economic model of Earth orbit use which accounts for the risk of satellite-destroying collisions and Kessler syndrome under rational expectations. Orbital decay and profit maximization can prevent Kessler syndrome even in the absence of cleanup technologies, but open access will result in inefficiently high levels of launches, debris, and collision risk. Steady state debris levels and the equilibrium collision rate are increasing in the excess return on a satellite, and sustained increases in the excess return will lead open access to cause Kessler syndrome. Short-run rebound effects can also make open access debris levels increase as the rate of orbital decay increases and as launches generate less debris. These results suggest that careful attention to economic incentives, particularly the returns to satellite ownership, is necessary to ensure orbital sustainability.

Elicitation and Corrective Taxation

Marginal contributions to observable aggregate stocks are often unobservable in games with negative stock externalities, making optimal corrective taxation a difficult endeavor. We propose a new class of mechanism, the elicited tax, for such settings. The elicited tax uses an observable aggregate measure to elicit private information about marginal contributions, and a scored tax to penalize reports which are inconsistent with the observable aggregate and other reports. In this paper, we define a notion of strict propriety for elicited taxes, show that under perfect competition reports are Nash equilibria if and only if they are consistent with the observable aggregate, and that strictly proper elicited taxes ensure socially optimal output and externality production. We then study a particular strictly proper elicited tax, the Brier-Pigou tax, which combines a modified Brier scoring rule with a Pigouvian tax. Numerical experiments highlight three properties of the Brier-Pigou tax: (1) the tax can maximize social welfare when firms are perfectly competitive; (2) the tax achieves close to optimal welfare even when firms are perfectly collusive reporters; and (3) the proportion of consistent lies which are risk-dominated by truthful reporting for each firm depends on the number of firms providing reports and that firm's true marginal externality, suggesting that truthful reporting equilibria may be selected in some cases.

Grants, Awards, and Fellowships:

2018 Sieglinde Talbott Haller Fellowship in Economics ($5000)
2018 Graduate School Domestic Travel Grant ($300)
Center to Advance Research and Teaching in the Social Sciences (CARTSS) Spring 2018 Graduate Student Award ($850)
2018 Summer Graduate School Dissertation Fellowship ($6000)
2017 Reuben A. Zubrow Fellowship in Economics ($5000)
2013 Coro Southern California Fellows Program in Public Affairs ($11250)

Teaching Experience (ratings in parentheses where available):

Instructor of Record:

Econ 1078 Math Tools for Economists 1
Fall 2018, Spring 2018 (4.8/6), Fall 2017 (4.9/6), Spring 2017 (5.4/6)

Teaching Assistant:

Econ 3070 Intermediate Microeconomics
Summer 2017 1st term (5.7/6)
Econ 2020 Principles of Macroeconomics
Spring 2016 (4.98/6), Spring 2015 (5.4/6)
Econ 2010 Principles of Microeconomics
Fall 2016 (5.48/6), Fall 2015 (5.6/6), Fall 2014 (5.45/6)

Conference and seminar presentations:

2018: Western Economic Association International; IEEE Aerospace Conference;
CU Algorithmic Economics Group; CU Macroeconomics Seminar;
CU Environmental Economics Seminar; PolicyWest (invited moderator)

2017: Heartland Environmental and Resource Economics Workshop at Illinois;
CU Environmental and Resource Economics Workshop;
CU Environmental and Economics Seminar; CU Macroeconomics Seminar

2016: CU Environmental Economics Seminar x2

2015: CU Environmental Economics Seminar

Selected Coursework (in addition to PhD Core Coursework):

- Environmental Economics I, II
- Econometrics I, II
- Economics of Risk and Time
- Computational Methods
- Algorithmic Economics and Machine Learning Theory
- Industrial Organization and Public Policy

Other Work Experience:

Data Analyst, Red9 Corporation, May 2013 - December 2015

References:

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