Logic, AI, and Tax Technology

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Mark Cuban Is Seeking the Next Generation of AI 'Superstars'

The billionaire investor is funding AI bootcamps aimed at young people in low-income communities. 'We don't recognize how much talent is there.'

CIO JOURNAL

By Sara Castellanos + Follow

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Mark Cuban has committed $2 million to expand a program he founded that aims to teach artificial-intelligence skills at no cost to high school students in low-income communities across the country.

The billionaire investor and Dallas Mavericks proprietor, who founded the Mark Cuban Foundation AI Bootcamps program in 2019, says educating young people about artificial intelligence is critical to the country's global competitiveness. Typically, students in low-income communities don't have exposure to the technology, he said.

"We don't recognize how much talent is there," said Mr. Cuban, who lives in Dallas. "One of my goals is to really go out and find the superstars. There are so many there that are under-appreciated and don't have access to resources."

Mr. Cuban's funding will be spent on resources to educate hundreds of students in AI over the next few years, with the goal of teaching 1,000 students a year from 2023. "We'll test it, build a curriculum, evolve it and iterate it as many times as we have to. This is important, and I'll keep funding it," Mr. Cuban said.

The money will be used to pay for equipment, transportation, food and venues to host lessons when it is safe to be teaching in-person, and to grow the curriculum and attract new corporate partners.

The bootcamps are currently being taught by AI and data-science experts at corporations that aim to use AI throughout their business operations, such as Walmart Inc. and McDonald's Corp.

Suresh Kumar, global chief technology officer and chief development officer at Walmart, said Mr. Cuban's AI mission resonates with him. "It's really essential that we start training the next generation of great technologists," he said. Walmart uses AI in part to create personalized experiences for shopping, such as product recommendations. The company has also developed an internal digital assistant for employees to use inside stores to get information about pricing and inventory.

'This is important, and I'll keep funding it,' Mark Cuban said of his AI education initiative.

Mr. Cuban's focus on AI comes as technologists and academics attempt to raise awareness about diversity and inclusion issues within AI and the technology industry. Women and minorities are underrepresented in artificial intelligence, and experts say that's a problem that could contribute to algorithmic bias.

His effort also comes as the Trump administration is completing guidance for agencies on how to regulate artificial intelligence and proposing a spending increase of about 30% in the 2021 nondefense budget for AI.

Mr. Cuban's AI Bootcamps program began last year with about 40 high school students in Dallas. By the end of this year, the program will have reached more than 150 high-schoolers in Dallas and five other cities including Detroit and Omaha, according to the foundation.

In the virtual bootcamps being conducted this fall, students will learn about four branches of AI: chatbots, machine learning, computer vision and natural language processing.

Student exercises include building chatbots, developing mock "smart homes" that can turn virtual lights on and off on command, and building an AI model that recognizes common traffic signs, a key requirement for self-driving cars. The applications are built using tools from Microsoft Corp.'s cloud computing platform, Azure. Each program consists of four half-day courses.

In the first virtual bootcamp session this fall, which took place on Oct. 24, some students built a chatbot that answers questions about a fictitious ice cream shop and another that answers questions about the AI Bootcamps, based on the program's website.

Earlier in the day, Mr. Cuban told the students that AI can be used in a variety of ways, ranging from developing vaccines for Covid-19 to analyzing basketball games to create better strategies for winning games.

He told students he's learned more about AI through tutorials from Coursera, an organization that offers online computer science classes, and Amazon.com Inc.'s cloud computing division, Amazon Web Services. Branches of AI he has studied include reinforcement learning, generative adversarial networks and machine learning.

"It's so important that everyone has the opportunity to understand how this technology works, and how it's affecting daily lives," said Craig Brabec, chief data analytics officer at McDonald's. Mr. Brabec, who will be a guest speaker at an upcoming bootcamp session, said the fast-food chain is exploring the use of AI to speed up the drive-through order process.

Write to Sara Castellanos at sara.castellanos@wsj.com

Scenario S (informal)

Suppose there are three agents, *a*, *b*, and *c*, with annual incomes of $20K, $60K, and $200K, resp. The ability of each agent on a scale of 1 (lowest) to 10 (highest) is: *a*:3; *b*:4; *c*:8. Each agent has been earning their income for each year five years running with a level of effort, during each year, of their choosing, on a scale of 1 (doing next to nothing) to 4 (an 80-hr work week). At present each agent is at level 4. The lower the effort, the lower the probability that any agent will remain employed; but here we assume a binary function from both effort and ability such that, the higher the ability, the less downward effect the function regiments for probablility of employment. Unemployment means a productivity of zero, and with lowered effort comes lower productivity as well. An unemployed agent generates no income and hence no revenue by taxation. Currently the probability that a member of the trio will remain employed is .8; this probability, again, is a function of both effort and ability. As effort declines, enjoyment from non-compensatory activity increases.

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Suddenly there arises a cost for protecting the trio from an exogenous malicious agent **D** who desires to destroy the trio and the system in which this trio live, and will likely do so unless protection is purchased. If protection is put in place, the odds of **D**'s success is zero. The levying of an income tax that annually generates funds to purchase (successful) protection from **D** on an ongoing basis can be instituted; it must generate at least $60K/yr. What do you suggest as a rational, optimal ongoing income tax system?

Some Options (informal)

Consider a few simple calculations based on three different types of income-tax systems

Lump-sum tax:
60000/3 = 20000
What do you think?

Linear/Flat Tax:
Eg 10% => 2K + 8K + 20K; insufficient.
Eg 20% => 4K + 16K + 40K = 60K; sufficient.
Is this okay? What do you think?

Progressive tax scheme:
Eg:
Above 100K: 50%
50–100: 25%
20–49: 10%
0–19: 0%
Then: 2K + 20K + 100K = 122K

How about a progression leaving: 0K, 20K, 100K?
Or why not a progression leaving: 0K, 0K, 100K?
Or for that matter: 0K, 0K, 60K?

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Can you see a road forward to any full formalization and theorems, using formal logic?

NP-completeness

(*quickly* by example)

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But first brief interlude on *real* jobs in tax tech …

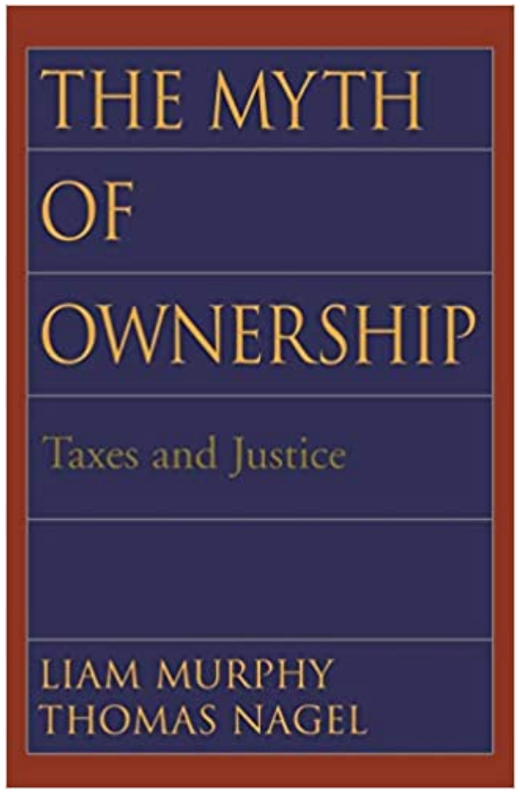
Alexander Bringsjord

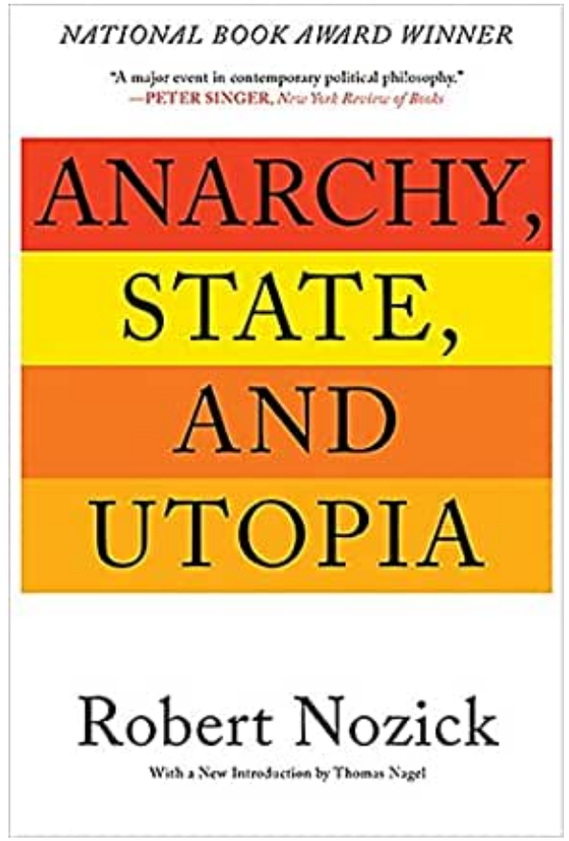
Senior Associate at PwC

So, taxation presents problems that are AI-complete, ethics-complete, and economics-complete? Really?

...

Ethics-completeness (shortcut)





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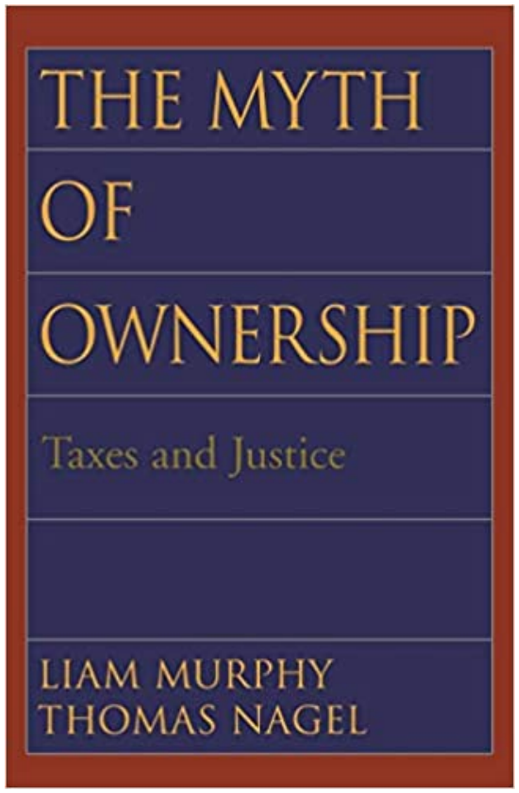

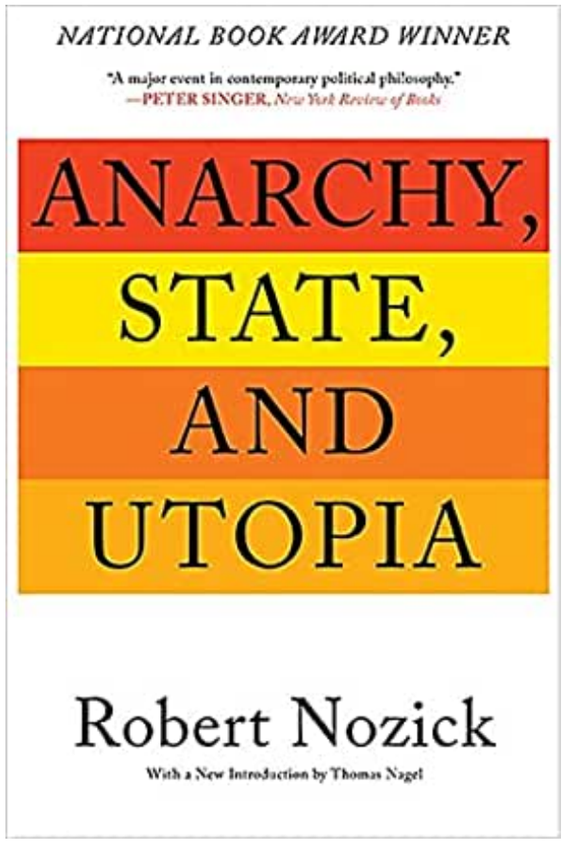

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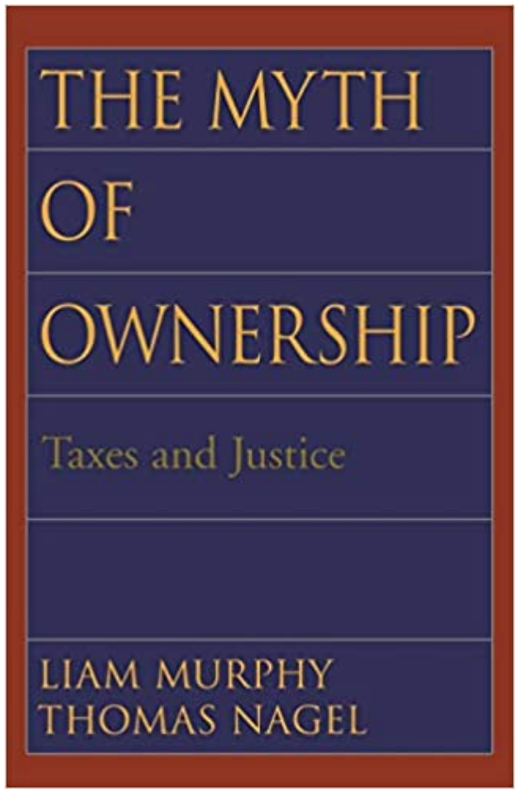

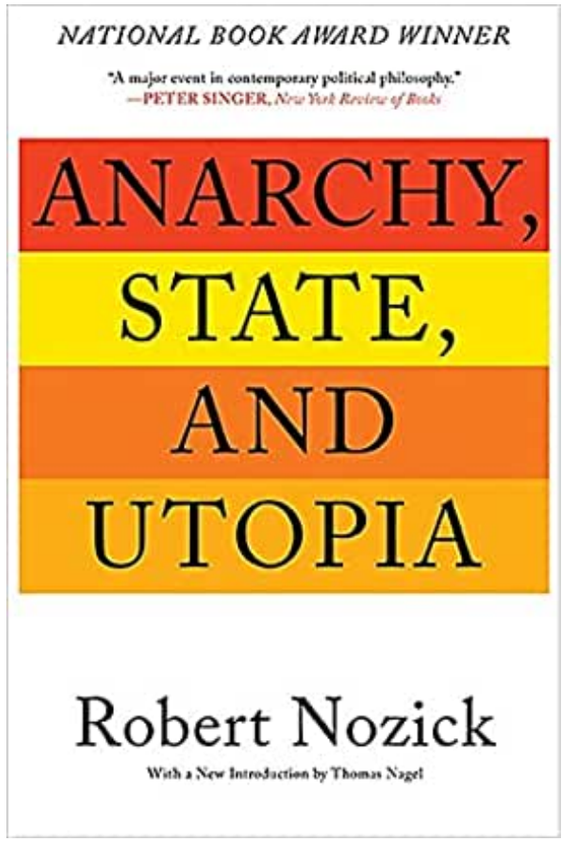

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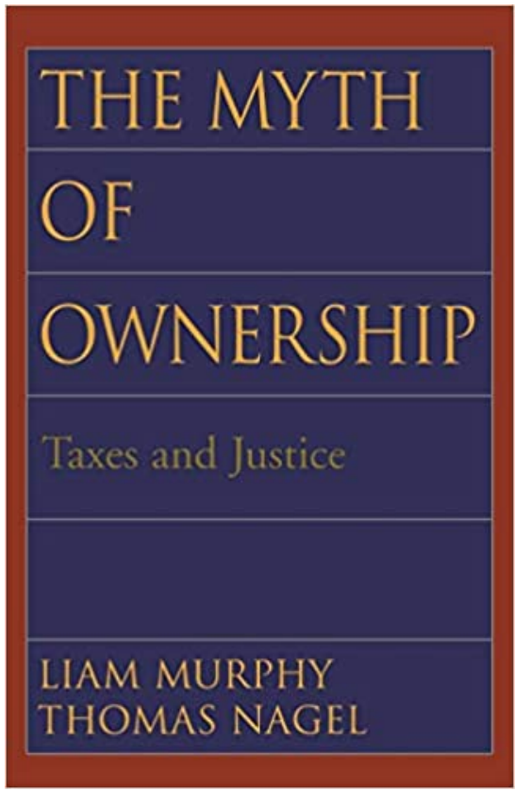

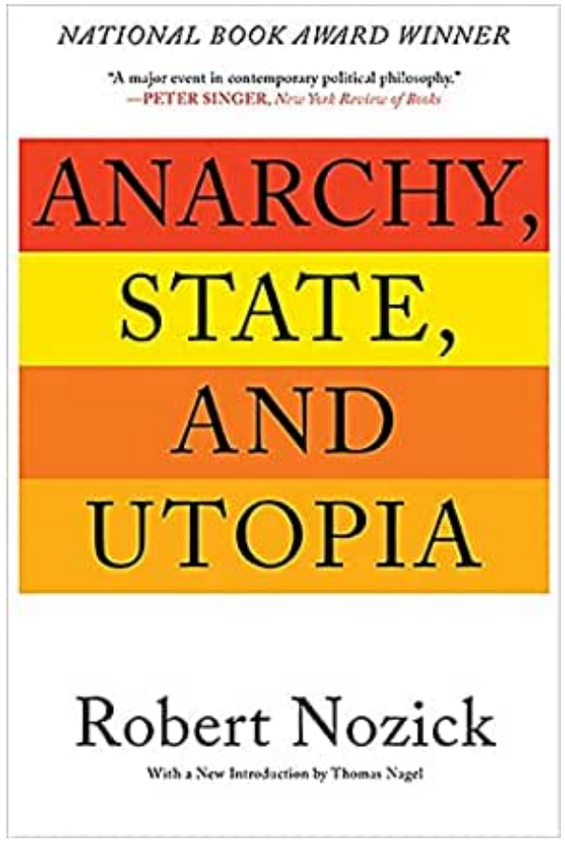

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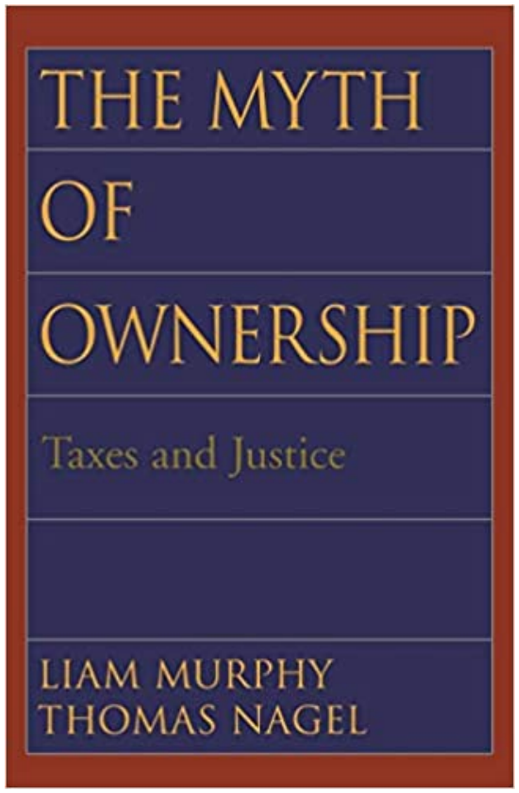

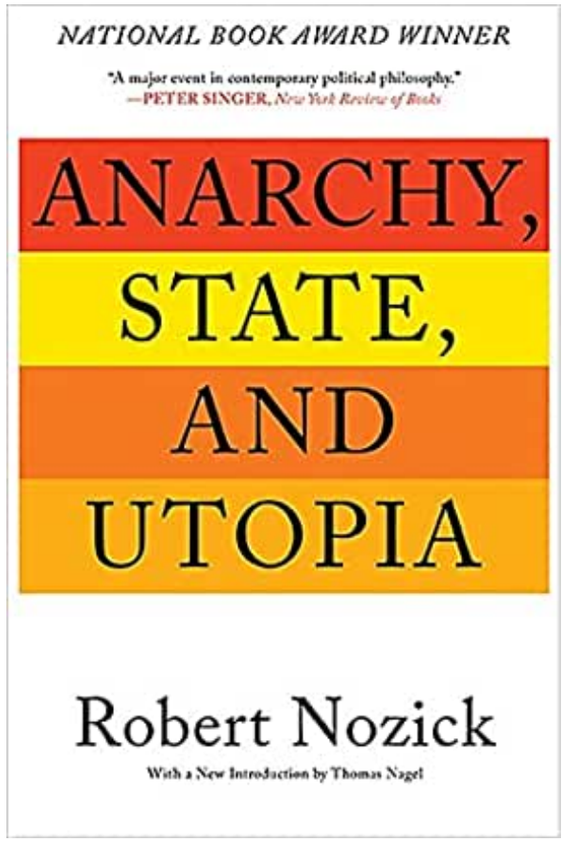

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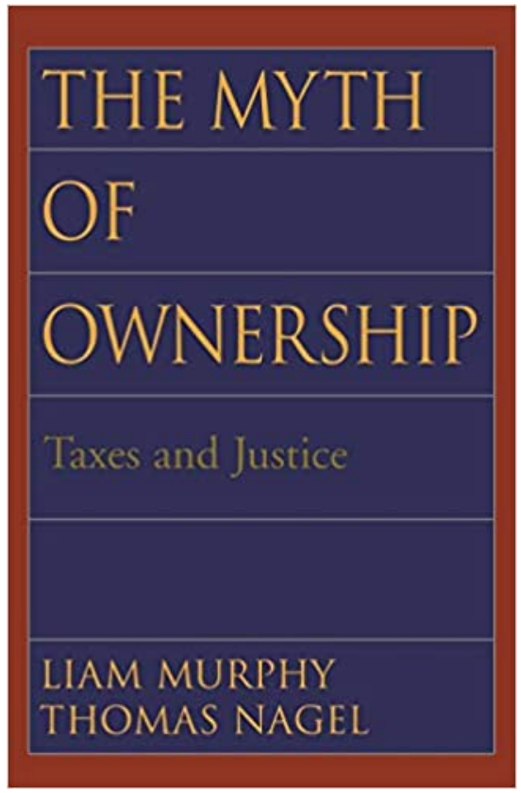

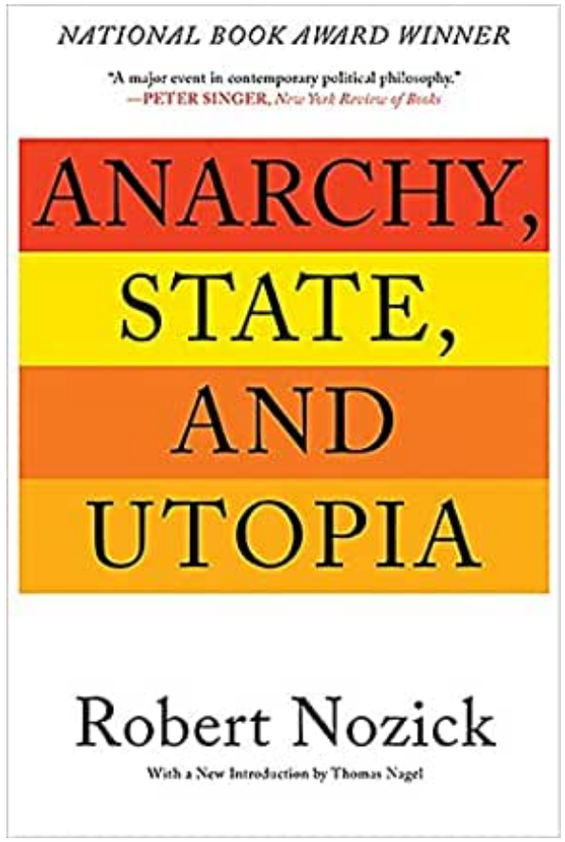

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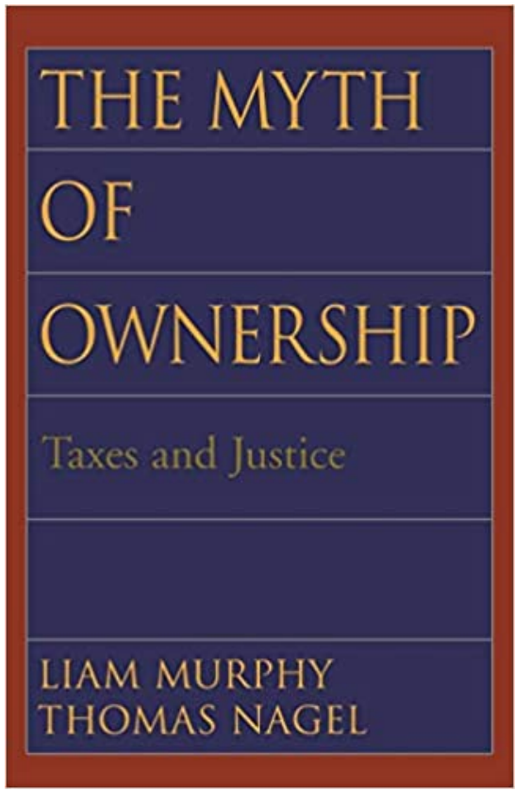

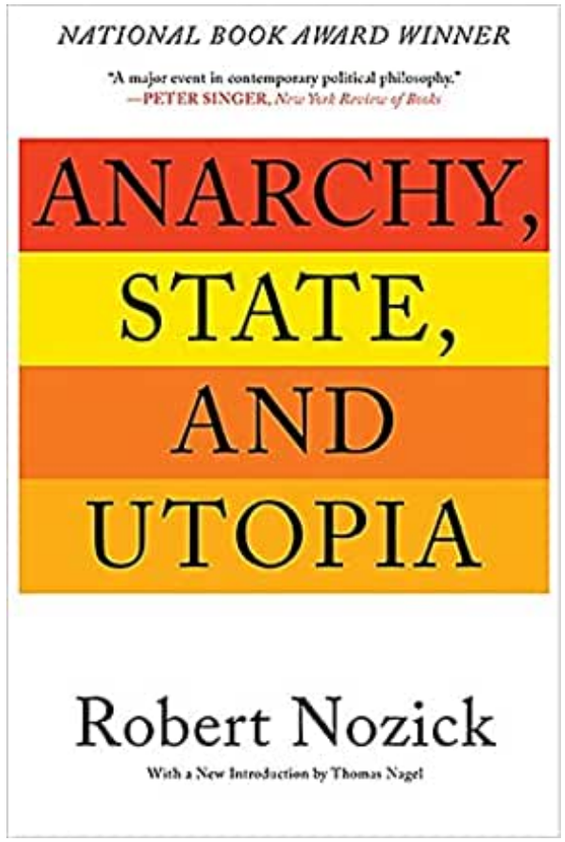

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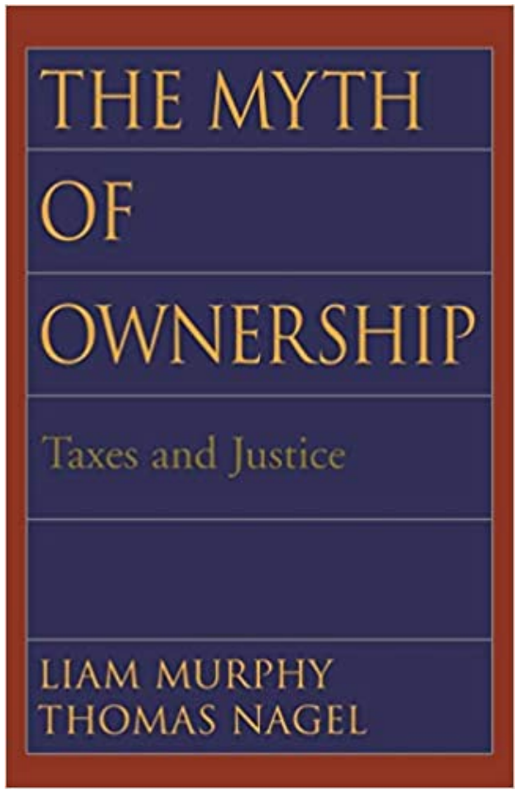

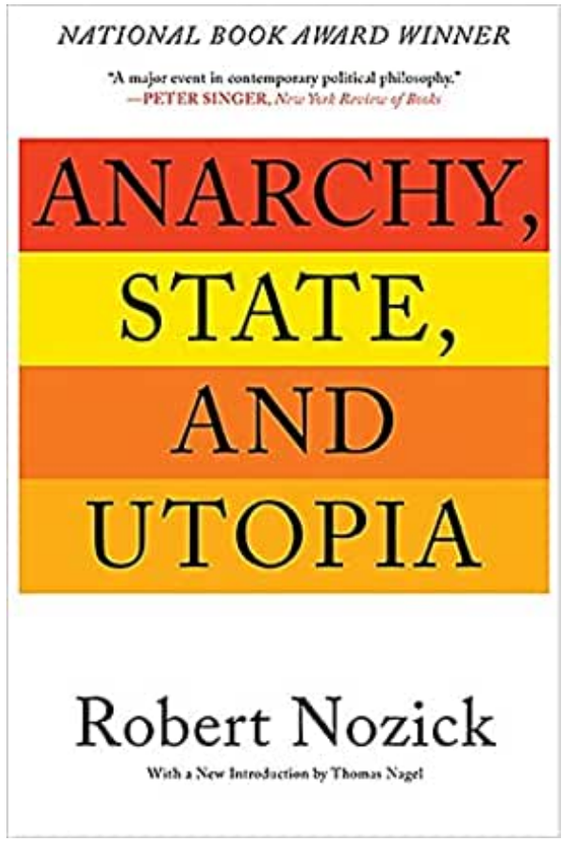

Since you don't own your pre-tax income (that you do is a myth), pretty much *any* level of income tax is ethically permissible.

Any level of taxation beyond a minimum required for Defense+ is the moral equivalent of forced labor.

But for IFLAI2 …

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> The original Mirrlees argument runs as follows. Suppose there is a positive marginal tax rate on the individual earning the top income in an economy, and suppose that income is *y*. The positive marginal tax rate has a discouraging effect on the individual's effort, generating an efficiency cost. If the marginal tax rate on that earner was reduced to zero for any income beyond *y*, then the same amount of revenue would be collected and the efficiency costs would be avoided. Thus, a positive marginal tax on the top earner cannot be optimal.

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Now a battle of AI simulations in the empirical realm?

Problem #1:

Engineer artificial agent to excel on CPA Exam, and provide proofs/justifications for answers!

What is the most likely opportunity for theft or fraud by employees?

- ◯ The belief that the theft is a common practice
- ◯ Needlessly complex transactions
- ◯ Access to assets that are easily traced
- ◯ Stock options that expire soon after the release of financial statements

3 / 24

CLOSE

Correct

Next Question

When transactions are complex, many individuals within the entity will not understand the intricacies and, as a result, it becomes easier to deceive others, creating an opportunity to commit fraud. Ineffective oversight by governance also creates an opportunity for individuals to commit fraud but does not provide an incentive. A belief that the theft is a common practice is a rationalization, not an opportunity. Access that are easily traced tend to result in apprehension and prosecution of the perpetrator of a theft, discouraging such theft. Stock options are due to expire shortly after financial statements are issued create an incentive to overstate results in order to increase the value of the options, but it does not provide an opportunity.

Problem #2:

Can the U.S. federal tax code (= IRC of 1986, as amended) by captured by some group Γ of formulae in some formal logic $\mathscr{L}$?

Problem #3:

Can an artificial agent able to create new and effective tax strategies to minimize tax bills be engineered?

Problem(s) #4:

Can an artificial agent automatically prove that some tax filing is illegal? Immoral? How about automatically proving that some tax code *itself* is immoral?!

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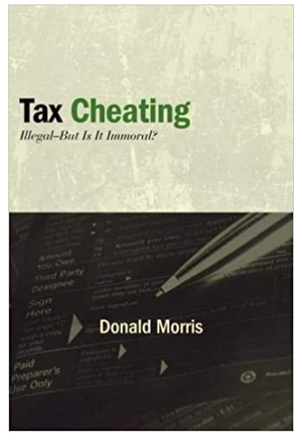

Returning now to S …

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- Paradigm: *Logicist Agent-based Economics* (LABE)
- Formalize S completely.
- Then, what theorems can be obtained re what tax frameworks are good or bad and in between?

Microsimulation

Orcutt's Vision, 50 years on

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October 2, 2007

Microsimulation

Microsimulation

Broadly defined, microsimulation is a methodology used in a large variety of scientific fields to simulate the states and behaviors of different *units* - e.g. individuals, households, firms - as they evolve in a given *environment* - a market, a state, an institution. Very often it is motivated by a policy interest, so that narrower definitions are generally provided. For instance, [Martini and Trivellato, 1997] define microsimulation models as

> computer programs that simulate aggregate and distributional effects of a policy, by implementing the provisions of the policy on a representative sample of individuals and families, and then summing up the results across individual units (p. 85).

MSM can answer relevant policy questions by handling simultaneously a large number of data, and calculating both individual and aggregate outcomes emerging from the *complex interaction* of several explanatory levels: the macro level, including e.g. demographic or labor market trends, the institutional level, including e.g. the tax and benefit system or a certain normative environment, and the micro level, including e.g. the characteristics, choices and actions of basic behavioral units such as households or firms.

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Are the models accurate?

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Microsimulation

2. Direct Taxation and Behavioural Microsimulation: A Review of Applications in Italy and Norway

Rolf Aaberge
Statistics Norway
Ugo Colombino
Turin University

2.1. Introduction

In this contribution we illustrate various applications of a behavioural microsimulation model that we have been developed during the last few years. Behavioural models are complex and costly tools to develop, use and maintain, but also very powerful ones as we wish to show through the examples that follow. In section 2.2 we present the main features of the microeconometric model. In section 2.3 we comment upon the labour supply elasticities implied by the estimates. In section 2.4 we illustrate a simulation of behavioural and welfare effects of some tax reform proposals. In section 2.5 we report on an exercise where we look for the optimal tax system. In section 2.6 we report on an ongoing project aimed at integrating the microeconometric model and a Computable General Equilibrium model. Lastly, in section 2.7, we show an out-of-sample test of the model, where we compare predictions of a model estimated on 1994 data to the observed effects of reform in 2001.

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Microsimulation

2. Direct Taxation and Behavioural Microsimulation: A Review of Applications in Italy and Norway

Rolf Aaberge
Statistics Norway
Ugo Colombino
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$$\begin{aligned} &\max_{h,w,j} U(C,h,z) \\ &s.t. \\ &C = f(wh,I) \\ &(h,w,z) \in B, \end{aligned} \tag{2.1}$$

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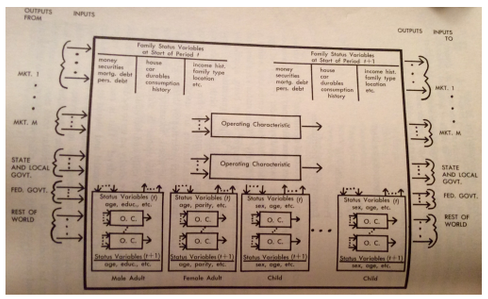

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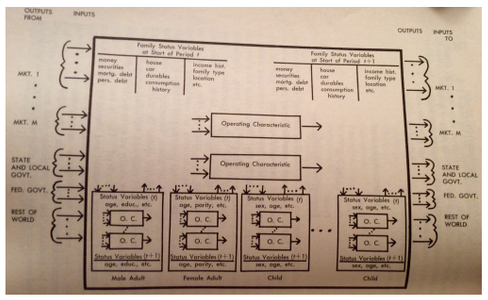

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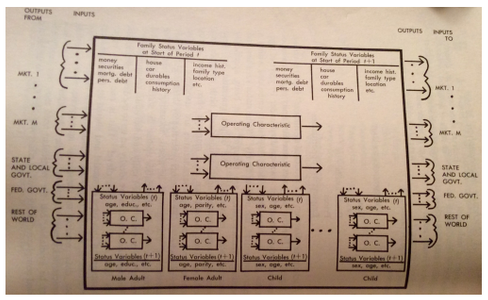

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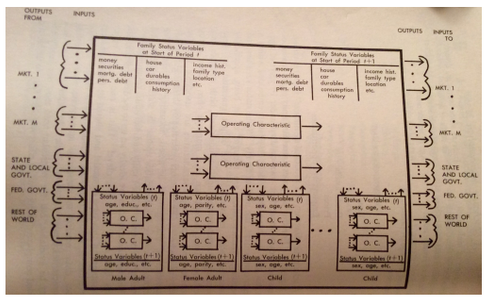

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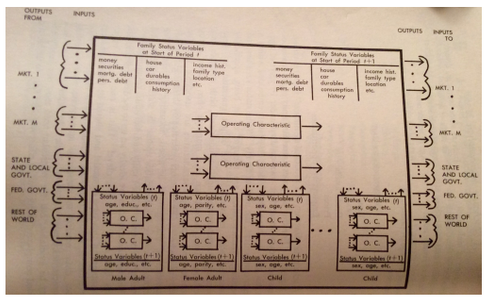

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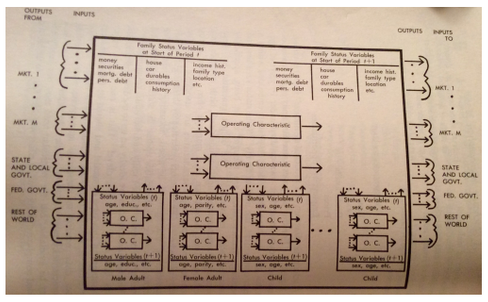

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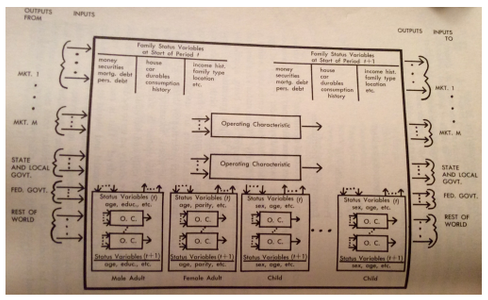

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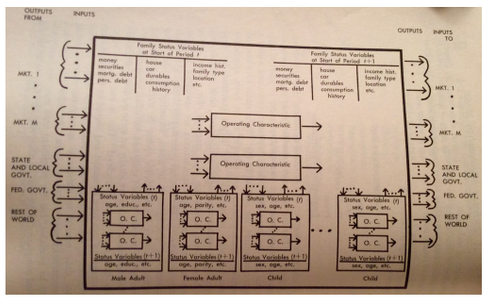

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Same Holds for Standard ABM

Agent-Based Modelling in Economics

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Published Online: 6 NOV 2015 10:15PM EST

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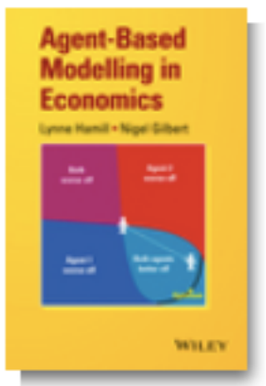

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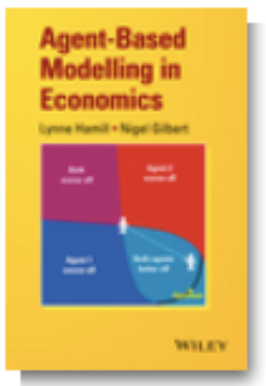

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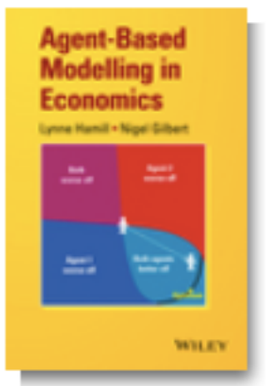

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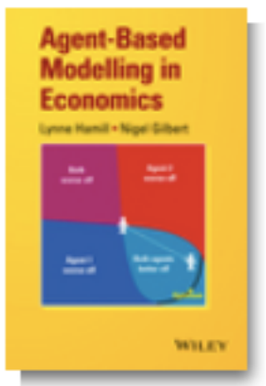

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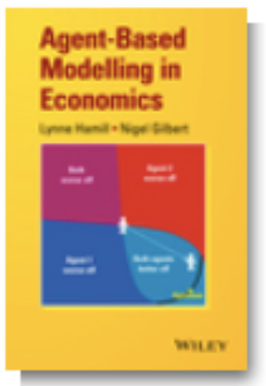

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Some Key Papers

Ramsey, F. (1927) "A Contribution to the Theory of Taxation" *The Economic Journal* **37.145**: 47–61.
https://eml.berkeley.edu/~saez/course131/Ramsey27.pdf

Mirrlees, J. (1971) "An Exploration in the Theory of Optimal Income Taxation" *Review of Economic Studies* **38**: 175–208.

"Optimal Taxation in Theory and Practice" by N. Gregory Mankiw, Matthew Weinzierl, and Danny Yagan.
https://scholar.harvard.edu/files/mankiw/files/optimal_taxation_in_theory.pdf

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