Economic Science
14.04 Intermediate Micro Theory: Lecture 1

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Motivation for the Class

1. Economic Science
2. Economies
3. Syllabus
Outline of the Science Part

- Frisch – economics as experiments, not simply measurement, prediction and policy
- Matzkin – econometrics, exogenous vs. endogenous, observable vs. unobservable, functions and distributions
- Angrist – randomized control trials vs. natural experiments
- Varian – big data, prediction vs. causal influence
- Lucas – models as (deliberately) artificial economies, the role of computation
Economics as Experiments

Ragnar Frisch opened his 1926 article “On a Problem in Pure Economics” with the following statement:

“Intermediate between mathematics, statistics, and economics... Econometrics has as its aim to subject abstract laws of theoretical political economy or “pure” economics to experimental and numerical verification, and thus to turn pure economics, as far as possible, into a science in the strict sense of the word.”

The examples given illustrate the authors’ scientific “strategy,” in which measurement and observation precede, and are largely independent of, any attempts toward the explanation of economic fluctuations.

However, I believe and will assume for the purpose of this discussion, that more is meant, namely, a genuine explanation of economic fluctuations, i.e., an explanation in which only extra-economic phenomena are accepted as “data” without further inquiry, all relevant economic phenomena being subject to explanation in terms of assumed behavior patterns of men in a given institutional and technological environment.

I am not sure whether a still further objective is included, which extrapolates the idea of explanation: the prediction, within the narrowest attainable limits of error, of the effects of stated hypothetical measures of economic policy on the level and movements of economic variables. However, I feel that such prediction is actually the most important objective of the analysis of economic fluctuations.
“The description of an economic model typically starts out by describing the economic agents involved, their objective functions, their information, and the interactions among the agents. When an econometrician tries to fit an economic model to the available data, he first needs to determine which of the variables in the model are observable and which are unobservable.”

Another important division of the variables in the model is between the variables that are determined outside of the model and those that are determined inside the model. The variables in the latter set are functions of the variables in the former set. In economic models, they are typically determined either by the choice of some agents or by the interaction among several agents.

The description of an economic model contains, as well, a list of functions and distributions. Some of these functions and distributions are primitive, in the sense that they are determined outside the model. Some are derived within the model.”
For example, Fehr and Goette (2007) randomized the pay of bicycle messengers, offering one group and then another a temporarily higher wage. This cleverly designed study shows how wages affect labor supply in an environment where lifetime wealth is unchanged. The result is dramatic and convincing: holding wealth constant, workers shift hours into high-wage periods, with an implied intertemporal substitution elasticity of about unity.

But experiments are time consuming, expensive, and may not always be practical.

However, human institutions or the forces of nature can step into the breach with informative natural or quasi-experiments. For example, in an influential paper, Card (1990a) used the Mariel boatlift from Cuba to Florida, when Cuban émigré’s increased Miami’s labor force by about 7 percent in a period of three months, as a natural experiment to study immigration.
More recently, paralleling the Moving to Opportunity experimental research agenda, Jacob (2004) studied the causal effects of public housing on housing project residents by exploiting the fact that public housing demolition in Chicago was scheduled in a manner unrelated to the characteristics of the projects and their residents.

Encouragingly, the recent financial crisis has spurred an effort to produce credible evidence on questions related to banking.
Machine learning specialists are often primarily concerned with developing high-performance computer systems that can provide useful predictions in the presence of challenging computational constraints. Data science, a somewhat newer term, is concerned with both prediction and summarization, but also with data manipulation, visualization, and other similar tasks.

However, the most important area for collaboration involves causal inference. ...Machine learning work has, for the most part, dealt with pure prediction. As economists know well there is a big difference between correlation and causation. A classic example: there are often more police in precincts with high crime, but that does not imply that increasing the number of police in a precinct would increase crime.

As Rubin [1974] and many subsequent authors have emphasized, when we want to estimate the causal impact of some treatment we need to compare the outcome with the intervention to what would have happened without the intervention. But this counterfactual cannot be observed, so it must be predicted by some model.
One of the functions of theoretical economics is to provide fully articulated, artificial economic systems that can serve as laboratories in which policies that would be prohibitively expensive to experiment with in actual economies can be tested out at much lower cost.

To serve this function well, it is essential that the artificial “model” economy be distinguished as sharply as possible in discussion from actual economies.

Insofar as there is confusion between statements of opinion as to the way we believe actual economies would react to particular policies and statements of verifiable fact as to how the model will react, the theory is not being effectively used to help us see which opinions about the behavior of actual economies are accurate and which are not.
Of these forces the most important, I believe [...] consists of purely technical developments that enlarge our abilities to construct analogue economies.

Here I would include both improvements in mathematical methods and improvements in computational capacity.

The neglect in traditional history of doctrine of this force for change in our thinking is a serious omission, and contributes to the common but mistaken sense that everything has been said before or “it’s all in Marshall.”
Economies (Townsend 1988) - I

- The first economy: Is a village economy consisting of about 300 households, each of whom can grow wheat, ploughs and oxen, seed, and of course land. But the land of each household is not consolidated. Rather, it is spread out over the arable fields of the village into long narrow strips, typically 30 acres into 30-60 strips.

- The second economy: Households grow rice in paddies but land is not scattered. Thus, if monsoon rains are abundant, households with mostly low lying lands do poorly relative to households with land on a rise, and conversely in a dry year. All households are obliged to transfer a pre-specified amount of their crop to the local temple. Then, households with relatively low crops are entitled to request an allotment from temple stocks, and repayment is contingent upon subsequent high yields. No borrowing and lending is observed.

- The third economy: Consists of a set of villages, separated from one another on a plain by distance and in some instances by rivers, valleys, and other topographical features. Each village specializes in the production of a distinct good, e.g., baskets, earthenware, textiles from a local fibre, vegetables, tools such as machetes, and so on, producing much of that good and relatively little of the others. But each village does value at least some of the commodities it does not produce. Trade occurs periodically in a series of regional markets. Trade is characterized by monetary exchange in spatially separated, regional markets.
The fourth economy: When traders meet periodically in spatially separated regional markets, they are observed to give up produced goods in return for promissory paper notes, IOU’s setting the time and place of future repayment. These notes are observed to circulate among village residents and to be used in exchange in the various regional markets.

The fifth economy village is located on an island, and the set of islands forms something of a circle. Typically, residents of each island embark periodically in canoes on trading expeditions, travelling either clockwise or counterclockwise to the island of their nearest neighbour. If travelling clockwise, residents of the first island give up their cargo as gifts to neighbouring islanders in a series of elaborate ceremonies, and receive in turn as gifts distinctive white shell armbands. If travelling counterclockwise residents of the first island receive distinctive red shell necklaces. The armbands and necklaces are reserved entirely for this ceremony. An unrequited gift of cargo is rarely observed.
Villages as Metaphor

- Lucas Trees! Trees as real and financial assets bearing fruit as dividends
- Paper IOU’s – US repo market
- Seashells as in last economy: Bitcoin, colored coins
Bitcoin, Blockchain, and Distributed Ledgers

- From BIS (2017): Definition of distributed ledger
  - Distributed Ledger Technologies (DLT) refers to the processes and related technologies that enable nodes in a network (or arrangement) to securely propose, validate, and record state changes (or updates) to a synchronized ledger that is distributed across the network’s nodes

- From Iansiti and Lakhani (2017)
  - “Contracts, transactions, and the records of them are among the defining structures in our economic, legal, and political systems…. And yet these critical tools and the bureaucracies formed to manage them have not kept up with the economy’s digital transformation. They’re like a rush-hour gridlock trapping a Formula 1 race car…. With blockchain, we can imagine a world in which contracts are embedded in digital code and stored in transparent, shared databases, where they are protected from deletion, tampering, and revision.”
Beware of the controversy about coins and ledgers

- Satoshi Nakamoto: “What is needed is an electronic payment system based on cryptographic proof instead of trust, allowing any two willing parties to transact directly with each other without the need for a trusted third party”
- BIS (2018): “Decentralized technology of cryptocurrencies, however sophisticated, is a poor substitute for the solid institutional backing of money”
- Denison, Lee, and Martin (2016): People do trust third parties, both central banks that provide currency and reserves and (derivative) payments systems run by the named and trusted institutions that maintain the ledgers and operating systems. Trustless, expensive decentralized systems . . . are not needed.
- Many DLT platforms disintermediate key services that banks provide, including payments, clearance and settlement, securities, loans and credit
**14.04 INTERMEDIATE MICROECONOMIC THEORY**  
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**READING LIST AND LECTURE CONTENT**

**A Brief Guide to this Reading List**

Required readings are marked by an asterisk (*). Most readings can be found on the Stellar course website. We use the following acronyms and shorthand:


**Lectures 1-4, Introduction: Motivation for the Course, Basics for Studying Real Economies**


Ragnar Frisch (1926) "On a Problem in Pure Economics: Translated by JS Chipman." Preferences, Utility, and Demand: A Minnesota Symposium. 1926."


*Medville, Chapter 1 “Introduction” *

*Emerging Thailand: The Spirit of Small Enterprise
[https://www.youtube.com/watch?v=b_rEmiu71Pk](https://www.youtube.com/watch?v=b_rEmiu71Pk)


Lecture 3: Consumer Choice: Consumption Set, Rational Preferences, Utility Functions, Some Properties of Preferences, Indifference Curves, Marginal Rates of Substitution, Example Indifference Curves and Functions; Application: Utility Maximization subject to Budget,
first order conditions, Major Method: General Constrained Optimization and Lagrangian Programs. Cobb-Douglas and expenditure shares

*Kreps Appendix A “Constrained Optimization”

*NS Chapter 3 “Preferences and Utility”

*NS Chapter 4 “Utility Maximization”

Lecture 4: Technology, Production Possibilities Sets and Properties, Returns to Scale, Aggregation over Production Sets; Major Application: Profit Maximization, Properties of Profit function, Hotelling Lemma, Isoquants, Cost Minimization and properties of cost curves; Method: Envelope Theorem. Illustrative example of basics onto modern systems: Input/Output and Google Search

*Kreps 7 “The Neoclassical Firm”

Lectures 5-9, Pareto Optimality; Risk Sharing and Dynamics; Application to Village Economies; Social Networks and Supply Chains in Villages and in the US and Japan

Lecture 5: Pareto Optimal Allocations and Model Prediction: Pareto Optimality, Pareto Dominance and Pareto Set, Utility Possibilities Frontier, Welfare function and a Programming Problem for determination of Optimal Allocations; Method: Separating Hyperplanes and theorems; Leading Example: Uncertainty and example in state space of the optimal allocation of risk with implications for data

*Kreps 5.1-4 (up to and including “the production and allocation of private goods”)

Lecture 6: Risk sharing: Village India with ex post consumption and income data, ex ante Land Division in the Medieval Village Economy

*NS Chapter 8 “Expected Utility and Risk Aversion”

*Townsend, R.M. “Risk and insurance in village India.” *Econometrica*, 62(3), 539-591

Medville, Chapter 2 “Uncertainty and Land-holding Patterns”

Lecture 7: Dynamic Optimization—Application: Storage, Seed and Starvation in Medieval Villages; Methods: Dynamic Programming, Value Functions

*Varian 19.1-3 “Time”
*Medville Chapter 3 “Storage as Risk Reduction”

Lecture 8: Risk Sharing Applications, continued: in Thai Villages, Risk and Return in Production Choice, using data on production and consumption, Idiosyncratic and aggregate risk; the Role of Gifts, Social Networks and the Transmission of Shocks in Villages: Informal Networks in US city neighborhoods, Fukushima Shock and Supply Chains in Japan


Lectures 10-11, Private Information, Contracts, Mechanism Design

Lecture 10: Contracts and Mechanism Design, Concepts and Methods: Motivation from rents and spatially scattered Medieval estates; the Revelation Principle, Optimal Multi-period Contracts and Inter-temporal Tie-ins, Costly State Verification and Audits; the Space of Lotteries, Smart Contracts on Distributed Ledgers, Implementation of Mechanism Design

*Medville, Chapter 5 “Rentals with Unobserved Outputs”

DLT: Section on “Contract theory and smart contracts: Mechanism design”

Lecture 11: Contracts and Mechanism Design continued, Applications: occupation choice and business starts, distinguishing obstacles (limited commitment versus moral hazard), rural versus urban Thailand and a battery of tests across information/financial regimes, linear programs to compute solutions to models and maximum likelihood for estimation in data


Lectures 12-13, Walrasian Equilibrium As Prediction; Application to International Trade, Tariffs, Real and Financial Liberalization


*Kreps 6.1 “Pure Exchange and Price Equilibrium”

*MWG 15.D, “The 2 X 2 Production Model”

Lecture 13: Creating village, regional and national income and product accounts, GDP and NI-PA; Flow of funds and balance of payments; Openness and prices in regional Thailand; Model of a small open economy with obstacles to trade, Calibration of the Model, Model-predicted and actual data compared at both village-level and individual-level; parallels for US economy: state-level trade and financial flows and impact of the China shock in the US


Lectures 14-16, Prediction with Alternative Concepts, Core and Nash Bargaining; the Fundamental Welfare Theorems and Market Failures, and Contract Theory in Extended Commodity Spaces

Lecture 14: Model Prediction Continued: Core, Nash Bargaining; inter-relationships among Pareto Optima, Core, Nash Bargaining and Walrasian Equilbrium, equivalence or lack thereof; N-replication economies, finite and continuum agent economies; Applications: the core in industrial organization and an example of non-existence, Nash bargaining in Thai villages

Telser, Lester G. “The Usefulness of Core Theory in Economics” *Journal of Economic Perspectives*, Volume 8 (2) – May 1, 1994


Lecture 15: Fundamental Welfare Theorems: Competitive equilibria are Pareto optimal; any Pareto Optimum can be supported as equilibrium with Transfers; Sufficient Assumption and proofs, with first order conditions and with supporting hyperplanes; finite dimensional Euclidean Space and extension to Valuation Equilibria in more general spaces

*Kreps 6.3 “The Efficiency of a General Equilibrium”


Lecture 16: Welfare Theorems in Extended Commodity Space—Application to incentive constrained contracts; the space of lotteries; welfare theorems extensions and qualifications


Lectures 17-18, Existence of Equilibria: Walras, Nash and Applications

Lecture 17: Existence of Competitive Equilibria: Fixed Point Theorems, Negishi Algorithm Using second welfare theorem, Gross Substitutes, Recent Computer Science Contributions

*Kreps 6.4 “Existence and The Number of Equilibria”


Lecture 18: Existence of Nash Equilibria: Nash equilibria in Mixed Strategies; Application to Financial Markets


Asu Ozdaglar’s Lecture material from Course 6.254. “Existence of a Nash equilibrium”


**Lectures 19-21, Microeconomics and Macro Aggregation, Theory and Data; Welfare Statements, Identification and Falsification**

Lecture 19: Consumer Behavior, Demand Functions, Homogeneity, Income and Substitute Effects, Engle Curves and Giffin Goods, Compensated (Hicks) and Uncompensated (Marshall) Demands, a first look at the Slutsky Equation, indirect utility and the expenditure function, Duality of Utility Maximization and Expenditure Minimization, properties of the expenditure function and Hicksian demand

*NS Chapter 5 “Income and Substitution Effects”


Lecture 20: Gorman Aggregation, the positive and normative representative consumer for prediction and welfare respectively, indirect utility and properties, Roy’s identity, Gorman Polar forms, Linear expansion paths and data, critical review of traditional and new founda-
Lectures 21-23, Failures of the Welfare Theorems and Some Market Structure Remedies

Lecture 22: Failure of the Second Welfare Theorem – Nonconvexity; Failure of the First Welfare Theorem - Local Satiation, Pollution but Fixed with Markets in Rights, Externalities generally, rights for assignment to others, Infinite Horizon and Infinite wealth


Lectures 24, Bitcoin, Blockchain, and Distributed Ledgers

Lecture 24: Bitcoin Values, Overlapping Generations and Bubbles, Lessons from Monetary Theory, Efficiency questions, is the bubble large enough in actual economies, the value of money as from cash-in-advance, removing indeterminacy in practice, a fin tech application in Southeast Asia, Commitment and a Digital Reserve Bank, activist monetary and token policy
DLT, Section on “Token Valuation”


