

14.04 INTERMEDIATE MICROECONOMIC THEORY

FALL 2022

TUE/THU 2:30-4PM, E51-372

Instructor: Robert Townsend, rtownsen@mit.edu

TA: Basil Halperin, basilh@mit.edu

Hours

Lecture: Tuesday and Thursday 2:30-4:00pm

Recitation: Fridays 3-4:00pm, E51-372

Prof. Townsend office hours: Thursday after class, 4:10-5:00pm

TA Basil Halperin office hours: Monday, 2-3pm, E52-516 [to be confirmed]

Overview

This course provides an introduction to theory and data designed to meet the needs of students interested in economic science. It provides an introduction to consumer choice, the theory of the firm and general equilibrium models, with an overview of the main results and tools used in these subjects, both directly and indirectly as used in a variety of fields. This includes analysis of consumer and producer decisions, partial and general equilibrium analysis, insurance, the welfare theorems and failures of these theorems as with externalities but with resolutions, contract theory and mechanism design, policy analysis, the content of theory for data, and the design of media of exchange as with Bitcoin and Central Bank Digital Currency and e-markets made possible by distributed ledgers.

If you have had an economics class before, you're probably used to the following drill: learn some theory; if time permits, consider some stylized evidence that may or may not test the theory; repeat. That is not what we will be doing in 14.04. The purpose of theory is to help us to think about how the world actually works. We are going to test various theories and learn from these tests, both when the data confirm the theory and when they reject it. John Maynard Keynes wrote: "Economics is a science of thinking in terms of models, joined to the art of choosing models which are relevant."

The Econometric Society and the Cowles Foundation framed economics as a science running in the laboratory of model economies. So, we are interested in inference, how do we measure, how do we estimate models, how to make welfare statements for actual policies as implemented and for counterfactual policies which might be undertaken.

In sum the class is organized around two intertwined themes:

1. Economic theory: what does it predict, and in what ways is it useful?
2. Empirical applications: Economic theory is a way of organizing facts and interpreting patterns in the world. This class will use data to test theory and use theory to interpret data.

Prerequisites

This is an intermediate course in microeconomic theory and its application to real world phenomena and policy problems. The class assumes proficiency with economic theory at the 14.01 level as well as multivariate calculus. It is also quite helpful if you have taken some linear algebra, statistics, or econometrics and are somewhat familiar with basic notions of algorithms and computing, but for those who are not familiar with these additional tools, the TA will provide a primer or fill in gaps for this material.

Class attendance and pre-recorded lectures

Attendance

14.04 is not a by-the-book micro-theory class. A significant portion of the class will focus on applications from empirical and theoretical papers, often combined. It will be difficult to master this material unless you attend both the lectures and recitations in person. Some lecture material will be posted online, in advance of class, and this is required reading for questions and discussion in class. More specifically:

Pre-recorded lectures

Class lectures have been pre-recorded. With the exception of the first class, we ask that students watch these recordings in advance and come to class prepared to participate in discussion of the content of the lecture.

Review sheets and class discussion

For each pre-recorded lecture, there is an associated review sheet with 10-20 related questions. During class time, we will go through these questions, asking for answers and class participation. As we go, we will review the corresponding lecture material. As discussed below, class participation is 20% of your grade and is highly encouraged.

Laptop/tablet/phone use during class

I strongly discourage you against texting, tweeting, emailing, blogging, posting, browsing, Instagramming, Googling, shopping, etc., during class. It wastes your class time—since you won't learn anything during lecture if you're distracted. I'm sympathetic to your desire to use your laptop or tablet to view the online lecture notes and take notes of your own. I would encourage you instead to print out the online lecture notes the night before class, and to write your notes directly on the paper lecture notes. In my experience, it's still faster and more accurate to take notes in class using paper and pen than to mark up a PDF file on your device.

Piazza

We will be using Piazza for class discussion. The system is highly catered to getting you help fast and efficiently from classmates, the TA, and myself. Rather than emailing questions to the teaching staff, we encourage you to post your questions. We also encourage you to help other students on Piazza. However, **do not** post any problem set solutions on Piazza.

Find our class signup link at: <https://piazza.com/mit/fall2022/1404>. The access code is: mit1404.

Grading

The class is not graded on a curve. It's possible for everyone to do well, and I'd be happy to have

a reason to assign mostly A's. If I assess that your performance in the class is of concern (C or lower), I will try to warn you before the drop date.

Here are the grading mechanics:

- Best four out of five problem set grades: 20%
- Three exams: 60%
- Course in-class participation: 20%

Problem sets (20%):

I will assign five problem sets. Problem sets typically include a set of pure theory questions and a set of application questions, often based on readings.

- Late problem sets will not be accepted. No exceptions.
- In order to accommodate unanticipated events, illness, or conflicts in your schedule, I will automatically drop the problem set with the lowest score (for example, the one that you don't hand in).
- You may collaborate with other students on problem sets, but you must write up all solutions independently and in your own words. If you submit a problem set that is a direct copy of another student's, or is found online, this will be considered academic dishonesty and will be dealt with accordingly.

We will use Gradescope to submit and grade problem sets:

- You can access our Gradescope page by clicking on "Gradescope" in the sidebar of Canvas and/or by going to <https://gradescope.com>.
- The entry code is PXWXZ6.
- Instructions on how to submit to Gradescope can be found [here](#), if you are unfamiliar.

If you are stuck on a question, feel free to see the TA during office hours or reach out on Piazza. We will do our best to point you in the right direction, but we will not fully answer the question for you. This is to ensure that you have adequate opportunity to master the material. After the problem set has been graded and handed back we are happy to go over solutions with you if they are still unclear.

Three exams (20% each, 60% total)

There will be two exams of 80 minutes in length. There will also be a final exam during the finals period. You will have 120 minutes to complete the final. You should have extra time to help you to relax. It will count the same as each of the prior two exams, so in terms of overall scores, it is counted as a third midterm. The date of the final exam is set by the MIT Registrar's office, which strategically withholds announcing the exam dates until late in the semester so that you cannot pick your classes based on final exam schedules. Each exam will tend to focus on the new material since the previous exam, although of course you will need to understand the older material to apply the new material. The final will be comprehensive, from the beginning of the class, as the material is cumulative. This is a good time to review the course material. The exams will be based on the lecture notes, review sheets, problem sets, assigned readings, classroom discussion and TA sessions.

Performance on exams is highly correlated with performance on problem sets. If you miss an

exam for an excused reason, I will offer an oral exam on a whiteboard online. Students typically find oral exams painful.

Course participation (20%)

You are expected to participate in this course quite actively, in class and ideally also on Piazza. Please ask questions to make sure you understand the lecture materials. Piazza participation is encouraged for all students. You are strongly encouraged to not only ask questions on Piazza, but also to provide helpful answers to the questions of your classmates. Course participation counts for 20%, from past experience this component has a lot of variation across students and matters significantly for final grades.

Study groups

You are encouraged to form study groups. Discussing the course materials with other students is helpful in your learning process. If you are looking for a study group, please post here:

<https://piazza.com/class/16usf4eku6arf/post/5>.

Questions regarding grading

Questions on grading should go first to the TA. Your TA must receive questions on exam or p-set grades no more than one week after the assignment/p-set has been handed back. To have the grading reconsidered, take the following steps:

- 1) Email the material to the TA along with a note describing specifically what you believe the problem to be. (Make a copy of your note and the problem set/exam for your own safekeeping.)
- 2) After the TA has contacted you by email, schedule a meeting to discuss the question.

This procedure is designed to facilitate fair and consistent grading. Please note that regrade requests for problem sets and exams should be submitted only for obvious grading errors (e.g. adding up points incorrectly, failing to see a correctly answered question, etc.) We are very unlikely to honor requests of the form “I think I deserve more points on this question because...” Furthermore, note that if you do request a regrade, we reserve the right to regrade your entire problem set or exam. Therefore, your final grade may increase or decrease as a result of the regrade request.

Getting help outside of class

If you have questions on the class material or problem sets, there are four ways to get help:

1. Use Piazza. We'll have threaded discussions there (monitored by the TA and professor as needed) for all problem sets and class topics. You should get a pretty quick response—and a good answer.
2. Drop in during TA office hours.
3. Drop in during Prof. Townsend's office hours.
4. Ask question during recitation (and in class as appropriate).

Please do not send us your class-related questions by email (except for personal class-related matters). Piazza is a more efficient way for us to communicate with you, and it is also benefits

your classmates. If you email class related questions to us, we may respond, but we will be irritated.

Schedule

Class topics and readings are subject to revision. It is possible that some topics and readings will be dropped if time runs short.

Textbooks

All class readings including relevant textbook chapters will be available on the class website. The four books listed at the top of the reading list will also be on reserve in the MIT library.

Required readings

Each lecture has an associated set of readings listed on the class schedule. These readings will be featured in lectures, exams and problem sets. If a reading is marked required, with *, you are responsible for it. For professional papers as opposed to textbook chapters, here are some guidelines:

- a) What is the paper's research question?
- b) What methodology is used to answer the question (e.g., an experiment, a quasi-experiment, a set of correlations, etc.)?
- c) What are the key findings?
- d) What is the economic interpretation of these findings?

Each lecture also comes with a Review Sheet set of questions, which is posted in advance of class. This is also required and indeed necessary to prepare for in-class Q/A sessions as we review the material.

Recommended readings

You will find a number of recommended readings on the syllabus for your education and entertainment. These papers should be useful—and in many cases fun—and can be raised for discussion on Piazza -- but if the papers are not marked with a *, then you will not be tested on their content.

Reporting bias-related or other incidents

The Economics Department fully endorses the Institute Discrimination and Harassment Response Office (IDHR) reporting process for any bias-related incident. We encourage students to use this valuable resource if needed for any reason. This process is useful for addressing any issues that may arise with professors, teaching assistants, or other students in this course. If you've had a negative experience and are not sure if IDHR is the place to go, they can also help you find the right office at MIT to receive support. The department values such reports as important to our pursuit of equitable and inclusive treatment for all students, faculty, and staff. <https://idhr.mit.edu/submitincidentreport>

Accessibility and support

The Economics Department values an inclusive environment. If you need a disability accommodation to access this course, please communicate with us early in the semester. If you

have your accommodation letter, please meet with the faculty so that we can understand your needs and implement your approved accommodations. If you have not yet been approved for accommodations, please contact Student Disability Services at <uaap-sds@mit.edu> to learn about their procedures. We encourage you to do so early in the term to allow sufficient time for implementation of services/accommodations that you may need.

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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 Canvas course website. We use the following acronyms and shorthand:

Kreps: Kreps, David M. 1990. *A Course in Microeconomic Theory*. Princeton: Princeton University Press

Medville: Townsend, Robert M. 1993. *The Medieval Village Economy: A Study of the Pareto Mapping in General Equilibrium Models*. Princeton: Princeton University Press.

MWG: Mas-Colell, A., Whinston, M. D., & Green, J. R. (1995). *Microeconomic theory*.

NS: Nicholson, W., and C.M. Snyder. 2016. *Microeconomic Theory: Basic Principles and Extensions*. Boston: Cengage Learning.

Varian: Varian, Hal. 1992. *Microeconomic Analysis*. Third Edition. New York: Norton.

DLT: Townsend, Robert. 2019. *Distributed Ledgers: Design and Regulation of Financial Infrastructure and Payment Systems*. Cambridge: MIT Press.

Lectures 1 Introduction: Motivation for the Course

Lecture 1 – Economics Science: Motivation and Objectives of the Course: Economics as Experiments, Models as Fully Articulated Systems or Labs, RCT's versus Natural Experiments, Prediction and Validation, Actual and Counterfactual Policy and Welfare, Theory and Measurement Unified, Big Data, Computation, Villages Economies Real and as Metaphors for Modern Systems, Bitcoin/Blockchain/Distributed Ledgers, A list of Economies to be Studied and Economies in the Language of General Equilibrium Environments, Review of the Reading List

*Koopmans, T., 1947. "Measurement without theory." *The Review of Economics and Statistics*, 29(3): 161-172.

*Medville, Chapter 1 "Introduction"

*Emerging Thailand: The Spirit of Small Enterprise

https://www.youtube.com/watch?v=b_rEmiu71Pk

Varian, H., 2014. "Big data: new tricks for econometrics." *Journal of Economic Perspectives*, 28(2): 3-28.

Lucas Jr, R.E., 1980. "Methods and problems in business cycle theory." *Journal of Money, Credit, and Banking*, 12(4): 696-715.

Angrist, Joshua D., and Jörn-Steffen Pischke. 2010. "The Credibility Revolution in Empirical Economics: How Better Research Design Is Taking the Con out of Econometrics." *Journal of Economic Perspectives*, 24 (2): 3-30.

Matzkin, Rosa L., 2007. "Nonparametric Identification," *Handbook of Econometrics*, in: J.J. Heckman & E.E. Leamer (ed.), *Handbook of Econometrics*, edition 1, volume 6, chapter 73 Elsevier.

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

Townsend, R.M., 1988. "Models as Economies." *The Economic Journal*, 98(390): 1-24.

Bank for International Settlements (BIS). 2017. "Distributed ledger technology in payment, clearing and settlement: An analytical framework." Committee on Payments and Market Infrastructures Papers No. 157 (February, 2017).

Iansiti, Marco and Karim R. Lakhani. 2017. "The Truth about Blockchain." *Harvard Business Review* 95 (1): 118-127.

Denison, Erin, Michael Lee, and Antoine Martin. 2016. "What do cryptocurrencies do?" Federal Reserve Bank of New York Paper.

Townsend R. 1995. "Financial Systems Northern Thai Villages." *Quarterly Journal of Economics*. Vol. 110, No. 4: 1011 -1046

Autor DH, Dorn D, Hanson GH. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *Am. Econ. Rev.* 103(6):2121–68

Malinowski, Bronisław. *Argonauts of the Western Pacific: An Account of Native Enterprise and Adventure in the Archipelagoes of Melanesian New Guinea*. London: Routledge and Kegan Paul.

Ralph L. Beals. 1975. *Peasant Marketing System of Oaxaca, Mexico*.

Lecture 2-4, Building Blocks for Constructing Economies: Preferences, Endowments, and Technology, with Partial Equilibrium Applications

Lecture 2 – 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.

*Kreps Appendix A “Constrained Optimization”

*NS Chapter 3 “Preferences and Utility”

*NS Chapter 4 “Utility Maximization”

Lecture 3 – Consumer Behavior: Demand Functions, Homogeneity, Income and Substitution Effects, Engle Curves and Giffen Goods, Major Application: expenditure shares, Giffen Goods and Expenditures shares in China, in the US for rich and poor. Compensated (Hicks) and Un-compensated (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, putting restrictions on data.

*NS Chapter 5 “Income and Substitution Effects”

*Jensen, Robert T., and Nolan H. Miller. 2008. "Giffen Behavior and Subsistence Consumption." *American Economic Review*, 98 (4): 1553-77.

MWG 3.D-F “The Utility Maximization Problem,” “The Expenditure Minimization Problem,” “Duality: A Mathematical Introduction”

Lecture 4 – Production: Inputs and Outputs, 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, Input Mix at Factor Prices; Method: Envelope Theorem. Illustrative example of basics onto modern systems: Robinson Crusoe (one person economy with preferences and production), International Trade (two country example), Leontief Input/Output Matrix, with applications to Google Search and Page Rank, Supply Chains and Great East Japan Earthquake

*Kreps 7 “The Neoclassical Firm”

Carvalho, Vasco M. and Nirei, Makoto and Saito, Yukiko and Tahbaz-Salehi, Alireza, Supply Chain Disruptions: Evidence from the Great East Japan Earthquake (December 11, 2016). Columbia Business School Research Paper No. 17-5.

Lecture 5-6, Decision Making Under Uncertainty, Linear Programs, Dynamic Programs

Lecture 5 – Uncertainty: Discrete commodity space and choice with lotteries, expected utility theory, risk and concave utility, Arrow Pratt measures of risk aversion, Uncertainty and states of the world. Application, Medieval Village Economy (risk and its magnitude, land fragmentation as diversification, cross village spatial correlations). Method: Linear Programs, in a variety of applications (location, activity analysis and profit max, utility max and budget)

*NS Chapter 8 “Expected Utility and Risk Aversion”

Lecture 6 – Dynamics and Programming: Application: Storage, Seed and Starvation in Medieval Villages; Method: Dynamic Programming, Value Functions

*Varian 19.1-3 “Time”

*Medville Chapter 3 “Storage as Risk Reduction”

Lectures 7-9, Pareto Optimality; Risk Sharing and Dynamics; Application to Village Economies; Social Networks and Supply Chains in Villages, Impact of Health Shocks and Covid-19

Lecture 7 – Pareto Optimality: Pareto Optimality, Pareto Dominance and Pareto Set, Edgeworth Box Economy, Utility Possibilities Frontier, Welfare function and a Programming Problem for determination of Optimal Allocations; Method: Separating Hyperplanes and theorems; Leading Example: Uncertainty and the state space of the optimal allocation of risk with implications for data, parametric examples to rejectable restrictions

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

Lecture 8 – Risk Sharing Applications: Village India with ex post consumption and income data, ex ante Land Division in the Medieval Village Economy

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

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

Townsend, R.M. 1995. “Consumption Insurance: An Evaluation of Risk-Bearing Systems in Low-Income Economies.” *Journal of Economic Perspectives* 9, no. 3: 83-102.

Lecture 9 – Risk Sharing with Production: 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:

*Samphantharak, K., and Townsend, R.M. 2018, “Risk and return in village economies.” *American Economic Journal: Microeconomics* 10 (1): 1–40, 2018.

*Kinnan, Cynthia, Krislert Samphantharak, Robert M. Townsend, and Diego Vera-Cosio. 2022. “Propagation and Insurance in Village Networks.” Working paper, MIT. And: IDB Research Insights article.

Kinnan, C., and Townsend, R.M., 2012. “Kinship and financial networks, formal financial access, and risk reduction.” *The American Economic Review*, 102(3): 289-293.

Dolls, Mathias. 2019. "An Unemployment Re-Insurance Scheme for the Eurozone? Stabilizing and Redistributive Effects." EconPol Policy Report 10-2019. https://www.econpol.eu/sites/default/files/2019-01/EconPol_Policy_Report_10_2018_Re-insurance_Dolls.pdf

Townsend, Robert M., Nicolas XY. Zhang and Mark York. 2022. "Securitizing micro-credit from emerging economies, using a public blockchain and smart contracts." Working paper.

Guvnen, Fatih, Sam Schulhofer-Wohl, Jae Song, and Motohiro Yogo. 2017. "Worker Betas: Five Facts About Systematic Earnings Risk." *American Economic Review* 107 (5): 398–403.

Lectures 10, Household Financial Accounts, Life Cycle and Cash Mgmt Programming, Bitcoin and Payments on Distributed Ledgers

Lecture 10 – Ledgers and Management: Household Financial Accounts (income statement and balance sheet), household profiles with Life Cycle Maximization and a Wealth Planner for Thai Villages, bitcoin, statement of cash flow and distributed ledgers, cash management through the lens of dynamic models in Thailand, Sweden as a cashless economy and Kenya e-money, Trusted Third Party and the Decentralization issue of Ledgers

* Alvarez, Fernando, Anan Pawasutipaisit and Robert M. Townsend. 2021. "Currency in Village Economies: Large Welfare Losses from the Mismanagement of Petty Cash". Working Paper.

* Samphantharak, K. and Townsend, R.M., 2009. *Households as corporate firms: an analysis of household finance using integrated household surveys and corporate financial accounting*. Econometric Society Monographs (Book 46). Cambridge University Press, Chs 2, 4.

Townsend, R and Narapong Srivisal. "The extraordinary financial lives of Ordinary People: Huge Variation in Financial Situations.

Jack, William, Tavneet Suri, and Robert Townsend. 2010. "Monetary Theory and Electronic Money: Reflections on the Kenyan Experience." *Economic Quarterly* 96 (1): 83–122

Jack, William, and Tavneet Suri. 2014. "Risk Sharing and Transactions Costs: Evidence from Kenya's Mobile Money Revolution." *American Economic Review*, 104 (1): 183-223.

DLT: Section on "e-Payments and e-messages"

Lectures 11-12, Private Information, Contracts, Mechanism Design

Lecture 11 – Contracts and Mechanism Design: 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, Incentives and Protocols, Smart Contracts, Implementation of Mechanism Design

*Medville, Chapter 5 “Rentals with Unobserved Outputs”

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

Townsend, Robert M., Nicolas XY. Zhang and Yinhong Zhao. 2022. “A Primer on Encryption.” Working Paper, https://www.lead-mit.com/_files/ugd/33f99a_3b12ddf1473640f2a486457ec2963d09.pdf

Townsend, Robert M. and Nicolas XY. Zhang. 2022. “Innovative financial designs utilizing homomorphic encryption and multiparty computation.” Working paper.

Auer, Raphael, Cyril Monnet and Hyun Song Shin. 2021. “Distributed ledgers and the governance of money.” BIS Working Paper No 924. <https://www.bis.org/publ/work924.htm>

Chung, Hao, Elaine Shi. 2022. “Foundations of Transaction Fee Mechanism Design.” Working Paper. <https://arxiv.org/abs/2111.03151>

Lecture 12 – Contract Applications, Obstacles: 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

*Karaivanov Alex, Anna L. Pauson, and Robert M. Townsend. 2006 “Distinguishing Limited Liability from Moral Hazard in a Model of Entrepreneurship.” *Journal of Political Economy* 114 (1): 100-144.

*Karaivanov, Alexander. 2001. “Computing Moral Hazard Programs with Lotteries Using Matlab.” Mimeo.

Karaivanov, Saurina, Townsend. 2019. “Family Firms, Bank Relationships and Financial Constraints: A Comprehensive Score Card” *International Economic Review*, Vol.-60, Issue-2

Ru, Hong, and Robert M Townsend. 2022. “Kinship Networks Enhanced by a Formal Financial Intervention: Costly State Verification and the Thai Village Fund.” Working Paper.

Lectures 13-15, Walrasian Equilibrium As Prediction; Application to International Trade, Tariffs, Real and Financial Liberalization

Lecture 13 – Walrasian Equilibrium and Trade: Application to International Trade, Commodity Price Differences across Countries, The Gains from Trade, Pricing Capital and Labor as Factors of Production, Who Wins and Who Losses from Tariffs, the Factor Price Equalization Theorem

*Kreps 6.1 “Pure Exchange and Price Equilibrium”

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

Lecture 14 – Real and Financial Flows: Thailand: Creating village, regional and national income and product accounts, GDP, NIPA; 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;

*Paweenawat, Archawa and Robert M. Townsend. 2021. “Inequality and Globalization: Measurement Through the Lens of Integrated Financial Accounts.” Working paper.

*Dawkins, C., T.N. Srinivasan and J Whalley, 2001. Chapter 58 - calibration. In Heckman, James J., and Edward E. Leamer (Eds) *Handbook of econometrics. Vol. 5.* Amsterdam: North Holland, pp. 3653-3703

Moll, B. R. M., Townsend and V. Zhorin. 2017. “Economic development, flow of funds, and the equilibrium interaction of financial frictions.” *Proceedings of the National Academy of Sciences* 114(24): 6176-6184.

Lecture 15 – Data and Policy US: China Shock, State Level Current Accounts, Measuring Wealth and Income, US Household Surveys are not Integrated Financial Accounts, Integrated Macro Accounts, Inequality and the top 1%, Distributional Accounts, the Difficulty of Gauging the Impact of Covid-19

* Chetty, Raj, John N. Friedman, Nathaniel Hendren, Michael Stepner, and the Opportunity Insights Team. 2020. “The Economic Impacts of COVID-19: Evidence from a New Public Database Built Using Private Sector Data.” NBER Working Paper No. 27431

* Baker, Scott R., R.A. Farrokhnia, Steffen Meyer, Michaela Pagel, Constantine Yannelis. 2021. “Income, Liquidity, and the Consumption Response to the 2020 Economic Stimulus Payments.” Working paper.

Batty, Michael, Jesse Bricker, Joseph Briggs, Elizabeth Holmquist, Susan McIntosh, Kevin Moore, Eric Nielsen, Sarah Reber, Molly Shatto, Kamila Sommer, Tom Sweeney,

and Alice Henriques Volz (2019). "Introducing the Distributional Financial Accounts of the United States," *Finance and Economics Discussion Series* 2019-017. Washington: Board of Governors of the Federal Reserve System.

Autor DH, Dorn D, Hanson GH. 2013. "The China Syndrome: Local Labor Market Effects of Import Competition in the United States." *Am. Econ. Rev.* 103(6):2121–68

Samphantharak, Krislert, Scott Schuh and Robert M. Townsend. 2018. "Integrated Household Surveys: An Assessment of U.S. Methods and an Innovation". *Economic Inquiry*, 56 (1), 2018: 50–80.

Piketty, Thomas, Emmanuel Saez, Gabriel Zucman, Distributional National Accounts: Methods and Estimates for the United States, *The Quarterly Journal of Economics*, Volume 133, Issue 2, May 2018, Pages 553–609, <https://doi.org/10.1093/qje/qjx043>

Smith, Matthew, Owen Zidar, Eric Zwick. 2020. "Top Wealth in America: New Estimates and Implications for Taxing the Rich." Working paper.

Bond, Philip, and Robert M. Townsend. 1996. "Formal and Informal Financing in a Chicago Ethnic Neighborhood." *Economic Perspectives*, July/August 1996, Federal Reserve Bank of Chicago.

Lectures 16-17 Optimality of Competitive Equilibria, and Existence of Competitive and Nash Equilibria

Lecture 16 – Optimality of Competitive Equilibrium: 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"

Debreu, G., 1954. "Valuation equilibrium and Pareto optimum." *Proceedings of the National Academy of Sciences* 40 (7): 588-592.

Prescott, E., and R.M. Townsend. 1984. "General competitive analysis in an economy with private information." *International Economic Review* 25 (1): 1-20

Lecture 17 – Existence: Fixed Point Theorems, Existence of Walrasian Equilibria with Negishi Algorithm Using second welfare theorem, Recent Computer Science Contributions, Nash equilibria in Mixed Strategies; Existence, Application to Financial Markets ,trade fails and penalties in limit order pricing

*Kreps 6.4 "Existence and The Number of Equilibria"

*Asu Ozdaglar's Lecture material from Course 6.254. "Existence of a Nash equilibrium"

Townsend R. M. 1983. "Theories of Intermediated Structures." Carnegie- Rochester Conference Series on Public Policy, Vol. 18, pp. 221-272.

Scarf, H.E., 1982. "The computation of equilibrium prices: an exposition." In Arrow, Kenneth J., and Michael D. Intriligator (Eds.) *Handbook of mathematical economics. Volume 2*. Amsterdam: North-Holland, pp. 1007-1061.

Negishi, T., 1960. "Welfare economics and existence of an equilibrium for a competitive economy." *Metroeconomica*, 12 (2-3): 92-97.

Echenique, F.; and Wierman, A. Finding a Walrasian Equilibrium is Easy for a Fixed Number of Agents. In Proceedings of the 13th ACM Conference on Electronic Commerce, of EC '12, pages 495-495, New York, NY, USA, 2012. ACM

Paes Leme and Chiu-wai Wong (2016) "Computing Walrasian Equilibria: Fast Algorithms and Structural Properties"

Jehle, Geoffrey A. and Philip J. Reny. 2011. *Advanced Microeconomic Theory*. Third Edition. New York: Financial Times/Prentice Hall. Chs. 7.1-7.2.2 "Strategic Decision Making", "Dominant Strategies", "Nash Equilibrium"

Fleming, Michael J. and Kenneth D. Garbade. "Explaining Settlement Fails." Federal Reserve Bank of New York: Current Issues in Economics and Finance. Volume 11, Number 9 September 2005

Dubey, Pradeep. 1982 "Price-quantity Strategic Market Games." *Econometrica* 50 (1): 111-126.

MWG: 18.A and 18.B "Some Foundations for Competitive Equilibria"

Lectures 18-19, Microeconomics and Macro Aggregation: Theory and Data from Two Perspectives, Imposed Structure from Above vs Identification and Falsification with Minimal Assumptions from Below

Lecture 18 – 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 foundations of macroeconomics, Application: The Representative Consumer in Aggregated Models

*Daron Acemoglu. Introduction to Modern Economic Growth. Princeton: Princeton University Press. Chapter 5.2. "The Representative Household", 218-226

Lecture 19 – Identification and Falsification, as applied to Consumer Optimization and to General Equilibrium theory, A Unified Approach—Infinite Data and the Slutsky Matrix, Finite data and Reveled preference, Convexity not testable, computational considerations, Falsifiability, income data alone is not enough to test

*Varian 8.1-3 on Slutsky matrix

*Varian 8.5 “Integrability”

*Varian 8.7 “Revealed Preference”

**Lectures 20-21, Failures of the Welfare Theorems and Some Market Structure Remedies;
Cryptocurrency Values, Monetary Theory and Some Policy Remedies**

Lecture 20 – Failures of the Welfare Theorems: 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, Economics of Platforms in a Walrasian Framework: Platform and Payment externalities, Internalizing Externalities with Market Design; Application: Competition in Cryptocurrencies

*Arrow, K.J., 1969. “The organization of economic activity: Issues pertinent to the choice of market versus nonmarket allocation.” In *The analysis and evaluation of public expenditure: the PPB-system*. Washington DC: Joint Economic Committee, 91st Cong., 1st sess 1, pp. 59-73.

*Jain, Anil and Robert M. Townsend. 2021. “The economics of platforms in a Walrasian setting.” *Economic Theory* 71 (3): 877–924.

Kilenthong, Weerachart T. and Robert M. Townsend. 2021. “A Market Based Solution for Fire Sales and Other Pecuniary Externalities.” *Journal of Political Economy* 129 (4): 981–1010.

Lecture 21 – Bubbles: 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

*Townsend, Robert M. 1980. “Models of Money with Spatially Separated Agents.” In *Models of Monetary Economies*, edited by John Kareken and Neil Wallace. Minneapolis: Federal Reserve Bank of Minneapolis, pp. 265-303

*Abel, Andrew B., N. Gregory Mankiw, Lawrence H. Summers, and Richard J. Zeckhauser. 1989. "Assessing Dynamic Efficiency: Theory and Evidence." *Review of Economic Studies* 56 (1): 1-19

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