Theory of Income, Part 2

This course is the second in a three-course sequence on macroeconomics. On the substantive side, issues to be covered include:

> — home production, growth with exogenous technical change
> — labor supply elasticities
> — real business cycles
> — asset pricing
> — consumption/saving decisions with idiosyncratic risk
> — fiscal policy
> — monetary policy, bank runs

On the technical side, the course will extend and apply tools/concepts you have seen already:

> — discrete-time dynamic programming
> — recursive competitive equilibria, (k,K) models
> — computing value and policy functions
> — Markov processes
> — formulating Bellman equations
> — sequential and date 0 markets, complete and incomplete markets

Items on the reading list marked "*" or "**" are required reading. Items marked "**" will be discussed in class. All are available on Canvas.

There is no textbook for the course, but two books that may be useful are

> Ljungqvist, Lars, and Thomas J. Sargent, *Recursive Macroeconomic Theory*, Third Edition, MIT Press, 2012. (RMT)

> Stokey, Nancy L. and Robert E. Lucas, Jr., with Edward C. Prescott, *Recursive Methods in Economic Dynamics*, Harvard University Press, 1989. (RMED)

Course grades will be a weighted average of grades on weekly problem sets (25%), the midterm (30%), and the final exam (45%). Problem sets will be posted on Monday and due the following Monday. Group problem sets are permitted only when indicated. The (in class) midterm exam will be on Monday, February 4. The (in class) final will be during the week of March 18.

Agustin Gutierrez (agusting@uchicago.edu) and Takashi Onoda (onoda@uchicago.edu) will hold weekly TA sessions on Thurs, at 5:30-6:20, in Pick 016.

Office hours are Wednesday 1:30-2:30 (walk-in) or by appointment (e-mail me at nstokey@uchicago.edu) in SHFE 326.

Reading List

1. Deterministic dynamic programming: (1 week)

The goal here is to learn how to formulate and analyze economic models as discrete-time dynamic programming problems. The basic DP model is a single-agent decision problem with an infinite horizon. For general equilibrium models with no taxes, externalities, etc., the competitive equilibrium solves a Pareto problem, and the economy can be analyzed by taking the Social Planner as the decision-maker.

Variations include finite-horizon models and k,K-models, where a tax or external effect means the competitive equilibrium is *not* Pareto-efficient. In the latter case the economy does *not* solve a Social Planner's problem, and a different method is required.

Highly elastic labor supply is critical for getting output responses of the right magnitude in many macro models. Including responses on the extensive margin reconciles these high elasticities with the low values estimated by labor economists for prime-age males.

* RMED, Ch. 3 (Mathematical Preliminaries).

** RMED, Sect. 4.2, 4.5, and 6.4 (Deterministic DP and Euler equations).

* Stokey, Notes on Recursive Competitive Equilibrium, 2019,

** Prescott, Edward C. 2002. Prosperity and depression, *American Economic Review, Papers and Proceedings*, 92: 1-15. Why is per capita output in most western European countries lower than in the U.S.?

* Rogerson, Richard, and Johanna Wallenius. 2009. Micro and macro elasticities in a life cycle model with taxes, *Journal of Economic Theory*, 144: 2277-2292. One of the first papers reconciling the micro and macro elasticities.

* Keane, Michael P. and Richard Rogerson. 2012. Reconciling micro and macro labor supply elasticities: a reassessment of conventional wisdom, *Journal of Economic Literature*, 50:2, 464-476.

* Greenwood, Jeremy, Richard Rogerson, and Randall Wright. 1993. Putting home economics into macroeconomics, *Quarterly Review*, Federal Reserve Bank of Minneapolis, 17(3).

** Greenwood, Jeremy, Zvi Hercowitz, and Per Krusell. 1997. Long-run implications of investment-specific technical change, *American Economic Review*, 87: 342-362. Shows how the declining relative price of capital goods affects long-run growth and short-run fluctuations.

Alvarez, Fernando, and Nancy L. Stokey. 1998. Dynamic programming with homogeneous functions, *Journal of Economic Theory*, 82: 167-189. Extends basic DP methods to problems with unbounded returns that display homogeneity.

2. Stochastic dynamic programming   (1 week)

Here we will add exogenous stochastic shocks to the DP model. As before, for general equilibrium models with no taxes, externalities, etc., the competitive equilibrium solves a Pareto problem, and the economy can be analyzed by taking the Social Planner as the decision-maker.

For example, the RBC model is a simply a growth model with stochastic shocks to the aggregate technology. Hence the competitive equilibrium is Pareto-efficient, and it can be studied as the solution to a standard (stochastic) DP problem, where the decision maker is the Social Planner.

The dynamics for a stochastic DP model consist of a Markov process describing the (joint) behavior of the exogenous shock(s) and the endogenous state variable(s). Thus, a good understanding of Markov processes is important, especially the possible types of long run behavior.

** RMED Sect. 9.2, 9.5, and 10.4 (Stochastic DP).

** RMED, Sect. 10.7 - 10.9.

** RMED Sect. 11.1 (Markov chains).

*   RMT, Ch. 2, pp. 29-39.

** RMT, Ch. 6, pp. 139-168, and Ch. 26.

** Long, John B., Jr. and Charles I. Plosser. 1983. Real business cycles, *Journal of Political Economy*, 91(1): 39-69.

*   Greenwood, Jeremy, and Zvi Hercowitz. 1991. The allocation of capital and time over the business cycle, *Journal of Political Economy,* 799(6): 1188-1214.

Ljungqvist, Lars, and Thomas J. Sargent. 1998. The European unemployment dilemma, *Journal of Political Economy* 106: 514-550. Adds on-the-job learning and off-the-job forgetting to a search model.

Chari, V. V., Patrick Kehoe, and Ellen McGrattan. 2007. Business cycle accounting, *Econometrica*, 75(3): 781-836. Wedges.

Lucas, Robert E. 2003. Macroeconomic priorities, *American Economic Review* 93: 1-14. A clear exposition and illustration of the standard method for calculating welfare gains/losses in macroeconomic settings.

3. Asset pricing   (1-1/2 week)

The classic "Lucas tree" model is a stochastic k,K model. Empirically it is a failure, but so are its many descendants and it's a useful place to start.

** Lucas, Robert E. 1978. Asset prices in an exchange economy, *Econometrica* 46: 1462-1445.

** RMED, Sect. 10.6.

*   RMT, Ch. 8 and 13.

*   Mehra, Rajnish and Edward C. Prescott. 1985. The equity premium: a puzzle, *Journal of Monetary Economics* 15: 145-162.

*   Kocherlakota, Narayana R. 1996. The equity premium: it's still a puzzle, *Journal of Economic Literature*, 34: 42-71.

Fama, Eugne F. 2001. Efficient capital markets: a review of theory and empirical work, *Journal of Finance*, 383-417.

Hansen, Lars Peter, and Ravi Jagannathan. 1991. Implications of security market data for models of dynamic economies. *Journal of Political Economy*, 99 (2): 225-262.

Shiller, Robert J. 1981. Do stock prices move too much to be justified by subsequent changes in dividends? *American Economic Review*, 71(3): 421–436.

Epstein, Larry G. and Stanley E. Zin. 1991. Substitution, risk aversion, and the temporal behavior of consumption and asset returns: an empirical analysis, *Journal of Political Economy*, 99: 263-286. Introduces Epstein-Zin preferences.

Kocherlakota, Narayana, and Luigi Pistaferri. 2009. Asset pricing implications of Pareto optimality with private information, *Journal of Political Economy*, 117(3): 555-590.

Monday, February 4: Midterm Exam

4. Consumption and saving (1-1/2 weeks)

Aiyagari studies a (k,K) model with ex ante identical agents. They experience uninsurable idiosyncratic income shocks, so markets are incomplete. Their wealth fluctuates as they save/dissave to smooth consumption. There are no aggregate shocks, so in steady state there are no macroeconomic fluctuations and the joint distribution of (income shocks, wealth) across households is time invariant. Deaton reviews evidence on the relative importance of

idiosyncratic and aggregate shocks for individual income and wealth fluctuation. Guvenen et. al. look at how the shock distribution varies with age and (permanent) income level.

** Aiyagari, S. Rao. 1994. Uninsured idiosyncratic risk and aggregate saving, *Quarterly Journal of Economics* 109: 659-684.

* RMT, Ch. 12, 16, 17.

* Deaton, Angus. 1991. Saving and liquidity constraints, *Econometrica*, 59: 1221-1248.

* Guvenen, Fatih, Fatih Karahan, Serdar Ozkan, and Jae Song. 2016. What do data on millions of U.S. workers reveal about life-cycle earnings dynamics? August, working paper.

   Kaplan, Greg, and Giovanni L. Violante. 2014. A model of the consumption response to fiscal stimulus payments, *Econometrica*, 82(4): 1199-1239.

   Heathcote, Jonathan, Kjetil Storesletten, and Giovanni L. Violante. 2008. Insurance and opportunities: a welfare analysis of labor market risk, *Journal of Monetary Economics*, 55(3): 501-525.

   Laitner, John. 1992. Random earnings differences, lifetime liquidity constraints, and altruistic intergenerational transfers, *Journal of Economic Theory*, 58:135-170. Integrates OG and dynastic elements in a model with bequests, with an eye to explaining, quantitatively, the empirical wealth/income ratio.

   Hall, Robert E. 1978. Stochastic implications of the life cycle-permanent income hypothesis: theory and evidence, *Journal of Political Economy* 86: 971-987.

   Hayashi, Fumio. 1985. The effect of liquidity constraints on consumption: a cross-sectional analysis, *Quarterly Journal of Economics* 100: 183-206.

5. Fiscal policy: tax smoothing over time, capital taxation (2 weeks)

If government spending fluctuates over time, contemporaneous tax rates should not accommodate those changes. Instead, there are substantial potential benefits from smoothing tax rates, using issues and purchases of government debt to balance the budget period-by-period.

There is an argument for taxing capital in the short run, since it is supplied inelastically. But in the longer run, investment is sensitive to the return on capital, so it is costly. Is it more costly than other distorting taxes? Does it reduce the growth rate? Or simply depress the level of income?

* Barro, Robert J. 1979. On the determination of the public debt, *Journal of Political Economy* 87: 940-971.

** Lucas, Robert E., Jr. and Nancy L. Stokey. 1983. Optimal fiscal and monetary policy in an economy without capital, *Journal of Monetary Economics* 12: 55-78. (Sect. 1-3 only)

** Chamley, Christophe. 1986. Optimal taxation of capital income in general equilibrium with infinite lives, *Econometrica* 54: 607-622. The original source on zero-capital-taxation.

* Lucas, Robert E., Jr. 1990. Supply-side economics: an analytical review, *Oxford Economic Papers* 42: 293-316. Quantitative assessment of capital taxation.

Straub, Ludwig and Ivan Werning. 2015. Positive long run capital taxation: Chamley-Judd revisited, working paper, MIT.

Chari, V.V., Juan Pablo Nicolini, and Pedro Teles. 2016. More on the optimal taxation of capital, working paper.

Golosov, Mikhail, Narayana Kocherlakota, and Aleh Tsyvinski, 2003. Optimal indirect and capital taxation, *Review of Economic Studies,* 70(3): 569-587.

Golosov, Mikhail, and Aleh Tsyvinski. 2006. Designing optimal disability insurance: a case for asset testing, *Journal of Political Economy,* vol. 114(2): 257-279.

Zhu, Xiaodong. 1992. Optimal fiscal policy in a stochastic growth model, *Journal of Economic Theory* 58:250-289. Shows how capital taxes, zero in expectation, can be used to smooth tax receipts.

Aiyagari, S. Rao, *et. al*. 2002. Optimal taxation without state-contingent debt. *Journal of Political Economy* 110: 1220-54. Shows the Lucas-Stokey results change dramatically if the government can issue only one-period, risk-free debt.

one-star   Angeletos, George-Marios. 2002. Fiscal policy with noncontingent debt and the optimal maturity structure, *Quarterly Journal of Economics*, 117(3): 1105-1131. Restores the Lucas-Stokey results, although the required policies are rather extreme.

Easterly, William, and Sergio Rebelo. 1993. Fiscal policy and economic growth: an empirical investigation, *Journal of Monetary Economics* 32: 417-458. Data on revenue sources for different types of countries.

Auerbach, Alan J. and Laurence J. Kotlikoff. 1987. *Dynamic Fiscal Policy*, Cambridge University Press. Uses an OG setup to look at the incidence across age cohorts of labor, capital and consumption taxes.

Rebelo, Sergio, and Nancy L. Stokey. 1995. Growth effects of flat-rate taxes, *Journal of Political Economy* 103: 519-550. Taxes do not seem to affect growth rates.

one-star Buera & Nicolini (JME 2004) - Optimal maturity of government debt without state contingent bonds

6. Monetary theory: models of payments (1-1/2 weeks)

** Freeman, Scott, and Finn E. Kydland. 2000. Monetary aggregates and output, *American Economic Review*, 90: 1125-1135.

* Lucas, Robert E. and Juan Pablo Nicolini. 2015. On the stability of money demand, *Journal of Monetary Economic*s, 73(C): 48-65.

* Krishnamurthy, Arvind, and Annette Vissing-Jorgensen 2012. The aggregate demand for treasury debt, *Journal of Political Economy* 120(2): 233-267. Evidence on the 'liquidity service' of T-bills. Figure 1 is worth a thousand words.

* Lucas, Robert E., Jr. 2014. Liquidity: meaning, measurement, management, Federal Reserve Bank of St. Louis *Review*, Third Quarter, 199-212.

* Atkeson, Andrew and Lee E. Ohanian. 2001. Are Phillips curves useful for forecasting inflation? *Quarterly Review*, Federal Reserve Bank of Minneapolis, Winter, pp 2-11.

* Lucas, Robert E., Jr. 2000. Inflation and welfare, *Econometrica* 68: 247-74.

* RMED, Sect. 13.5 - 13.7.

McCallum, Bennett T. and Marvin S. Goodfriend. 1987. Demand for money: theoretical studies, in *The New Palgrave: A Dictionary of Economics*, ed. by J. Eatwell, M. Milgate, and P. Newman, London: Macmillan; New York: Stockton Press, 775-781. Replaces CIA with a more flexible transaction technology.

Teles, Pedro and Ruilin Zhou. 2005. A stable money demand: looking for the right monetary aggregate, *Economic Perspectives*, Federal Reserve Bank of Chicago, issue Q I, 50-63.

McCandless, George T., Jr. and Warren E. Weber. 1995. Some monetary facts, Federal Reserve Bank of Minneapolis *Quarterly Review* 19,3: 1-11.

Sargent, Thomas J. and Neil Wallace. 1981. Some unpleasant monetarist arithmetic, Federal Reserve Bank of Minneapolis *Quarterly Review* 5(3). A classic. Its main point is very relevant for current policy.

Sargent, Thomas J. 1986. The ends of four big inflations, in T.J. Sargent, *Rational Expectations and Inflation*, Harper & Row. The key to disinflation is always and everywhere fiscal.

7. Bank runs and depression (1/2 week)

** Diamond, Douglas W. and Philip H. Dybvig. 1983. Bank runs, deposit insurance, and liquidity, *Journal of Political Economy*, 91(3): 401-419.

* Friedman, Milton and Anna J Schwartz. 1971. A monetary history of the United States, 1867-1960. Princeton U. Press. Ch. 7: The Great contraction, 1929-33.

Lucas, Robert E., Jr. and Nancy L. Stokey. 2011. Liquidity crises, Economic Policy Paper, Federal Reserve Bank of Minneapolis.

Kocherlakota, Narayana. 2010. Taxing risk and the optimal regulation of financial institutions, Economic Policy Paper, Federal Reserve Bank of Minneapolis.

Kocherlakota, Narayana R. 2000. Creating business cycles through credit constraints, *Quarterly Review*, 24(3): 2-10. A more readable version of Kiyotaki & Moore.

Kiyotaki, Nobuhiro and John Moore. 1997. Credit Cycles, *Journal of Political Economy*, 105: 211-248. Read Kocherlakota's 2000 QR article first.

Cole, Harold L. and Lee E. Ohanian. 2004. New Deal policies and the persistence of the Great Depression: a general equilibrium analysis, *J. of Political Economy*, 112(4): 779-816.

Kocherlakota, Narayana R. 2009. Assessing resolutions of the banking crisis, working paper, University of Minnesota. Nice description of debt overhang.

8. Time consistency (0 weeks)

* Barro, Robert J. and David B. Gordon. 1983. Rules, discretion, and reputation in a model of monetary policy. *Journal of Monetary Economics*, 12: 101-121.

Stokey, Nancy L. 1989. Reputation and time consistency, *American Economic Review* 79: 134-139.

* Kydland, Finn E. and Edward C. Prescott. 1977. Rules rather than discretion: the inconsistency of optimal plans, *Journal of Political Economy* 85: 473-491.

* Fischer, Stanley. 1980. Dynamic inconsistency, cooperation, and the benevolent dissembling government, *Journal of Economic Dynamics and Control* 2: 93-107.

Chari, V.V. 1988. Time consistency and optimal policy design, Federal Reserve Bank of Minneapolis *Quarterly Review* 12,4: 17-31.

Final Exam (week of March 18)