

DEPARTMENT OF ECONOMICS
YALE UNIVERSITY
Eduardo Engel

**ECON 525a. SECOND HALF
“HETEROGENEITY IN MACROECONOMICS”
COURSE SYLLABUS¹**

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Fall Semester, 2011
Meeting times: Mon and Wed 10.30.
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OVERVIEW:

The first half of Econ 525a covers models with heterogeneous agents, moving beyond standard “representative agent” models used in macro. We focus on models that consider the aggregation of infrequent and lumpy microeconomic behavior, with applications to aggregate dynamics of inflation, investment, employment, consumer durable, money demand and inventories. The techniques we study are also useful to study other problems where heterogeneous agents play a central role, such as the dynamics of the wealth distribution.

ASSIGNMENTS AND EVALUATION FOR FIRST HALF:

1. Each student will present one paper related to the material covered in the course.
2. There will be three problem sets, but no exam. No consultations among students are allowed when solving the problem sets.
3. Students will write a referee report on recent papers.
4. A term paper on a topic of your choice related to those discussed in class (only one term paper is required for both halves of the course).

Meeting times

Official times for lectures are Monday and Wednesday from 10.30 to 12.30 (on Wednesdays with a Cowles lunch we'll end at 11.50). Lectures are longer than usual because there will be a number of weeks without lectures.

¹Last revised: August 8, 2011.

Calendar of Lectures

	Monday	Wednesday
August		31: EE Lecture 1. Introduction.
September	5: EE Lecture 2. Micro Policies. 12: EE Lecture 3. Prices. 19: EE Lecture 5. Prices. 26: EE Lecture 6. Factor markets	7: EE Guest Lecture: Klenow on prices. 14: EE Lecture 4. Prices. 21: EE Student presentations 28: EE Guest lecture: Bewley. Field study of pricing
October	3: EE Lecture 7. Factor markets. 10: EE Student presentations 17: No lecture. 24: PK Lecture 1. 31: PK Lecture 3.	5: EE Lecture 8. Factor markets. 12: EE Guest Lecture: Guimaraes. Sales and monetary policy. 19: No lecture. 26: PK Lecture 2.
November	7: PK Lecture 5. 14: No lecture. 28: PK Lecture 7.	2: PK Lecture 4. 9: PK Lecture 6. 16: No lecture. 30: PK Lecture 8.
December	5: No lecture.	7: No lecture.

CONTENTS AND READINGS:

There will be handouts for most lectures. Readings marked ** will be covered in detail in class, readings marked * won't be covered in detail but are important, so you will benefit from reading (some/most) of them. The remaining references (unstarred) are included for completeness. Most of the readings with ** and * will be posted on the course site. Readings appear roughly in the order they will be covered.

I. Introduction and Motivation

Classic aggregation and the representative agent paradigm. Evidence on infrequent and lumpy adjustment, and on non-convex adjustment costs, for prices, capital, durables, employment, money holdings. Calvo pricing and aggregate dynamics. To what extent can linear models (e.g., VARs) capture the deep parameters in a model with lumpy microeconomic adjustment?

Lecture 1: Introduction and Motivation

*CAPLIN, A. AND J. LEAHY (2010): "Economic Theory and the World of Practice: A Celebration of the (s, s) Model," *J. of Economic Perspectives*, Winter 2010.

STOKER, T. (1986): "Simple Tests of Distributional Effects on Macroeconomic Equations," *Journal of Political Economy*, **94**, 763–795.

BLUNDELL, R. AND T. STOKER (2005): "Heterogeneity and Aggregation," *J. of Economic Literature*, **93**, 347–91.

DOMS, M. AND T. DUNNE (1998): "Capital Adjustment Patterns in Manufacturing Plants", *Review of Economic Dynamics*, **1, 409–429.

**KLENOW, P. AND B. MALIN (2010): "Microeconomic Evidence on Price-Setting," mimeo.

NAKAMURA, E. AND J. STEINSSON (2006): "Five Facts About Prices: A Reevaluation of Menu Cost Models," *Quarterly Journal of Economics*, (2008), **123 (4), 1405–1464.

- GOLDBERG, P. AND R. HELLERSTEIN (2009): “How Rigid are Producer Prices?”, mimeo
- **RAMEY, V., AND M. SHAPIRO (2001): “Displaced Capital: A Study of Aerospace Plant Closings”, *J. of Political Economy*, **109** (5), October 2001, 958-92.
- *GOURIO, F., AND A. KASHYAP (2007): “Investment Spikes: New Facts and a General Equilibrium Exploration,” *Journal of Monetary Economics*.
- BILS, M. AND P. KLENOW (2004): “Some Evidence on the Importance of Sticky Prices,” *J. of Political Economy*, **112**, 947–985.
- *DHYNE, ALVAREZ, LE BIHAN, VERONESE, DIAS, HOFFMANN, JONKER, LÜNNEMANN, RUMLER AND VILMUNEN (2006): “Price Changes in the Euro Area and the United States: Some Facts from Individual Consumer Price Data”, *J. of Economic Perspectives*, **20**, Spring 2006, 171–192.
- *FABIANI, S., M. DRUANT, I. HERNANDO, C. KWAPIL, B. LANDAU, C. LOUPIAS, F. MARTINS, T. MATHA, R. SABBATINI, H. STAHL, AND A. STOKMAN (2006): “The Pricing Behavior of Firms in the Euro Area: New Survey Evidence,” *International Journal of Central Banking*, **2** (3), September, 3–47.
- *BEWLEY, T. (2007): “Report on an Ongoing Field Study of Pricing as it Relates to Menu Costs”, mimeo, Yale
- AGUIAR, M. AND E. HURST (2005): “Consumption versus Expenditures,” *J. of Political Economy*, 919–948.
- DAVIS, S., AND J. HALTIWANGER (1999): “Gross Job Flows”, in O. Aschenfelter and D. Card (eds), *Handbook of Labor Economics*, vols. 3 and 4, 2711–2805.
- BAR-ILAN, A. AND A. BLINDER (1992): “Consumer Durables: Evidence on the Optimality of Doing Nothing.” *Journal of Money, Credit and Banking*, **24**, 253–272.
- LEVY, D., M. BERGEN, S. DUTTA AND R. VENABLE (1997): “The Magnitude of Menu Costs: Direct Evidence from Large U.S. Supermarket Chains,” *Quarterly Journal of Economics*, **112** (3), 791-825.
- *ANDERSON, E.T., AND D.I. SIMESTER (2010): “Price Stickiness and Customer Antagonism,” *Quarterly Journal of Economics*, May 2010.
- NAKAMURA, E. (2008) :“Pass-Through in Retail and Wholesale,” *American Economic Review*, 430–437.
- PELTZMAN, S. (2000): “Prices Rise Faster than They Fall,” *J. of Political Economy*, 466–502.
- **EICHENBAUM, M., N. JAIMOVICH AND S. REBELO (2011): “Reference Prices, Costs, and Nominal Rigidities.” *American Economic Review*, 101(1): 23462.
- **BERGER, D., R. CABALLERO AND E. ENGEL (2011): “Lumpy Microeconomic Adjustment, Large Idiosyncratic Shocks and Missing Aggregate Dynamics.” Mimeo.

II. Microeconomic Policies

Optimal policies with non-convex adjustment costs. We will cover both classic results (fixed adjustment costs or fixed + proportional), stochastic adjustment costs and recent papers that combine non-convex adjustment costs with costs of acquiring information.

Lecture 2: Optimal Micro Policies with Non-Convex Adjustment Costs

SAINT PAUL, G. (2005): “Some Evolutionary Foundations for Price Level Rigidity,” *American Economic Review*.

- HARRISON, J.M., T. SELLKE AND A.J. TAYLOR (1983): “Instantaneous Control of Brownian Motion,” *Mathematics of Operations Research*, **8**: 439–453.
- **STOKEY, N. (2008): *The Economics of Inaction: Stochastic Control Models with Fixed Costs*, Princeton University Press.
- **CABALLERO, R. AND E. ENGEL (1999): “Explaining Investment Dynamics in US Manufacturing: A Generalized (S,s) Approach,” *Econometrica*, **67** (4), 741–782.
- *ABEL, A., J. EBERLY AND S. PANAGEAS (2007): “Optimal Inattention to the Stock Market,” *American Economic Review P&P*.
- **ABEL, A., J. EBERLY AND S. PANAGEAS (2009): “Optimal Inattention to the Stock Market with Information Costs and Transaction Costs,” mimeo, 2009.
- **ALVAREZ, F., F. LIPPI AND L. PACIELLO (2010): “Optimal price setting with observation and menu costs,” mimeo.
- **BONOMO, M., C. CARVALHO AND R. GARCIA (2010): “State-Dependent Pricing Under Infrequent Information,” mimeo, 2010.
- *ALVAREZ, F. AND F. LIPPI (2009): Financial Innovation and the Financial Demand for Cash,” *Econometrica*, **77**: 363–402.
- *ALVAREZ, F., F. LIPPI AND L. GUIISO (2010): “Durable consumption and asset management with transaction and observation costs,” mimeo.
- *GORODNICHENKO, Y. (2010): “Endogenous information, menu costs and inflation persistence.”

III. Prices

Theoretical work by Golosov-Lucas, Midrigan and others, and empirical work by Bils-Klenow and Nakamura-Steinsson and others, led to a recent wave of research on pricing and non-convex adjustment costs. Nonetheless, important challenges remain. We briefly review the partial equilibrium literature, emphasizing insights that have reemerged in the recent wave of DSGE models. This is followed by a study of distributional dynamics, which is relevant for lumpy adjustment models in general, both in partial and in general equilibrium. Next we turn to DSGE models. Finally, we cover recent developments. We will also have two three guest lectures on pricing: Pete Klenow will present his recent chapter in the Handbook of Monetary Economics, Truman Bewley will give a preview of his ongoing field research on price-setting, and Bernardo Guimaraes will present a paper published recently in the AER on the relation between sales and monetary policy.

Lecture 3: Aggregation and Distributional Dynamics

Distributional dynamics are at the essence of models with heterogeneity. Here we explore these dynamics in the context of models of inflation based on lumpy price adjustment, but the insights we obtain are of interest in many other contexts.

- **CAPLIN, A. AND D. SPULBER (1987): “Menu Costs and the Neutrality of Money,” *Quarterly Journal of Economics*, **102**, 703–26.
- **CAPLIN, A. AND J. LEAHY (1991): “State-Dependent Pricing and the Dynamics of Money and Output,” *Quarterly Journal of Economics*, **106**, 683–708.

CABALLERO, R. AND E. ENGEL (2007): “Price Stickiness in Ss Models: New Interpretations of Old Results,” *J. of Monetary Economics*, **54, 100–121.

Lectures 4 and 5: DSGE Models

*DOTSEY, M. R. KING AND A. WOLMAN (1999): “State-dependent pricing and the general equilibrium dynamics of money and output,” *Quarterly Journal of Economics*, **114**, 655–90.

GOLOSOV, M. AND R.E. LUCAS (2007): “Menu Costs and Phillips Curves,” *J. of Political Economy*, **115 (2), 171–199.

*MIDRIGAN, V. (2006): “Menu Costs, Multi-product Firms, and Aggregate Fluctuations,” NYU, mimeo.

BURSTEIN, A. AND C. HELLWIG (2006): “Prices and Market Shares in a Menu-Cost Model,” mimeo, UCLA.

*KEHOE, P. AND V. MIDRIGAN (2007): “Sales, Clustering of Price Changes, and the Real Effects of Monetary Policy,” mimeo.

CARVALHO, C. (2006): “Heterogeneity in Price Stickiness and the Real Effects of Monetary Shocks,” *Frontiers of Macroeconomics*, **2**(1), Article 1.

NAKAMURA, E. AND J. STEINSSON (2006): “Monetary Non-Neutrality in a Multi-Sector Menu Cost Model,” Harvard University, mimeo.

DANZIGER, L. (1999): “A Dynamic Economy With Costly Price Adjustment,” *American Economic Review*, **89**, 878–901.

*GERTLER, M. AND J. LEAHY (2008): “A Phillips Curve with Ss Foundations,” *J. of Political Economy*, **116**, 3, 533572, Jun 2008.

**WOODFORD, M. (2009): “Information-Constrained State-Dependent Pricing,” *J. of Monetary Economics*.

COIBION, O. AND Y. GORODNICHENKO (2008): “Strategic Interaction Among Heterogeneous Price-Setters in an Estimated DSGE Model,” NBER WP No. 14323.

*KRUSELL, P. AND A. SMITH (1998): “Income and Wealth Heterogeneity in the Macroeconomy,” *J. of Political Economy*, 867–896.

DORAZELSKI, U. AND A. PAKES (2009): “A Framework for Applied Dynamic Analysis in I.O.” in M. Armstrong and R. Porter (eds.), *Handbook of Industrial Organization*, forthcoming.

Recent Developments

BERNANKE, B., J. BOIVIN AND P. ELIASZ (2005): “Measuring the effects of monetary policy: A factor-augmented vector autoregressive (FAVAR) approach,” *Quarterly Journal of Economics*.

**BOIVIN, J., M. GIANNONI AND I. MIHOV (2009): “Sticky Prices and Monetary Policy: Evidence from disaggregated US data,” *American Economic Review*.

**GUIMARAES, B. AND N. SHEEDY (2009): “Sales and Monetary Policy,” *American Economic Review*.

*MACKOWIAK, B., E. MOENCH AND M. WIEDERHOLT (2009): “Sectoral Price Data and Models of Price Setting,” mimeo.

*CHEVALIER, J. AND A. KASHYAP (2010): “Best Prices,” mimeo.

**VAVRA, J. (2010): “Monetary Policy is Less Effective in Uncertain Times: New Evidence and an S_s Interpretation”, mimeo.

KLESHCHELSKI, I. AND N. VINCENT (2009): “Market share and price rigidity,” *J. of Monetary Economics*, 2009.

ZHANG, F. (2011): “Rational Inattention in Uncertain Business Cycles.” Mimeo. Ohio State University.

IV. Factor Markets

Investment is arguably the area in macroeconomics where models incorporating lumpy adjustment and heterogeneity have had the highest payoff in terms of improving the ability of dynamic macroeconomic models to match the data. We first review partial equilibrium investment models with lumpy adjustment. In particular, we study the cautionary effect of uncertainty, increasing hazards and time-varying impulse response functions, uncertainty shocks and an application to 9/11 (which is arguably also relevant for the recent financial crisis). Next we turn to DSGE models with lumpy capital adjustment, discussing how to define and approximate the equilibrium.

Then we turn to vintage models. This is an old idea, that could potentially provide a better understanding of investment, employment and wage dynamics. This is another area ripe for more work using the material covered in this course.

Finally, we cover recent work linking the firm/plant size distribution to inefficient allocation of resources, with quantifiable implications for aggregate productivity. This literature still is at the stage where assumptions are stronger and models simpler than they need to be if the conclusions are to guide economic policy. But this line of research holds lots of potential. From a policy perspective, disentangling the extent to which suboptimal allocation reflects regulations and other distortions, and to what an extent it is due to real costs of adjusting factors of production across firms, is of paramount importance and ties in nicely with the material covered in the course.

Lecture 6: Aggregate Dynamics for Investment and Employment Models.

LEAHY, J. AND T. WHITED (1996): “The Effects of Uncertainty on Investment: Some Stylized Facts,” *J. of Money, Credit and Banking*, **28**, 64–83.

GUISSO, L. AND G. PARIGI (1999): “Investment and Demand Uncertainty,” *Quarterly Journal of Economics*, **114**, 185–227.

BLOOM, N. BOND, S. AND J. VAN REENEN (2007): “Uncertainty and Investment Dynamics,” *Review of Economic Studies*, **74, 391–415.

**CABALLERO, R., E. ENGEL AND J. HALTIWANGER (1995): “Plant-Level Adjustments and Aggregate Investment Dynamics”, *Brookings Papers on Economic Activity*, (2), 1–34.

CABALLERO, R. AND E. ENGEL (1999): “Explaining Investment Dynamics in US Manufacturing: A Generalized (S, s) Approach,” *Econometrica*, **67 (4), 741–782.

COOPER, R. J. HALTIWANGER AND L. POWER (1999): “Machine Replacement and the Business Cycle: Lumps and Bumps”, *American Economic Review*, 1999, **89**, 921–946.

ABEL, A. AND J. EBERLY (2003): “Investment and q with Fixed Costs: An Empirical Analysis,” mimeo, Wharton and Northwestern.

**BLOOM, N. (2007): “The Impact of Uncertainty Shocks,” *Econometrica*, May.

ESLAVA, M., J. HALTIWANGER, A. KUGLER AND M. KUGLER (2006): “Factor Adjustments After Deregulation: Panel Evidence from Colombian Plants,” mimeo, November.

- THOMAS, J. (2001): "Is Lumpy Investment Relevant for the Business Cycle?," *J. of Political Economy*, **110**, 508–34.
- VERACIERTO, M. (2002): "Plant-Level Irreversible Investment and Equilibrium Business Cycles," *American Economic Review*, **02**, 181–97.
- **KHAN, A. AND J. THOMAS (2008): "Idiosyncratic Shocks and the Role of Nonconvexities in Plant and Aggregate Investment Dynamics," *Econometrica*, **76**, 395–436.
- SIM, J. W. (2006): "Irreversible Investment and Option Values in Equilibrium Business Cycle Models", mimeo.
- BAYER, C. (2006): "Non-convex Factor Adjustments in a Two-Country Real Business Cycle Model", mimeo.
- **BACHMANN, R. R. CABALLERO AND E. ENGEL (2008): "Aggregate Implications of Lumpy Investment: New Evidence and a DSGE Model". Mimeo.
- *BLOOM, N., N. JAIMOVICH AND M. FLOETTATO (2009): "Real Uncertain Business Cycles," mimeo.
- *GOURIO, F. AND L. RUDANKO (2011): "Customer Capital." Mimeo.

Lecture 7: Models with Entry and Exit

- HOPENHAYN, H. (1992): "Entry, Exit, and Firm Dynamics in Long Run Equilibrium," *Econometrica*, **60**, 1127–1150.
- HOPENHAYN, H. AND R. ROGERSON (1993): "Job Turnover and Policy Evaluation: A General Equilibrium Analysis," *J. of Political Economy*, **101**, 915-938.
- HURST, E. AND B. PUGSLEY (2011): "Understanding Small Business Heterogeneity." Mimeo.

Lecture 8: Factor Misallocation and Aggregate Productivity.

- **SYVERSON, C. (2011): "What determines productivity," *J. of Economic Literature*, **49**(2) 329-365.
- ALFARO, L., A. CHARLTON AND F. KANCZUK (2009): "Plant Size Distribution and Cross-Country Income Differences," NBER.
- BARTELSMAN, E., J. HALTIWANGER AND S. SCARPETTA (2009): "Measuring and Analyzing Cross-Country Differences in Firm Dynamics," in *Producer Dynamics: New Evidence from Micro Data*, Ed., T. Dunne, J.B. Jensen and M.B. Roberts, Chicago: Chicago University Press for NBER.
- HOPENHAYN, H. AND A. NEUMEYER (2008): "Productivity and Distortions," mimeo.
- **HSIEH, C. AND P. KLENOW (2009): "Misallocation and Manufacturing TFP," *Quarterly Journal of Economics*, **124** 1403–1448.
- MIDRIGAN, V. AND D. XU (2009): "Accounting for Plant Level Misallocation," Mimeo.
- MIDRIGAN, V. AND D. XU (2010): "Finance and Misallocation: Evidence from plant level data," NBER Working Paper No. 15647.
- **RESTUCCIA, D. AND R. ROGERSON (2008): "Policy Distortions and Aggregate Productivity with Heterogeneous Establishments," *Review of Economic Dynamics*, **11**, 707-20.

V. Student Presentations

Durables

- GABAIX, X. AND D. LAIBSON (2001): “The 6D Bias and the Equity Premium Bias,” in B. Bernanke and K. Rogoff (eds), *NBER Macroeconomics Annual*, 257–311.
- FERNÁNDEZ-VILLAYERDE, J. AND D. KRUEGER (2002): “Consumption and Saving Over the Life Cycle: How Important are Consumer Durables?”, mimeo.
- STACCHETTI, E. AND D. STOLYAROV (2004): “Obsolescence of Durable Goods and Aggregate Fluctuations,” mimeo, NYU and U. of Michigan.
- HOUSE, C. AND J. LEAHY (2004): “An sS Model with Adverse Selection,” *Journal of Political Economy*, **112**, 581–614.
- BERTOLA, G., L. GUIISO AND L. PISTAFERRI (2005): “Uncertainty and Consumer Durables Adjustment,” *Review of Economic Studies*, **72**, 973–1007.
- LEAHY, J. AND J. ZEIRA (2005): “The Timing of Purchases and Aggregate Fluctuations,” *Review of Economic Studies*, **72**, 1127–1151.
- CAPLIN, A. AND J. LEAHY (2006): “Equilibrium in a durable goods market with lumpy adjustment,” *J. of Economic Theory*, **128**, 187–203.

Vintage Models

- COOLEY, T., G.D. HANSEN AND E.C. PRESCOTT (1995): “Equilibrium Business Cycles with Idle Resources and Variable Capacity Utilization,” *Economic Theory*, **6**, 35–49.
- GREENWOOD, J., Z. HERVOWITZ AND P. KRUSELL (1997): “Long-run implications of investment specific technological change,” *American Economic Review*, **87**, 342–62.
- BOUCEKKINE, R., M. GERMAINE, O. LICANDRO AND A. MAGNUS (1998): “Creative Destruction, Investment Volatility and the average age of capital,” *J. of Economic Growth*, **3**, 361–84.
- ATKESON, A. AND P. KEHOE (1999): “Models of Energy Use: Putty-Putty vs. Putty-Clay,” *American Economic Review*, **89**, 1028–43.
- GILCHRIST, S. AND J.C. WILLIAMS (2000): “Putty-Clay and Investment: A Business Cycle Analysis,” *J. of Political Economy*, **108**, 928–960.
- HANSEN, G.D. AND E. PRESCOTT (2005): “Capacity constraints, asymmetries, and the business cycle,” *Review of Economic Dynamics*, **8**, 850–65.
- GILCHRIST, S. AND J.C. WILLIAMS (2005): “Investment, capacity and uncertainty: a putty-clay approach,” *Rev. of Economic Dynamics*, **8**, 1–27.

Inventories

- AGUIRREBEIRA, V. (1999): “The Dynamics of Markups and Inventories in Retail Firms,” *Review of Economic Studies*, 275–308.
- FISHER, J.D.M. AND A. HORNSTEIN (2000): “ (S, s) Inventories Policies in General Equilibrium,” *Review of Economic Studies*, **67**, 117–145.

- BILS, M. AND J.A. KHAN (2000): “What inventory behavior tells us about business cycles,” *American Economic Review*, **90**, 458–81.
- COEN-PIRARNI, D. (2004): “Markups, Aggregation, and Inventory Adjustment,” *American Economic Review*, **2004**, 1328– .
- COPELAND, A., W. DUNN AND G. HALL (2009): “Inventories and the Automobile Market,” NBER working paper.
- KHAN, A. AND J.K. THOMAS (2007): “Explaining inventories: A business cycle assessment of the stockout avoidance and S_s motives,” *Macroeconomic Dynamics*, 2007.
- KHAN, A. AND J. THOMAS (2007): “Inventories and the Business Cycle: An Equilibrium Analysis of (S, s) Policies,” *American Economic Review*, **97** 4, 1165–1188.
- DAVIS, S.J. AND J.A. KHAN (2008): “Interpreting the Great Moderation: Changes in the Volatility of Economic Activity at the Macro and Micro Levels”, mimeo.
- WEN, Y. (2005) : “Understanding the inventory cycle,” *J. of Monetary Economics*, **52**, 1533–1555.
- KRYVTSOV, O. AND V. MIDRIGAN (2009): “Inventories, Markups, and Real Rigidities in Menu Cost Models,” NBER Working Paper No.

Money Demand

- ATTANASIO, O., L. GUISO AND T. JAPPELLI (2002): “The Demand for Money, Financial Innovation, and the Welfare Cost of Inflation: An Analysis with Household Data,” *J. of Political Economy*, **110**, 317–351.
- ALVAREZ, F. AND F. LIPPI (2009): “Financial Innovation and the Transactions Demand for Cash,” *Econometrica*, **77**, 363–402.
- ALVAREZ, F., A. ATKESON AND C. EDMOND (2008): “Sluggish Res[ponses of Prices and Inflation to Monetary Shocks in an Inventory Model of Money Demand,” working paper.