

# ECON 890      FIRM DYNAMICS AND PRODUCTION NETWORKS

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UNIVERSITY OF NORTH CAROLINA

DEPARTMENT OF ECONOMICS

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**Lectures:** T/TH 9:45 – 11am, <https://unc.zoom.us/j/98522827066>  
**Office Hours:** By appointment via Zoom/Skype

**Course Description.** This second year course introduces a set of theoretical and quantitative models to study **producer heterogeneity** and its (macroeconomic) implications. It aims to provide a coherent view of aggregate production from a disaggregated perspective. Topics on firm dynamics provide micro foundations for aggregate growth and fluctuations, and topics on networks show channels for micro disturbances to have aggregate impacts.

In the process, you will learn the necessary tools for related research; you will become familiar with commonly used data; and you may develop some ideas for your second year paper and more. The materials of this course connect to and complement topics in a variety of fields such as IO, labor, and finance.

**Safety.** Please wear a mask/face covering when leaving home, and practice physical social distancing of at least 6 feet apart. Follow the [CDC guidelines](#) to protect yourself. If you show symptoms of COVID-19, test positive, or come into contact with others who test positive, please stay at home and call for medical help immediately.

**Evaluation.** Participation, in-class presentation/discussion, homework assignments (analytical + quantitative), final project (choose one: a short paper/proposal, a literature review, 2 referee reports, a quantitative replication)

**Tentative List of Topics and Readings.** [subject to future updates]

## PART 0. USEFUL RESOURCES

Some (relatively gentle) coding is inevitable. You may use any language that you prefer, including but not limited to Matlab, Python, Julia, C/C++, Fortran, etc.

Regardless of your language choice and your level of skills, you will find this website very useful: [quantecon.org](http://quantecon.org). This is the place if you want to learn Python and Julia from ground 0. Lectures are designed by Thomas J. Sargent and John Stachurski, helpful even if you code in other languages. They are about to publish a book that is not language specific: [High-Dimensional Economics](#).

If you choose Matlab, you can register a Mathworks account using your unc .edu email. Then you will have access to a few high-quality training programs for free. You may also want to install the

[CompEcon Toolbox](#) accompanying this older but still very useful book: Mario J Miranda and Paul L Fackler. *Applied computational economics and finance*. MIT press, 2004.

## PART 1. FIRM DYNAMICS

Firms differ from one another. They enter and exit, and they grow and shrink. Firm activities determine the aggregate outcome; and the aggregate economic condition affects a firm's decisions as well. We first look at a set of general observations regarding the distribution of firms. Then we study a set of theories explaining the findings, each with a distinct emphasis. We dive deeper into two topics out of many: financial constraints faced by firms and innovation of firms.

### 0. General facts and common sources of data

[TBC] US: LBD, LRD ([Census Bureau](#) has quite a few at least partially public ones, e.g., BDS, ABS, SUSB, CBP, ASM, LEHD, etc.), [SBA](#), BED/BDM, Compustat, etc.

### 1. Firm dynamics models: main types

- Hugo A Hopenhayn. "Entry, exit, and firm dynamics in long run equilibrium". *Econometrica: Journal of the Econometric Society* (1992): 1127–1150
- Hugo Hopenhayn and Richard Rogerson. "Job turnover and policy evaluation: A general equilibrium analysis". *Journal of Political Economy* (1993): 915–938
- Marc J Melitz. "The impact of trade on intra-industry reallocations and aggregate industry productivity". *Econometrica* 71, no. 6 (2003): 1695–1725
- Erzo G. J. Luttmer. "Selection, Growth, and the Size Distribution of Firms". *The Quarterly Journal of Economics* 122, no. 3 (Aug. 2007): 1103–1144
- Gian Luca Clementi and Berardino Palazzo. "Entry, exit, firm dynamics, and aggregate fluctuations". *American Economic Journal: Macroeconomics* 8, no. 3 (2016): 1–41
- Boyan Jovanovic. "Selection and the Evolution of Industry". *Econometrica: Journal of the Econometric Society* (1982): 649–670
- Esteban Rossi-Hansberg and Mark LJ Wright. "Establishment size dynamics in the aggregate economy". *American Economic Review* 97, no. 5 (2007): 1639–1666
- Andrew Atkeson and Patrick J Kehoe. "Modeling and measuring organization capital". *Journal of political Economy* 113, no. 5 (2005): 1026–1053
- Leo Kaas and Philipp Kircher. "Efficient firm dynamics in a frictional labor market". *American Economic Review* 105, no. 10 (2015): 3030–60
- (a survey) Erzo G.J. Luttmer. "Models of Growth and Firm Heterogeneity". *Annual Review of Economics* 2, no. 1 (2010): 547–576

### 2. Firm dynamics and financial frictions

- Thomas F Cooley and Vincenzo Quadrini. “Financial markets and firm dynamics”. *American economic review* 91, no. 5 (2001): 1286–1310
- Gian Luca Clementi and Hugo A Hopenhayn. “A theory of financing constraints and firm dynamics”. *The Quarterly Journal of Economics* 121, no. 1 (2006): 229–265
- Rui Albuquerque and Hugo A Hopenhayn. “Optimal lending contracts and firm dynamics”. *The Review of Economic Studies* 71, no. 2 (2004): 285–315
- Aubhik Khan and Julia K Thomas. “Credit shocks and aggregate fluctuations in an economy with production heterogeneity”. *Journal of Political Economy* 121, no. 6 (2013): 1055–1107
- Virgiliu Midrigan and Daniel Yi Xu. “Finance and Misallocation: Evidence from Plant-Level Data”. *The American Economic Review* 104, no. 2 (2014): 422–458
- Cristina Arellano, Yan Bai, and Patrick J. Kehoe. “Financial Frictions and Fluctuations in Volatility”. *Journal of Political Economy* 127, no. 5 (Oct. 2019): 2049–2103

### 3. Firm dynamics and innovation

- Tor Jakob Klette and Samuel Kortum. “Innovating firms and aggregate innovation”. *Journal of political economy* 112, no. 5 (2004): 986–1018
- Rasmus Lentz and Dale T. Mortensen. “An Empirical Model of Growth through Product Innovation”. *Econometrica* 76, no. 6 (2008): 1317–1373
- Daron Acemoglu et al. “Innovation, reallocation, and growth”. *American Economic Review* 108, no. 11 (2018): 3450–91
- Daniel Garcia-Macia, Chang-Tai Hsieh, and Peter J. Klenow. “How Destructive Is Innovation?” *Econometrica* 87, no. 5 (2019): 1507–1541

## PART 2. NETWORKS IN (MACRO) ECONOMICS

Why networks? Because firms (including financial institutions) are not isolated islands, despite being a common simplifying assumption. A network view of the production side acknowledges the interactions among individual firms, and emphasizes the consequences of these connections: how one firm’s decision affects other firms connected to it, potentially affects even more firms through these other firms’ connections, and affect the consumption/labor supply side of the economy at the same time.

Why now? Because we have a better theoretical toolkit and emerging new micro data, and unfortunate recent global events call for a deeper understanding of global/local supply chains and the consequence of their disruptions, among other things. Some tools and language introduced here are borrowed from statistics, computer science, sociology, epidemiology, etc. They are applicable in a wide variety of issues in economics, such as aggregate growth and fluctuations, evaluation

of policies (targeted tax, tariff, stimulus, and/or monetary), (global) supply chains, labor markets, income difference, systemic risks of financial institutions, etc. The data examined here that are useful for other topics as well. After all, a network is just a systematic view of a collection of transactions/ownerships/credit/other connections among agents.

### 1. **Micro origins of macro disturbances: baseline models and a brief history**

Can micro shocks cause sizable macro fluctuations? If so, when?

▣ Baseline models (modern takes):

- (granularity) Xavier Gabaix. “The granular origins of aggregate fluctuations”. *Econometrica* 79, no. 3 (2011): 733–772
- (network origins, asymmetry) Daron Acemoglu et al. “The network origins of aggregate fluctuations”. *Econometrica* 80, no. 5 (2012): 1977–2016
- (long-term trend) Vasco Carvalho and Xavier Gabaix. “The great diversification and its undoing”. *American Economic Review* 103, no. 5 (2013): 1697–1727
- (risk aggregation) Daron Acemoglu, Asuman Ozdaglar, and Alireza Tahbaz-Salehi. “Microeconomic origins of macroeconomic tail risks”. *American Economic Review* 107, no. 1 (2017): 54–108
- (finite firms) Vasco M. Carvalho and Basile Grassi. “Large Firm Dynamics and the Business Cycle”. *American Economic Review* 109, no. 4 (Apr. 2019): 1375–1425
- (a survey) Vasco M Carvalho. “From micro to macro via production networks”. *Journal of Economic Perspectives* 28, no. 4 (2014): 23–48
- (a survey) Vasco M. Carvalho and Alireza Tahbaz-Salehi. “Production Networks: A Primer”. *Annual Review of Economics* 11, no. 1 (2019): 635–663

▣ Earlier insights:

- (weighted aggregation) Charles R Hulten. “Growth accounting with intermediate inputs”. *The Review of Economic Studies* 45, no. 3 (1978): 511–518
- (intertemporal transmission) John B Jr Long and Charles I Plosser. “Real business cycles”. *Journal of Political Economy* 91, no. 1 (1983): 39–69
- (complementarity) Boyan Jovanovic. “Micro shocks and aggregate risk”. *The Quarterly Journal of Economics* 102, no. 2 (1987): 395–409

▣ A debate on sectoral shocks → aggregate fluctuations:

- (no: averaged-out micro shocks) Robert E Lucas Jr. “Understanding business cycles”. In *Carnegie-Rochester conference series on public policy*, 5:7–29. North-Holland, 1977

- (yes: sparseness of the I-O matrix) Michael Horvath. “Cyclicalities and sectoral linkages: Aggregate fluctuations from independent sectoral shocks”. *Review of Economic Dynamics* 1, no. 4 (1998): 781–808
- (yes) Michael Horvath. “Sectoral shocks and aggregate fluctuations”. *Journal of Monetary Economics* 45, no. 1 (2000): 69–106
- (no) Bill Dupor. “Aggregation and irrelevance in multi-sector models”. *Journal of Monetary Economics* 43, no. 2 (1999): 391–409

## 2. Empirical and quantitative findings on producer connections

Properties of input-output networks and firm-to-firm connections; transmission patterns along these connections; quantitative analysis.

### ▣ Common sources of data

[TBC] US-industry: BEA industry account; OECD-industry: STAN database; more countries-industry: GTAP; etc.

US-public firms: Compustat, Capital IQ, FactSet Revere; Belgium; Japan; Turkey; etc.

### ▣ Sector/industry level

- Daron Acemoglu, Ufuk Akcigit, and William Kerr. “Networks and the macroeconomy: An empirical exploration”. *NBER Macroeconomics Annual* 30, no. 1 (2016): 273–335
- Enghin Atalay. “How important are sectoral shocks?” *American Economic Journal: Macroeconomics* 9, no. 4 (2017): 254–80
- Andrew T Foerster, Pierre-Daniel G Sarte, and Mark W Watson. “Sectoral versus aggregate shocks: A structural factor analysis of industrial production”. *Journal of Political Economy* 119, no. 1 (2011): 1–38
- Vasco Carvalho and Xavier Gabaix. “The great diversification and its undoing”. *American Economic Review* 103, no. 5 (2013): 1697–1727

### ▣ Firm level firm-to-firm connections

- Enghin Atalay et al. “Network structure of production”. *Proceedings of the National Academy of Sciences* 108, no. 13 (2011): 5199–5202
- Jean-Noël Barrot and Julien Sauvagnat. “Input specificity and the propagation of idiosyncratic shocks in production networks”. *The Quarterly Journal of Economics* 131, no. 3 (2016): 1543–1592
- Andrew B Bernard et al. *The origins of firm heterogeneity: A production network approach*. Tech. rep. National Bureau of Economic Research, 2019

- Vasco M Carvalho et al. *Supply chain disruptions: Evidence from the great east japan earthquake*. Tech. rep. 17-5. Columbia University, 2016
- Christoph E Boehm, Aaron Flaaen, and Nitya Pandalai-Nayar. “Input linkages and the transmission of shocks: firm-level evidence from the 2011 Tōhoku earthquake”. *Review of Economics and Statistics* 101, no. 1 (2019): 60–75
- Julian Di Giovanni, Andrei A Levchenko, and Isabelle Mejean. “Firms, destinations, and aggregate fluctuations”. *Econometrica* 82, no. 4 (2014): 1303–1340

### 3. Frictions and market imperfections in a fixed network

- Charles I Jones. “Input—Output Economics”. In *Advances in Economics and Econometrics: Tenth World Congress*, 2:419. Cambridge University Press, 2013
- Ernest Liu. *Industrial Policies and Economic Development*. Tech. rep. Princeton University, 2017
- David Rezza Baqaee. “Cascading failures in production networks”. *Econometrica* 86, no. 5 (2018): 1819–1838
- Saki Bigio and Jennifer La’O. “Distortions in Production Networks”. *The Quarterly Journal of Economics* (forthcoming)
- David Rezza Baqaee and Emmanuel Farhi. “Productivity and misallocation in general equilibrium”. *The Quarterly Journal of Economics* 135, no. 1 (2020): 105–163
- Basile Grassi et al. “IO in I-O: Size, industrial organization, and the input-output network make a firm structurally important”. *Work. Pap., Bocconi Univ., Milan, Italy* (2017)

### 4. Network formation

#### ▣ Exogenous, statistical models of production network formation/evolution:

- Matthew O Jackson and Brian W Rogers. “Meeting Strangers and Friends of Friends: How Random Are Social Networks?” *American Economic Review* 97, no. 3 (May 2007): 890–915
- Enghin Atalay et al. “Network structure of production”. *Proceedings of the National Academy of Sciences* 108, no. 13 (2011): 5199–5202
- Vasco M Carvalho and Nico Voigtländer. *Input diffusion and the evolution of production networks*. Tech. rep. National Bureau of Economic Research, 2014
- Thomas Chaney. “The Network Structure of International Trade”. *American Economic Review* 104, no. 11 (Nov. 2014): 3600–3634

#### ▣ Endogenous production network formation:

- Ezra Oberfield. “A theory of input–output architecture”. *Econometrica* 86, no. 2 (2018): 559–589
- Daron Acemoglu and Pablo D Azar. “Endogenous production networks”. *Econometrica* 88, no. 1 (2020): 33–82
- Mathieu Taschereau-Dumouchel. “Cascades and fluctuations in an economy with an endogenous production network”. *Available at SSRN 3115854* (2019)
- Kevin Lim et al. “Firm-to-firm Trade in Sticky Production Networks”. In *2017 Meeting Papers*. 280. Society for Economic Dynamics, 2017
- Johannes Boehm and Ezra Oberfield. “Misallocation in the Market for Inputs: Enforcement and the Organization of Production”. *The Quarterly Journal of Economics* (June 2020)

#### 5. **Networks in finance**

- Daron Acemoglu, Asuman Ozdaglar, and Alireza Tahbaz-Salehi. “Systemic risk and stability in financial networks”. *American Economic Review* 105, no. 2 (2015): 564–608
- Matthew Elliott, Benjamin Golub, and Matthew O Jackson. “Financial networks and contagion”. *American Economic Review* 104, no. 10 (2014): 3115–53
- (a survey) Paul Glasserman and H. Peyton Young. “Contagion in Financial Networks”. *Journal of Economic Literature* 54, no. 3 (Sept. 2016): 779–831

#### 6. **Knowledge network** (optional, if time permits) [TBC]

- Daron Acemoglu, Ufuk Akcigit, and William R. Kerr. “Innovation network”. *PNAS; Proceedings of the National Academy of Sciences* 113, no. 41 (2016): 11483–11488
- Jie Cai and Nan Li. “Growth Through Inter-sectoral Knowledge Linkages”. *The Review of Economic Studies* 86, no. 5 (Nov. 2018): 1827–1866

#### 7. **Networks in trade** (optional, if time permits)

- Thomas Chaney. “The Network Structure of International Trade”. *American Economic Review* 104, no. 11 (Nov. 2014): 3600–3634
- (a survey) Andrew B. Bernard and Andreas Moxnes. “Networks and Trade”. *Annual Review of Economics* 10, no. 1 (2018): 65–85