There is tremendous heterogeneity across firms at the micro level; even within narrowly defined sectors, firms vary a lot in their productivity, investment, hiring, and other variables. This part of the course is designed to introduce you to these facts and assess their implications for macroeconomic outcomes. We will emphasize the interaction between empirical evidence – which tells us how firms behave – and quantitative, heterogeneous agent macro models – which tells us how to map that behavior into macroeconomic outcomes. A key question throughout the course is: how does firm heterogeneity change our understanding of the dynamics of aggregate variables, relative to the predictions of representative agent models? We will discuss two broad answers to this question:

1. The dynamics of aggregate variables depend on the entire distribution of heterogeneous firms, which cannot be captured in a representative agent framework.
2. Cross-sectional or panel micro data provides direct evidence on how firms make decisions, and therefore provide valuable information for estimating model parameters not included in aggregate time series data.

To do research in this area you should be comfortable both with doing empirical work in micro data and in quantitative modeling. I will assign two homework exercises to introduce you to both of these skills. In the first assignment (due January 18th), you will use Compustat microdata to estimate firms’ productivity and how it is related to the firms’ decisions. In the second assignment (due February 1st), you will numerically solve a simple investment model and compare the model’s prediction for the relationship between investment and productivity to that you found in the data.

The course is organized in five different topics plus one short review topic of representative agent macroeconomics. I have compiled a list of readings for each topic, some of which we will cover in class and others which are for your own reference. Before the lecture for each topic, I ask that you:

1. Read the papers with the **Required Reading** marker. Starting in the second lecture, I will randomly call on a registered student to lead an informal, five minute summary of the paper. Be prepared to explain: (1) the main question of the paper, (2) the paper’s answer to the question, (3) how they arrived at that answer, and (4) how it contributes to the existing literature.
2. Starting in the third lecture, we will have students formally present papers with the **Presentations** marker. The length of the presentations will be 30-45 minutes, depending on the number of registered students in the course (not all students will present in my half; others will present in Rohan’s half). See the presentation guidelines on my website for details on how to make a successful presentation. Students not presenting should still read the paper carefully and be prepared to have an informed discussion.
3. Skim the other papers if you are interested.
**Topic 0: Course Introduction and Representative Agent Macroeconomics**

Before diving into the role of firm heterogeneity in understanding aggregate dynamics, we must first establish the representative agent benchmark.

**Real Business Cycles and Indivisible Labor**

In class, we will carefully go through the specification and calibration of the real business cycle model, and discuss the key economic forces the model captures. We will also discuss how indivisible labor implies that micro-level labor supply elasticities may be very different from macro-level elasticities.


**New Keynesian Models**

Although we will not have time to discuss it, interested students should also look into the New Keynesian DSGE literature, which introduces complicated frictions into the real business cycle model and often formally estimates models using likelihood-based econometrics.


**Topic 1: Productivity Dispersion, Aggregation, and Misallocation**

At face value, the representative agent assumption says that there is only one firm in the economy which loosely corresponds to an “average” firm in the data.

**Productivity, Churning, and Heterogeneity**

In this topic, we will first discuss empirically that firms differ greatly along a key dimension: productivity.
“Misallocation” and Reduced-Form Frictions to Factor Choices

The fact that firms are heterogeneous is not enough to allow us to conclude that representative agent models are not useful: we will see in class that if there are no frictions to firms adjusting inputs, the dynamics of aggregate variables behave as if there is a representative firm, even if at the micro-level firms in fact are heterogeneous over productivity. We will then discuss a literature that argues there are many such frictions, and that they can be captured using a reduced-form measure of “misallocation.” This literature generally finds that these reduced-form frictions matter a lot for determining aggregate outcomes. For the rest of the class, we will discuss various structural models which can account for part of these reduced-form frictions.


**Topic 2: Capital Investment and Adjustment Costs**

The first structural friction that we will discuss is adjustment costs to firms’ capital accumulation.

*Empirics and Basic Investment Theory*
We will begin by discussing the empirical patterns of firm-level investment decisions. In order to do this, we will need to briefly review user cost and q theory approaches to investment, since a lot of the older papers in the literature are built around those models. Many of the papers we read will use tax policy as a source of variation in the cost of capital.


**Partial Equilibrium Investment Models**

Having established some basic facts about investment, we will then move to studying what those facts tell us about the structure of the investment problem faced by firms.


**Aggregate Implications of Fixed Costs**

The partial equilibrium literature typically finds that fixed costs are important in accounting for the lumpiness of investment at the micro level. We will then assess the implications of these models for aggregate investment dynamics.

Solving Heterogeneous Firm Macro Models

In order to discuss the aggregate implications in a general equilibrium environment, we will also have to briefly think about how to compute the equilibria of models which feature heterogeneity. The main challenge is that the entire distribution of firms is a relevant state variable for the economy. The distribution is typically an infinite-dimensional object whose dynamics must satisfy a complicated fixed point problem: each firms’ decision depends on the expectations of the evolution of the distribution, and the evolution of the distribution depends on firms’ decisions.


Topic 3: Financial Frictions

The third topic that we will discuss is financial frictions. Although we will mainly focus on the implications of financial frictions on investment, there are parallel literatures studying the implications of financial frictions on hiring and pricing decisions.

Empirical Evidence

We will begin our discussion of financial frictions by giving an overview of the empirical literature on how financial variables affect investment (and other) firm-level decisions. Many of the older empirical papers were concerned with showing clear evidence that financial constraints affect firms’ decisions. Since the financial crisis, however, a number of recent papers are concerned with studying how the effect particular macroeconomic shocks depend on firms’ financial positions.


*Business Cycle Implications of Financial Frictions*

After reviewing the empirical evidence, we will incorporate financial frictions into the benchmark Khan and Thomas (2008) heterogeneous firm model and study aggregate business cycle outcomes.

• **Required Reading:** Khan, Aubhik and Julia Thomas (2013), “Credit Shocks and Aggregate Fluctuations in an Economy with Production Heterogeneity,” *Journal of Political Economy*


*Representative Agent Business Cycle Models with Financial Frictions*

Although we will not discuss representative firm models with financial constraints in our class, there are a number of such models.


*Models for Development*
There is also a sizeable literature studying how financial constraints affect development. The following paper is a good introduction to this literature.


**Topic 4: Entry, Exit, and the Lifecycles of Firms**
The fourth topic that we will discuss is the lifecycle of firms. In a model without any frictions to firm growth, new entrants would immediately grow to their optimal scale. However, in the data, the growth process takes many years. The literature on firm lifecycles studies potential frictions in this process and to what extent they can account for the growth patterns of firms.

*The Classics*
These two papers are among the first modern empirical and theoretical studies of firm dynamics. Hopenhayn’s model forms the backbone of the heterogeneous firm models we have studied in class so far.


*Capital Adjustment Costs*
One strand of literature studies whether capital adjustment costs can quantitatively account for lifecycle growth dynamics among firms.


*Accumulating Customers*
Another strand of literature studies whether the process of accumulating customers can account for prolonged growth dynamics among firms.

- **Presentation**: Foster, Lucia, John Haltiwanger, and Chad Syverson (2016), “The Slow Growth of New Plants: Learning About Demand?,” *Economica*
Declining Entry over Time

- **Presentation**: Karahan, Fatih, Ben Pugsley, and Aysegul Sahin, “Demographic Origins of the Startup Deficit” (2018)

Topic 5: Trends in Concentration, Competition, and Markups
The last topic that we will discuss is a new literature studying trends in market concentration, competition, and markups.

Declining Dynamism

Markups

Competition and Investment
- Gutierrez, German and Thomas Phillipon (2017), “Declining Dynamism and Investment in the U.S.,” *NBER WP 23583*

Labor Share