Anthony Tokman, CC '16
Project Title: Firm Dynamics and Macroeconomic Growth
Professor: Costas Arkolakis

Project Overview

The purpose of this project was to simulate and assess a novel framework for firm selection and growth, which is capable of explaining patterns at the macroeconomic level and in international trade. The framework uses stochastic processes (such as Brownian motion) to model firm productivities over time, as well as aggregate technology shocks that affect the whole economy. Because of the model's mathematical complexity, simulation is the quickest and cleanest way to extract numerical results from the theory. Simulation allowed us to create economies (consisting of millions of potentially profitable ideas) according to the model, then solve for the trade equilibrium between the economies. We used the results of the simulation to compute various statistics, which could then be compared to real-world trade and sales data. Although this is an ongoing project—and the simulation is still being calibrated—we already found that the simulation results closely match real-world data.

Responsibilities

I wrote MATLAB script to streamline and extend the functionality of the simulation, pieces of which had been coded earlier. My work included:

- Making the code much more efficient by using some of MATLAB's unique features, and modularizing it to make it easier to read and understand.
- Adding support for new stochastic processes (Ornstein-Uhlenbeck and autoregressive) to the simulation.
- Computing statistics such as individual firm sales and ages, consumer price index, and Haltiwanger decomposition, which gives the contributions of incumbent, newcomer, and exiting firms to overall productivity.
- Writing code to facilitate calibration of the model (by changing parameters such as trade costs).

What I Learned

The most important lesson that I took away from this project is that undergraduate macroeconomics is nothing like the research currently being done in the field. The macro at the cutting-edge is much more mathematically demanding, and often requires simulations like the one I worked on for this project. It also tries to build on more rigorous microfoundations, rather than trying to both start and end with an economy that has millions of agents. This project introduced me to some of the widely-accepted models in contemporary macro research, as well as those that are currently being developed. On a more modest level, my work led me to learn about stochastic processes and a bit about stochastic differential equations; I also greatly improved my MATLAB programming skills, and learned (the hard way) that sometimes 16 GB of RAM simply doesn't cut it.

Overall Experience

I greatly enjoyed the SRO experience. Prof. Arkolakis was a pleasure to work with: he was very helpful, his assignments were reasonably challenging, and he made the research assistantship more of a two-way collaboration. The work I was doing was not at all mechanical—it required thinking and experimentation, as well as learning advanced new concepts. I'm very glad that I had the chance to get involved in economics research at this time, as it will help guide my decision regarding graduate school in the near future.