ECON5529

Final Project

Due December 17th

1 Gibrat's Law

This project draws from the following resources available on Blackboard:

- R. Axtell et al., Zipf Distribution of U.S. Firm Sizes, *Science*, Vo. 293 (2001).
- G. Bottazzi and A Secchi, Common Properties and Sectoral Specificities in the Dynamics of U.S. Manufacturing Companies *Review of Industrial Organization*, Vol. 23 (2003) pp.217-232.
- E. Cefis, Testing Gibrat's legacy: A Bayesian approach to study the growth of firms, *Structural Change and Economic Dynamics*, Vol.18, (2007) pp. 348-369.
- M. Kalecki, On the Gibrat Distribution, *Econometrica*, Vol. 13, No. 2 (Apr., 1945), pp. 161-170
- R. Lucas, On the Size Distribution of Business Firms, *The Bell Journal of Economics*, Vol. 9, No. 2 (1978), pp. 508-523.
- H. Simon, The size distribution of business firms, *American Economic Review*, Vol. 48, No. 4 (1958), pp.607-617.

1. In the field of industrial organization that studies the distributional regularities of firms, one important finding was made by Robert Gibrat in 1931. He discovered what is now known as the "law of proportionate effect." This law (also called "Gibrat's law"), originally used as an explanation of the highly skewed firms size distributions, states that the proportional rate of growth of a firm is independent of its absolute size. Gibrat's law implies that as a firm evolves, its size follows a random walk. This suggests that the growth of firms (measured e.g. by total revenue) is driven by small idiosyncratic

random shocks and hence there is no short-run or long-run convergence of firms to an “optimal size."

a) Go to https://wrds-web.wharton.upenn.edu/wrds/ and create and register for an account. Navigate to COMPUSTAT North America Fundamentals Annual.
   - Step 1: Set the date range as 1962-12 to 2016-12.
   - Step 2: select GVKEY and "Search the entire database". Under screening variables remove financial services (FS) from industry format and Canadian dollars (CAD) from currency.
   - Step 3: Include Company Name, SIC, FYEAR, SALE, AT, in your query. Select the .csv output format and submit query.
   - Step 4: Import the data into R as a data.table.

b) Subset the data to only include the manufacturing industry (SIC 2000-3900) and complete cases. You should have no NAs after this step.

c) Create a new variable representing the years survived by each firm. For example,

   `data[,surv:=length(fyear),by=gvkey]`

d) Subset the data to only include firms that have lived the span of the data set.

e) Create a unique numeric identifier for each firm .

If the evolution of firm sizes follows Gibrat’s law then firm growth rates are determined by a random walk with an autoregressive specification:

$$g_t = \alpha + \rho g_{t-1} + \epsilon_t \tag{1.1}$$

where ϵ_t are independently and normally distributed with mean zero and variance σ_i^2. If $\rho = 1$ Gibrat’s law is confirmed and the growth of the firm is unrelated to its current size and only depends on the sum of idiosyncratic shocks.

a) Define the growth of firm size to be $\log[\frac{sale_{i,t}}{mean[sale_t]}]$. Dividing by each year’s mean revenue will control for the increasing trend of total revenue as well any common shocks experience by all firms. You can use data.table to calculate the mean efficiently:

   `data[,rbar:=mean(sale),by=fyear]`

b) To test this model run the following $AR(1)$ model in STAN (see stan user guide for details on time series models):

$$g_t = \alpha + \rho g_{t-1} + \epsilon_t \tag{1.2}$$

c) Does it appear Gibrat’s law holds for long-lived manufacturing firms in the US? Explain in term of the posterior density of ρ, i.e. how probable is Gibrat’s law?

d) Test that this finding using total sales (SALE) is robust to other measures of firm size such as total assets (AT).

e) Compare your results to long-lived firms in other sectors of your choice.