Graduate Trade (II): ECON 8433

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University of Colorado Boulder
Fall Semester 2020

Plan

WEEK	TOPIC
Week 1	Introduction to Structural Gravity Equation
Week 2	Calibration and Estimation
Week 3	Mapping Models to the Data
Week 4	Designing Counterfactual Experiments in General Equilibrium
Week 5	Presentations (I) and Catch-up
Week 6	Heterogeneous Firms (I)
Week 7	Heterogeneous Firms (II)
Week 8	Ricardian Models
Week 9	Multi-Sector Models
Week 10	Global Value Chains
Week 11	Presentations (II) and Catch-up
Week 12	Extensions: Demand Side
Week 13	Extensions: Supply Side
Week 14	Extensions: Migration and Geography
Week 15	Presentations (III) and Catch-up

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Timing

FCQ's:

- colorado.campuslabs.com/courseeval

Extensions: Supply Side

Extensions: Supply Side

What we have seen so far:

- We started with a version where labor was the only factor of production
- In a multi-sector version, we incorporated intermediate inputs
- TFP parameters are firm-specific and follow a known p.d.f.

There are many possible extensions on the supply side:

- Separate unskilled and skilled workers as in Parro (2013)
- Make share of intermediate inputs endogenous as in Blaum, Lelarge and Peters (2018)
- Estimate and apply more plausible distribution of TFP parameters as in Nigai (2017)

Firm heterogeneity and aggregate economic outcomes

- Aggregate productivity
  - Restuccia and Rogerson (2008), Hsieh and Klenow (2009)
- Comparative advantage
  - Bernard, Redding and Schott (2007)
- Wage inequality
  - Egger and Kreickemeier (2009), Helpman, Itskhoki and Redding (2010), Card, Cardoso, Heining and Kline (2016)
- Innovation and growth
  - Baldwin and Robert-Nicoud (2008), Sampson (2016)

Firm heterogeneity and international trade

- Trade elasticity (import price elasticity)
  - Eaton and Kortum (2002), Costinot, Donaldson and Komunjer (2012)
- Firm entry and exit in production and exporting
  - Melitz (2003), Chaney (2008), Melitz and Ottaviano (2008)
- Size of trade flows across countries and time
  - Melitz and Ghironi (2007), Melitz, Helpman, and Rubinstein (2008), Bernard, Jensen, Redding and Schott (2012), Freund and Pierola (2015)
- Welfare gains from trade
  - Melitz and Redding (2014), Head, Mayer and Thoenig (2014)

Productivity distribution and selection effects

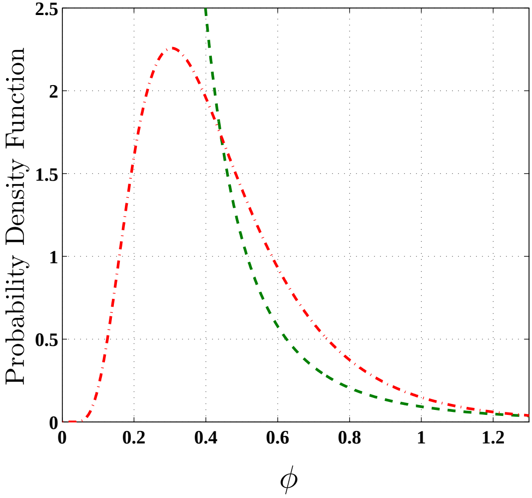

Figure: Productivity distributions and selection

Productivity distribution and selection effects

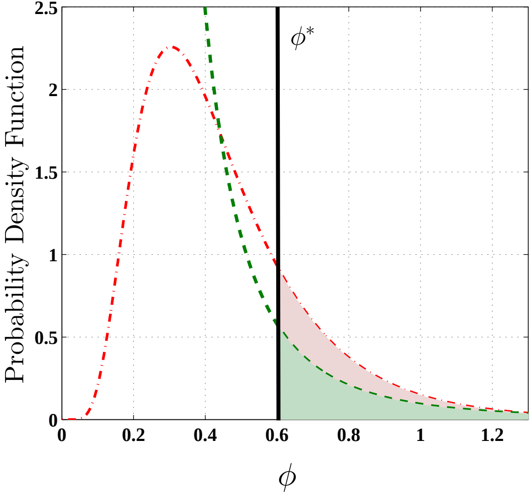

Figure: PRODUCTIVITY DISTRIBUTIONS AND SELECTION

Outline

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1. Overview of current approaches
2. Two-piece distribution
3. Data and estimation
4. Workhorse trade model with heterogeneous firms
5. Counterfactual experiments
6. Sensitivity analysis and extensions
7. Follow-up research
8. Conclusion

Left tail (bottom 95%) : Pareto or Log-normal?

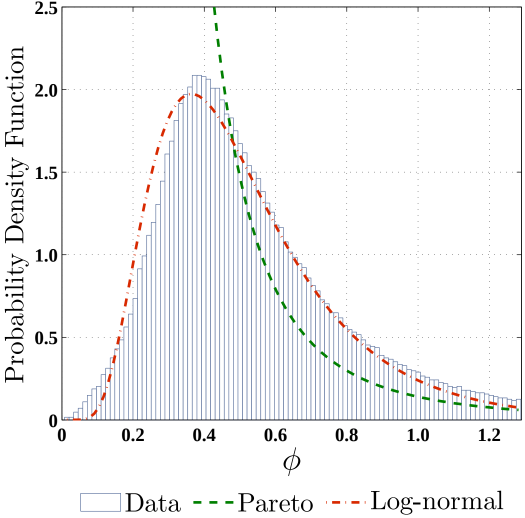

Figure: Empirical and Parametric p.d.f.'s (Left Tail)

Right tail (top 5%) : Pareto or Log-normal?

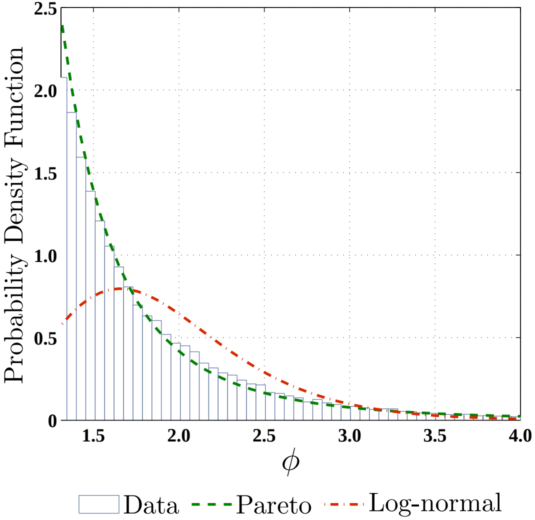

Figure: Empirical and Parametric p.d.f.'s (Right Tail)

Right tail (top 5%) : Pareto or Log-normal?

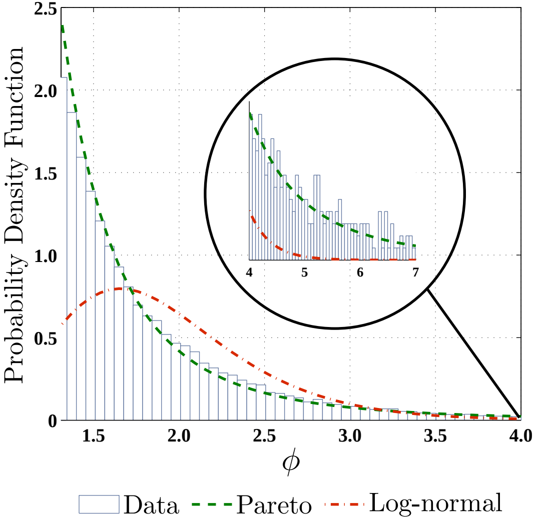

Figure: EMPIRICAL AND PARAMETRIC P.D.F.'S (RIGHT TAIL)

Pareto or Log-normal?

Three main observations:

- Pareto does not capture the shape of the left tail
- Log-normal underpredicts the thickness of the right tail
- Neither captures the empirical distribution over the entire support

So what?

Are deviations from the empirical distribution harmful?

- Both (un-)bounded Pareto and Log-normal lead to significant errors in trade outcomes:
  - Welfare gains from trade
  - Extensive margin of trade
  - Intensive margin of trade

Why?

- Efficiency distribution determines the magnitude of the selection effects:
  - Entry and exporting
  - Available varieties and their prices

Contribution of this paper

This paper proposes using a mixed distribution dubbed *Two-piece*. The distribution has several advantages:

- Models left tail as Log-normal (captures bell shape)
- Models right tail as Pareto (captures fat right tail)
- Amalgamates the relevant portions of the p.d.f.'s at an endogenous threshold
- Still parametric, tractable and well-behaved distribution
- Fits the data considerably better than (un-)bounded Pareto and Log-normal almost everywhere
- Produces negligible errors in the estimates of the gains from trade and other trade outcomes

Related literature

Why one may choose Pareto:

- Many firm-specific outcomes follow Pareto (at least in the upper tail):
  - Simon and Bonini (1958), Luttmer (2007), Axtell (2001), Gabaix (2008), Levchenko and di Giovanni (2012)
- By far the most popular choice in quantitative models:
  - Following Baldwin (2005) and Chaney (2008), hundreds of papers use Pareto, e.g., Melitz and Ottaviano (2008), Arkolakis, Costinot and Rodríguez-Clare (2012), Melitz and Redding (2014) and many others
- Elegant and easy to handle analytically

Related literature

Why one may choose Log-normal:

- Fits the data better on a larger interval of the support ($> 90\%$):
  - Head, Mayer and Thoenig (2014), Freund and Pierola (2015)
- Leads to non-linear trade elasticities which are supported by the data:
  - Yang (2014), Bas, Mayer and Thoenig (2015), and Fernandes, Klenow, Meleshchuk, Pierola, and Rodríguez-Clare (2015)
- Not as elegant as Pareto but still tractable

Related literature

The paper is related to:

- Arkolakis (2015), who shows how endogenous growth processes can lead to mixture distribution of productivities
- Mrazova, Neary and Parenti (2015), who show how different assumptions about the structure of demand and technology affect distribution of firms outcomes
- Papers when the choice between Pareto and Log-normal is unclear, e.g., the debate about the city size distribution Gabaix (1999), Eeckhout (2004, 2009) and Levy (2009)

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Log-normal meets Pareto

Following Cooray and Ananda (2005) and Scollnik (2007) start with:

$$f_L(\phi) = \frac{1}{\sqrt{2\pi} s\phi} e^{-\frac{1}{2}\left(\frac{\ln\phi-\mu}{s}\right)^2} \text{ and } f_P(\phi) = \frac{\alpha\theta^\alpha}{\phi^{\alpha+1}}. \tag{1}$$

Derive Two-piece distribution by imposing the following conditions:

- Random variable ϕ follows Log-normal up to a threshold, θ, and Pareto after that
- Two-piece is a well-behaved distribution:
  - continuous
  - differentiable
  - p.d.f. and c.d.f. have all necessary properties

Two-piece distribution

The resulting distribution has the following c.d.f. and p.d.f. :

$$F(\phi) = \begin{cases} \dfrac{\rho}{\Phi[\alpha s(\alpha,\rho)]}\Phi\left(\alpha s(\alpha,\rho) + \dfrac{\ln\phi - \ln\theta}{s(\alpha,\rho)}\right) & \text{for } \phi \in (0,\theta] \\ 1-(1-\rho)\dfrac{\theta^\alpha}{\phi^\alpha} & \text{for } \phi \in [\theta,\infty) \end{cases}$$

$$f(\phi) = \begin{cases} \dfrac{\rho}{\Phi[\alpha s(\alpha,\rho)]}\dfrac{1}{\sqrt{2\pi}s(\alpha,\rho)\phi}e^{-\frac{1}{2}\left(\alpha s(\alpha,\rho)-\frac{\ln\theta-\ln\phi}{s(\alpha,\rho)}\right)^2} & \text{for } \phi \in (0,\theta] \\ (1-\rho)\dfrac{\alpha\theta^\alpha}{\phi^{\alpha+1}} & \text{for } \phi \in [\theta,\infty) \end{cases}$$

where $\Phi(\cdot)$ is c.d.f. of standard normal and $s(\rho,\alpha)$ is an implicit function that defines s given ρ and α according to:

$$\Phi\left[\alpha s(\alpha,\rho)\right]\sqrt{2\pi}[\alpha s(\alpha,\rho)]e^{\frac{1}{2}[\alpha s(\alpha,\rho)]^2} = \frac{\rho}{1-\rho}$$

Two-piece distribution

The Two-piece distribution is characterized by the following parameters:

- Threshold parameter, θ, identifies the cut-off point
- Second scale parameter, ρ, identifies the share of the population that follows Log-normal
- Shape parameter, α, comes from the original Pareto distribution

Parameterized example:

- Set $\theta = 1$, $\rho = 0.95$, $\alpha = 3$.
- Choose parameters for Log-normal and Pareto to match the first two moments

Parameterized example

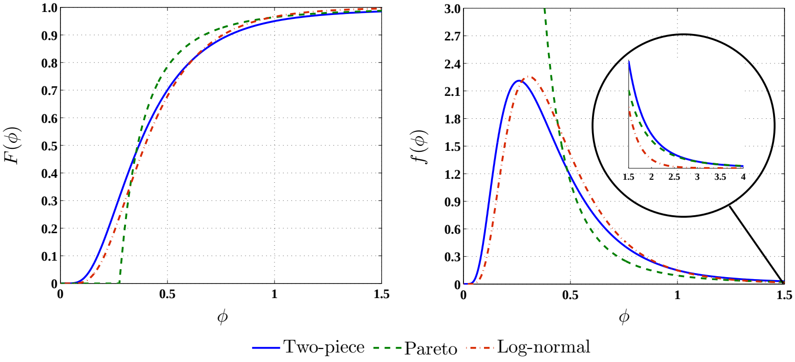

Figure: Two-piece, Log-normal and Pareto