Large Firm Dynamics and the Business Cycle

Carvalho and Grassi, AER 2019

Presenting by: Pooya Rashidi Ravari

University of British Columbia

pooyaravari@gmail.com

March 2, 2020

Overview

Question and Method

- Do large firm dynamics drive the business cycle?
- Using standard heterogeneous firm dynamics setup
- Show the role of large firm dynamics, in shaping aggregate fluctuations, theoretically, quantitatively, and in the data.

Main Story: Law of Large Number

- Even in perfect competitive economy, if we have finite firms $\Rightarrow$ NO LLN (Law of Large Numbers):
  - We don't have stationary distribution
  - We can have fluctuations

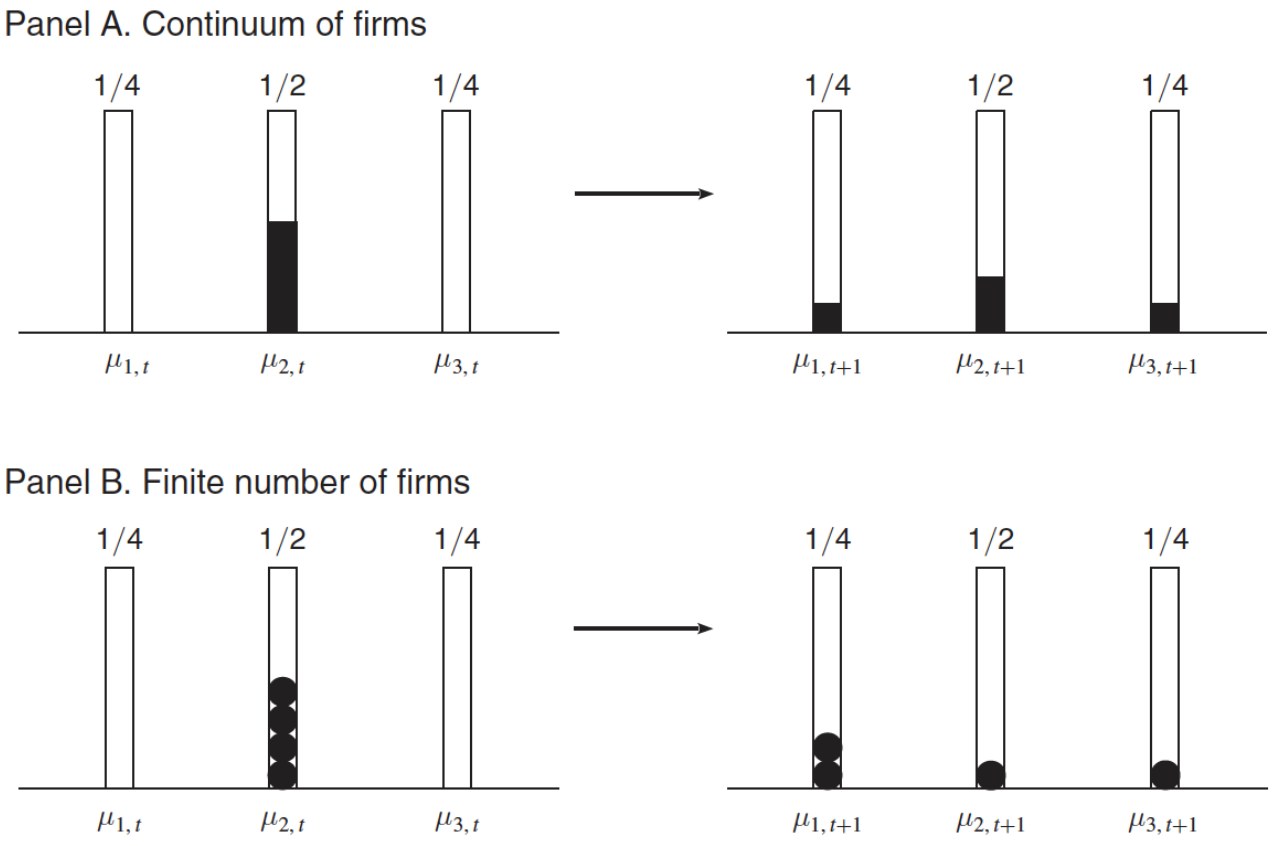


FIGURE 1. WHY THE VECTOR μ_{t+1} FOLLOWS A MULTINOMIAL DISTRIBUTION

Model

- Productivity Process: $\Phi := \{\rho^1, ..., \rho^S\}$
- The only aggregate state variable of this model is the distribution of firms on the set Φ : μ_t
- Incumbents' Problem: $\pi^*(\mu, \rho^s) = \max_n\{\rho^s n^\alpha - w(\mu)n - c_f\}$ which gives following Bellman equation:

$$V(\mu, \rho^s) = \pi^*(\mu, \rho^s) + \max\{0, \beta \int_{\mu' \in \Lambda} \sum_{\rho^{s'} \in \Phi} V(\mu', \rho^{s'}) F(\rho^{s'}|\rho^s) \Gamma(d\mu'|\mu)\} \quad (1)$$

Model: continued

- Entrants' Problem':

$$V^e(\mu, \rho^q) = \max\{c_e, \beta \int_{\mu' \in \Lambda} \sum_{\rho^{q'} \in \Phi} V(\mu', \rho^{q'}) F(\rho^{q'}|\rho^q) \Gamma(d\mu'|\mu)\} \tag{2}$$

- supply of labor: $L^s(w) = Mw^\gamma$
  M: the number of potential entrants.
- Aggregate Output: $Y_t = A_t^{1-\alpha}(L_t^d)^\alpha$
  $A_t = \sum_{i=1}^{N_t} (\rho^{s_{i,t}})^{\frac{1}{1-\alpha}}$

Special Markov Process

- ASSUMPTION 1: Firm-level productivity evolves as a Markov chain on the state space $\Phi = \rho_{ss}$ with transition matrix:

$$P = \begin{bmatrix} a+b & c & 0 & .... & ..... & 0 & 0 \\ a & b & c & .... & ..... & 0 & 0 \\ . & . & . & .... & ..... & 0 & 0 \\ . & . & . & .... & ..... & 0 & 0 \\ 0 & 0 & 0 & .... & a & b & c \\ 0 & 0 & 0.... & ..... & 0 & a & b+c \end{bmatrix} \quad (3)$$

- Córdoba (2008) shows that the stationary distribution associated with this Markovian process is a power law distribution with tail index: $\delta = log(a/c)/log(\rho)$
- Assumption 2: Allow the maximum productivity level to increase with the number of firms: $\rho^S = ZN^{1/\delta}$

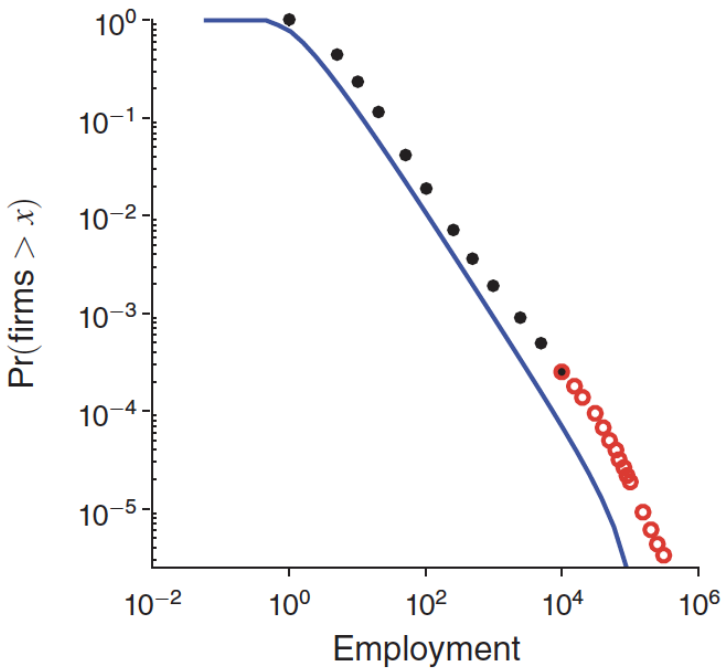
Data: BDS 1977-2012

- Assume $\alpha = 0.8 \Rightarrow$ tail of the productivity distribution of incumbents
- fix the tail index for entrant distribution
- Targets of other parameters:
  - volatility of firm-level productivity growth
  - the steady-state entry rate, i.e., the ratio of entrants to incumbents.

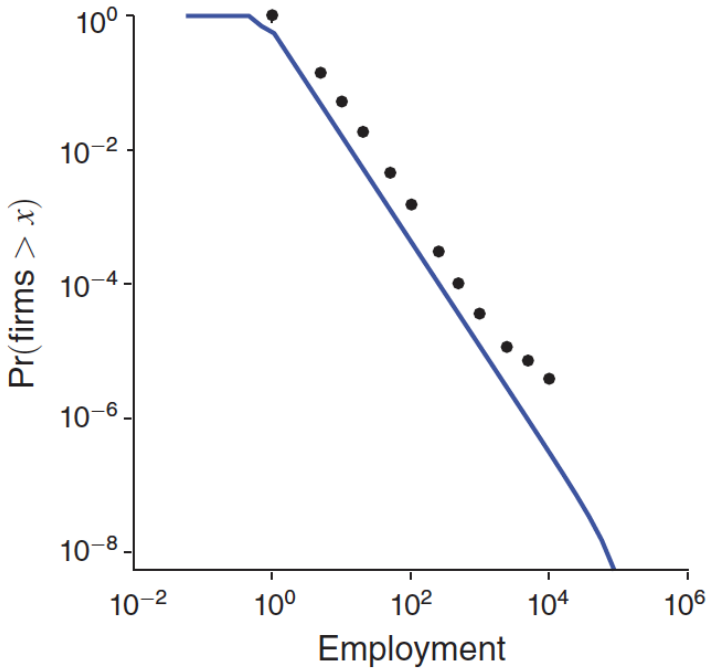
Performance of Model

- BDS doesn't have firms with more than 10,000 employers $\Rightarrow$ Compustat data.
- Model accurately reproduces both the mass of small firms in the BDS data and the mass of large firms in the Compustat data. NOTE: calibration strategy was only the tail estimated on BDS data

Panel A. Incumbent distribution against data



Panel B. Entrant distribution against data



Performance of Model

- Aggregate Fluctuations:
  - evolution of micro-level productivity
  - optimal decisions by firms regarding size, entry, and exit

TABLE 3—BUSINESS CYCLE STATISTICS

	Model			Data		
	$\sigma(x)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$	$\sigma(x)$	$\frac{\sigma(x)}{\sigma(y)}$	$\rho(x,y)$
Output	0.55	1.0	1.0	1.83	1.00	1.00
Hours	0.36	0.66	1.0	1.78	0.98	0.90
Aggregate TFP	0.25	0.46	1.0	1.04	0.57	0.66

Notes: The model statistics are computed for the baseline calibration (cf. Table 2) for an economy simulated for 20,000 periods. The data statistics are computed from annual data in deviations from an HP trend. The source of the data is Fernald (2014). The aggregate productivity series is the Solow residual series. For further details refer to online Appendix C.

Main Story: LLN

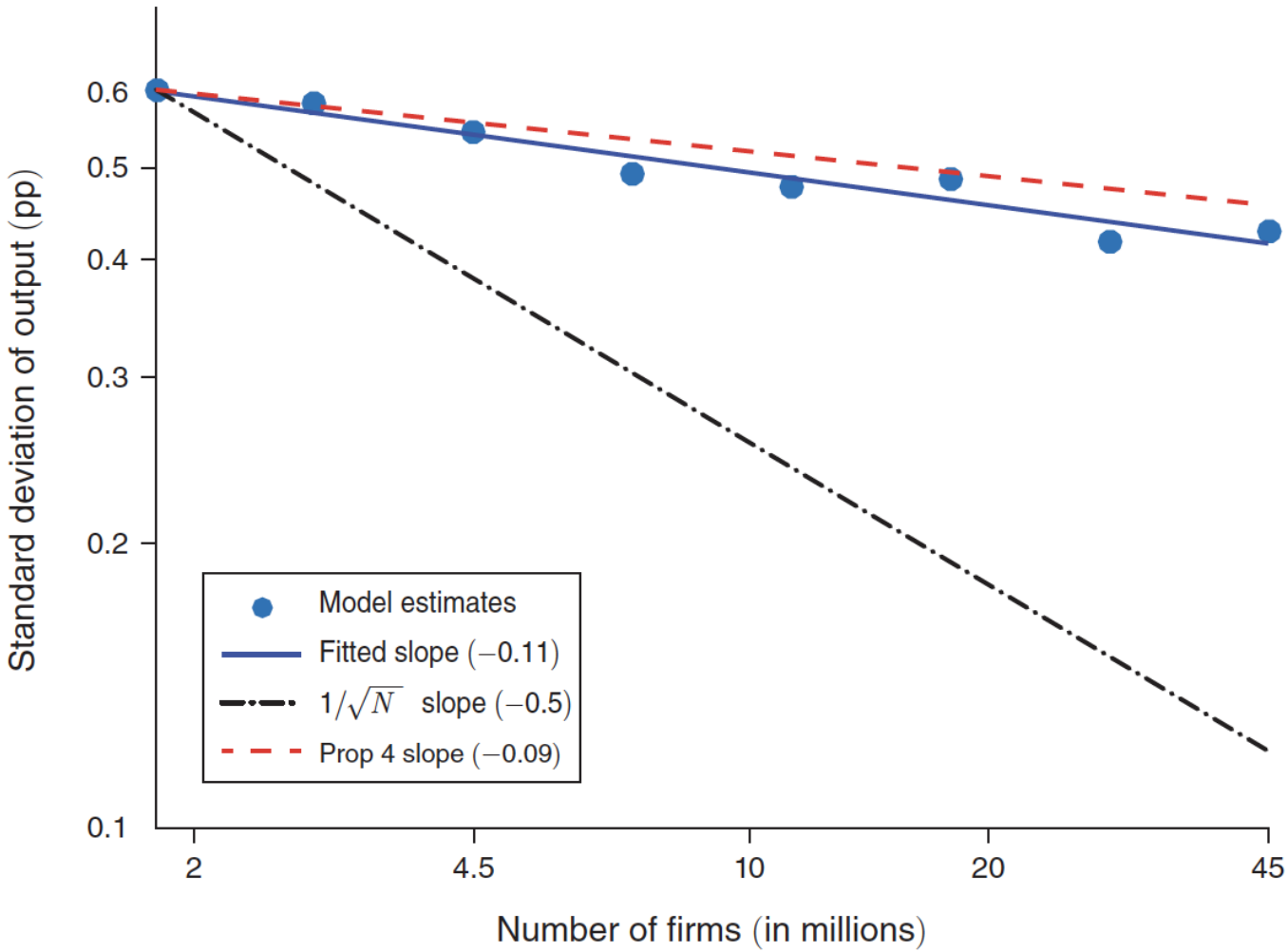
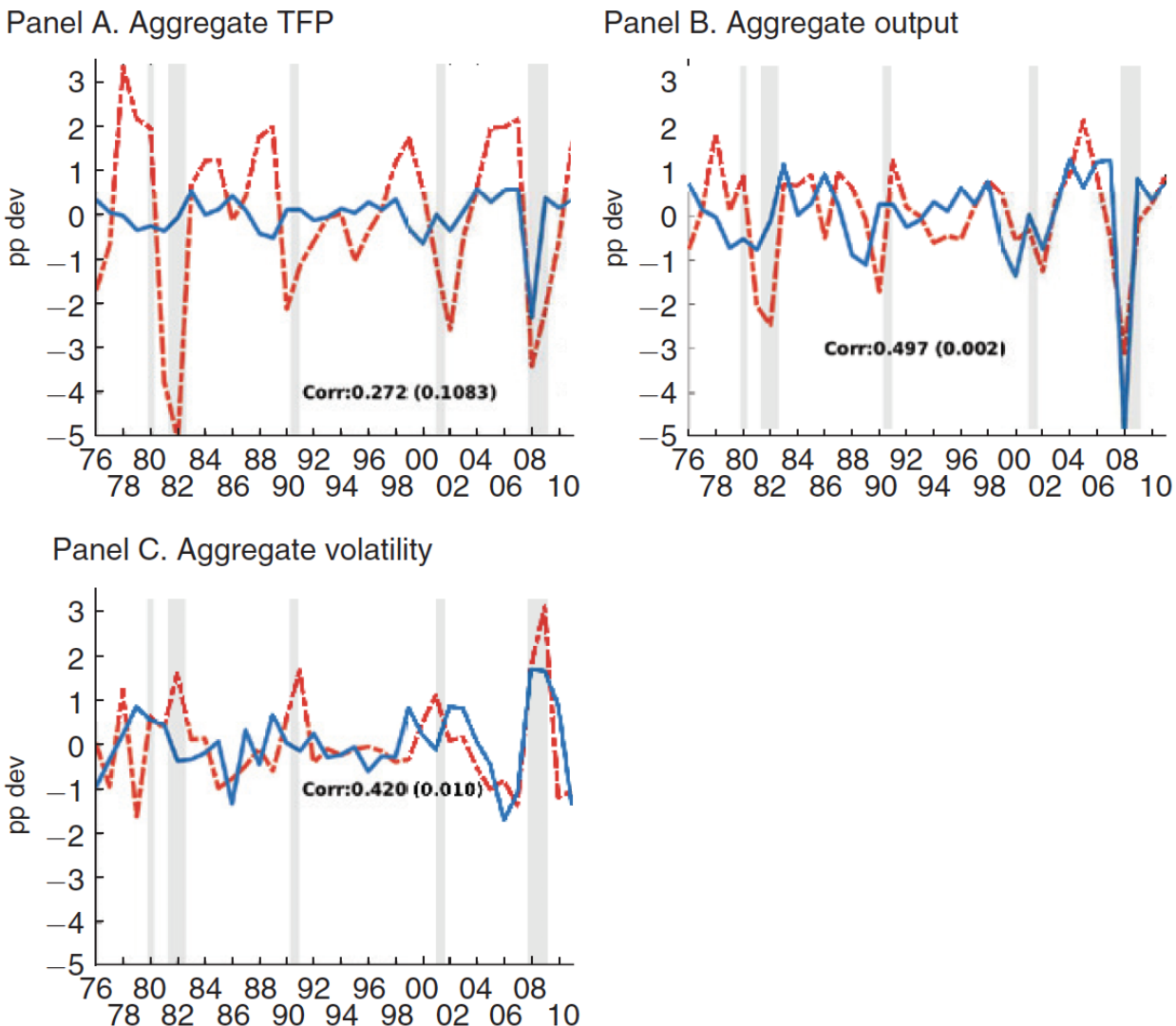


FIGURE 3. DECAY OF VOLATILITY OF AGGREGATE OUTPUT

BUSINESS CYCLE IN ACTION

- Fernald (2014) and Bloom et al. (2018).



Conclusion

- LLN might be violated in finite samples: Potentially any place in the literature it's been used, maybe it worth trying to investigate it again.
- Even in partial equilibrium setting or linear in consumption setting, we can see the importance of firms being connected through labor in aggregate fluctuations.