PhD Topics in Macroeconomics

Lecture 9: misallocation, part one

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This lecture

Restuccia/Rogerson (2008) model of idiosyncratic distortions

1- model with exogenous idiosyncratic distortions

2- calibration to firm size distribution

3- quantifying the extent of aggregate productivity losses

Overview

- Goal: to assess quantitative significance of resource misallocation across productive units

- Introduces idiosyncratic (micro) distortions to producer prices

  - product market regulation etc
  - represented as output tax/subsidy τ

- Misallocation can cause quantitatively large output and productivity losses, on the order of 30 to 50%

- Distortions may or may not be correlated with firm-size, generally larger effects if correlated with size

Model

- Representative consumer maximizes

$$\sum_{t=0}^{\infty} \beta^t U(C_t)$$

subject to the period budget constraint

$$C_t + K_{t+1} = w_t + (r_t + 1 - \delta)K_t + \Pi_t - T_t$$

where Π_t and T_t denote aggregate lump-sum profits and net taxes

- In steady state

$$r = 1/\beta - 1 + \delta$$

Firms

- Face output tax/subsidy $\tau \in (-1, +1)$

- Idiosyncratic productivity a is constant over time

- Production function

$$y = ak^{\alpha}n^{\gamma}, \qquad 0 < \alpha + \gamma < 1 \qquad \text{(DRS)}$$

- Maximizing static profits

$$\pi(a, \tau) = \max_{k,n} \left[(1-\tau)ak^{\alpha}n^{\gamma} - rk - wn - f\right]$$

implies factor demands $k(a, \tau)$ and $n(a, \tau)$

- Fixed cost f, entry cost f_e, exogenous exit probability $1 - \phi$

Entry/exit

- Let $v(a,\tau)$ denote expected present value of per-period profits

$$v(a,\tau) = \frac{\pi(a,\tau)}{1-\phi\beta}$$

- Firms face *joint distribution* $G(a,\tau)$ with

$$G(a,\tau) = P(\tau \,|\, a)H(a)$$

allows distortion to be correlated with productivity via $P(\tau \,|\, a)$

- Free entry condition

$$v_e := \iint \max\Big[0, v(a,\tau)\Big]\, dG(a,\tau) \leq f_e$$

Stationary distribution

- Let $\mu_t(a,\tau)$ denote the time-t joint distribution of (a,τ)

- Law of motion

$$\mu_{t+1}(a,\tau) = \phi\mu_t(a,\tau) + m_t e_t(a,\tau)G(a,\tau)$$

  where m_t denotes mass of entrants and $e_t(a,\tau) = 1$ if there is 'successful' entry

- In a stationary equilibrium this simplifies to

$$\mu(a,\tau) = m\frac{e(a,\tau)G(a,\tau)}{1-\phi}$$

  where m and $e(a,\tau)$ are to be determined

Market clearing conditions

- Key equilibrium conditions: market clearing, free entry, optimal production and entry/exit policies of firms, the consumption Euler equation, and the definition of a stationary distribution for $\mu(a,\tau)$

- Labor market

$$\iint n(a,\tau)\, d\mu(a,\tau) = 1$$

- Capital market

$$\iint k(a,\tau)\, d\mu(a,\tau) = K$$

- Goods market

$$C + \delta K + m f_e = \iint \left[a k(a,\tau)^{\alpha} n(a,\tau)^{\gamma} - f \right] d\mu(a,\tau)$$

Calibration: aggregates

- Treat US as *no distortion benchmark* (i.e., $\tau = 0$ for all a)
- Time period: one year, $\beta = .96$
- DRS in production: $\alpha + \gamma = .85$, split $1/3$ to capital and $2/3$ to labor, so $\alpha = .28$ and $\gamma = .57$
- Depreciation $\delta = .08$ to match investment/output ratio $\delta K/Y = .2$ (equivalently, $K/Y = 2.3$)
- No per-period fixed costs $f = 0$, entry cost normalized to $f_e = 1$
- Exit probability $1 - \phi = .10$ per period

Calibration: heterogeneity

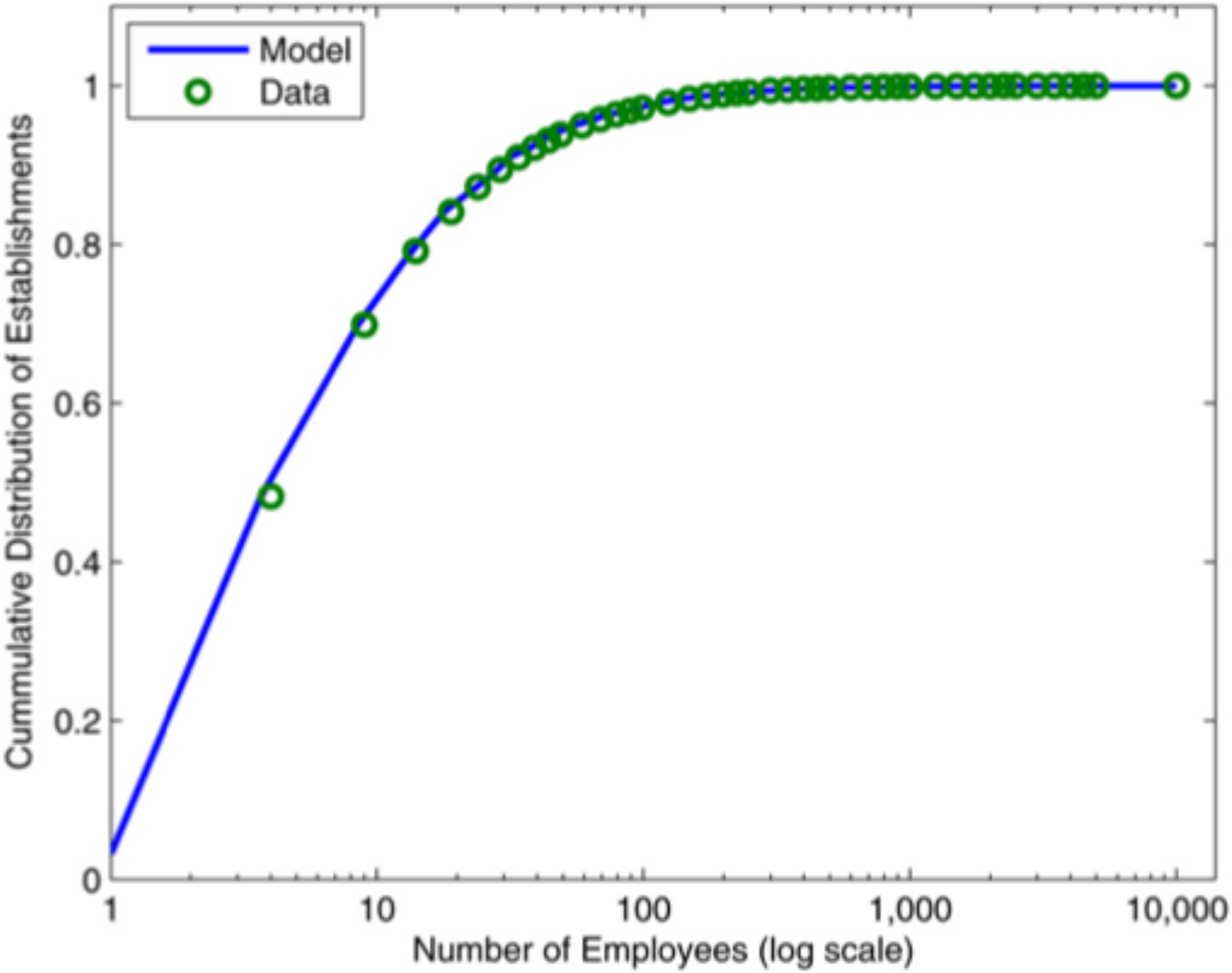
- Range of producer productivities pinned down by relative employment

$$\frac{n_i}{n_j} = \left(\frac{a_i}{a_j}\right)^{1/(1-\alpha-\gamma)}$$

- In US data, biggest firms are 10,000 times larger than smallest. With $\alpha + \gamma = .85$, largest have productivity 3.98 times smallest

- Distribution $H(a)$ (here $= G(a)$) chosen to match size distribution on a grid with 100 points

Calibrated size distribution



Most firms small but most output from large

Table 2
Distribution statistics of benchmark economy

	Establishment size (number of employees)		
	< 5	5 to 49	⩾ 50
Share of establishments	0.56	0.39	0.05
Share of output	0.08	0.34	0.58
Share of labor	0.08	0.34	0.58
Share of capital	0.08	0.34	0.58
Average employment	2.4	15.5	183.0

Since capital/labor ratios are equalized across producers, the distribution of labor and capital is the same as the distribution of output across producers.

Quantitative analysis

- Two cases

  (i) uncorrelated distortions, τ independent of a

  (ii) correlated distortions, (either positively or negatively)

- Want to disentangle the micro misallocation effect of τ on TFP from the usual distortionary effect of taxes on capital accumulation

- Adjust aggregate level of τ such that there is no effect on K

Uncorrelated idiosyncratic distortions

- To begin: half producers taxed, half subsidized
- Resources flow from taxed to subsidized, but no systematic effect across productivity classes
- Four tax rates: $\tau = 0.1, 0.2, 0.3, 0.4$ with associated subsidies τ_s
- Subsidies to undo effects on capital accumulation are smaller: $\tau_s = 0.06, 0.09, 0.10, 0.11$
- This is because of convexity of capital demand $k(s, \tau)$ in τ

Table 3
Effects of idiosyncratic distortions–uncorrelated case

Variable	τ_t			
	0.1	0.2	0.3	0.4
Relative Y	0.98	0.96	0.93	0.92
Relative TFP	0.98	0.96	0.93	0.92
Relative E	1.00	1.00	1.00	1.00
Y_s/Y	0.72	0.85	0.93	0.97
S/Y	0.05	0.08	0.09	0.10
τ_s	0.06	0.09	0.10	0.11

Non-degenerate distribution of size within productivity class. Y_S/Y denotes output share of subsidized firms, S/Y aggregate subsidy as share of output.

Table 4
Relative TFP–uncorrelated distortions

Fraction of establishments taxed (%):	τ_t			
	0.1	0.2	0.3	0.4
90	0.92	0.84	0.78	0.74
80	0.95	0.89	0.84	0.81
60	0.98	0.94	0.91	0.89
50	0.98	0.96	0.93	0.92
40	0.99	0.97	0.95	0.94
20	1.00	0.99	0.98	0.97
10	1.00	0.99	0.99	0.99

Instead of 50/50 split between taxed/subsidized firms, we now have different configurations. When most taxed and few subsidized, amount of misallocation is larger.

Correlated idiosyncratic distortions

- Suppose low productivity firms subsidized, high productivity taxed
- To begin: lowest half subsidized, top half taxed
- Systematic reallocation across productivity classes, not just within productivity class (i.e., not just in response to 'noise')

Table 5
Effects of idiosyncratic distortions–correlated case

Variable	τ_t			
	0.1	0.2	0.3	0.4
Relative Y	0.90	0.80	0.73	0.69
Relative TFP	0.90	0.80	0.73	0.69
Relative E	1.00	1.00	1.00	1.00
Y_s/Y	0.42	0.67	0.83	0.92
S/Y	0.17	0.32	0.43	0.49
τ_s	0.40	0.48	0.52	0.53

Larger implications for output/TFP. Also more costly to finance.

Table 6
Relative TFP–correlated distortions

Fraction of establishments taxed (%):	τ_t			
	0.1	0.2	0.3	0.4
90	0.81	0.66	0.56	0.51
80	0.84	0.70	0.62	0.57
60	0.88	0.77	0.69	0.65
50	0.90	0.80	0.73	0.69
40	0.92	0.82	0.76	0.72
20	0.95	0.89	0.84	0.81
10	0.97	0.92	0.88	0.86

Again, amount of misallocation is larger when most taxed and few subsidized.

Extensions

- Non-constant aggregate capital
  - taxing all but some exempt producers (rebated lump-sum)
  - lower capital stock, wages and entry also fall in proportion
- Taxes on capital and labor
  - taxes on capital and/or labor inputs, not output

Next

- Misallocation, part two
- Evidence from micro data
  - Hsieh and Klenow (2009): Misallocation and manufacturing TFP in China and India, *Quarterly Journal of Economics*.