The Life Cycle of Plants in India and Mexico

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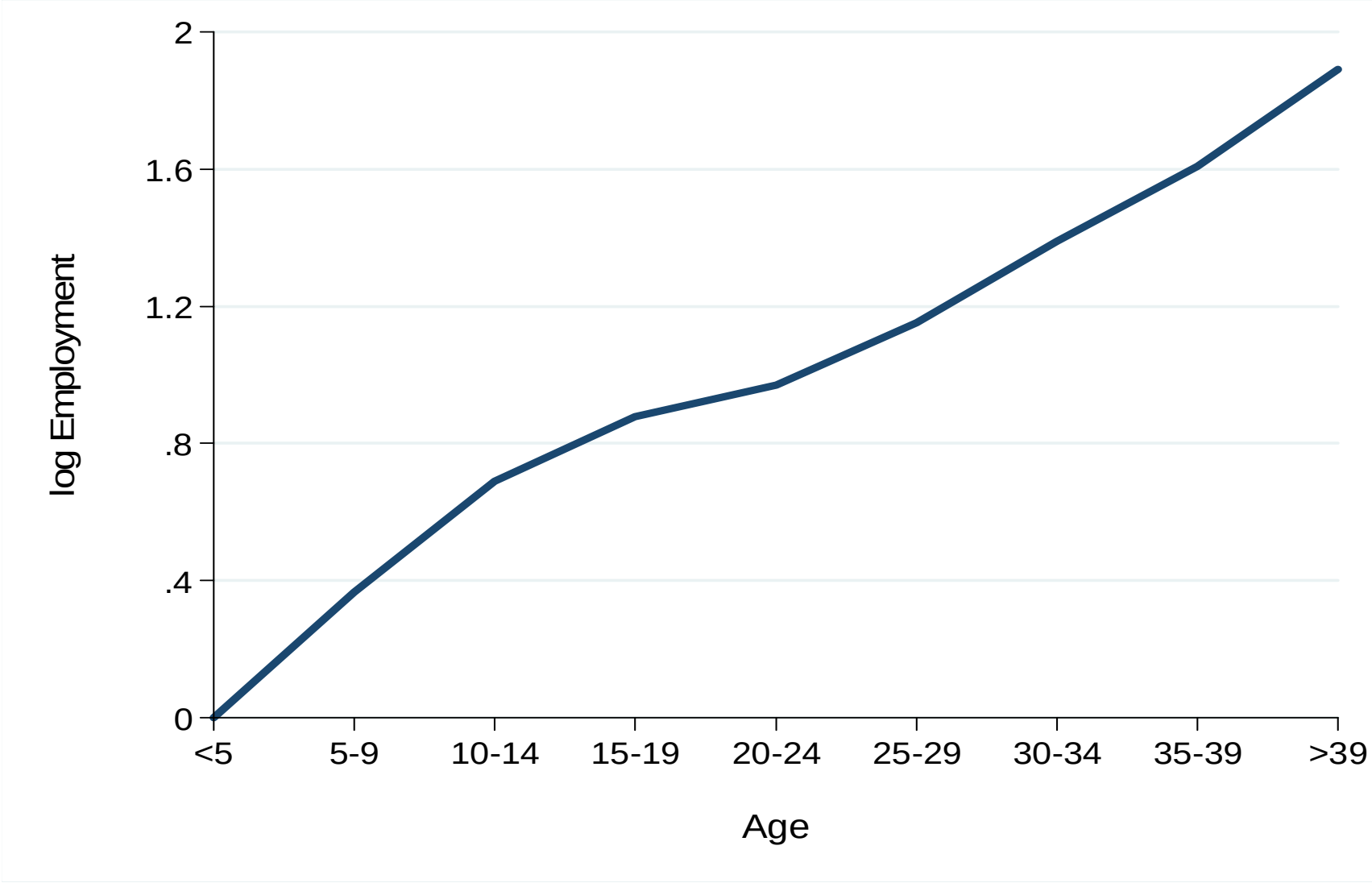
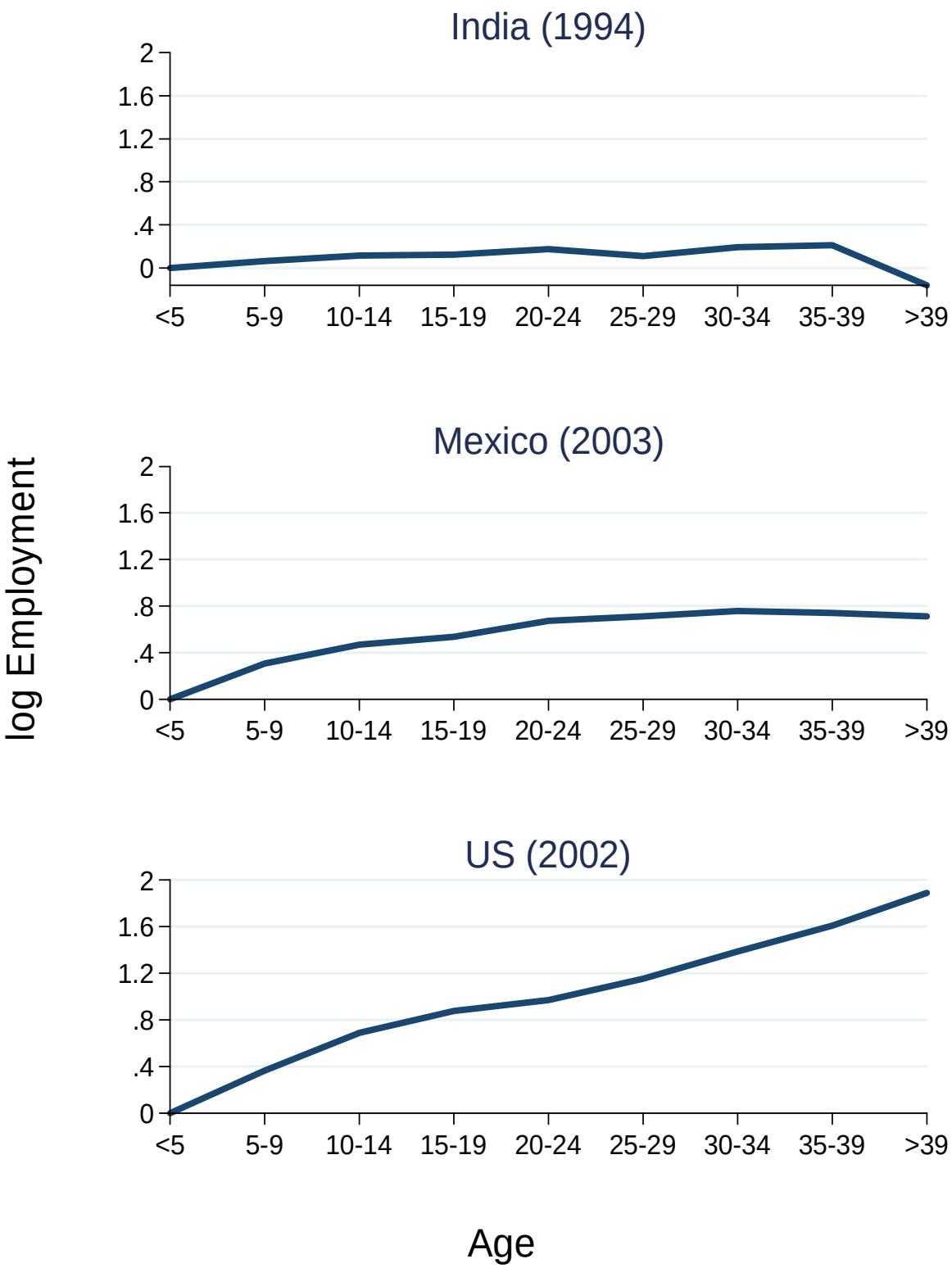
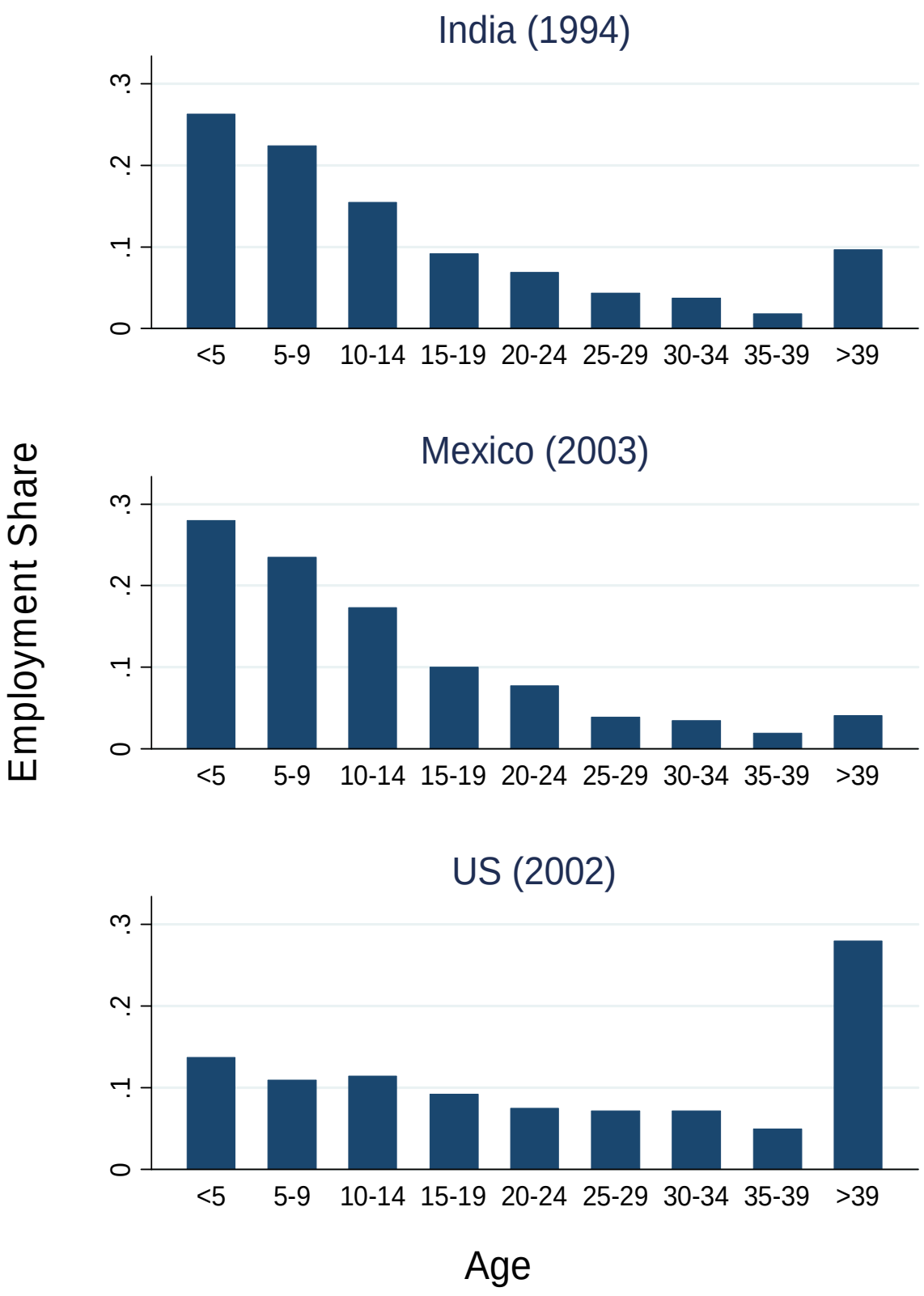
Plant Size by Age in the US Cross-Section (2002)



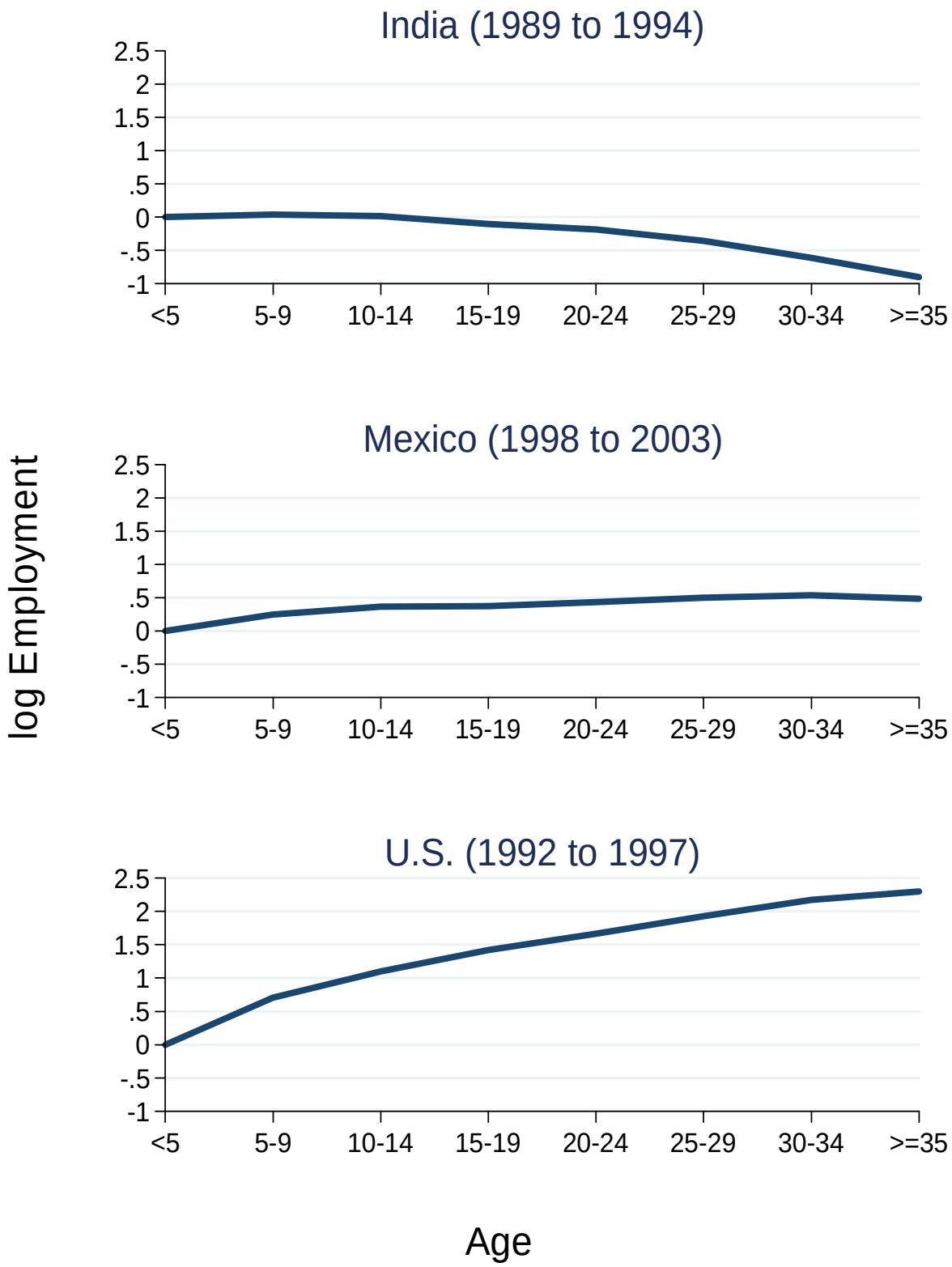
Plant Size by Age in the Cross-Section



Employment Shares by Age



Plant Employment over the Life-Cycle



Imposing more structure

$$Y = \left[\sum_{a} \sum_{i=1}^{N_a} Y_{a,i}^{\frac{\sigma-1}{\sigma}} \right]^{\frac{\sigma}{\sigma-1}}$$

$$Y_{a,i} = A_{a,i} K_{a,i}^{\alpha} L_{a,i}^{1-\alpha}$$

$$\pi_{a,i} = (1-\tau_{Y_{a,i}}) P_{a,i} Y_{a,i} - wL_{a,i} - (1+\tau_{K_{a,i}}) RK_{a,i}$$

Static equilibrium

$$Y_{a,i} \propto \left(\frac{A_{a,i}}{TFPR_{a,i}} \right)^{\sigma}$$

$$TFPR_{a,i} \propto \frac{\left(1+\tau_{K_{a,i}}\right)^{\alpha}}{1-\tau_{Y_{a,i}}}$$

$$Y = \underbrace{\left[\sum_{a} \sum_{i=1}^{N_a} \left(A_{a,i} \cdot \frac{\overline{TFPR}}{TFPR_{a,i}} \right)^{\sigma-1} \right]^{\frac{1}{\sigma-1}}}_{TFP} K^{\alpha} L^{1-\alpha}$$

Aggregate TFP

$$TFP = \left[\sum_a N_a \left(A_a \cdot \frac{\overline{TFPR}}{TFPR_a} \right)^{\sigma-1} \right]^{\frac{1}{\sigma-1}}$$

"representative" productivity of a cohort:

$$A_a \equiv \left(\sum_{i=1}^{N_a} A_{a,i}^{\sigma-1} \Big/ N_a \right)^{\frac{1}{\sigma-1}}$$

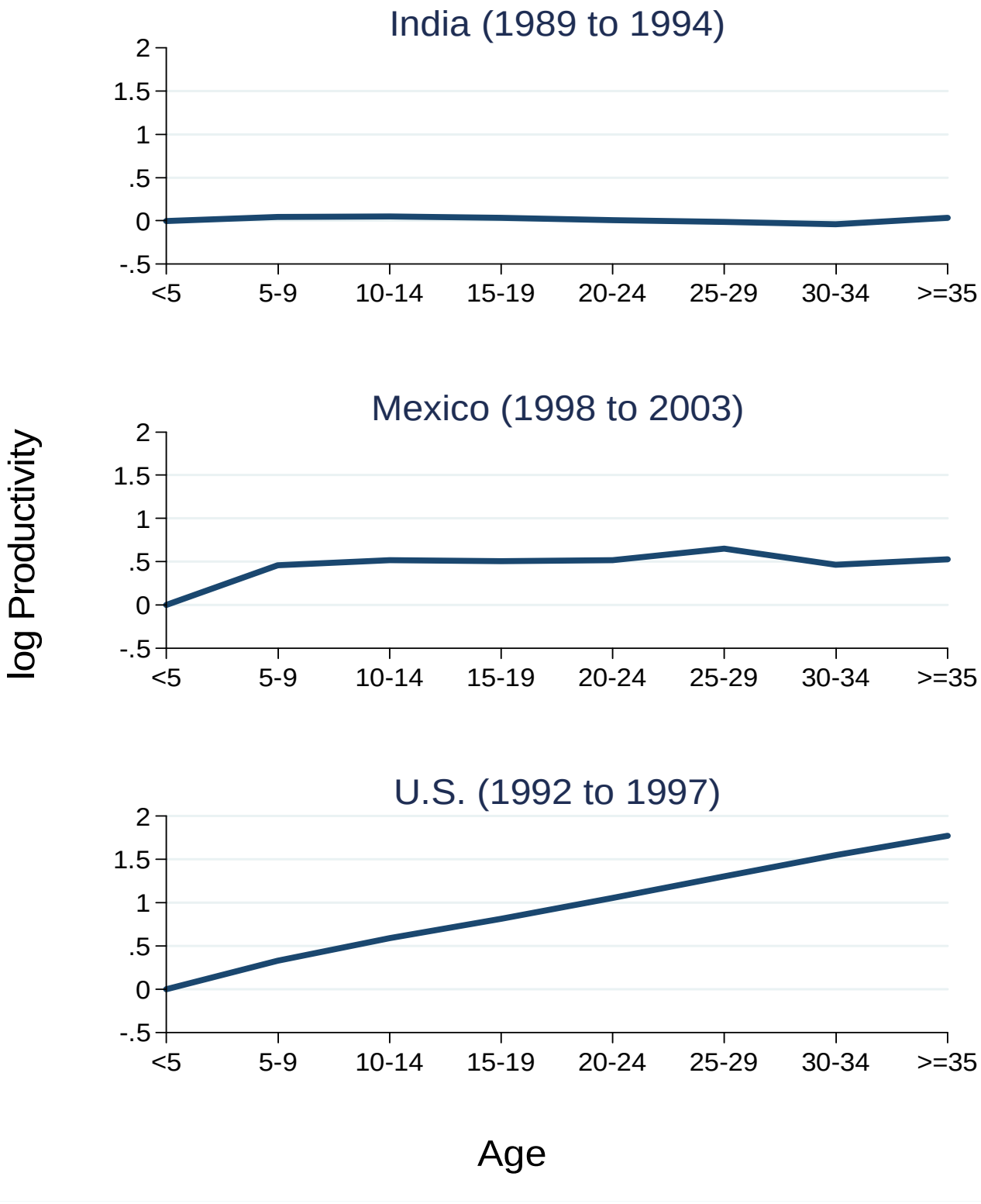
Life-Cycle Growth and Exit

$$\frac{A_{old}(t)}{A_{young}(t)} = \underbrace{\frac{A_{old}(t)}{A_{young}(t-1)}}_{\text{"life cycle" growth}} \cdot \underbrace{\frac{A_{young}(t-1)}{A_{young}(t)}}_{1/\text{cohort quality growth}}$$

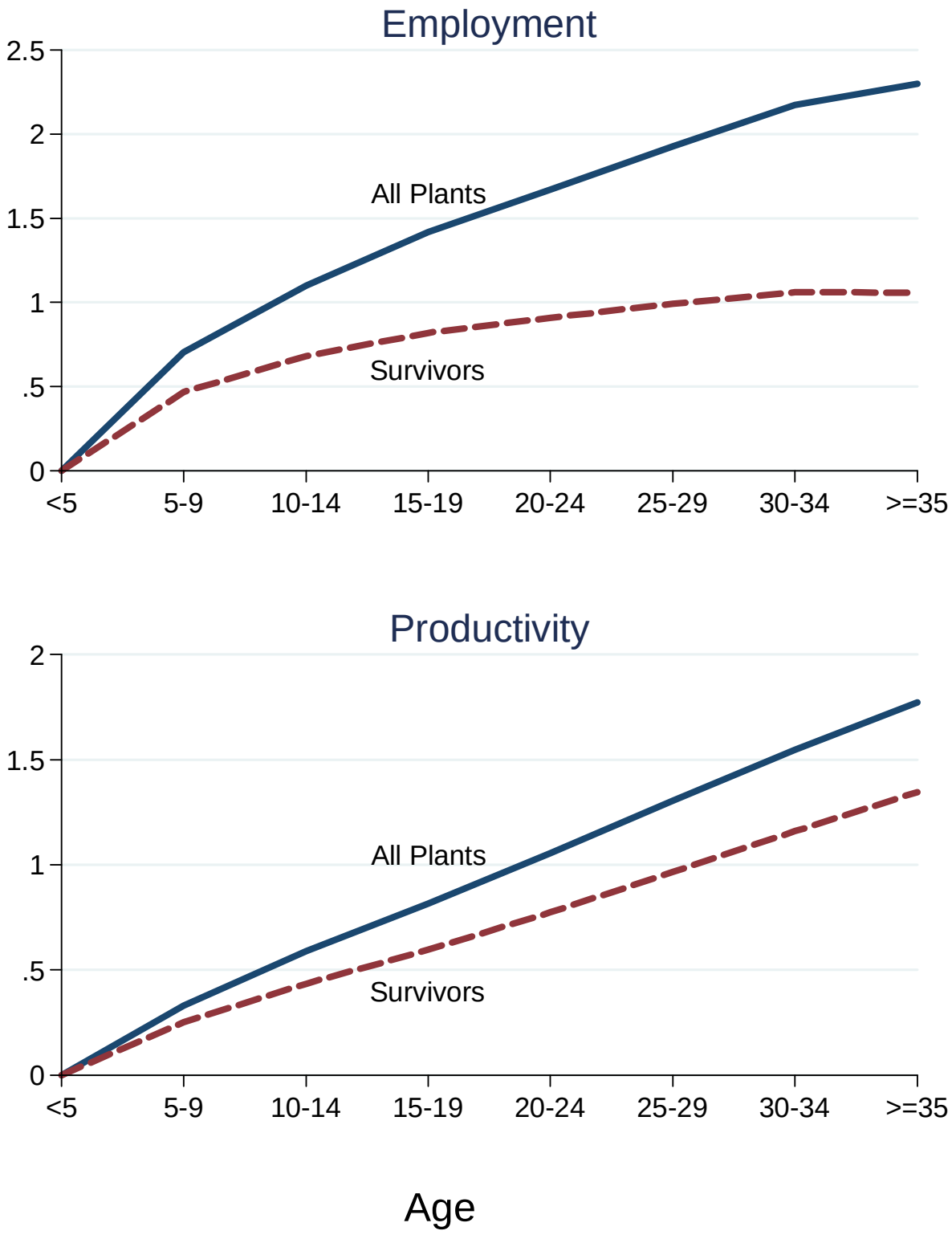
$$\frac{N_{old}(t)}{N_{young}(t)} = \underbrace{\frac{N_{old}(t)}{N_{young}(t-1)}}_{\text{"life cycle" exit}} \cdot \underbrace{\frac{N_{young}(t-1)}{N_{young}(t)}}_{1/\text{cohort size growth}}$$

$$\text{Log Normality} \Rightarrow \log A_a = E \log A_{a,i} + \frac{\sigma - 1}{2} Var \log A_{a,i}$$

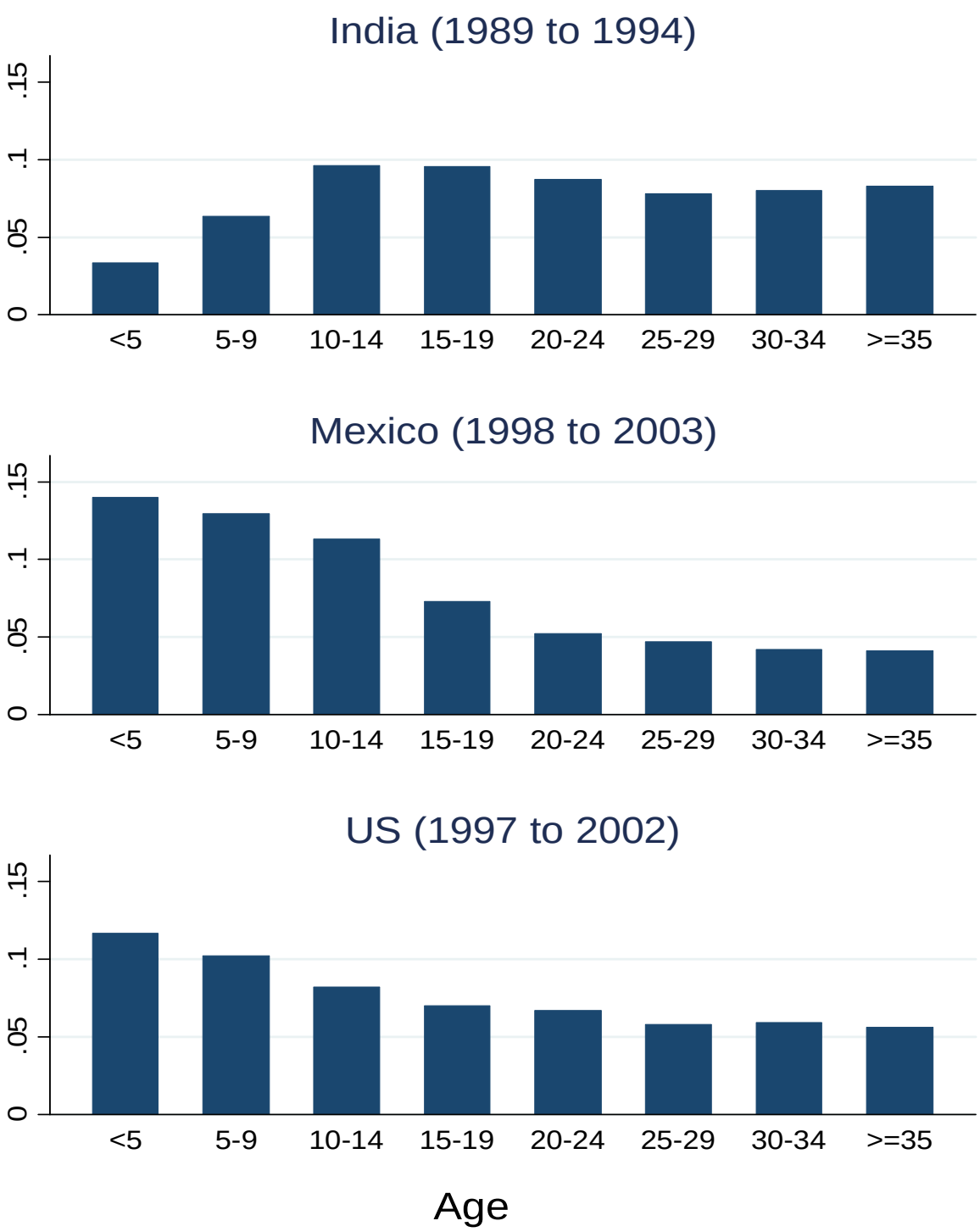
Plant Productivity over the Life-Cycle



U.S. Employment and Productivity over the Life-Cycle



Exit Rate


India (1989 to 1994)
0
.05
.1
.15
<5
5-9
10-14
15-19
20-24
25-29
30-34
>=35
Mexico (1998 to 2003)
0
.05
.1
.15
<5
5-9
10-14
15-19
20-24
25-29
30-34
>=35
US (1997 to 2002)
0
.05
.1
.15
<5
5-9
10-14
15-19
20-24
25-29
30-34
>=35
Age

Direct Effect of Life-Cycle Growth on TFP (Holding Entry Fixed)

$$TFP = N_0^{1/(\sigma-1)} \frac{A_0}{\delta + g_C - g_{LC}}$$

Indian TFP with U.S. Productivity Growth: +28%

U.S. TFP with Indian Productivity Growth: -22%

Not exactly symmetric because evaluated at Indian {TFPR, exit rates} vs. U.S. {TFPR, exit rates} by age.

Life Cycle Growth and Plant Size

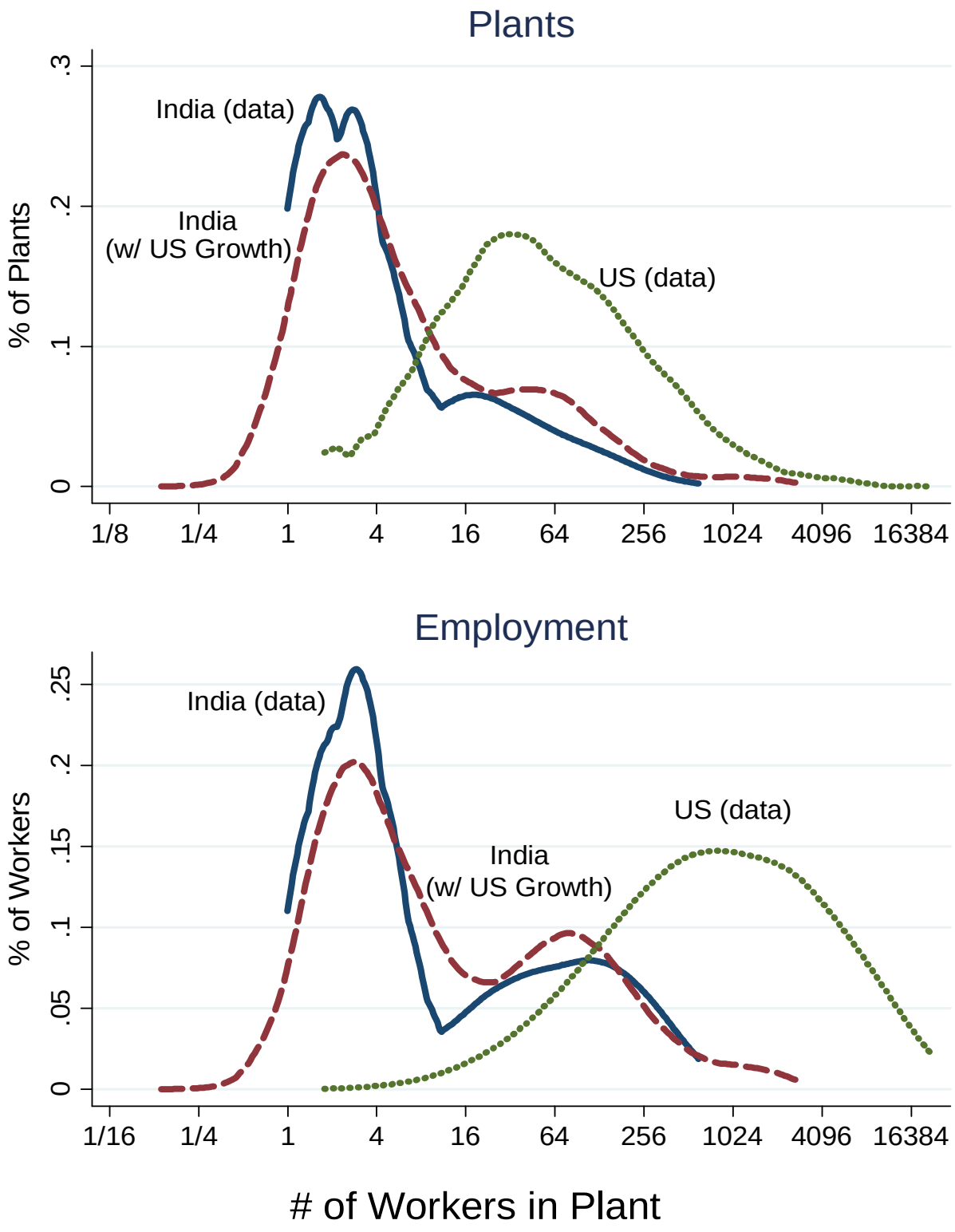
$$L_{a,i} = \left(\frac{A_{a,i}}{TFP} \right)^{\sigma-1} L$$

$$= \frac{L}{N} \left(\frac{A_{a,i}}{A} \right)^{\sigma-1}$$

Holding Entry and Exit Rates (N) fixed:

Size of representative firm will not change

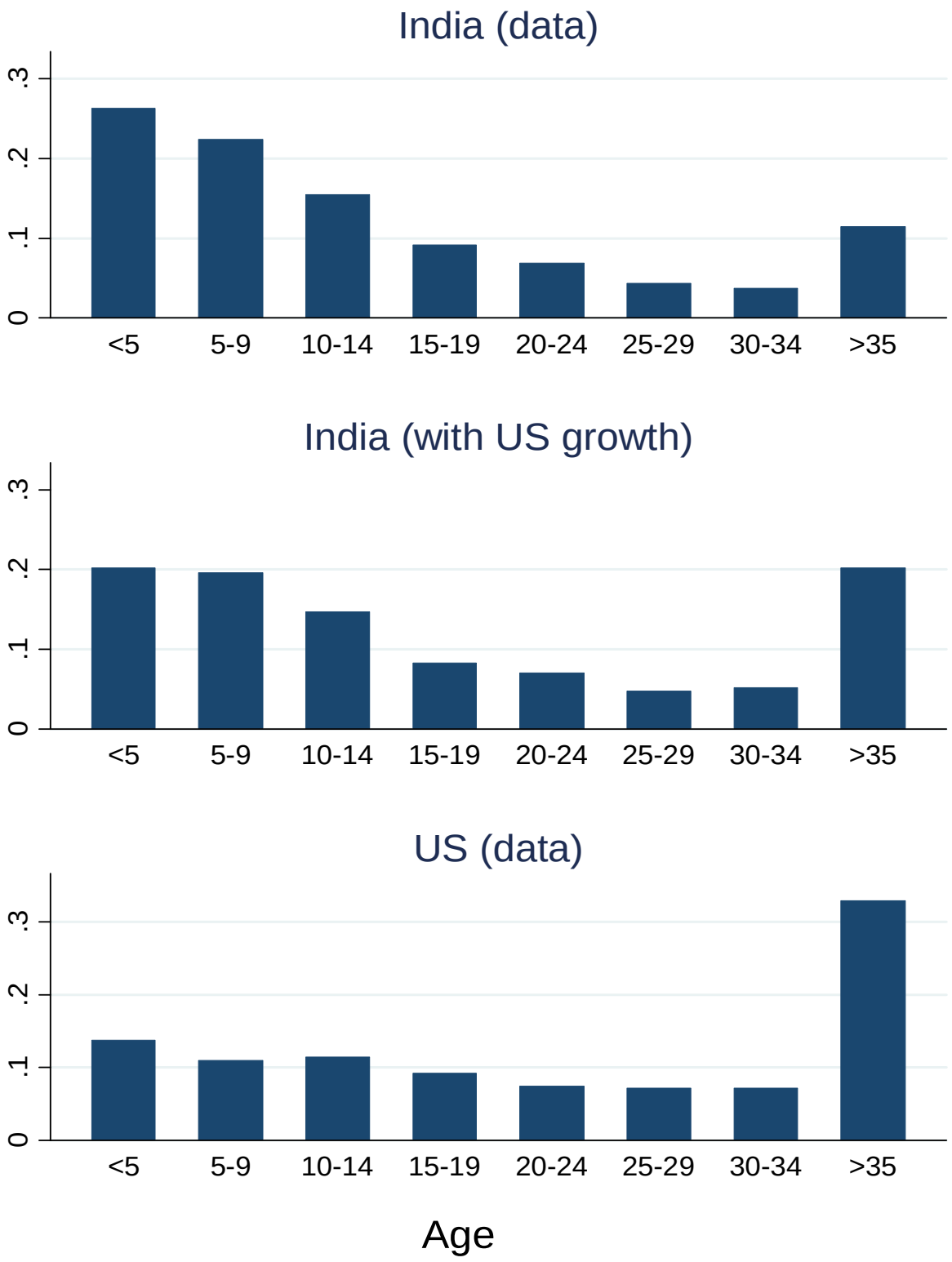
U.S. vs. Indian Density of Plant and Employment by Size



Distribution of Employment by Plant Size

	25th	Median	75th
India (data)	2	6	38
India (w/ US Growth)	3	8	50
US (data)	272	868	2,773

U.S. vs. Indian Employment Share by Age



Life-Cycle Growth and Entry

Entry Cost $\propto W$

Profit of Marginal Entrant: $\pi_a^* \propto W\left(\frac{A_a^*}{W}\right)^{\sigma-1}$

$$\frac{PDV\ of\ Profits}{Entry\ Cost} \propto \left(\frac{A_0^* / (\delta + R - g)}{W}\right)^{\sigma-1}$$

$$W \propto N_0^{\frac{1}{\sigma-1}} \cdot \frac{A_0}{\delta - g}$$

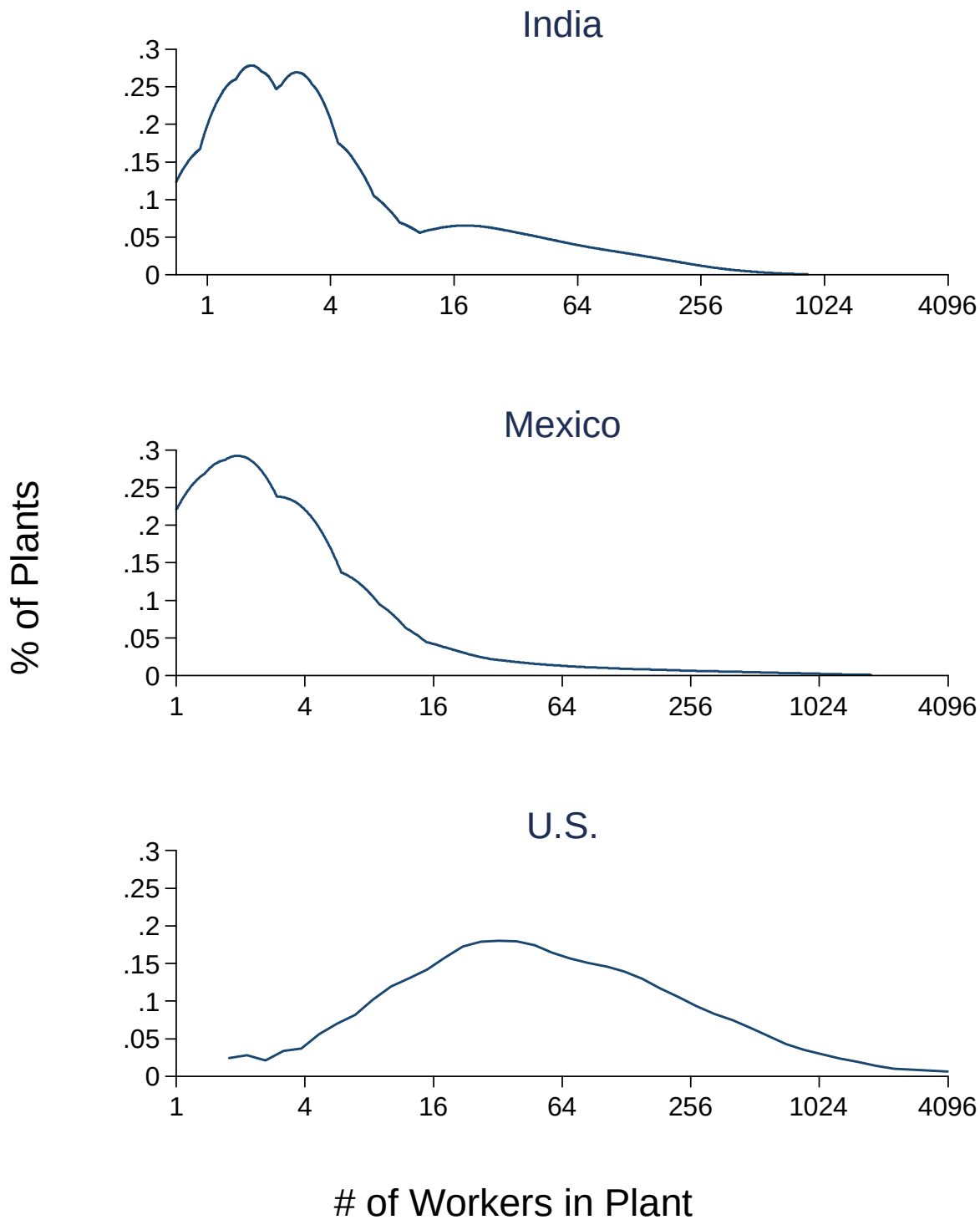
Life-Cycle Growth and Entry

$$\frac{PDV\ of\ Profits}{Entry\ Cost} \propto \frac{1}{N_0} \cdot \left(\frac{A_0^* / (\delta + R - g)}{A_0 / (\delta - g)} \right)^{\sigma - 1}$$

Effect of lower *g*:

More entry ($\uparrow N_0$)

Density of Plants by Size



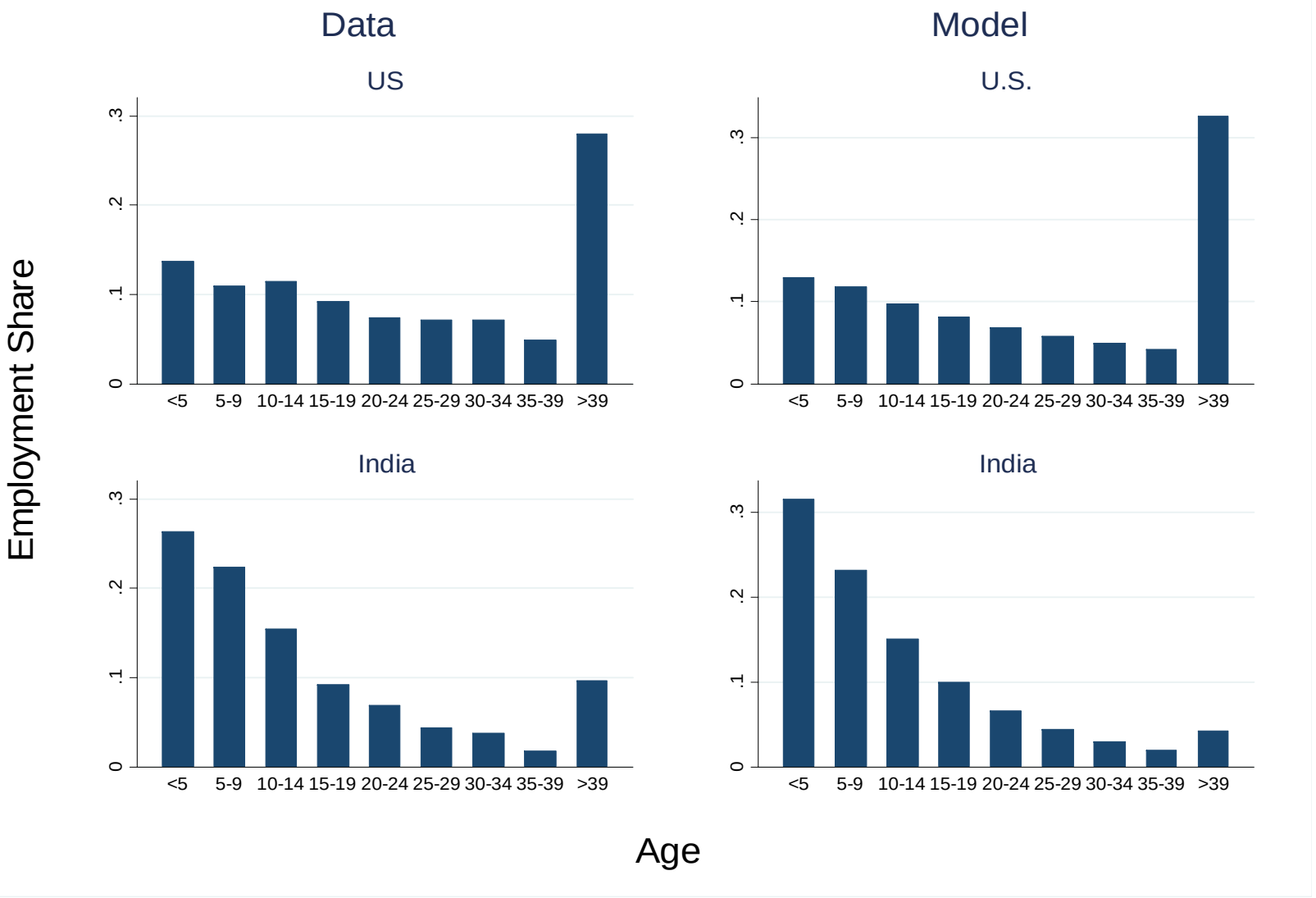
Distribution of Plant Size

	25	Median	75
India	2	3	5
Mexico	1	2	5
U.S.	18	48	152

Change in U.S. TFP with Indian (vs. U.S.) Life-Cycle – plus Endogenous Entry

	Exogenous *A*	Endogenous *A*
Representative *A*	- 38 %	- 30 %
Entry	+ 39 %	+ 48 %
Aggregate TFP	- 27 %	- 14 %

U.S. vs. Indian Age Distributions: data vs. model with endogenous entry (exogenous *A*)



Entry and Entrant Quality

Simulation assumes no selection in entry

⇨ Entry has no effect on average entrant productivity

More dispersion in entrant productivity in India than U.S.

S.D. of (log) Entrant Productivity

India: 1.2 U.S.: 0.3

Lower wages could induce lower quality firms to enter

Potential effects of lower life-cycle growth

1) Direct effect on aggregate TFP ($\downarrow TFP/A_0$)

   No effect on firm size

2) More entry ($\uparrow$ Welfare)

   $\downarrow$ Firm size

3) ***Possibly*** lower quality entrants ($\downarrow A_0$)

   More dispersion of Entrant Productivity