Older and Slower: The Effects of the Startup Deficit on Aggregate Productivity Growth*

Titan Alon [a] David Berger [b] Robert Dent [c] Benjamin Pugsley [c]

[a]Northwestern University

[b]Northwestern University and NBER

[c]New York Fed

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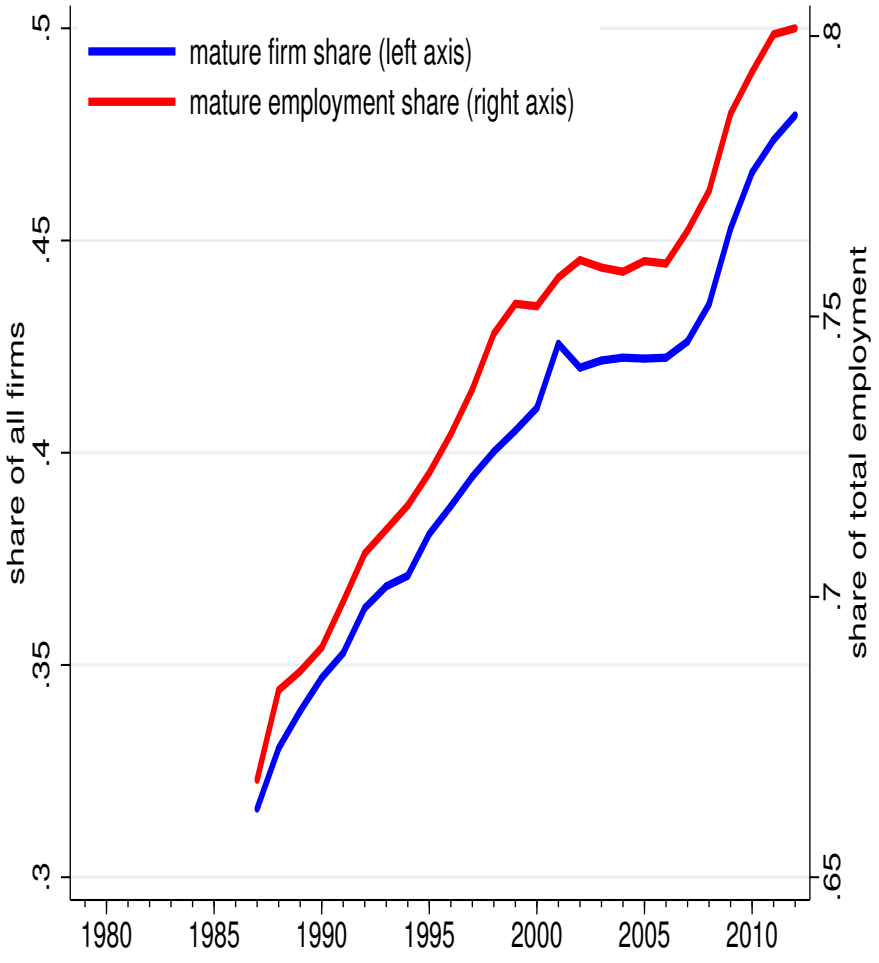
*Any opinions and conclusions expressed herein are those of the author(s) and do not necessarily represent the views of the U.S. Census Bureau, Federal Reserve Bank of New York or the Federal Reserve System. All results have been reviewed to ensure that no confidential information is disclosed.

The Startup Deficit and Aging of American Businesses



The Startup Deficit and Aggregate Productivity

Main Question: How has the decline in entry and its effects on the age distribution ("startup deficit") impacted aggregate productivity?

Economic Theory suggests many important channels:

Growth Theory: Innovation, New Products

Trade: Opening of New Markets

Industrial Organization: Competition

Firm Dynamics: Selection, Reallocation, Learning (Demand/Process)

Though theory does not offer an unambiguous answer.

Related Literature

Cross-Sectional Evidence

Dependent Variable: Local labor productivity growth

Demographic IV: 20-year lagged fertility rates †

Collateral IV: Speculative housing price rises‡

	Baseline	Demographics Channel		Collateral Channel	
	(1)	(2)	(3)	(4)	(5)
Startup Rate	0.796***	1.46**	1.796***	1.618***	3.767***
	(0.210)	(0.620)	(0.910)	(0.388)	(1.134)
Year FE	Yes	Yes	Yes	–	–
Entity FE	Yes	Yes	Yes	Yes	Yes
Type	OLS	IV	IV	IV	IV
	State x Ind	State x Ind	CBSA x Ind	MSA All Ind	MSA Ex-Con,NT

†See Karahan, Pugsley, Sahin (2016) for more details

‡See Charles, Hurst, Notowidigdo (2016) for details on IV construction

Our Approach and Preview of Results

Our Aim: Isolate age-composition channel

Our Approach:

- Estimate *age-productivity* profile
- Develop explicit aggregation technique
- Adapt DOP to provide economic interpretation
- Illustrative model based on Hopenhayn (1992)

Main Findings:

- Robust link between firm age and productivity
- Selection and Reallocation are primary channels
- Between 1980-2014, aggregate productivity reduced by 3-4%
- Additional declines in allocative-efficiency of oldest firms

Data and Methodology

The Data

Main Data Set: Census Administrative Data on Firm-Level Labor (Revenue) Productivity for Non-Farm Business Sector, 1996-2012.

- *Longitudinal Business Database* (LBD) - geography, industry, firm age, employment, organizational structure
- *Business Register* (SSEL) - firm tax receipts
- *Bureau of Labor Statistics* (BLS) - 4-digit NAICS price indicies

Create *Revenue-Enhanced LBD* following Haltiwanger et. al. (2016).

- Panel Data for Entire Non-Farm Business Sector
- Propensity Score Sampling Weights for Match Bias
- Filters for Outliers, Coding Errors, M&A activity, etc.

Age-Productivity Profile Estimation

Let Φ_{iat} be the employment weighted log labor productivity of a cohort of firms age a in industry i at period t. We estimate:

$$\triangle_{at}\Phi_{ait} = \nu_i + \mu_t + \sum_{a}^{A} \mathbf{1}_{at}\delta_a + \varepsilon_{ait}$$

where the δ_a non-parametrically identify firm lifecycle productivity growth.

For new entrants, we run auxiliary regression

$$\triangle_{t}\Phi_{E,it} = \eta + \nu_i + \epsilon_{E,it}$$

where we interpret η as common trend in new entrants.

Aggregating Firm Level Findings

To isolate effects of aging, we observe that the empirical design implies

$$\mathbb{E}\left[\triangle \Phi_{ait} | \mu = 0, \nu = 0\right] = \delta_a \qquad \mathbb{E}\left[\triangle \Phi_{E,it} | \mu = 0, \nu = 0\right] = \eta$$

so that for surviving incumbents (dropping $\mathbb{E}$ notation)

$$\Phi_{a,t} = \sum_{j=1}^{a} \delta_j + \Phi_{E,t-a}$$

and for new entrants

$$\Phi_{E,t} - \Phi_{E,t-1} = \eta$$

which also allows us to write:

$$\Phi_{E,t-a} = -\eta a + \Phi_{E,t}$$

Aggregating Firm Level Findings

Rewriting aggregate productivity growth conditional on a historical time path for employment shares:

$$\mathbb{E}[\triangle\Phi|s_{a,t}] = \sum_{a}^{A} s_{a,t}\Phi_{a,t} - \sum_{a}^{A} s_{a,t-1}\Phi_{a,t-1}$$

we can plug in our results above to calculate the net effect on aggregate productivity had shares followed a counter-factual trajectory s_t^{cf}

$$\mathbb{E}[\triangle\Phi|s_{a,t}^{cf}] - \mathbb{E}[\triangle\Phi|s_{a,t}] = \underbrace{\sum_{a}^{A}(\triangle s_{a,t}^{cf} - \triangle s_{a,t}) \sum_{j=1}^{a} \delta_j}_{\text{Lifecycle}} \underbrace{- \eta \sum_{a}^{A}(\triangle s_{a,t}^{cf} - \triangle s_{a,t})a}_{\text{Cohort}}$$

Decomposing Labor Productivity Growth

To interpret results, we adapt the *Dynamic Olley-Pakes* decomposition.

For a cohort, year $t-1$ productivity is composed of survivors and exiters

$$\begin{aligned}\Phi_{a,t-1} &= s_{sa,t-1}\Phi_{sa,t-1} + s_{xa,t-1}\Phi_{xa,t-1} \\ &= \Phi_{sa,t-1} + s_{xa,t-1}\left(\Phi_{xa,t-1} - \Phi_{sa,t-1}\right)\end{aligned}$$

Expressing the cohort's period t productivity in terms of survivors yields

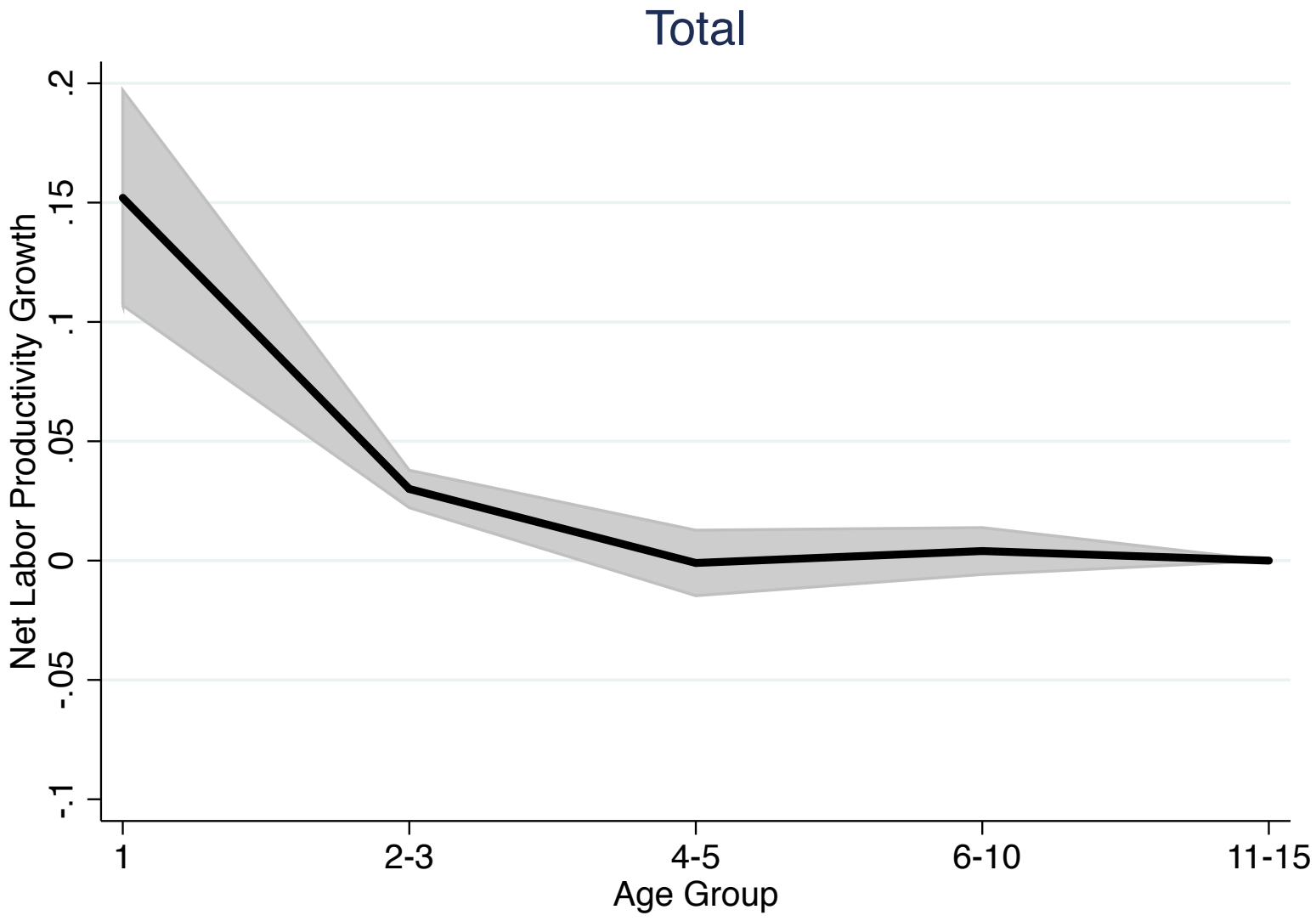
$$\triangle_{at}\Phi_{at} = \triangle\Phi_{sa,t} - s_{xa,t-1}\left(\Phi_{xa,t-1} - \Phi_{sa,t-1}\right)$$

Applying the Olley-Pakes Decomposition to first component

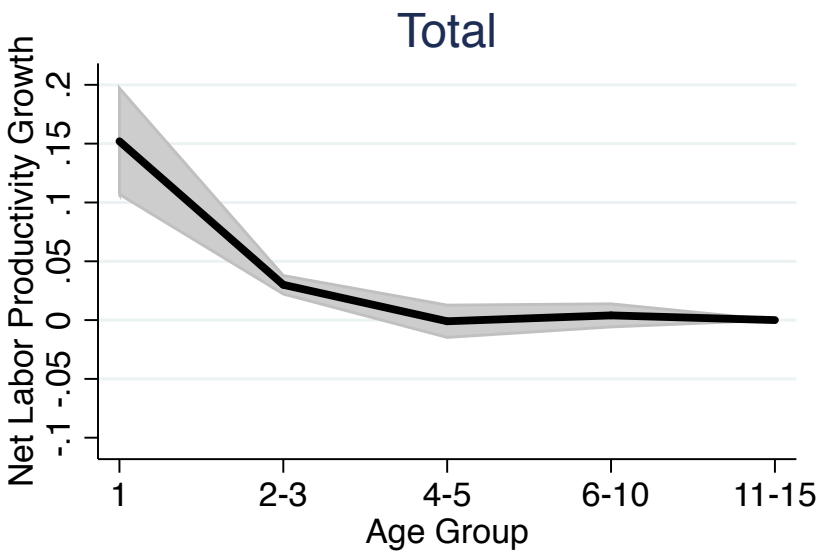
$$\triangle_{at}\Phi_{at} = \underbrace{\triangle\bar{\phi}_{sa,t}}_{\text{Within Firm}} + \underbrace{\triangle\hat{Cov}_a(s_{ist}, \rho_{ist})}_{\text{Allocative Efficiency}} - \underbrace{s_{xa,t-1}\left(\Phi_{xa,t-1} - \Phi_{sa,t-1}\right)}_{\text{Selection}}$$

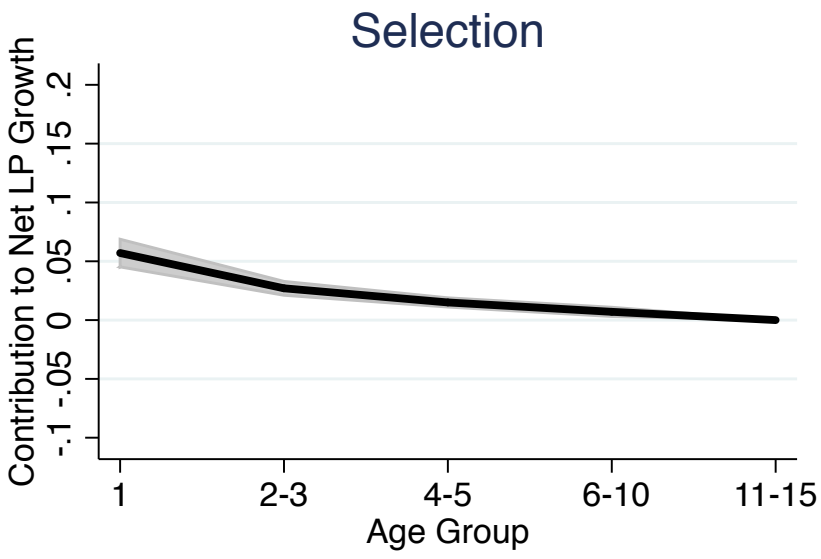
Results and Robustness

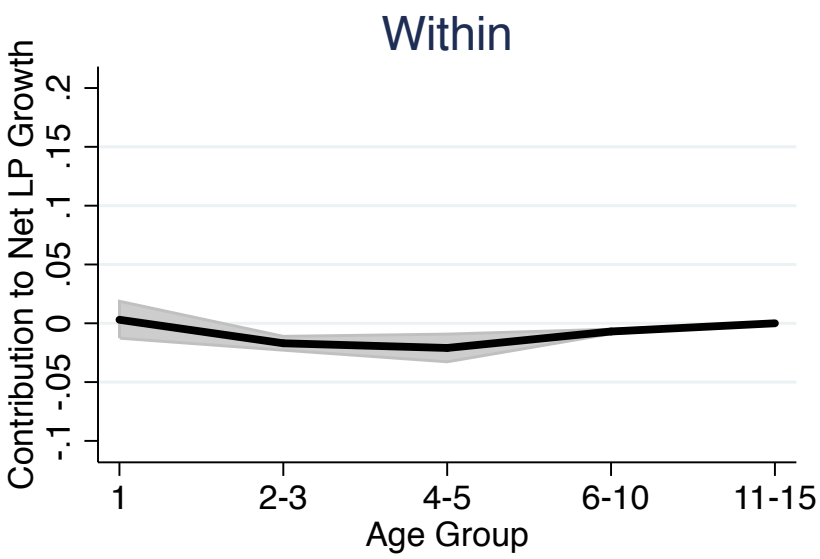
The Age-Productivity Profile

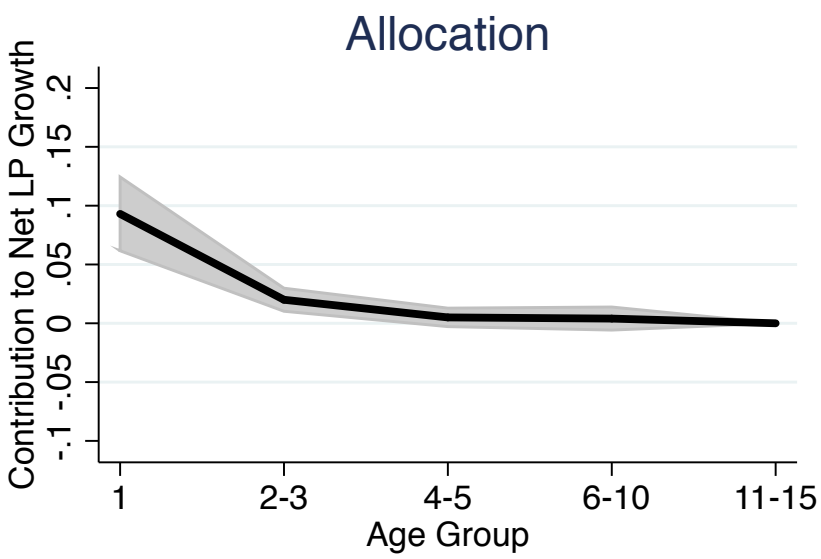


The Firm Dynamics Decomposition







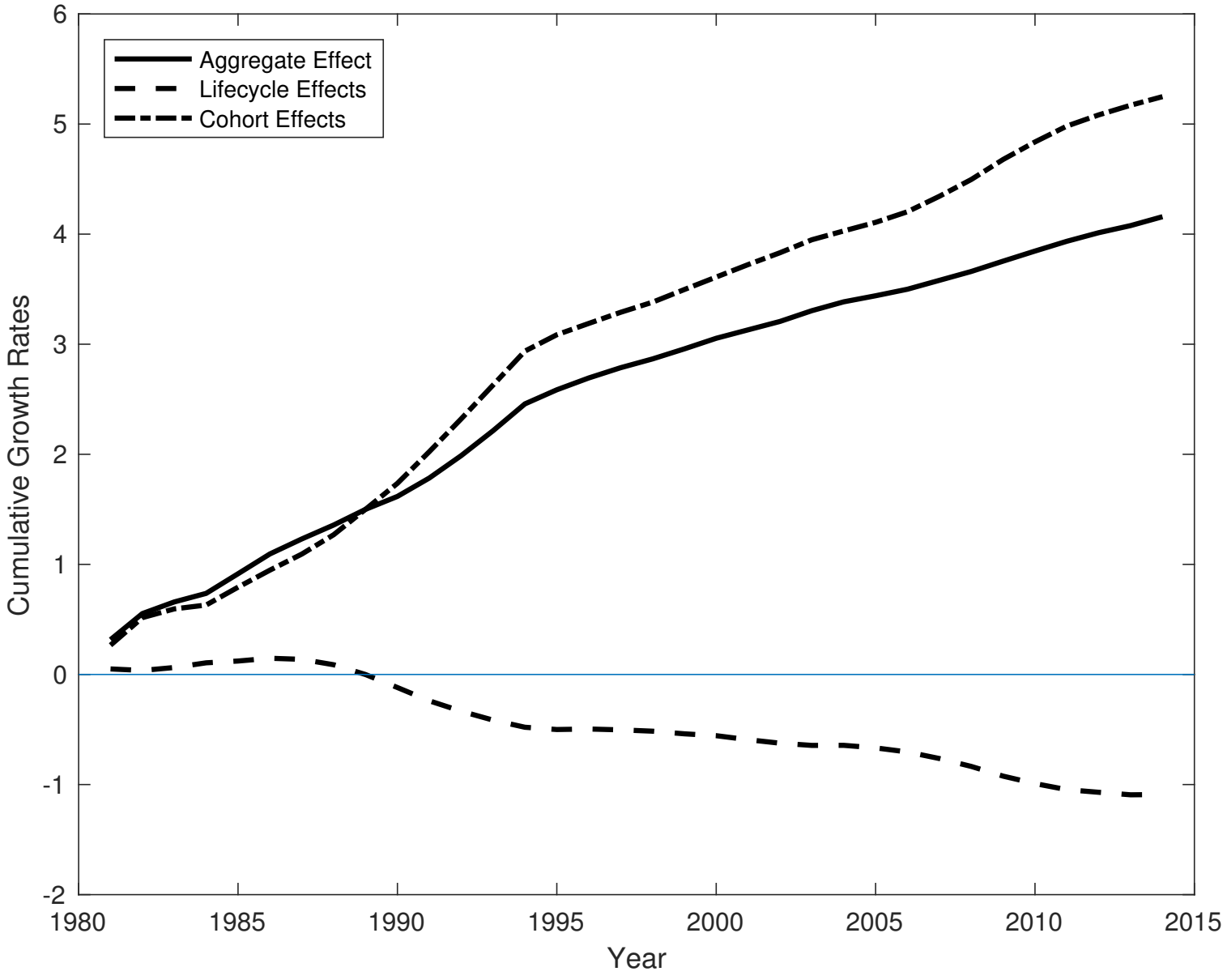


Robustness

- **Price Effects:** Real versus Nominal
- **Organizational:** Multi-Unit versus Single-Unit Firms
- **Industrial:** Industry Compositions
- **Geography:** Geographic Variations
- **Age Censoring:** Triangular Panel Approach
- **Weight Aggregation:** Cross-Sectional Weighting
- **Time Stability:** High Growth (1994-04) and Low Growth (2005-12)

Price Effects | Organizational | Industrial | Cyclicality | Age Censoring | Weighting | Time Stability

No Startup Deficit Counter-Factual, 1980-2014



Mature Firms

	Change in Average Mature (Age 16+) Firm Industry Productivity Growth $\Delta\Phi_{16+jt}$			
	Total	Within	Allocation	Selection
Late Period	-0.023	-0.006	-0.019	0.002
(2005-2012)	(0.018)	(0.004)	(0.017)	(0.002)

Time Stability Age Censoring

Conclusions and Takeaways

Conclusions and Takeaways

Takeaways

- In last three decades, there has been a substantial reallocation of activity away from entrants and young firms to older incumbents...
- ...which is worrisome because labor productivity varies significantly across cohorts and with firm age
- ...due mainly to the forces of selection and reallocation on the young
- ...accounting for a cumulative reduction in aggregate productivity of 3.00-4.15% from 1980-2014.

Other content in the full paper...

- Illustrative simulations from modified Hopenhayn (1992)
- Many more cross-sectional regressions
- A battery of robustness checks

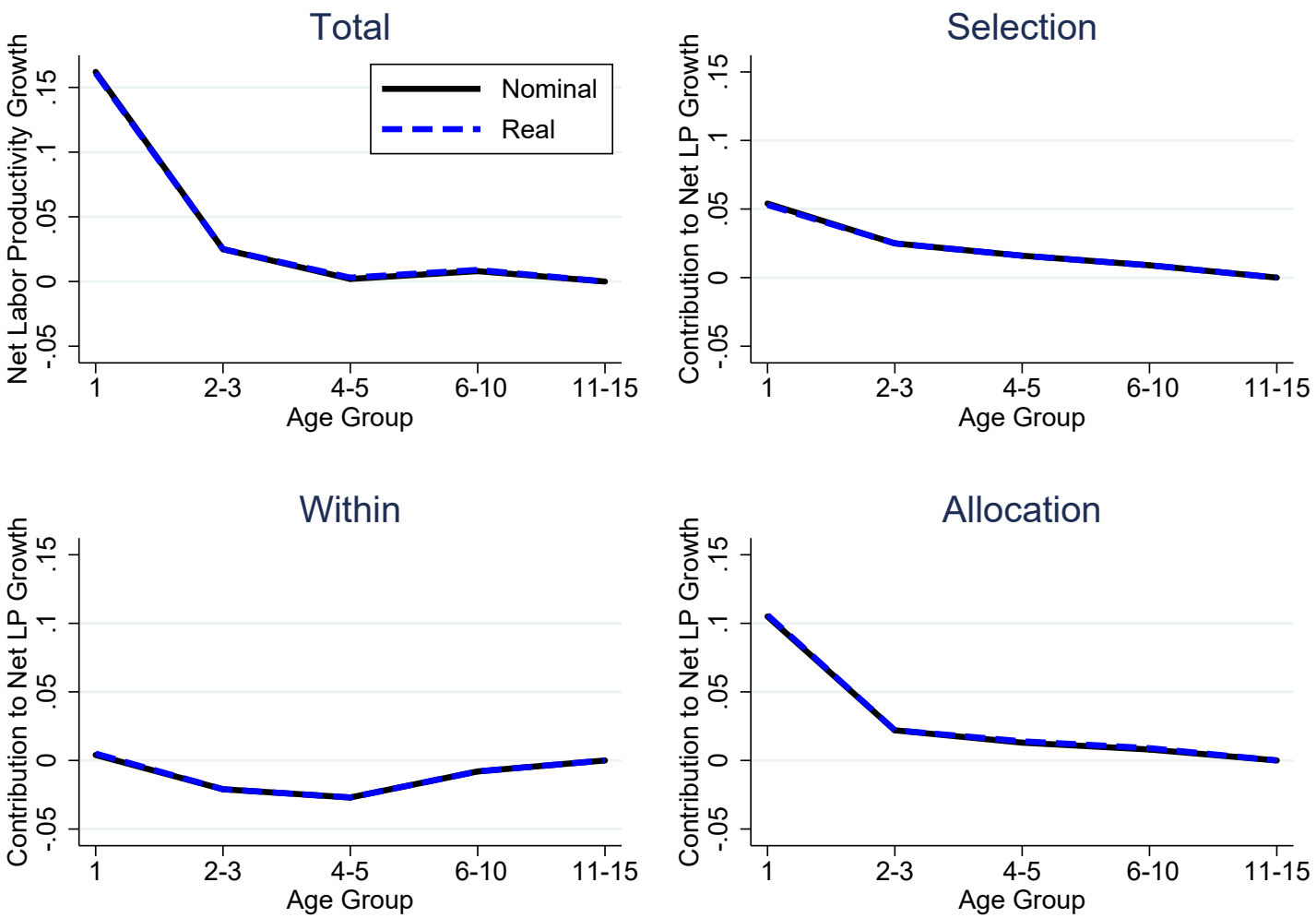
Linked Appendix

Related literature

- **Business dynamism:** Davis, Haltiwanger, Jarmin and Miranda (2006); Reedy and Litan (2011); Decker, Haltiwanger, Jarmin and Miranda (2014); Davis and Haltiwanger (2014);
- **Importance of firm age:** Dunne, Roberts and Samuelson (1996); Haltiwanger, Jarmin and Miranda (2013); Adelino, Ma and Robinson (2014); Pugsley and Şahin (2014)
- **Productivity and firm dynamics:** Baily, Hulten and Campbell (1992); Olley and Pakes (1996); Campbell (1998); Foster, Haltiwanger and Krizan (2001, 2002, 2005); Foster, Haltiwanger and Syverson (2008); Bartelsman, Haltiwanger, and Scarpetta (2013)
- **Entrepreneurship, innovation and growth:** Schumpeter (1942), Aghion and Howitt (1994); Caballero and Hammour (1994); Klette and Kortum (2004); Ackigit and Kerr (2010), Acemoglu, Ackigit, Bloom and Kerr (2013)

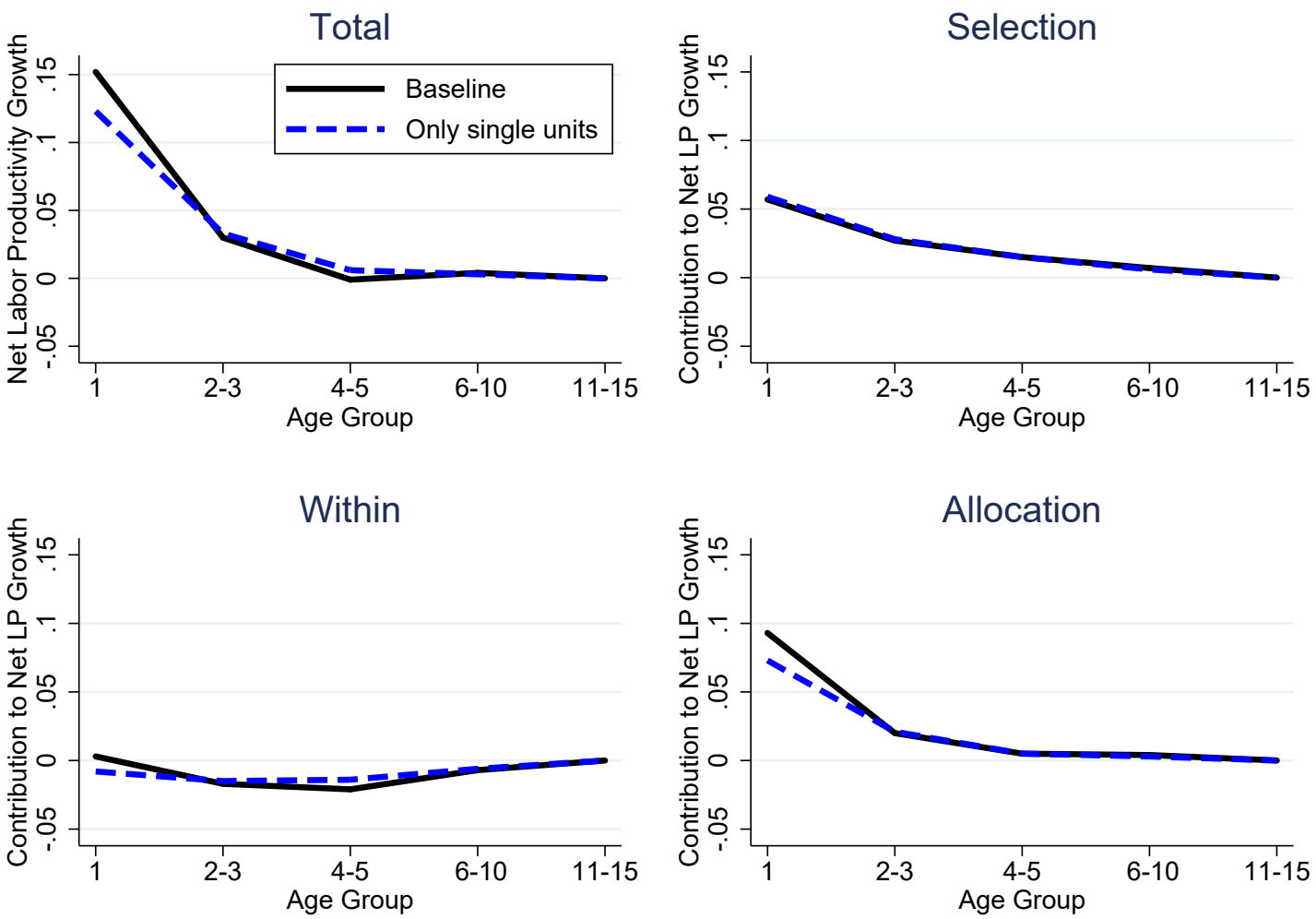
Back

Robustness: Price Effects



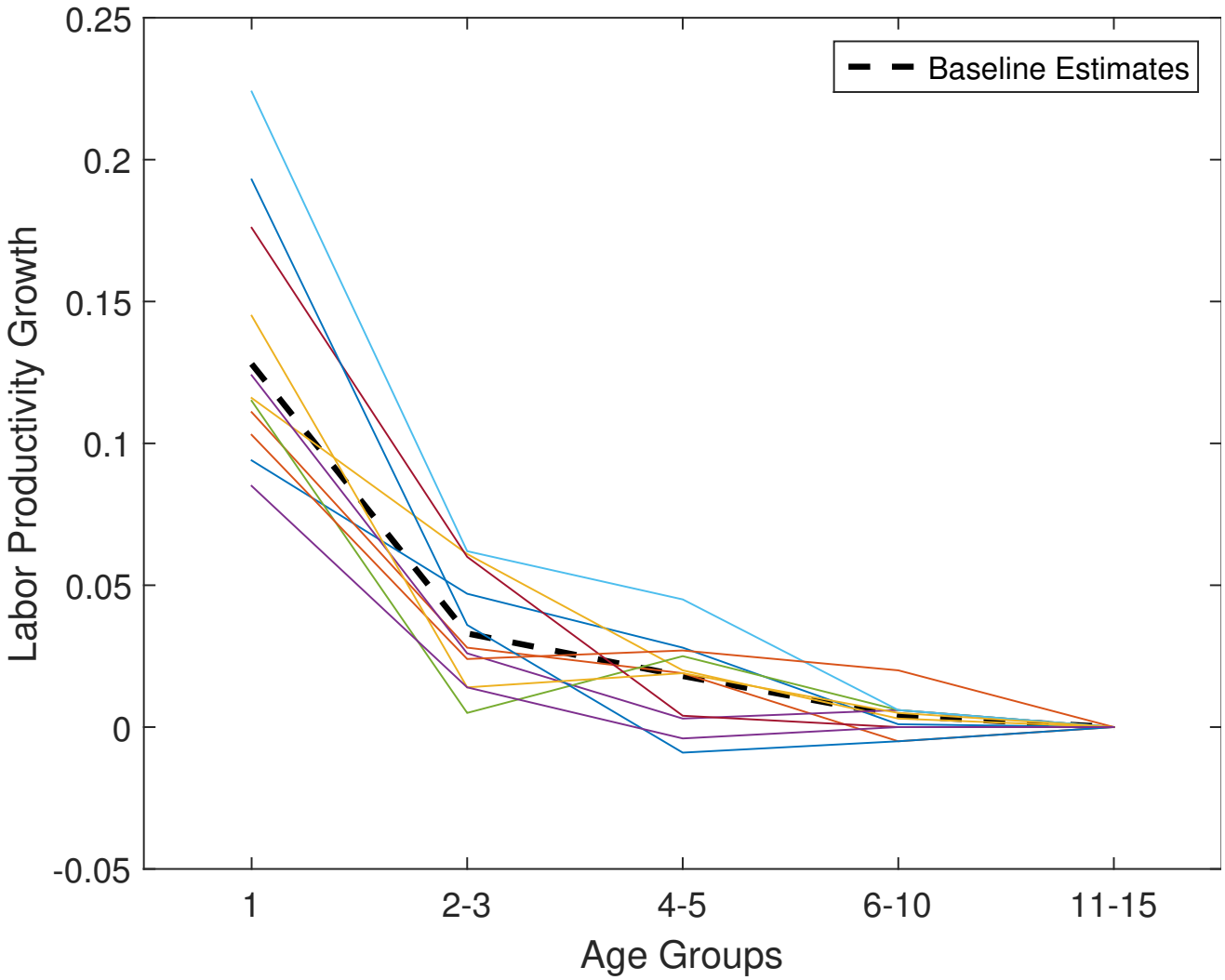
Back

Robustness: Organizational



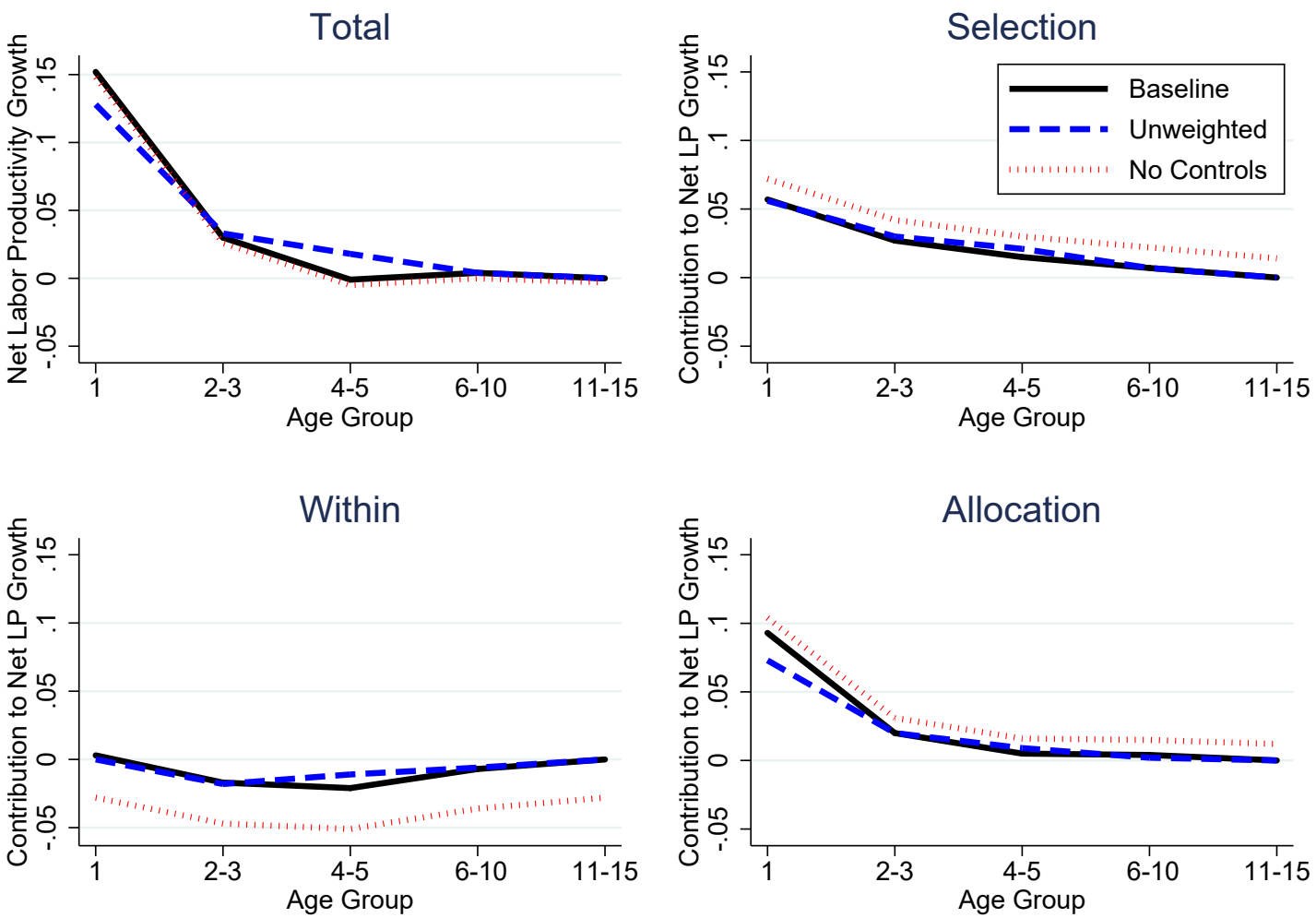
Back

Robustness: Industrial



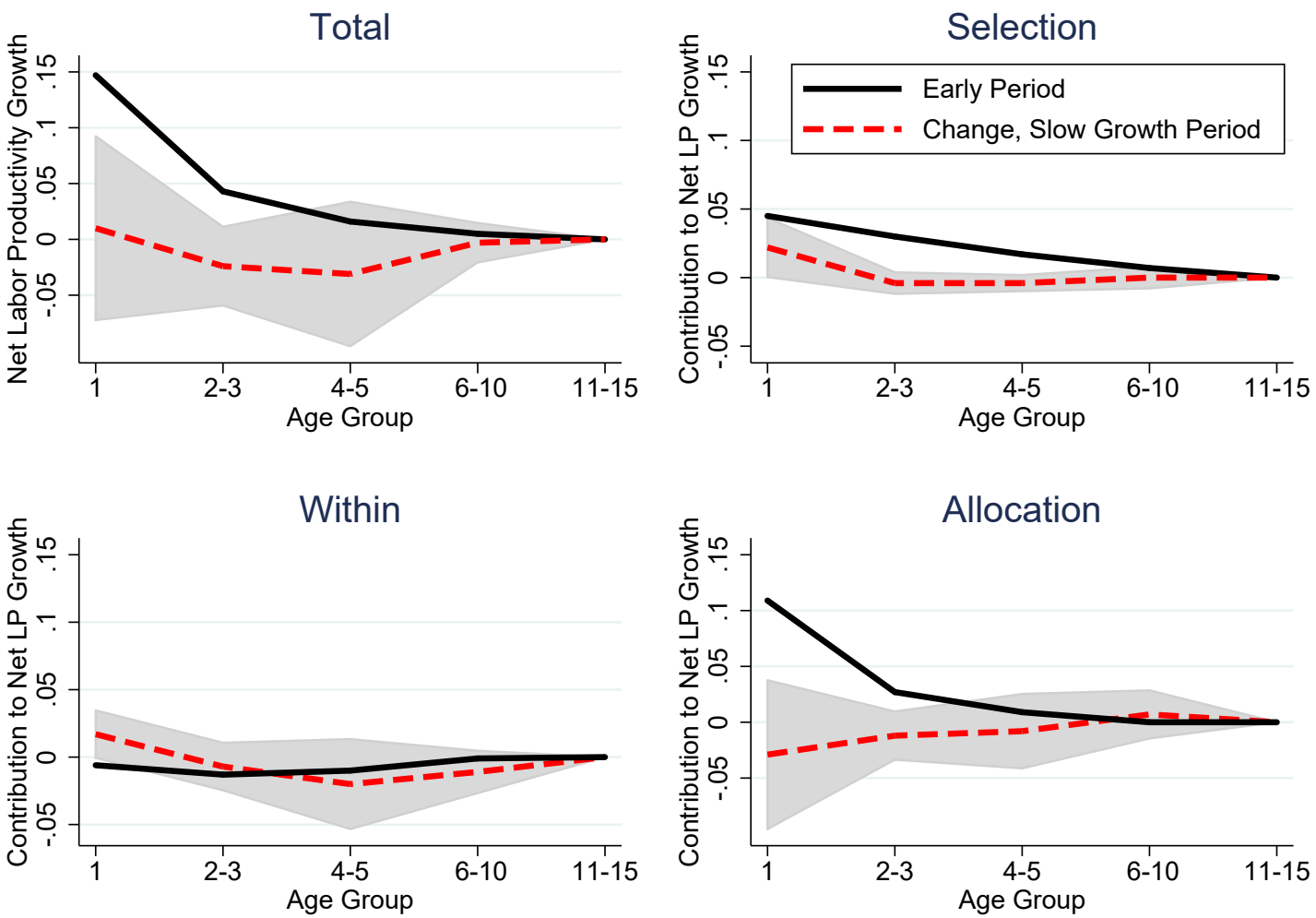
Back

Robustness: Weighting



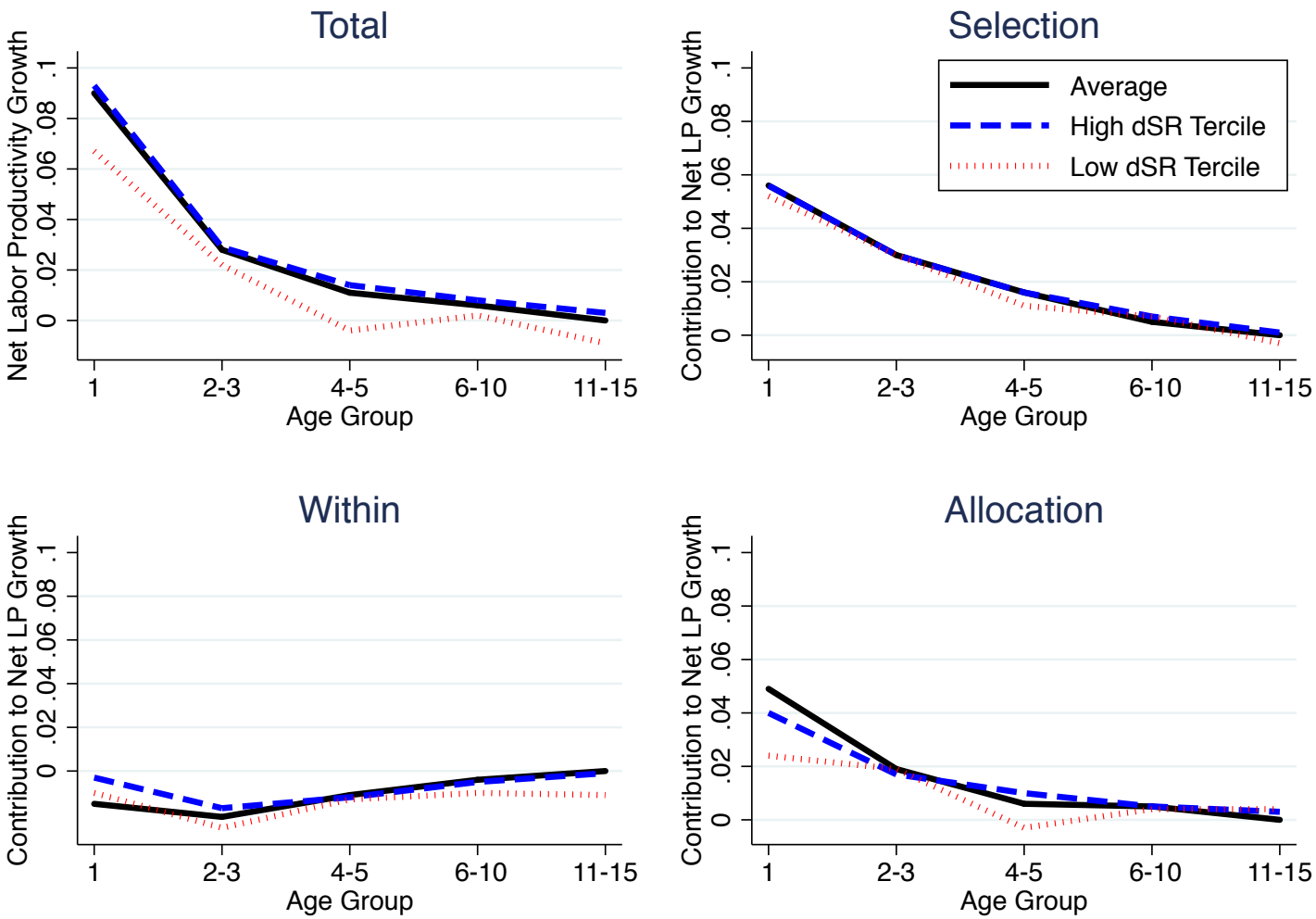
Back

Robustness: Time Stability



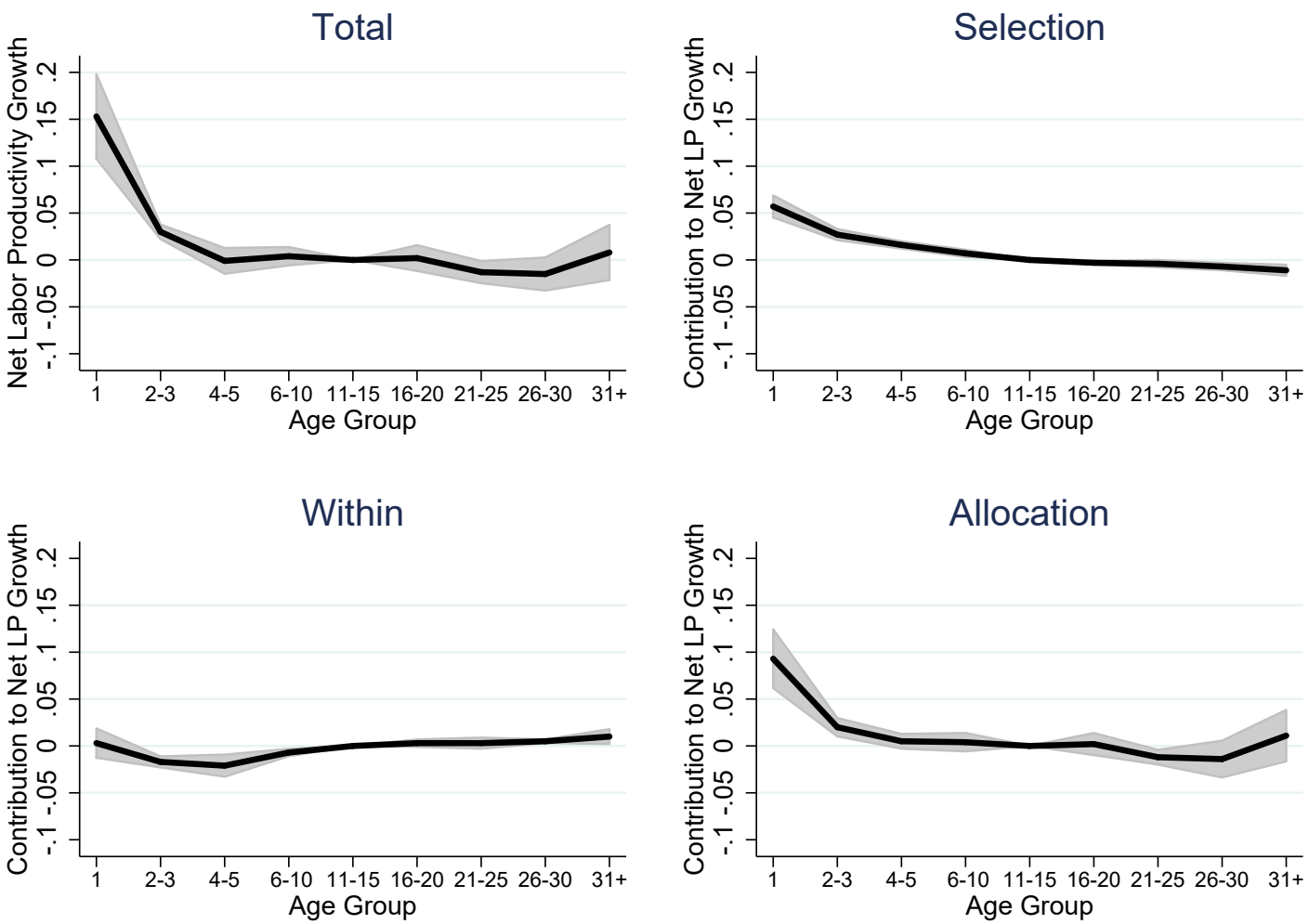
Back Mature Firms

Robustness: Geographic Cyclicality



Back

Robustness: Age Censoring



Back Mature Firms