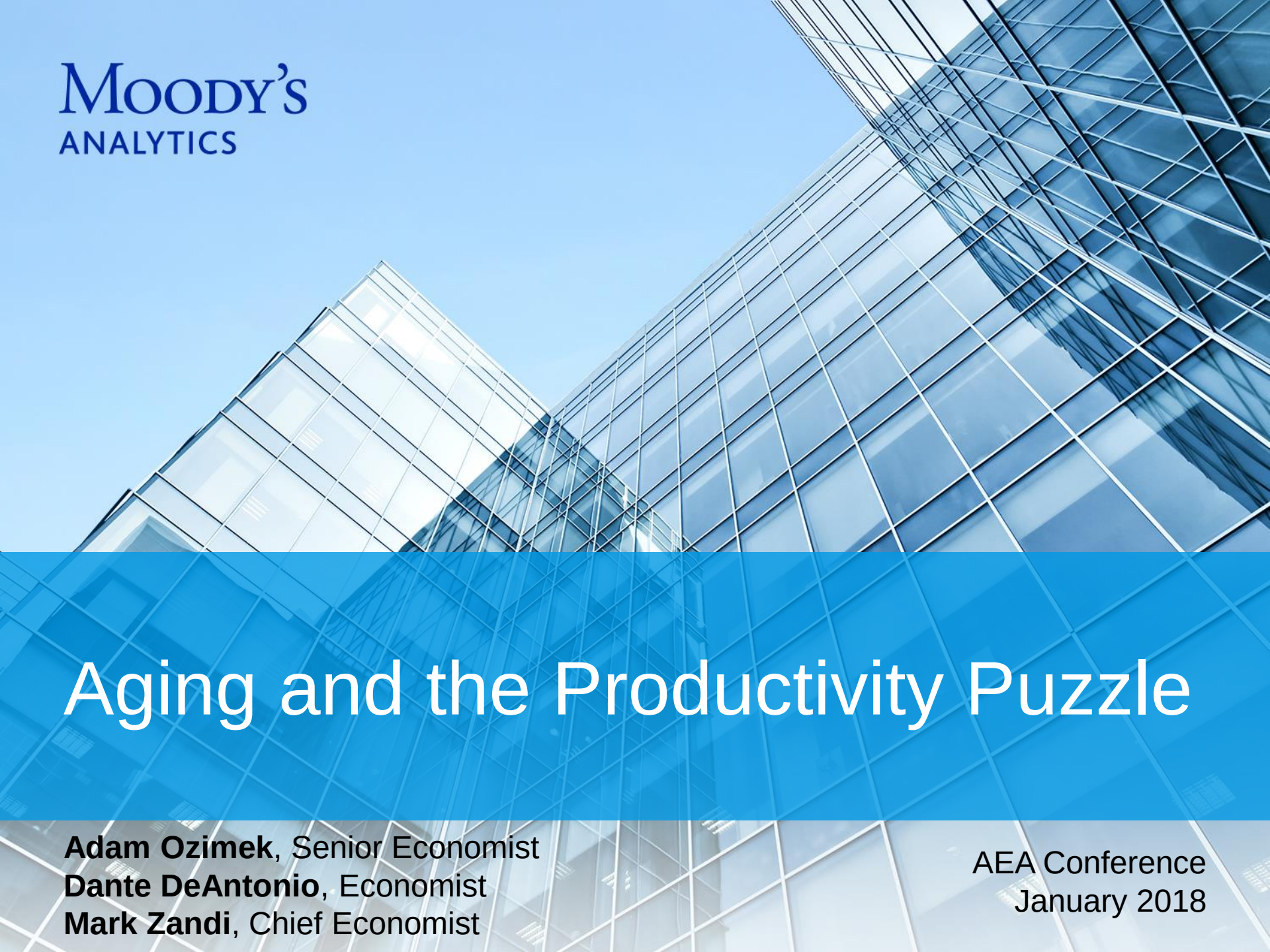

Aging and the Productivity Puzzle

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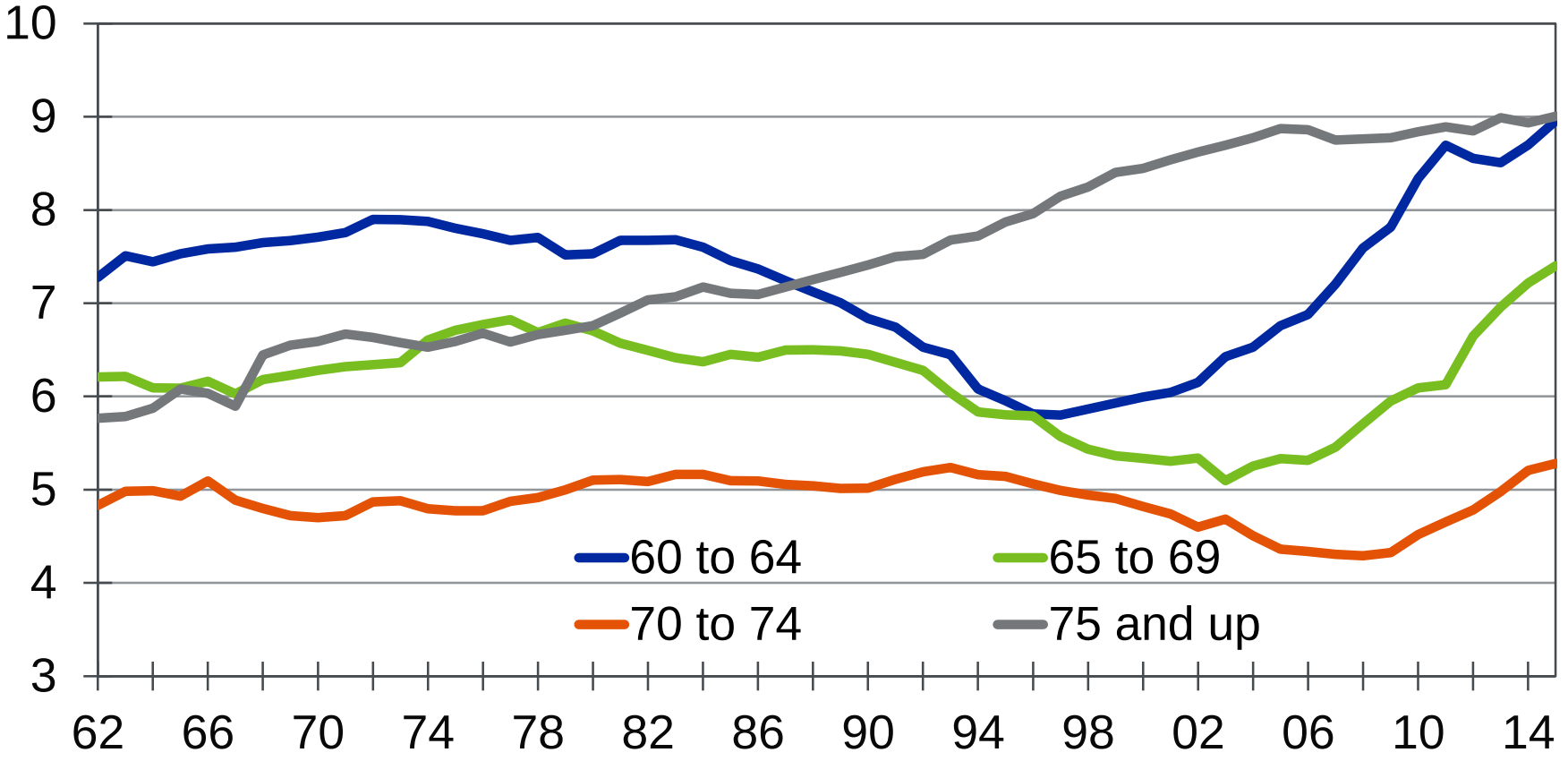
Introduction

- The workforce has aged significantly over the last decade.
- Two main factors:
  - Demographics
  - Older workers remaining in the workforce

The Adult Population Is Getting Older…

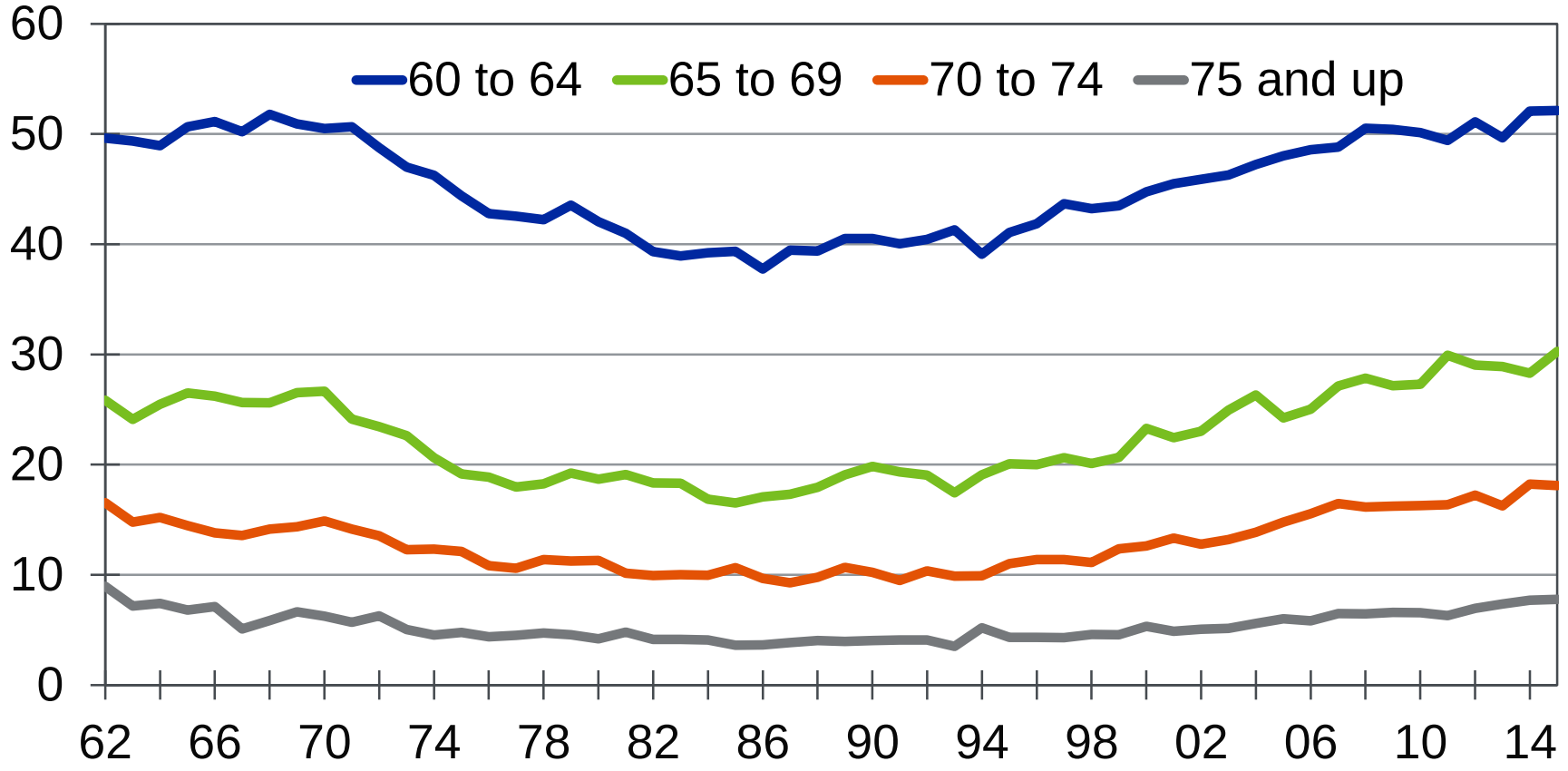
Share of the 25 and older population, by age, %



Sources: Census Bureau, Moody's Analytics

…And Working More…

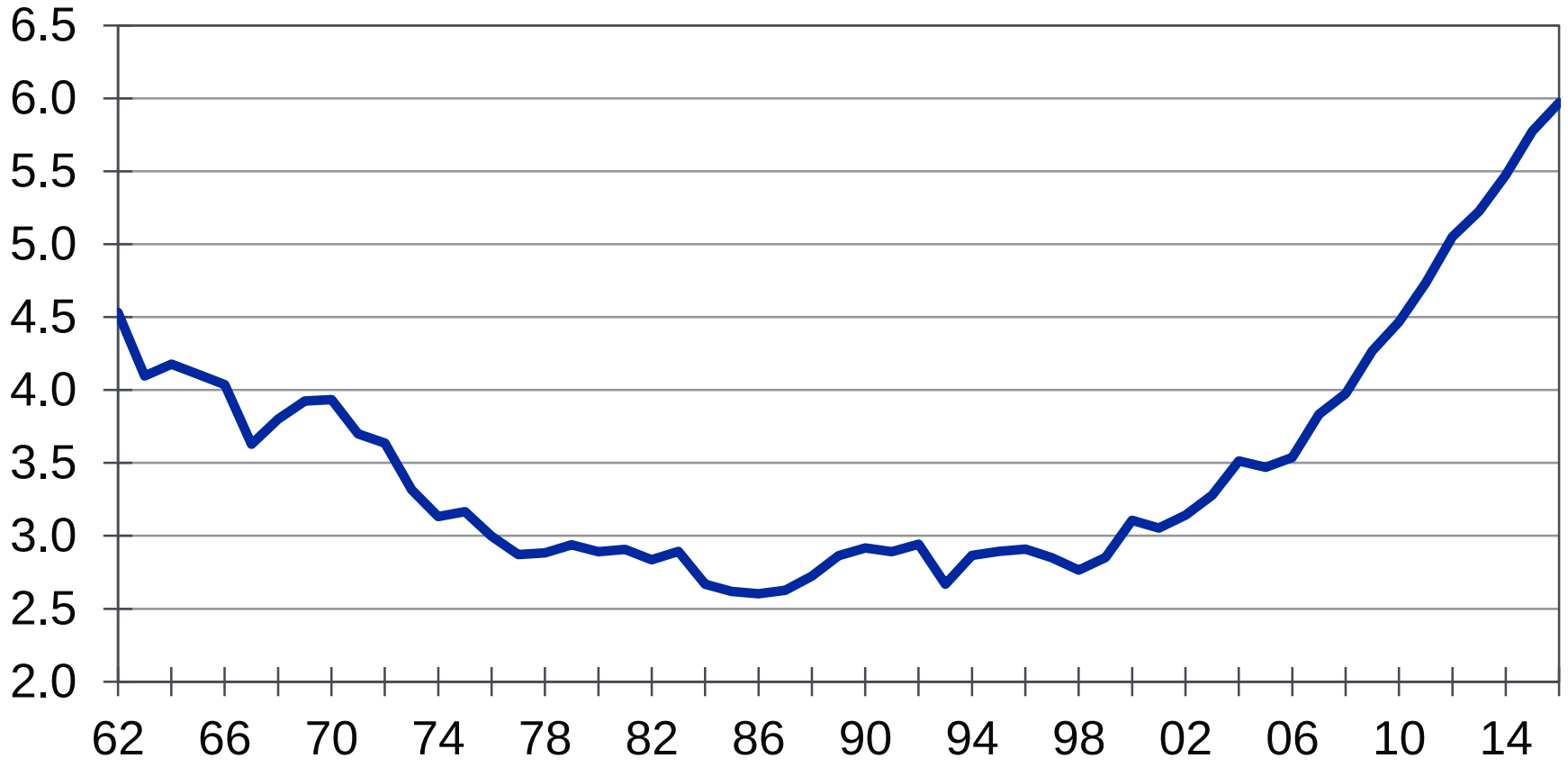
Employment-to-population ratio, by age, %



Sources: BLS, Moody's Analytics

…Leading to an Older Overall Workforce

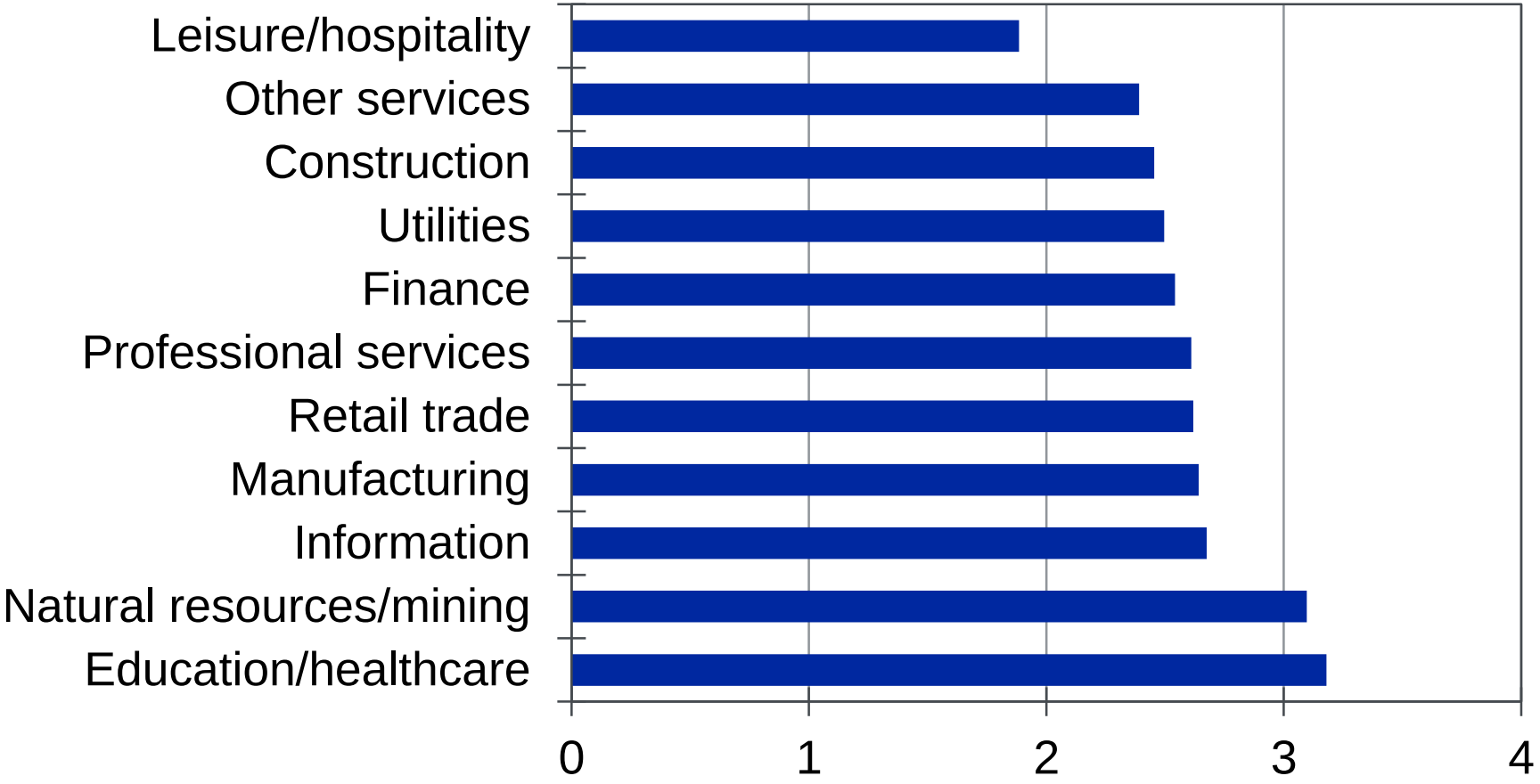
Share of employed age 65 and older, %



Sources: BLS, Moody's Analytics

Every Industry Has More Older Workers

Share of workforce age 65 and older, change 2000 to 2015, ppt



Sources: Census Bureau, Moody's Analytics

Aging and Productivity

- Coincidental timing of aging workforce alongside declining productivity raises questions about whether aging has been partly responsible for the slowdown in productivity growth
- A direct effect of aging on own productivity is not supported by lifecycle wage data, which does not show a drop off in wages for older workers
- Possible spillovers?

Possible Productivity Spillovers

- An older workforce may slow the adoption of productivity enhancing technologies that require learning
  - Benefits from such learning would be lowest for older workers, due to shorter remaining careers
  - Costs may also be higher for older workers if they have a harder time learning new skills

Existing Research Disagrees

- Acemoglu and Restrepo (2017)
  - Older population is associated with higher GDP per capita growth in cross-country growth regressions of 169 countries from 1990 to 2015.
  - Labor scarcity leads to more robotics.
- Maestas, Mullen, Powell (2016)
  - 60+ population growth is associated with lower productivity in state panel model, 1980-2010.
  - 0.3 pp lower GDP growth per year from 1980 to 2010, 1.2 pp lower from 2010 to 2020.

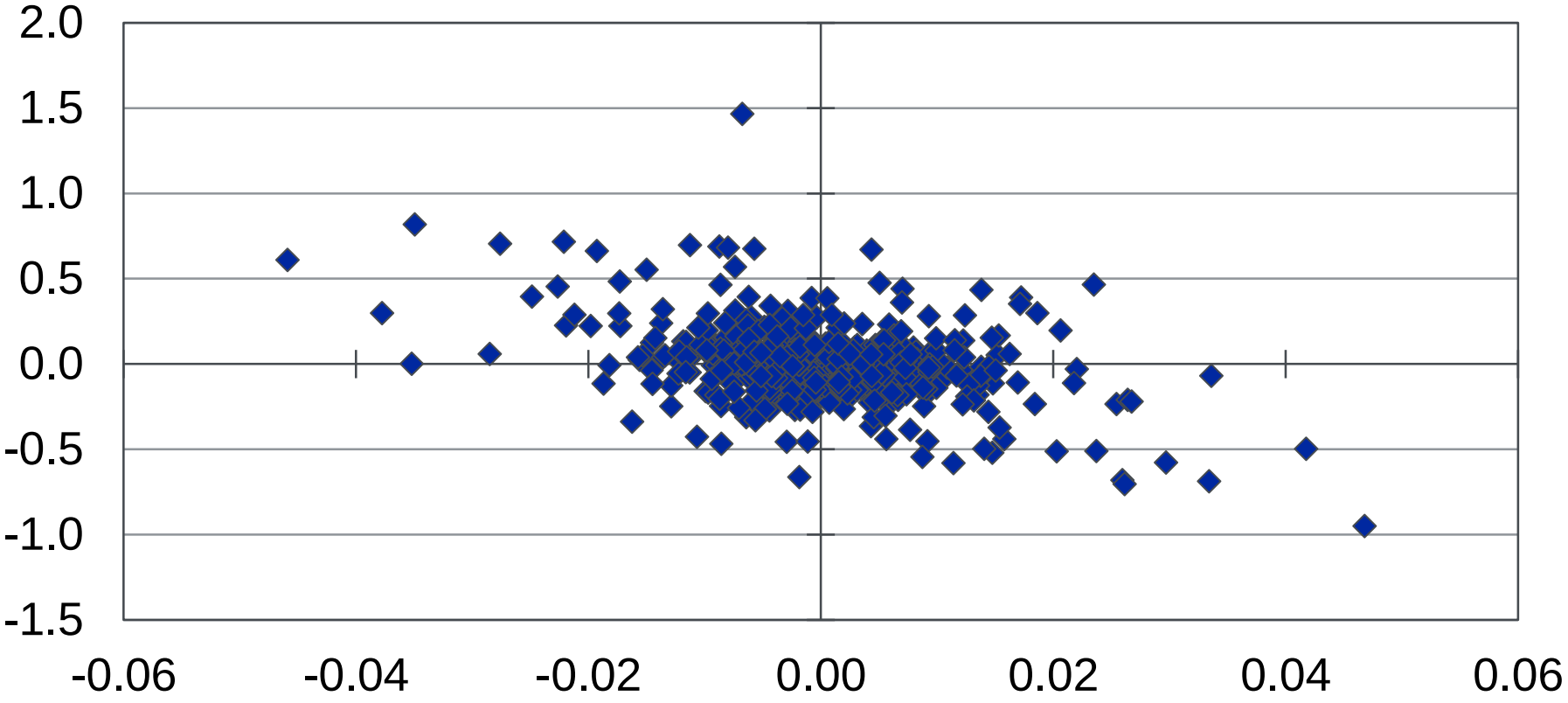
QWI Aggregate Analysis

- A clear relationship is shown between aggregate aging and productivity in cross-sections of state-industry data
- Annual state-industry QWI data is matched to BEA data on state-level productivity by industry
  - The matched data covers 50 states and D.C., along with 11 industry aggregations

Clear 2015 Cross-Sectional Relationship

X-axis: % of workers 65 and up minus state & industry fixed effect

Y-axis: Log productivity minus state & industry fixed effect



Sources: Census Bureau, BEA, Moody's Analytics

Regression Models Verify Relationship

Regressions of log(productivity) by state and industry

	2000	2005	2010	2015	Stacked differences	Stacked differences
Share 65 and up						
Coefficient	-10.191	-10.835	-10.273	-9.278	-4.051	-4.459
P-value	0.000	0.000	0.000	0.000	0.020	0.014
Sample size	462	549	560	549	1,560	1,560
Adjusted R-squared	0.946	0.938	0.940	0.938	0.363	0.371
Employment control?	N	N	N	N	N	Y

Notes: All models include state and industry fixed effects, standard errors clustered by state.

ADP Worker-Level Analysis

- Individual-level data used to ensure compositional effects are not driving results
- Analysis used ADP quarterly payroll records to estimate Mincer equations:

$$\ln\left(Y_{i,j,t}\right) = \alpha + \beta_1 X_{i,t} + \beta_2 \Pi_{j,t} + \beta_3 \theta_{j,t} + \mu_{j,t} + \varepsilon_{i,j,t}$$

  - Y is the hourly wage for individual i, at firm j, in period t
  - $X_{i,t}$ includes worker specific controls
  - $\Pi_{j,t}$ includes firm specific controls
  - $\theta_{j,t}$ measures the share of workers at firm j who are age 65 and older

Basic Model Results

	Ln(wage) 2016Q4	Dlog(wage) 2013Q4-2016Q4
65+ share of firm employment	-1.008*** (0.0365)	
Change in 65+ share of firm employment		-0.0857*** (0.0132)
Sample size	914,627	914,627
Adjusted R-squared	0.374	0.090

Notes: All models include controls by 3-digit ZIP code, firm industry classification, as well as worker characteristics. Standard errors clustered at the 3-digit ZIP code level in parentheses. Sample includes workers at firms with 20-499 employees. *** p<0.01, ** p<0.05, * p<0.1

Albatross vs. Wise Man Theories

- The results of the initial model are consistent with two opposing theories:
  - Older works have negative productivity spillover effects, so having more of them brings down productivity (Albatross theory)
  - Older workers have positive spillover effects, and firms with more older workers have more retiring workers (Wise man theory)

Flow Model

- To determine which theory is appropriate, it is useful to break the stock of older workers in period t into flows from period t-1 into period t as:

$$\theta_{j,t} = \theta_{j,t-1} + \mathrm{H}_{j,t} + \mathrm{A}_{j,t} - \mathrm{E}_{j,t}$$

  - $\theta_{j,t-1}$ is the number of older workers at firm j, in period t-1
  - $\mathrm{H}_{j,t}$ is the number of older workers hired at firm j, between period t-1 and period t
  - $\mathrm{A}_{j,t}$ is the number of workers who aged into the older working group and were employed at firm j in period t and period t-1
  - $\mathrm{E}_{j,t}$ is the number of older workers who were employed at firm j in period t-1 but exited prior to period t

Flow Model Results

	Dlog(wage) 2013Q4-2016Q4
65+ share in 2013Q4 ($\theta_{j,t-1}$)	-0.0674*** (0.0111)
65+ hires between 2014Q4 and 2016Q4 ($H_{j,t}$)	0.0242 (0.0190)
Workers aged into 65+ share ($A_{j,t}$)	-0.0856*** (0.0166)
65+ exits from firm between 2013Q4 and 2016Q4 ($E_{j,t}$)	0.0287*** (0.0111)
Sample size	1,412,164
Adjusted R-squared	0.601

Notes: All models include controls by 3-digit ZIP code, firm industry classification, as well as worker characteristics. Standard errors clustered at the 3-digit ZIP code level in parentheses. Sample includes workers at firms with 20-499 employees. *** p<0.01, ** p<0.05, * p<0.1

Robustness Check

- The initial models leave open the possibility that firms with higher shares of older workers experience some other negative shocks which influence wage levels/growth
- A robustness check can be performed by focusing on variation in geographic labor markets within large national firms
- Large firms are segmented into local labor markets using 3-digit ZIP codes of workers' home addresses

Robustness Check

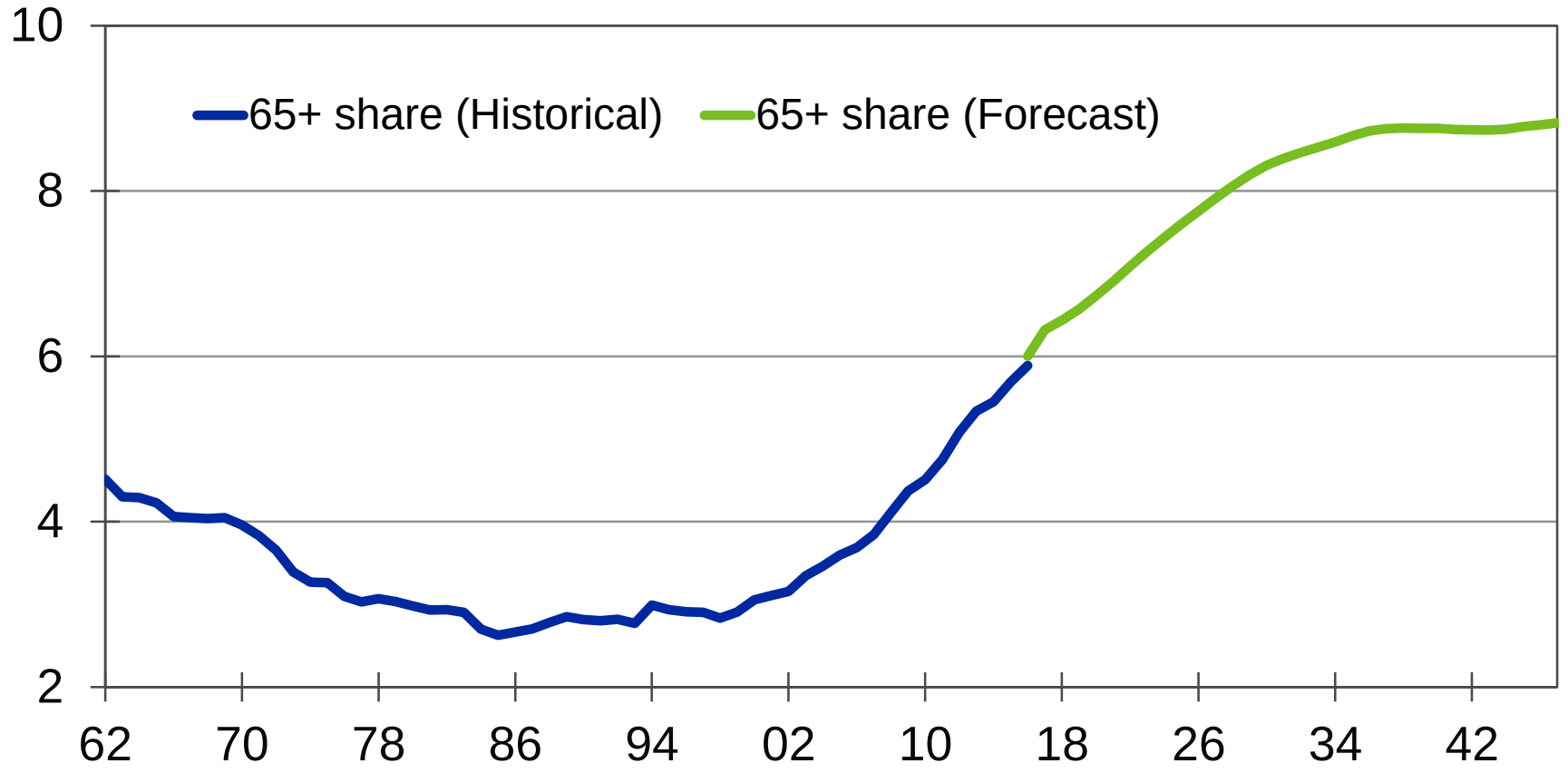
- The sample is limited to firms with workers who live in 100 or more 3-digit ZIP codes, and the model includes firm-specific fixed effects, along with geographic fixed effects
  - This focuses the analysis only on within-firm, within 3-digit ZIP code wage variation

	Ln(wage) 2016Q4	Ln(wage) 2016Q4
65+ share of firm employment	-1.489*** (0.0999)	-0.626*** (0.0936)
Sample size	1,412,164	1,412,164
Adjusted R-squared	0.601	0.712
Firm-level fixed effects?	No	Yes

Notes: All models include controls by 3-digit ZIP code, firm industry classification, as well as worker characteristics. Standard errors clustered at the 3-digit ZIP code level in parentheses. Sample includes firms with workers in 100 or more 3-digit ZIP codes. *** p<0.01, ** p<0.05, * p<0.1

Workforce Will Age Further…

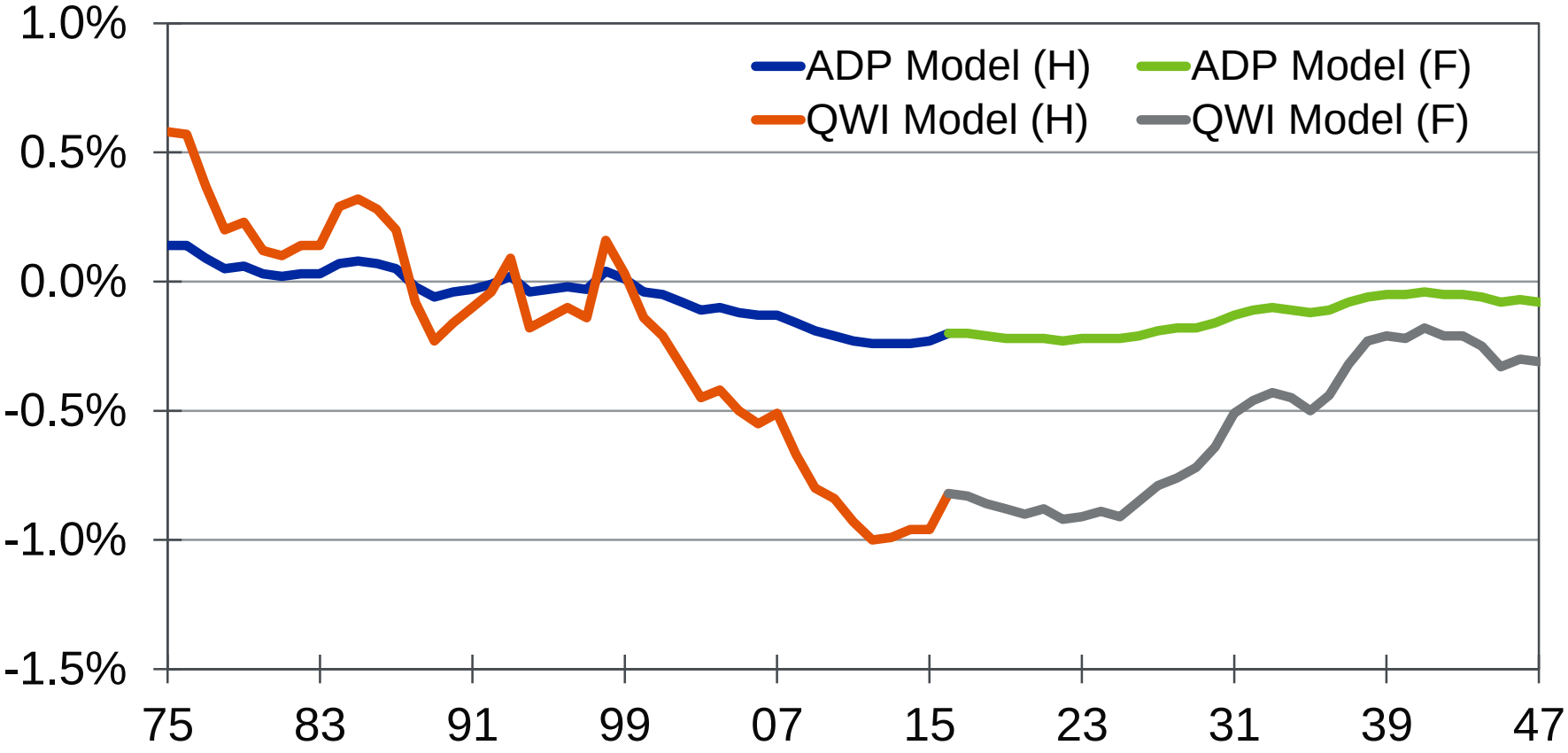
Share of employed age 65 and older, %



Sources: BLS, Moody's Analytics

…Leading to Productivity Losses

Reduction in productivity growth from aging workforce, ppt



Sources: BLS, Moody's Analytics

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