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

Leisure/hospitality
Other services
Construction
Utilities
Finance
Professional services
Retail trade
Manufacturing
Information
Natural resources/mining
Education/healthcare

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

<table>
<thead>
<tr>
<th></th>
<th>2000</th>
<th>2005</th>
<th>2010</th>
<th>2015</th>
<th>Stacked differences</th>
<th>Stacked differences</th>
</tr>
</thead>
<tbody>
<tr>
<td>Share 65 and up</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>P-value</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.020</td>
<td>0.014</td>
</tr>
<tr>
<td>Sample size</td>
<td>462</td>
<td>549</td>
<td>560</td>
<td>549</td>
<td>1,560</td>
<td>1,560</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.946</td>
<td>0.938</td>
<td>0.940</td>
<td>0.938</td>
<td>0.363</td>
<td>0.371</td>
</tr>
<tr>
<td>Employment control?</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>N</td>
<td>Y</td>
</tr>
</tbody>
</table>

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:

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

- \( Y \) 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

<table>
<thead>
<tr>
<th></th>
<th>Ln(wage) 2016Q4</th>
<th>Dlog(wage) 2013Q4-2016Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>65+ share of firm employment</td>
<td>-1.008***</td>
<td>-0.0857***</td>
</tr>
<tr>
<td></td>
<td>(0.0365)</td>
<td>(0.0132)</td>
</tr>
<tr>
<td>Change in 65+ share of firm employment</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sample size</td>
<td>914,627</td>
<td>914,627</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.374</td>
<td>0.090</td>
</tr>
</tbody>
</table>

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:

\[ \theta_{j,t} = \theta_{j,t-1} + H_{j,t} + A_{j,t} - E_{j,t} \]

- \( \theta_{j,t-1} \) is the number of older workers at firm j, in period t-1
- \( H_{j,t} \) is the number of older workers hired at firm j, between period t-1 and period t
- \( A_{j,t} \) 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
- \( E_{j,t} \) 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

<table>
<thead>
<tr>
<th></th>
<th>Dlog(wage) 2013Q4-2016Q4</th>
</tr>
</thead>
<tbody>
<tr>
<td>65+ share in 2013Q4 (θ_{j,t-1})</td>
<td>-0.0674*** (0.0111)</td>
</tr>
<tr>
<td>65+ hires between 2014Q4 and 2016Q4 (H_{j,t})</td>
<td>0.0242 (0.0190)</td>
</tr>
<tr>
<td>Workers aged into 65+ share (A_{j,t})</td>
<td>-0.0856*** (0.0166)</td>
</tr>
<tr>
<td>65+ exits from firm between 2013Q4 and 2016Q4 (E_{j,t})</td>
<td>0.0287*** (0.0111)</td>
</tr>
<tr>
<td>Sample size</td>
<td>1,412,164</td>
</tr>
<tr>
<td>Adjusted R-squared</td>
<td>0.601</td>
</tr>
</tbody>
</table>

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.

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

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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