

MOODY'S
ANALYTICS

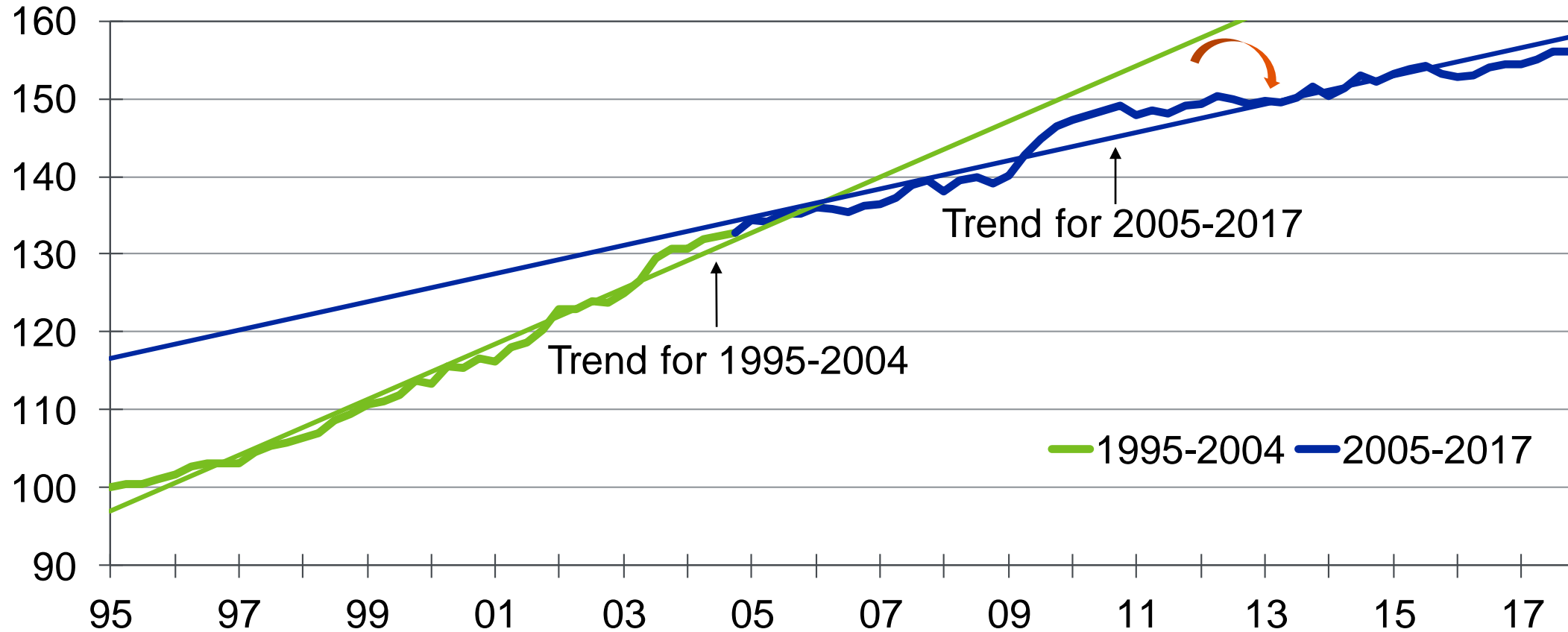
EOC
18

The Productivity Puzzle

Dante DeAntonio, Assistant Director
Ilir Hysa, Associate Director

Why Does This Matter?

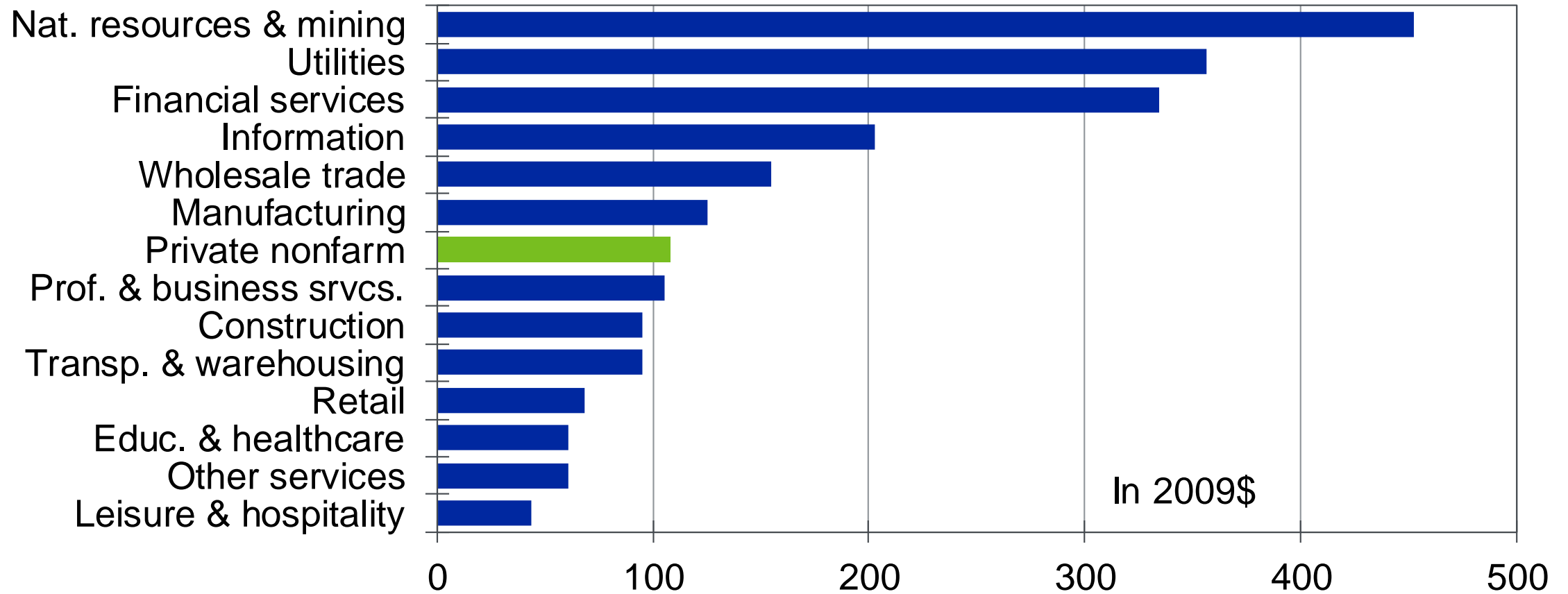
Nonfarm business labor productivity, 1995Q1=100



Sources: BLS, Moody's Analytics

Industry Productivity Varies

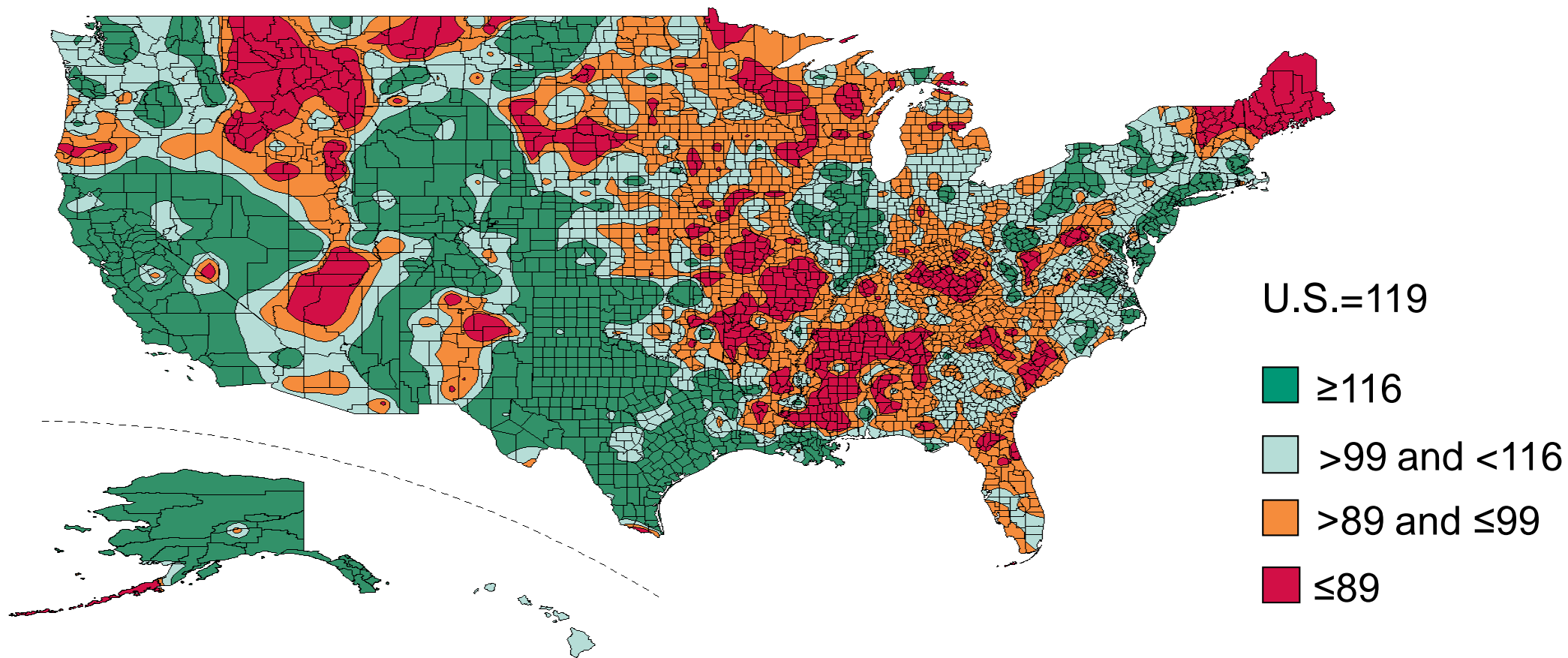
U.S. industry productivity, real \$ ths per worker per yr, 2005



Sources: BLS, BEA, Moody's Analytics

Diverse Regional Productivity

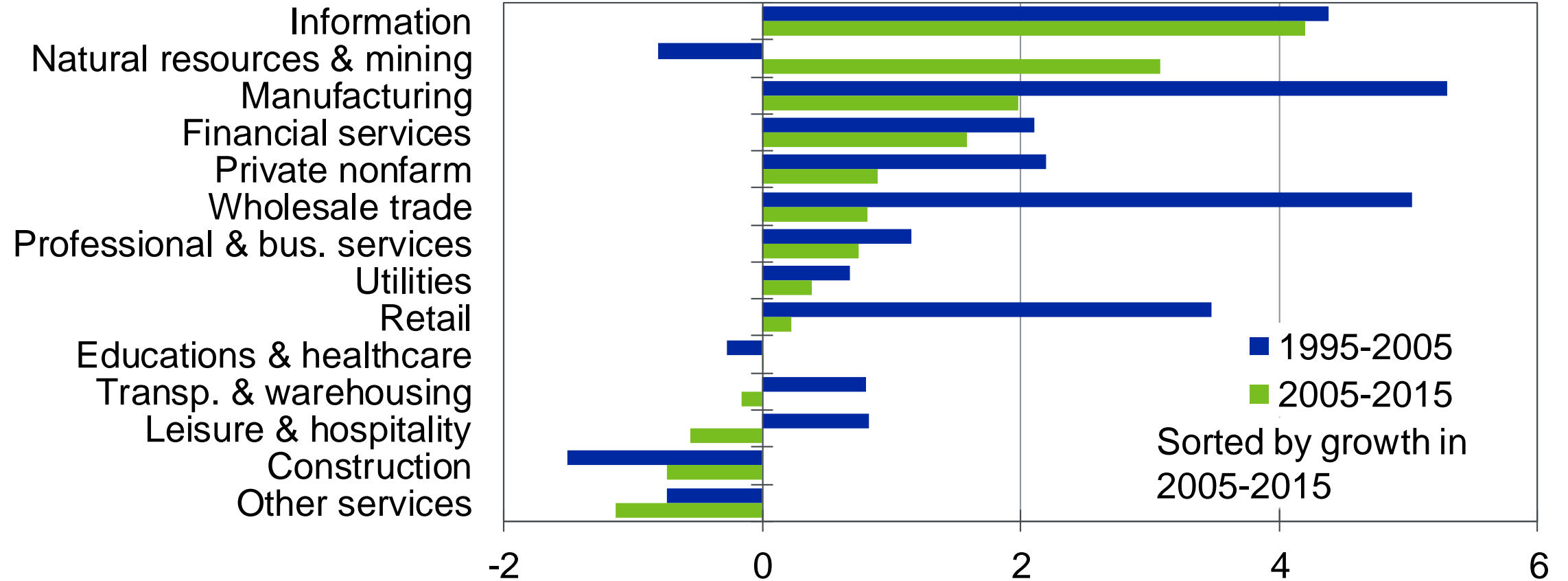
Private nonfarm labor productivity, real output in \$ ths per yr, 2015



Sources: BEA, BLS, Moody's Analytics

A Broad-Based Slowdown

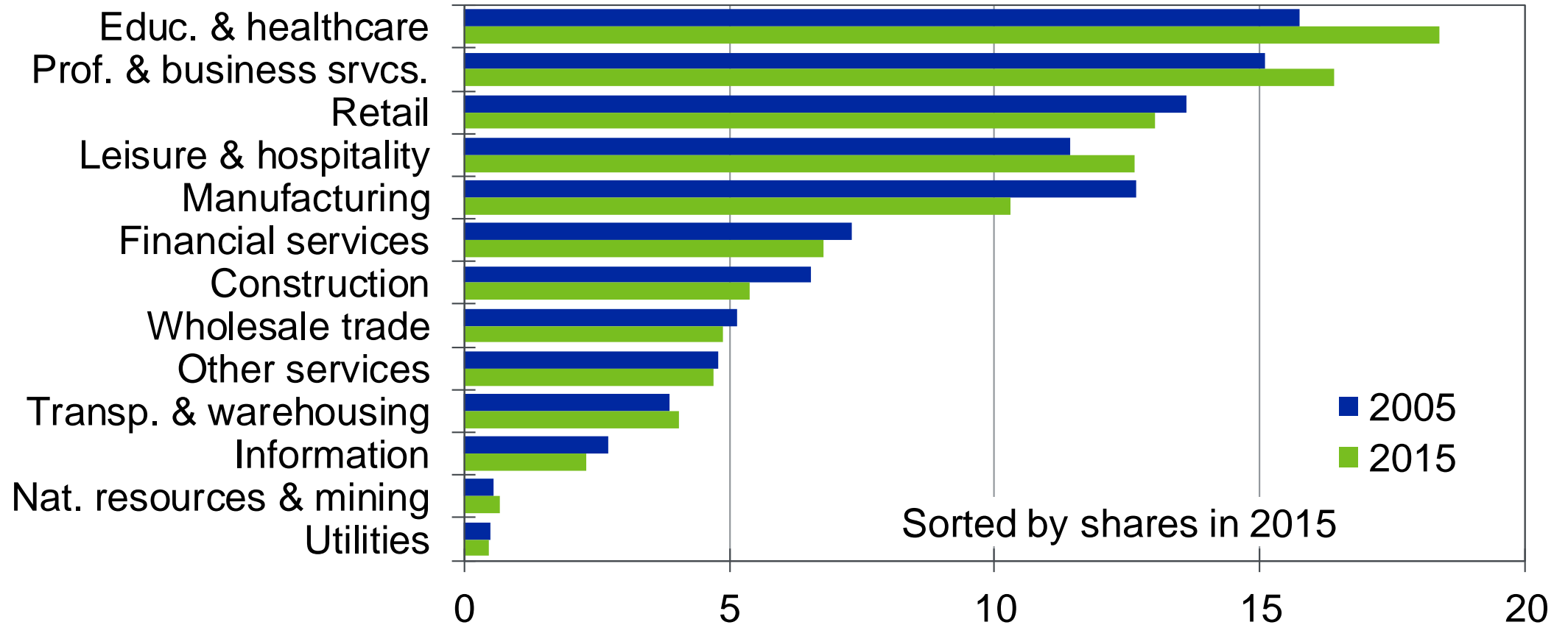
U.S. worker productivity by industry, % change annualized rate



Sources: BLS, BEA, Moody's Analytics

A Shifting Industry Jobs Mix

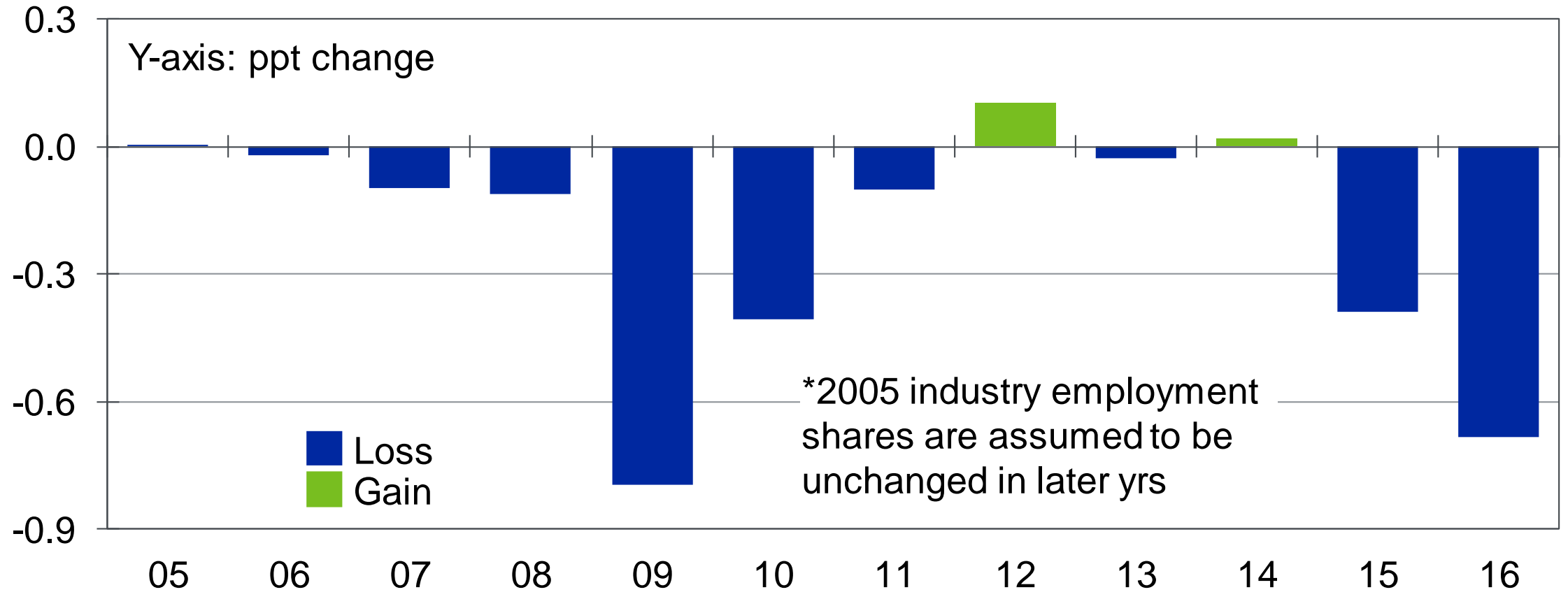
U.S. industry employment share, %



Sources: BLS, Moody's Analytics

Changing Mix Hurts Productivity

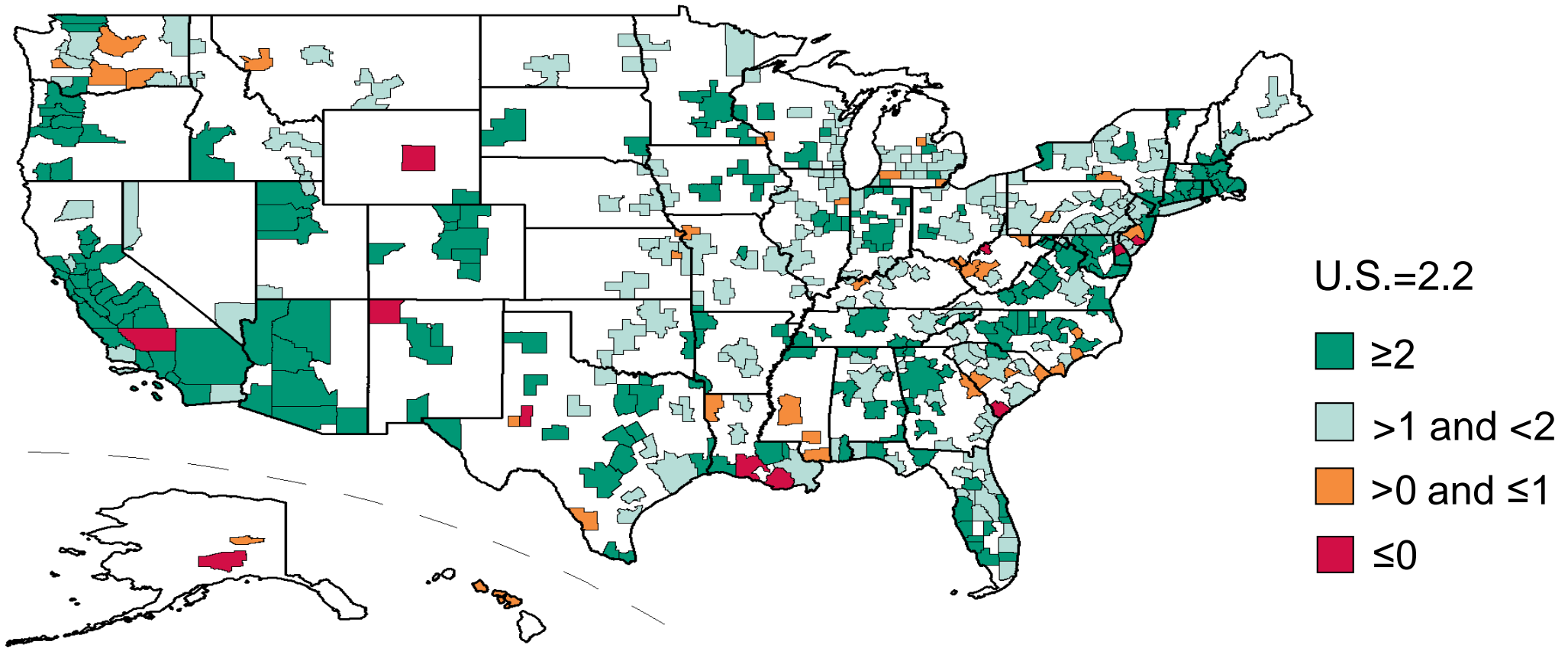
Gain/loss in productivity growth due to industry composition change*



Source: Moody's Analytics

Good Times Lift All Boats...

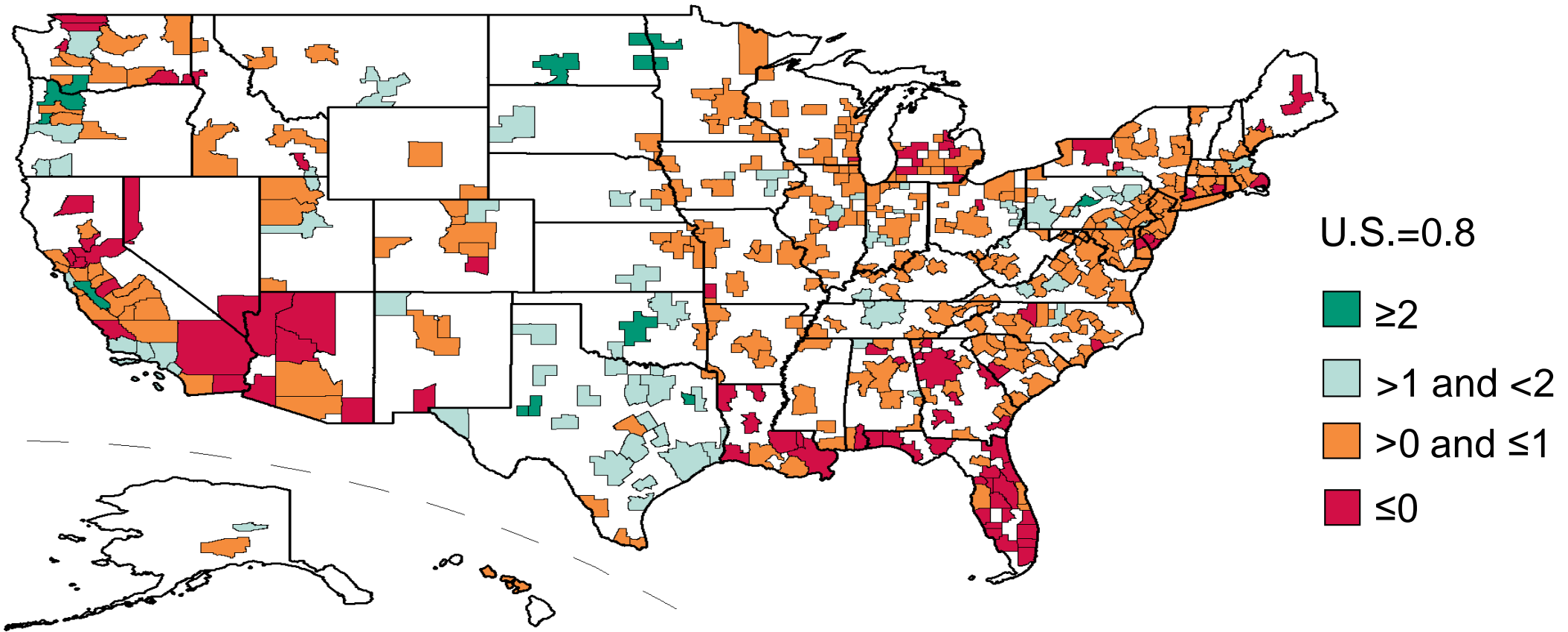
Private nonfarm labor productivity growth, % change yr ago, 1995-2005



Sources: BEA, BLS, Moody's Analytics

...But Not for Long

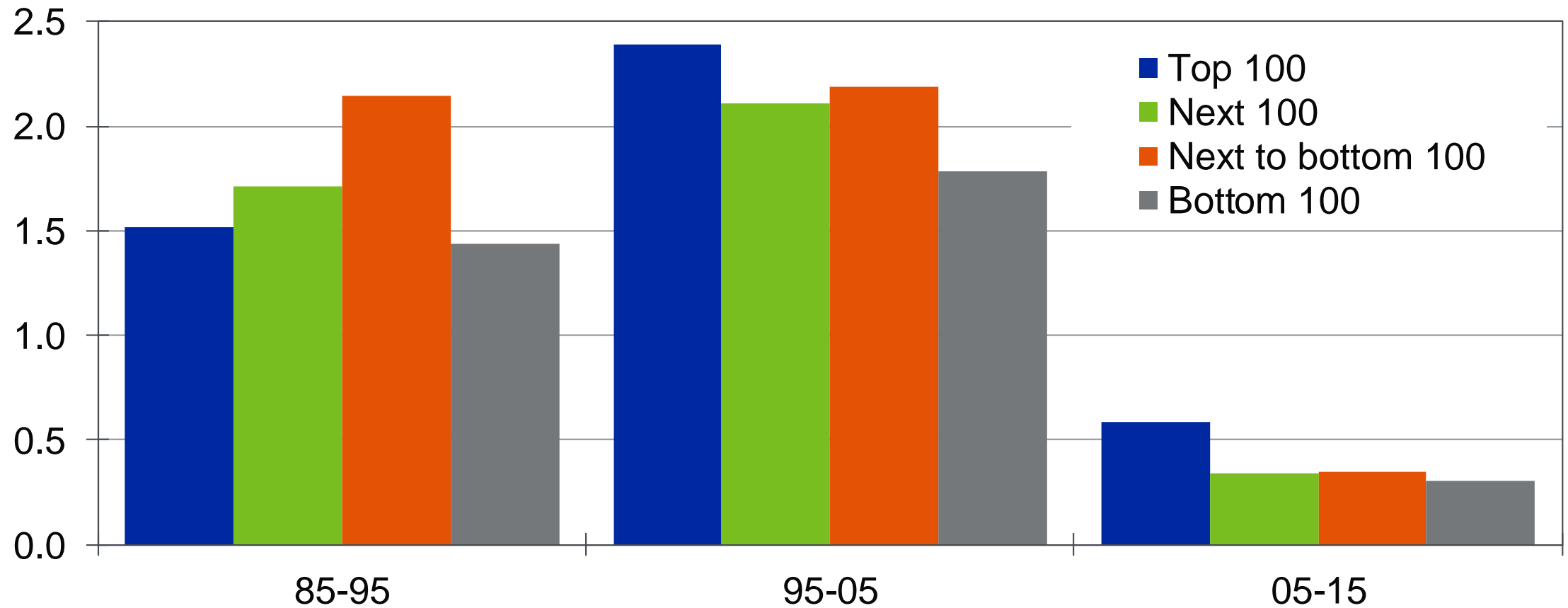
Private nonfarm labor productivity growth, % change yr ago, 2005-2015



Sources: BEA, BLS, Moody's Analytics

Larger Areas Have Done Most Damage

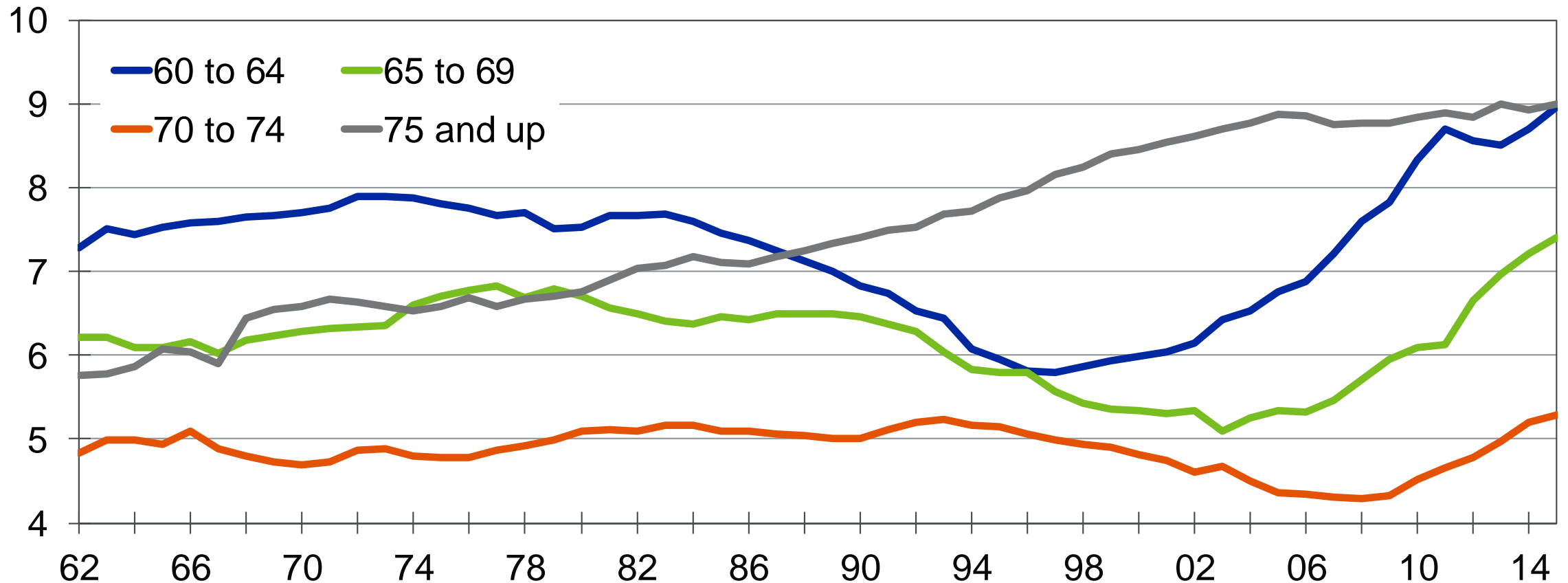
Productivity, % change annualized, by metro area size



Source: Moody's Analytics

Adult Population Is Aging...

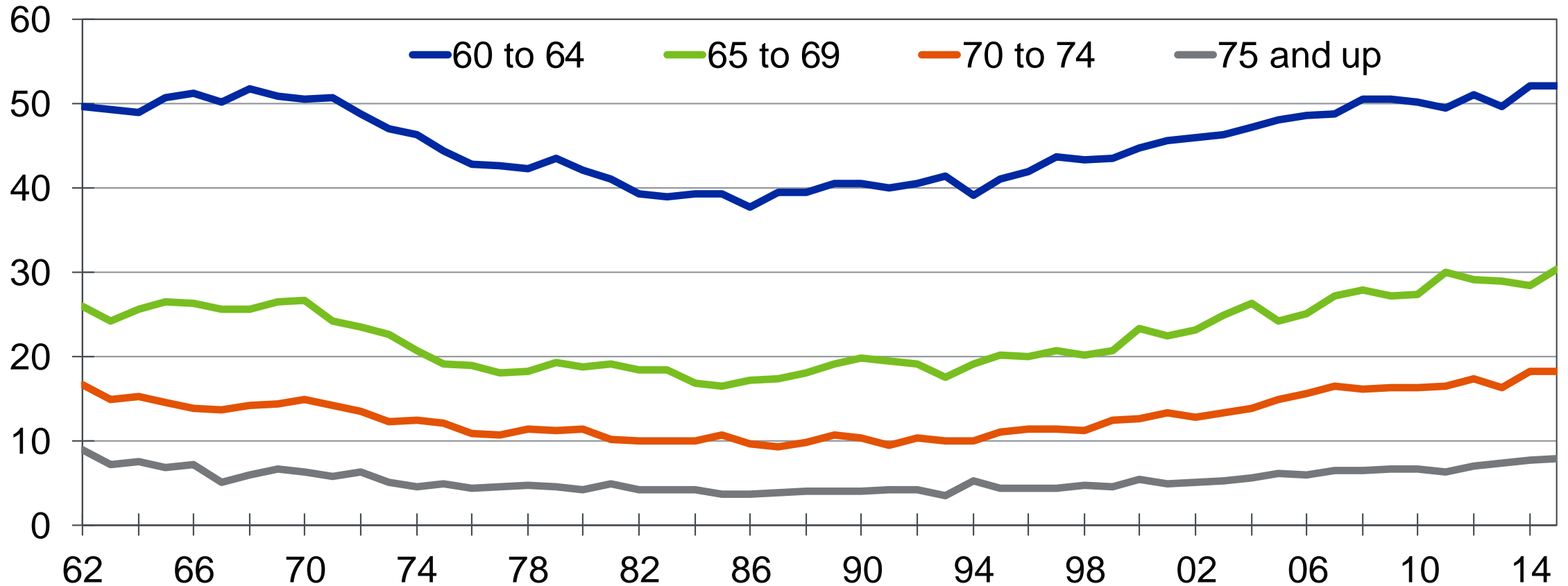
Share of the 25 and older population, by age, %



Sources: Census Bureau, Moody's Analytics

...And Working More...

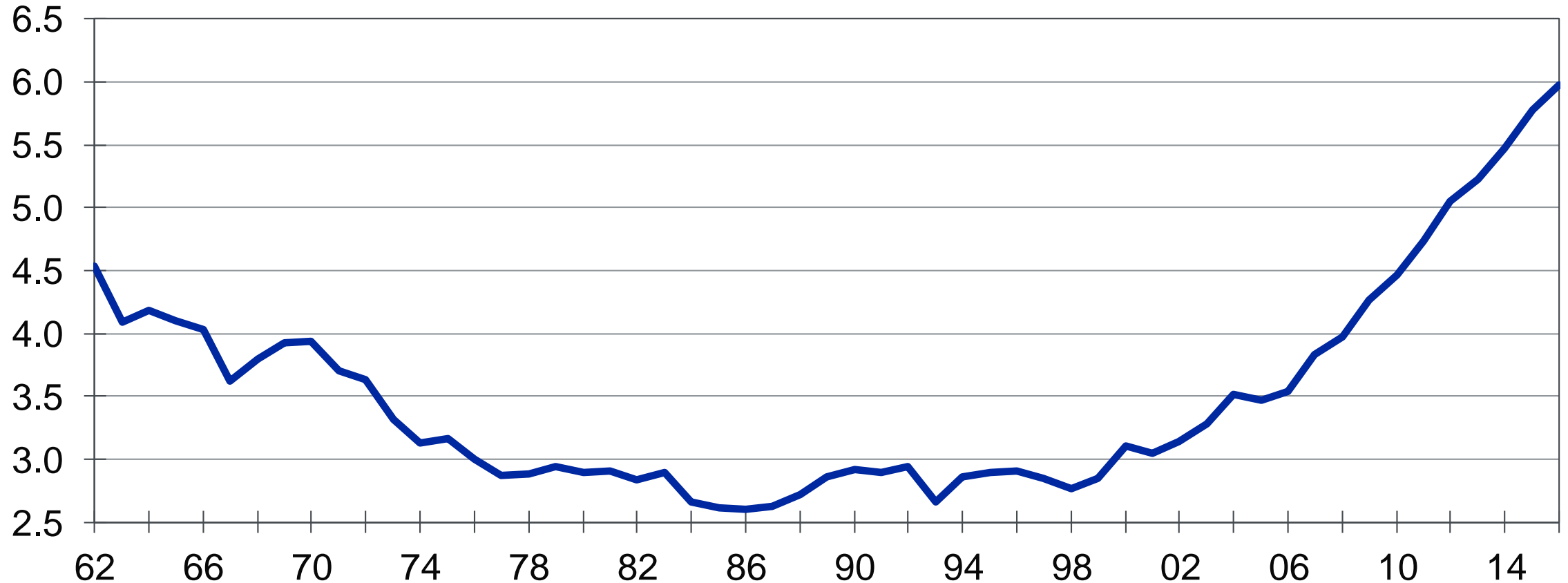
Employment-to-population ratio, by age, %



Sources: BLS, Moody's Analytics

...Leading to an Older Workforce

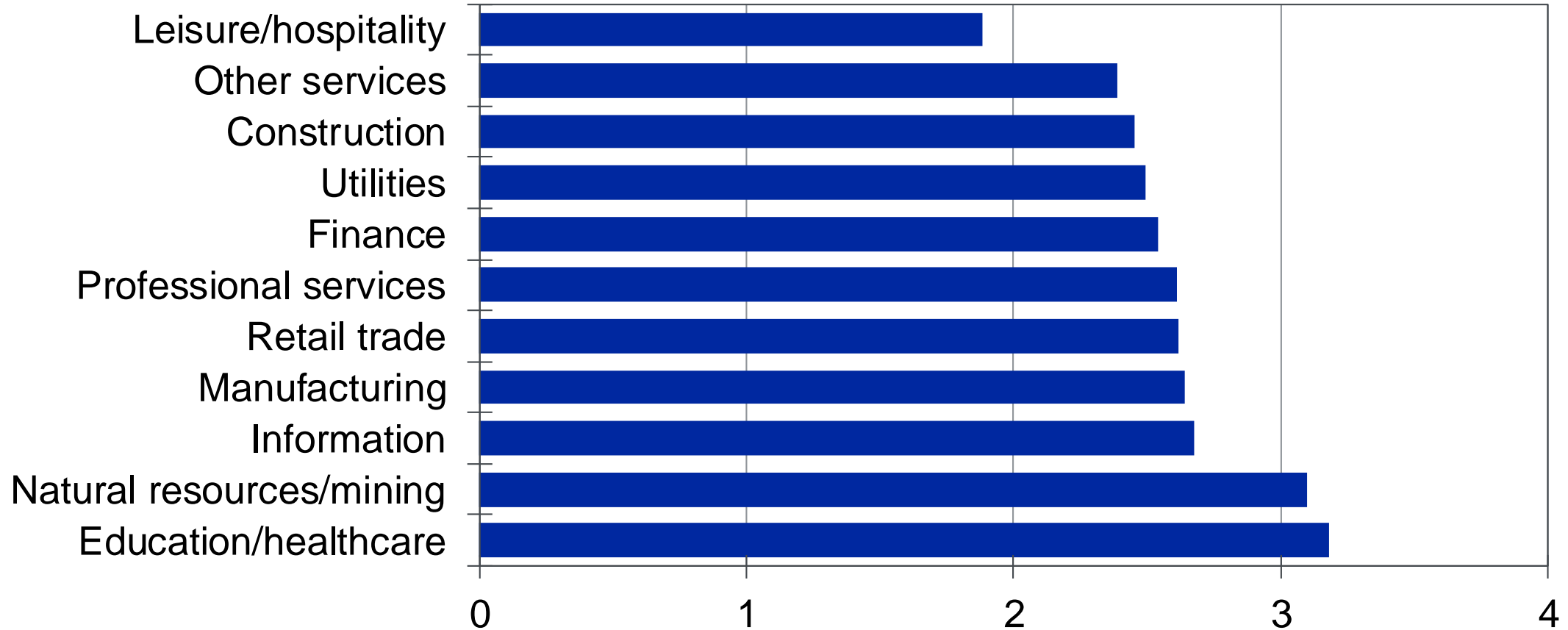
Share of employed age 65 and older, %



Sources: BLS, Moody's Analytics

Every Industry Is Aging

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



Sources: Census Bureau, Moody's Analytics

Worker-Level Analysis Using ADP Data

Regression results

| Variables | 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 |

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

Sources: ADP, Moody's Analytics

Albatross vs. Wise Man Theories

- » Initial model results are consistent with two opposing theories:
 - **Albatross**: Older workers have negative productivity spillover effects, so having more of them brings down productivity—and wages
 - **Wise man**: Older workers have positive spillover effects, but firms with more older workers have more retiring workers, which brings down productivity—and wages

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

Albatross or Wise Man

Regression results

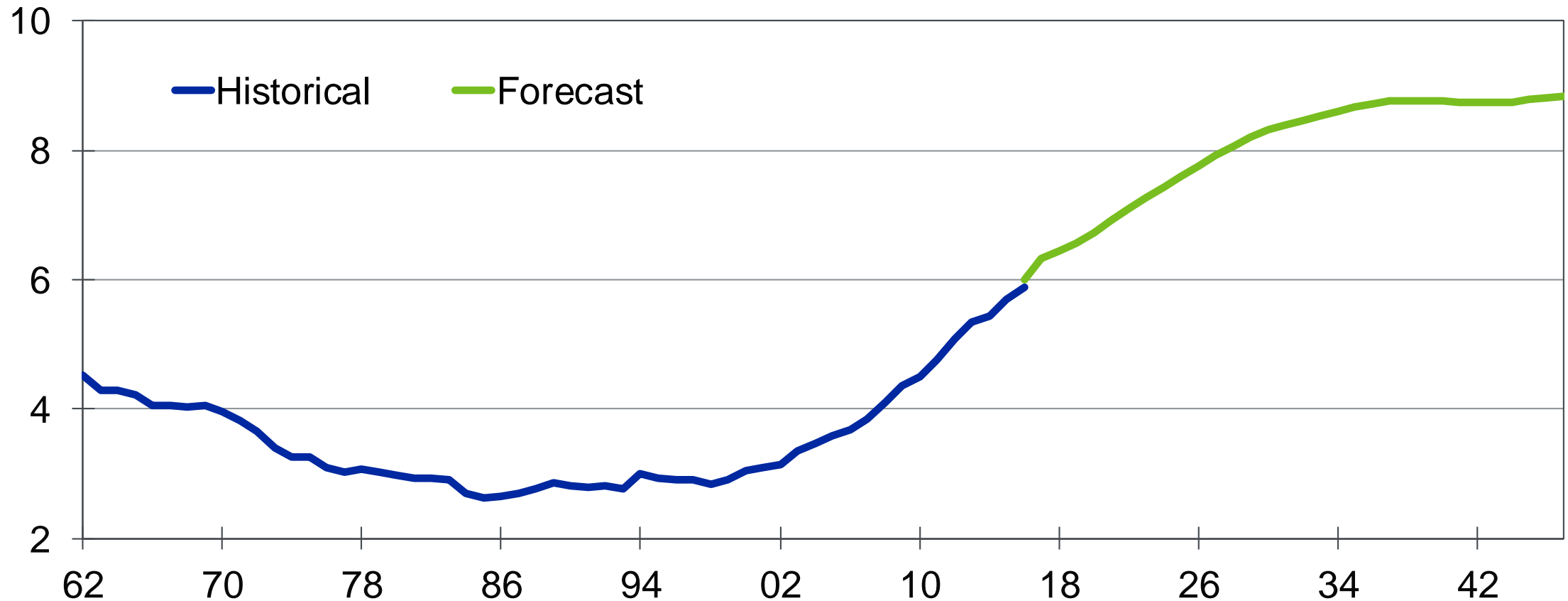
| Variables | Dlog(wage) 2013Q4-2016Q4 |
|---|-----------------------------|
| 65+ share in 2013Q4 ($\theta_{j,t-1}$) | -0.0674* (0.0111) |
| 65+ hires between 2014Q4 and 2016Q4 ($H_{j,t}$) | 0.0242 (0.0190) |
| Workers aged into 65+ share ($A_{j,t}$) | -0.0856* (0.0166) |
| 65+ exits from firm between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

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

Sources: ADP, Moody's Analytics

Workforce Will Age Further...

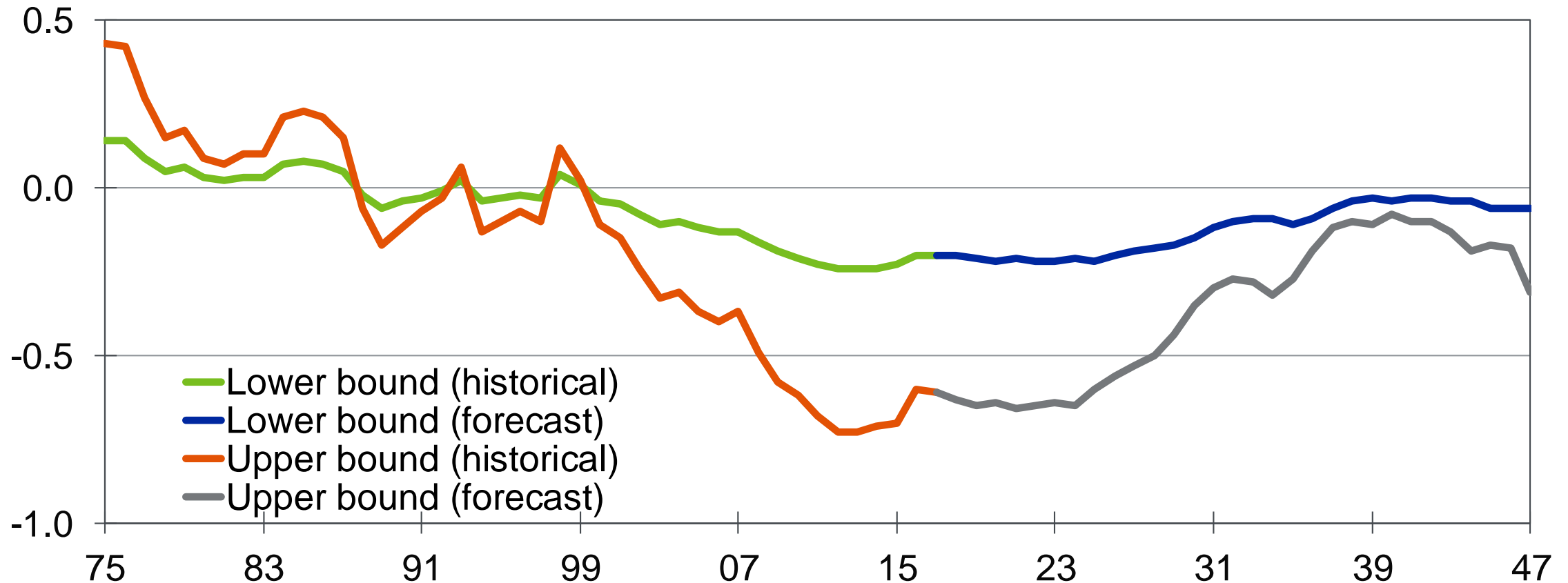
Share of employed age 65 and older, %



Sources: BLS, Moody's Analytics

...Leading to Productivity Losses

Reduction in productivity growth from aging workforce, ppt



Sources: BLS, Moody's Analytics

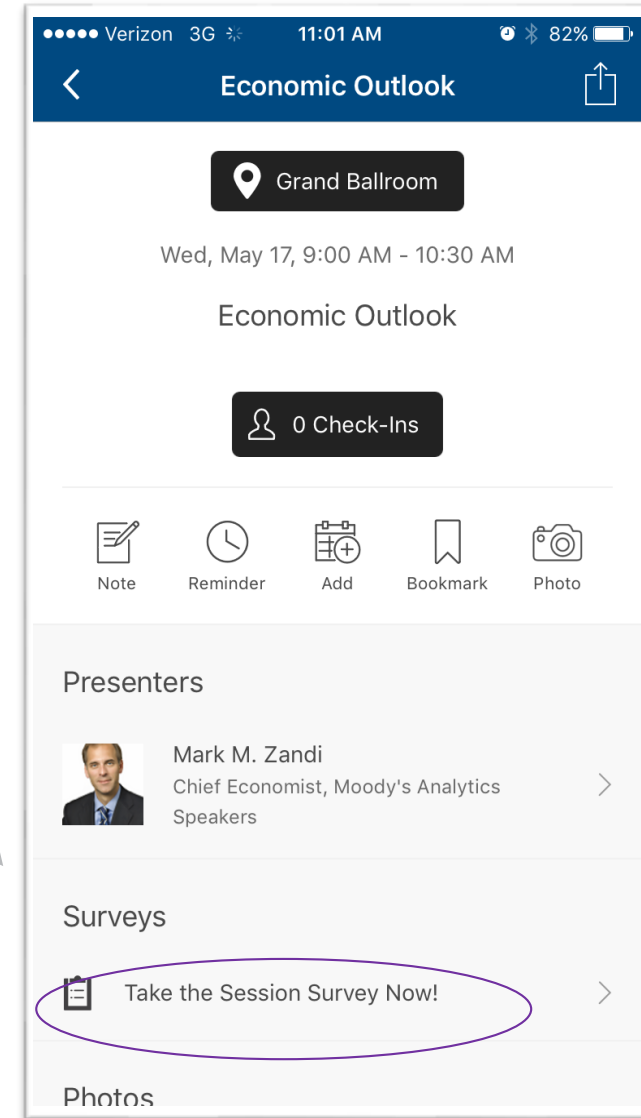
Takeaways

- » The slowdown in productivity growth has been broad-based across industries and regions.
- » A portion of this slowdown can be attributed to the aging of the population.
- » Other potential causes of productivity slowdown?

Session Evaluation: We Want to Hear From You!



1. Open the mobile app on your device
2. Navigate to “Schedule” and open today’s session
3. Tap the bar “**Take the Session Survey Now**” to answer the brief 3 questions
4. Once complete – back out and continue exploring the EOC18 app!



United States
121 North Walnut Street
Suite 500
West Chester PA 19380
+1.610.235.5299

United Kingdom
One Canada Square
Canary Wharf
London E14 5FA
+44.20.7772.5454

Australia
Level 10
1 O'Connell Street
Sydney, NSW, 2000
Australia
+61.2.9270.8111

Prague
Washingtonova 17
110 00 Prague 1
Czech Republic
+420.22.422.2929

© 2018 Moody's Corporation, Moody's Investors Service, Inc., Moody's Analytics, Inc. and/or their licensors and affiliates (collectively, "MOODY'S"). All rights reserved.

CREDIT RATINGS ISSUED BY MOODY'S INVESTORS SERVICE, INC. AND ITS RATINGS AFFILIATES ("MIS") ARE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES, AND MOODY'S PUBLICATIONS MAY INCLUDE MOODY'S CURRENT OPINIONS OF THE RELATIVE FUTURE CREDIT RISK OF ENTITIES, CREDIT COMMITMENTS, OR DEBT OR DEBT-LIKE SECURITIES. MOODY'S DEFINES CREDIT RISK AS THE RISK THAT AN ENTITY MAY NOT MEET ITS CONTRACTUAL, FINANCIAL OBLIGATIONS AS THEY COME DUE AND ANY ESTIMATED FINANCIAL LOSS IN THE EVENT OF DEFAULT. CREDIT RATINGS DO NOT ADDRESS ANY OTHER RISK, INCLUDING BUT NOT LIMITED TO: LIQUIDITY RISK, MARKET VALUE RISK, OR PRICE VOLATILITY. CREDIT RATINGS AND MOODY'S OPINIONS INCLUDED IN MOODY'S PUBLICATIONS ARE NOT STATEMENTS OF CURRENT OR HISTORICAL FACT. MOODY'S PUBLICATIONS MAY ALSO INCLUDE QUANTITATIVE MODEL-BASED ESTIMATES OF CREDIT RISK AND RELATED OPINIONS OR COMMENTARY PUBLISHED BY MOODY'S ANALYTICS, INC. CREDIT RATINGS AND MOODY'S PUBLICATIONS DO NOT CONSTITUTE OR PROVIDE INVESTMENT OR FINANCIAL ADVICE, AND CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT AND DO NOT PROVIDE RECOMMENDATIONS TO PURCHASE, SELL, OR HOLD PARTICULAR SECURITIES. NEITHER CREDIT RATINGS NOR MOODY'S PUBLICATIONS COMMENT ON THE SUITABILITY OF AN INVESTMENT FOR ANY PARTICULAR INVESTOR. MOODY'S ISSUES ITS CREDIT RATINGS AND PUBLISHES MOODY'S PUBLICATIONS WITH THE EXPECTATION AND UNDERSTANDING THAT EACH INVESTOR WILL, WITH DUE CARE, MAKE ITS OWN STUDY AND EVALUATION OF EACH SECURITY THAT IS UNDER CONSIDERATION FOR PURCHASE, HOLDING, OR SALE.

MOODY'S CREDIT RATINGS AND MOODY'S PUBLICATIONS ARE NOT INTENDED FOR USE BY RETAIL INVESTORS AND IT WOULD BE RECKLESS AND INAPPROPRIATE FOR RETAIL INVESTORS TO USE MOODY'S CREDIT RATINGS OR MOODY'S PUBLICATIONS WHEN MAKING AN INVESTMENT DECISION. IF IN DOUBT YOU SHOULD CONTACT YOUR FINANCIAL OR OTHER PROFESSIONAL ADVISER.

ALL INFORMATION CONTAINED HEREIN IS PROTECTED BY LAW, INCLUDING BUT NOT LIMITED TO, COPYRIGHT LAW, AND NONE OF SUCH INFORMATION MAY BE COPIED OR OTHERWISE REPRODUCED, REPACKAGED, FURTHER TRANSMITTED, TRANSFERRED, DISSEMINATED, REDISTRIBUTED OR RESOLD, OR STORED FOR SUBSEQUENT USE FOR ANY SUCH PURPOSE, IN WHOLE OR IN PART, IN ANY FORM OR MANNER OR BY ANY MEANS WHATSOEVER, BY ANY PERSON WITHOUT MOODY'S PRIOR WRITTEN CONSENT.

All information contained herein is obtained by MOODY'S from sources believed by it to be accurate and reliable. Because of the possibility of human or mechanical error as well as other factors, however, all information contained herein is provided "AS IS" without warranty of any kind. MOODY'S adopts all necessary measures so that the information it uses in assigning a credit rating is of sufficient quality and from sources MOODY'S considers to be reliable including, when appropriate, independent third-party sources. However, MOODY'S is not an auditor and cannot in every instance independently verify or validate information received in the rating process or in preparing the Moody's publications.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability to any person or entity for any indirect, special, consequential, or incidental losses or damages whatsoever arising from or in connection with the information contained herein or the use of or inability to use any such information, even if MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers is advised in advance of the possibility of such losses or damages, including but not limited to: (a) any loss of present or prospective profits or (b) any loss or damage arising where the relevant financial instrument is not the subject of a particular credit rating assigned by MOODY'S.

To the extent permitted by law, MOODY'S and its directors, officers, employees, agents, representatives, licensors and suppliers disclaim liability for any direct or compensatory losses or damages caused to any person or entity, including but not limited to by any negligence (but excluding fraud, willful misconduct or any other type of liability that, for the avoidance of doubt, by law cannot be excluded) on the part of, or any contingency within or beyond the control of, MOODY'S or any of its directors, officers, employees, agents, representatives, licensors or suppliers, arising from or in connection with the information contained herein or the use of or inability to use any such information.

NO WARRANTY, EXPRESS OR IMPLIED, AS TO THE ACCURACY, TIMELINESS, COMPLETENESS, MERCHANTABILITY OR FITNESS FOR ANY PARTICULAR PURPOSE OF ANY SUCH RATING OR OTHER OPINION OR INFORMATION IS GIVEN OR MADE BY MOODY'S IN ANY FORM OR MANNER WHATSOEVER.

Moody's Investors Service, Inc., a wholly-owned credit rating agency subsidiary of Moody's Corporation ("MCO"), hereby discloses that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by Moody's Investors Service, Inc. have, prior to assignment of any rating, agreed to pay to Moody's Investors Service, Inc. for appraisal and rating services rendered by it fees ranging from \$1,500 to approximately \$2,500,000. MCO and MIS also maintain policies and procedures to address the independence of MIS's ratings and rating processes. Information regarding certain affiliations that may exist between directors of MCO and rated entities, and between entities who hold ratings from MIS and have also publicly reported to the SEC an ownership interest in MCO of more than 5%, is posted annually at www.moody's.com under the heading "Investor Relations — Corporate Governance — Director and Shareholder Affiliation Policy."

Additional terms for Australia only: Any publication into Australia of this document is pursuant to the Australian Financial Services License of MOODY'S affiliate, Moody's Investors Service Pty Limited ABN 61 003 399 657AFSL 336969 and/or Moody's Analytics Australia Pty Ltd ABN 94 105 136 972 AFSL 383569 (as applicable). This document is intended to be provided only to "wholesale clients" within the meaning of section 761G of the Corporations Act 2001. By continuing to access this document from within Australia, you represent to MOODY'S that you are, or are accessing the document as a representative of, a "wholesale client" and that neither you nor the entity you represent will directly or indirectly disseminate this document or its contents to "retail clients" within the meaning of section 761G of the Corporations Act 2001. MOODY'S credit rating is an opinion as to the creditworthiness of a debt obligation of the issuer, not on the equity securities of the issuer or any form of security that is available to retail investors. It would be reckless and inappropriate for retail investors to use MOODY'S credit ratings or publications when making an investment decision. If in doubt you should contact your financial or other professional adviser.

Additional terms for Japan only: Moody's Japan K.K. ("MJJK") is a wholly-owned credit rating agency subsidiary of Moody's Group Japan G.K., which is wholly-owned by Moody's Overseas Holdings Inc., a wholly-owned subsidiary of MCO. Moody's SF Japan K.K. ("MSFJ") is a wholly-owned credit rating agency subsidiary of MJJK. MSFJ is not a Nationally Recognized Statistical Rating Organization ("NRSRO"). Therefore, credit ratings assigned by MSFJ are Non-NRSRO Credit Ratings. Non-NRSRO Credit Ratings are assigned by an entity that is not a NRSRO and, consequently, the rated obligation will not qualify for certain types of treatment under U.S. laws. MJJK and MSFJ are credit rating agencies registered with the Japan Financial Services Agency and their registration numbers are FSA Commissioner (Ratings) No. 2 and 3 respectively.

MJJK or MSFJ (as applicable) hereby disclose that most issuers of debt securities (including corporate and municipal bonds, debentures, notes and commercial paper) and preferred stock rated by MJJK or MSFJ (as applicable) have, prior to assignment of any rating, agreed to pay to MJJK or MSFJ (as applicable) for appraisal and rating services rendered by it fees ranging from JPY200,000 to approximately JPY350,000,000.

MJJK and MSFJ also maintain policies and procedures to address Japanese regulatory requirements.