

YARDI

2018 Multifamily Market Update

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The Yardi Matrix View- A Sharpshooter's Game Short-Term, Back to Intellectual Hubs Longer-Term

So what's different from the last time we spoke?

- **U.S. economy is in VERY good shape**
  - GDP/Employment up and growth is humming >3%, but appear to be leveling out at this growth rate
  - Trade and immigration policies appear to be driving the downshift in the pace of growth
  - Oil Prices Up => $70/bbl – will stay high ($80/bbl?) for what looks like 18-24 months – Iran/Venezuela/Saudi/Russia impacts
    - As a meaningful producer, not a clear negative anymore, positive for the Oil Patch
  - Wages rising ~2.6% and labor market tight – people being pulled off the sidelines
  - Inflation rising, but unlikely to break 2.5%; Short-Term interest rates up, 10 Yr range with 3% to 3.5%; Watch Yield Curve!

- **Multifamily market faces increasing Cross-Winds:**
  - Demand (Jobs/Population) is strong, but shifting to lower cost cities; and homeownership rate is/will gradually rise
  - Financing costs up – find situations where change in NOI outruns impact of increasing rates
  - Multifamily Capital is abundant – debt and equity – acquisition and development – cap rates steady, spreads compressing
  - New Supply deliveries are weighing down on several markets, and the level of new supply is flattening but not declining

The Yardi Matrix View- A Sharpshooter's Game Short-Term, Back to Intellectual Hubs Longer-Term

- **Tech Hubs are Emerging both in Formerly Non-tech Metros and Traditionally Overlooked Cities:**
  - Cost advantages and Emerging Intellectual Hubs are shifting the geography of jobs
    - The longer the expansion goes on the more established the intellectual critical mass becomes
    - Tax reform will likely accelerate these trends
    - But the process does take time, allowing multiple entry points for investors
    - Many of these cities have had modest levels of new supply and institutional investor interest

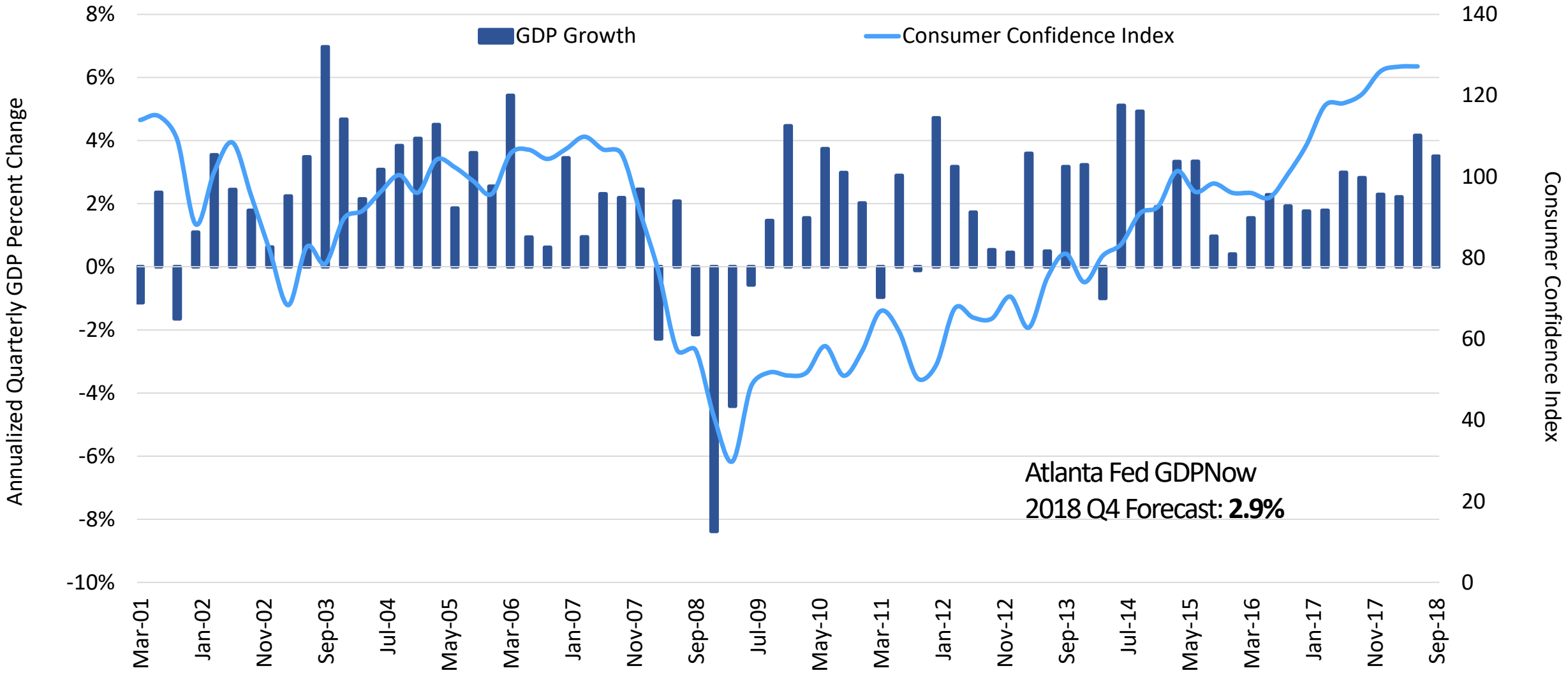
- **Advances in The Internet of Things (IoT) and Artificial Intelligence (AI), and the 5G network which is its underpinning, drive-**
  - The ability to have self correcting and self learning processes which will streamline production (reduce costs)
  - The ability to leverage data to create new products, services, and create new "gatekeepers" to consumer $
    - Both of these will pressure mid-skill jobs, widening again the issues of income distribution

- **Outlook on 2019**
  - GDP and employment will continue to grow, but at a slower, steadier pace than the past two years
  - New multifamily supply is the **key** variable in the next 2-5 years; with or without a mild recession – recent demand has been stronger than anticipated
  - Changing demographics will diversify multifamily and office asset types (coliving, coworking, medical office…)
  - Technological advances are coming that will impact jobs and how we invest in and manage commercial real estate
  - While it's a SHARPSHOOTER'S game for the next few years…in the longer-term (5-10 years) we return to intellectual capital hubs in primary and secondary cities as having the most attractive fundamentals

Source: Yardi®Matrix

Macroeconomic Outlook

U.S. Economic Growth is Pretty Good – Q3 GDP Up 3.5%



Source: Moody's Analytics; Bureau of Labor Statistics (BLS); S&P Dow Jones Indices LLC; CoreLogic, Inc; Federal Housing Agency (FHFA); Freddie Mac; Fannie Mae; U.S. Bureau of Economic Analysis (BEA); U.S. Board of Governors of the Federal Reserve System (FRB); Investing.com; Federal Reserve Bank of Atlanta

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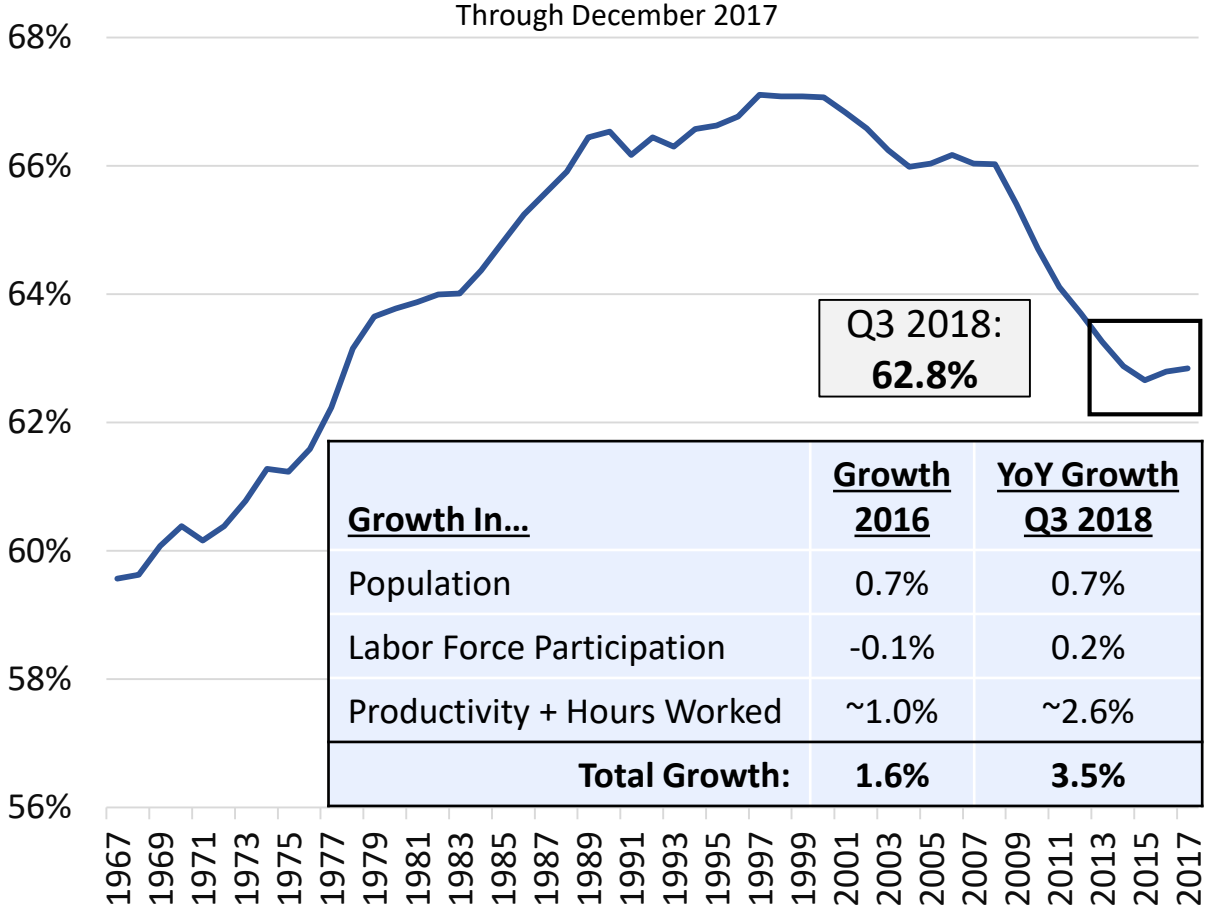
Factors Driving GDP Show Signs of Growth

Where will U.S. GDP growth come from?

Labor Force Participation Rate

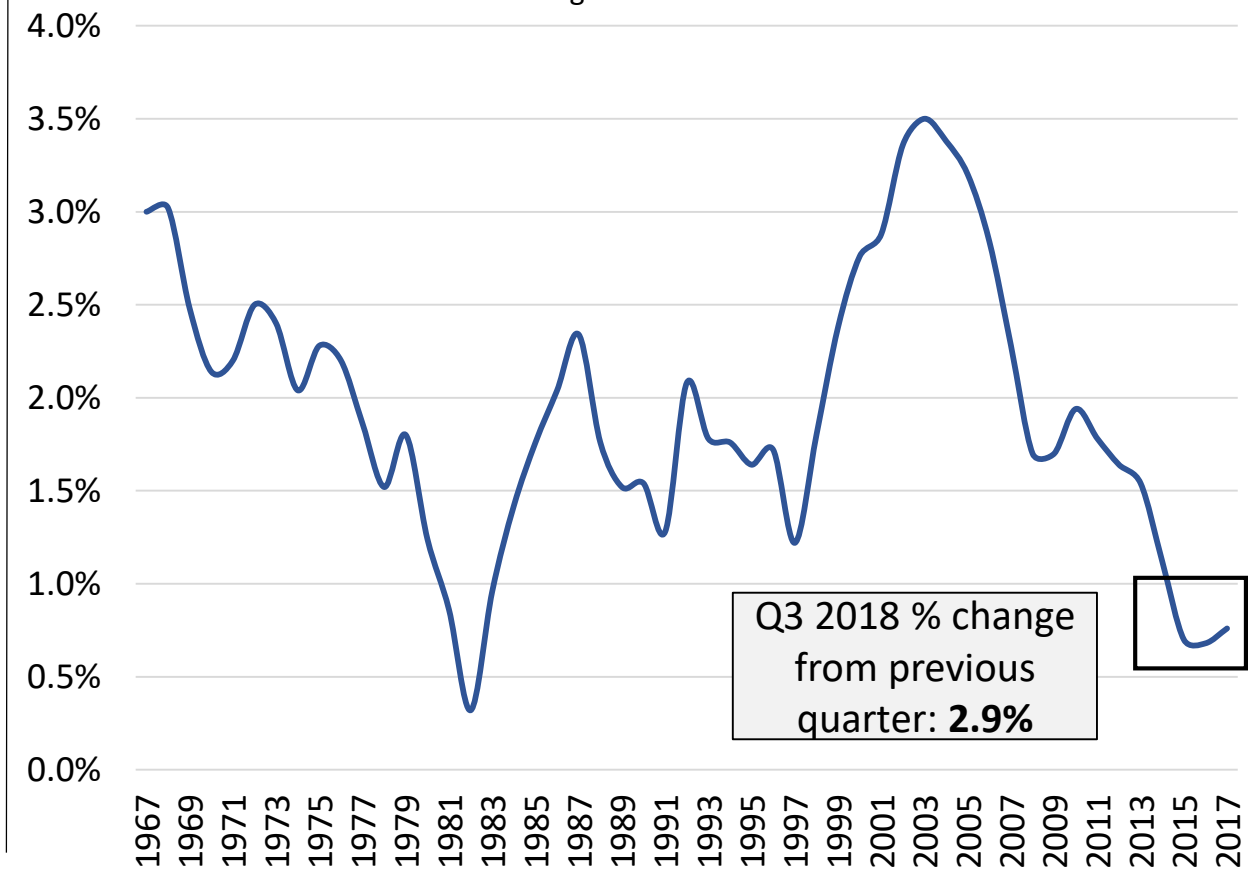
Through December 2017



Growth In…	Growth 2016	YoY Growth Q3 2018
Population	0.7%	0.7%
Labor Force Participation	-0.1%	0.2%
Productivity + Hours Worked	~1.0%	~2.6%
Total Growth:	**1.6%**	**3.5%**

Labor Productivity Annual Change
Nonfarm Business Sector

Through December 2017



*Labor productivity graph is based on a 6-year rolling average

Source: Moody's Analytics; Bureau of Labor Statistics (BLS)

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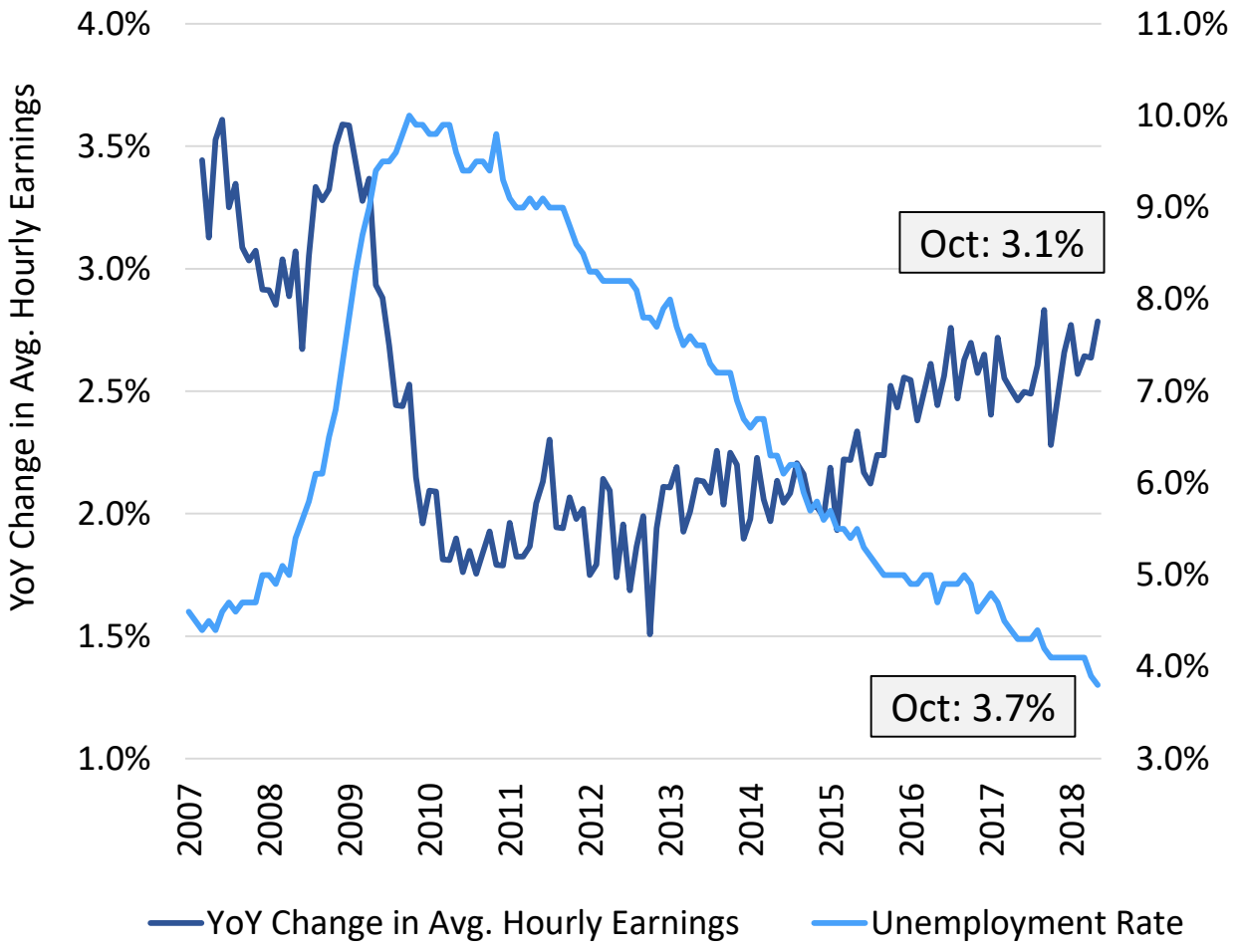
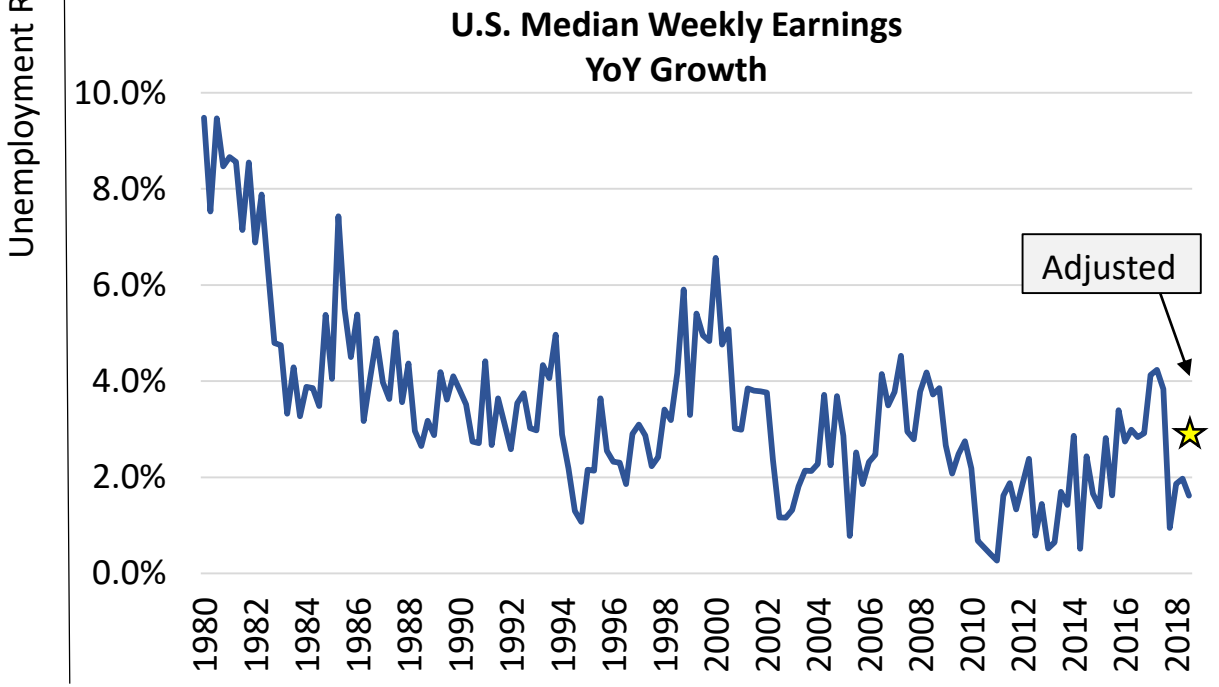
Will Productivity Out-Distance Real Wage Growth?

U.S. Wage Pressure Increasing



Wage Growth Reports Hide Demographic Shift

- 2018 Q3 median weekly earnings of full time workers rose 1.6%
- Wage growth is better than the headline numbers indicate
- Held down by the exchange of new workers for new retirees
- New workers generally earn less than workers who are leaving full-time employment (boomers)
- Adjusting for this, 2018 Q3 wage growth was actually closer to 3%



Source: Moody's Analytics; Bureau of Labor Statistics (BLS); Current Population Survey (CPS); Mary C. Daly, The San Francisco Fed; Daly, Mary C., Bart Hobijn, and Benjamin Pyle. 2016. "What's Up with Wage Growth?" FRBSF Economic Letter 2016-07; Daly, Mary C., and Bart Hobijn. 2016. "The Intensive and Extensive Margins of Real Wage Adjustment." Federal Reserve Bank of San Francisco Working Paper 2016-04

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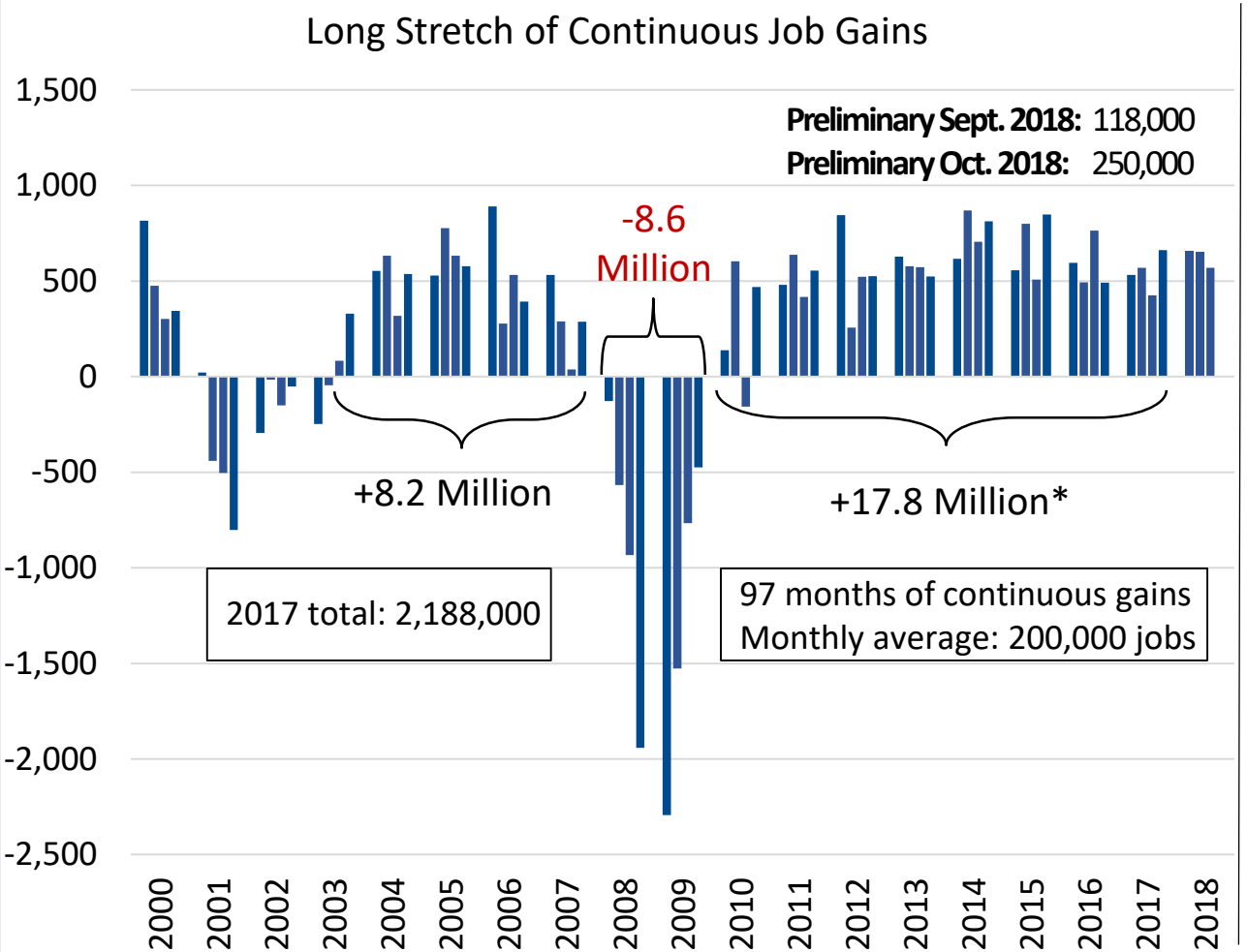
Tight Labor Market, Pulling People off the Sidelines

It is difficult to find labor at the right ***price***, with the right ***skills***, in the right ***city***



*Through December 2017

Source: Moody's Analytics; Bureau of Labor Statistics (BLS); The Conference Board

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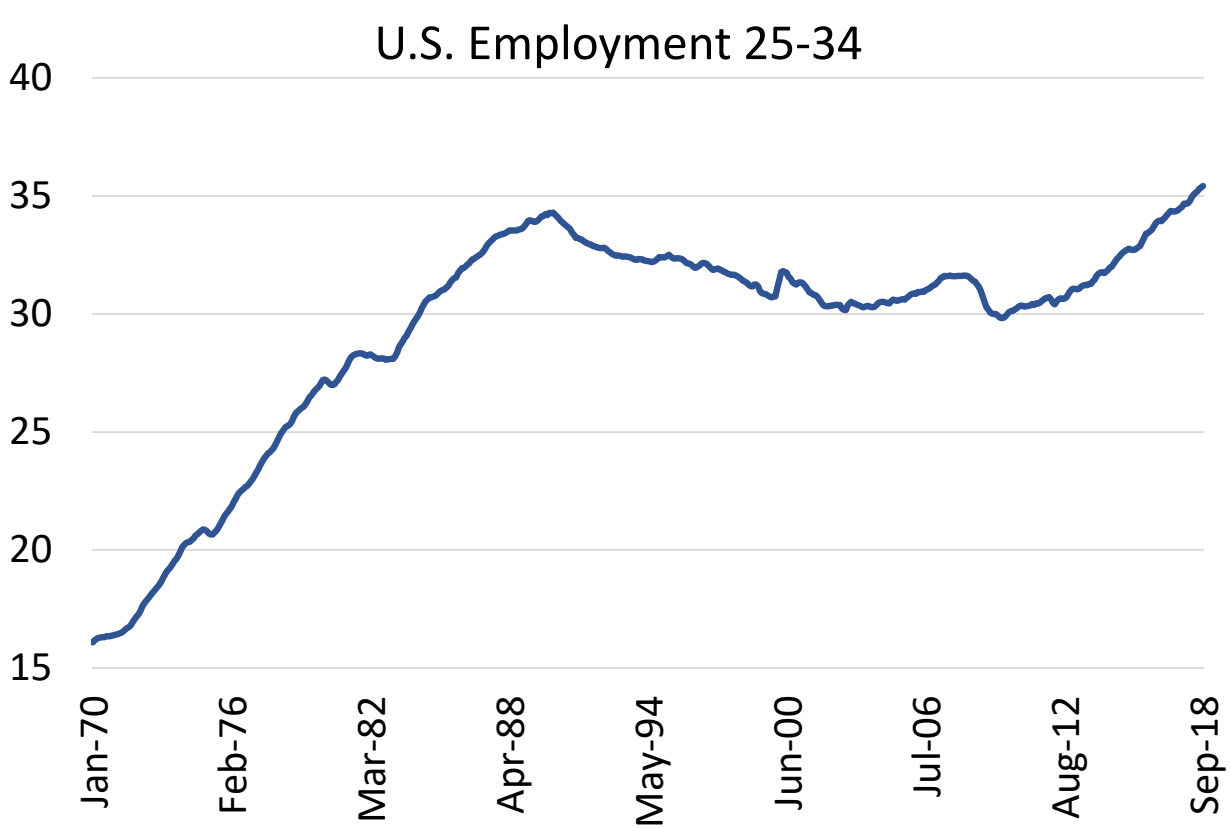
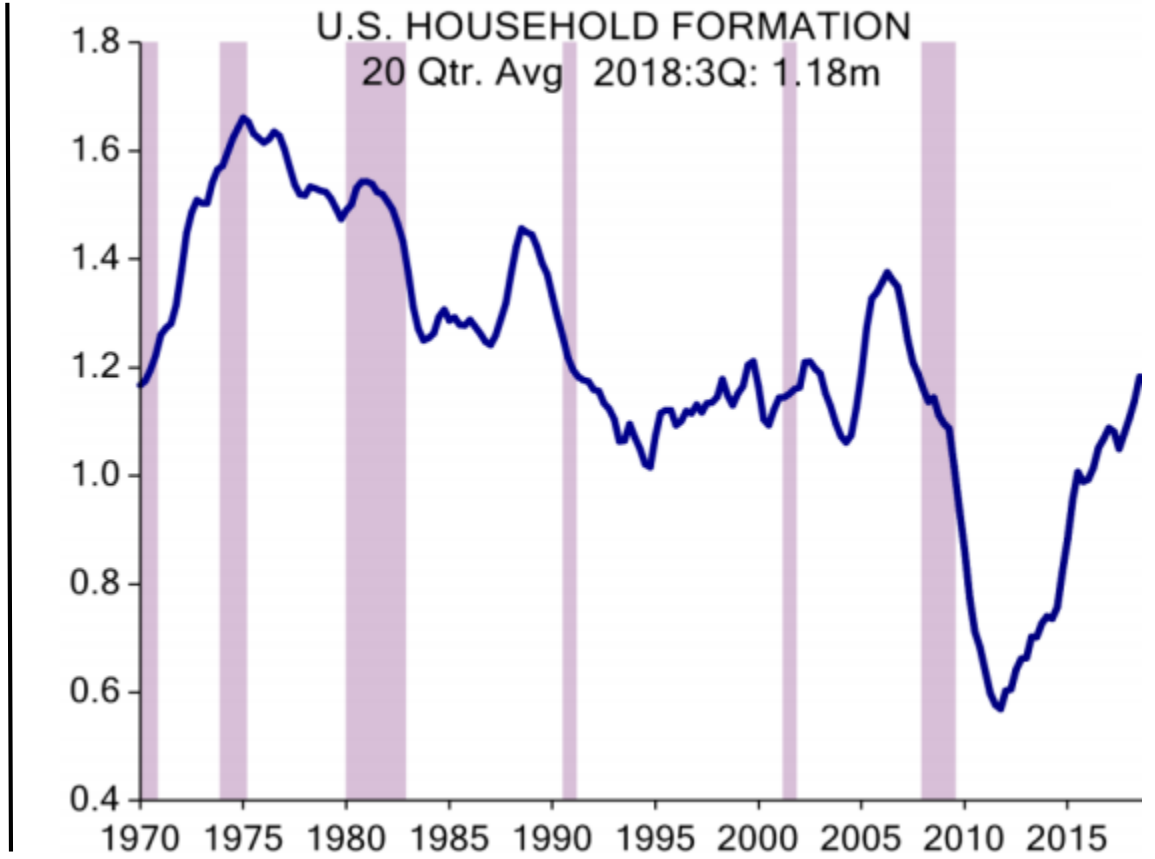
Millennials are a Positive Force for the Expansion

- Employment of Millennials has accelerated over the past decade
- Employment of Millennials increased 2.4% YoY in September vs. 1.1% for employment excluding Millennials
- Household formation has doubled





Source: Ed Hyman, Evercore ISI; Moody's Analytics; Bureau of Labor Statistics (BLS)

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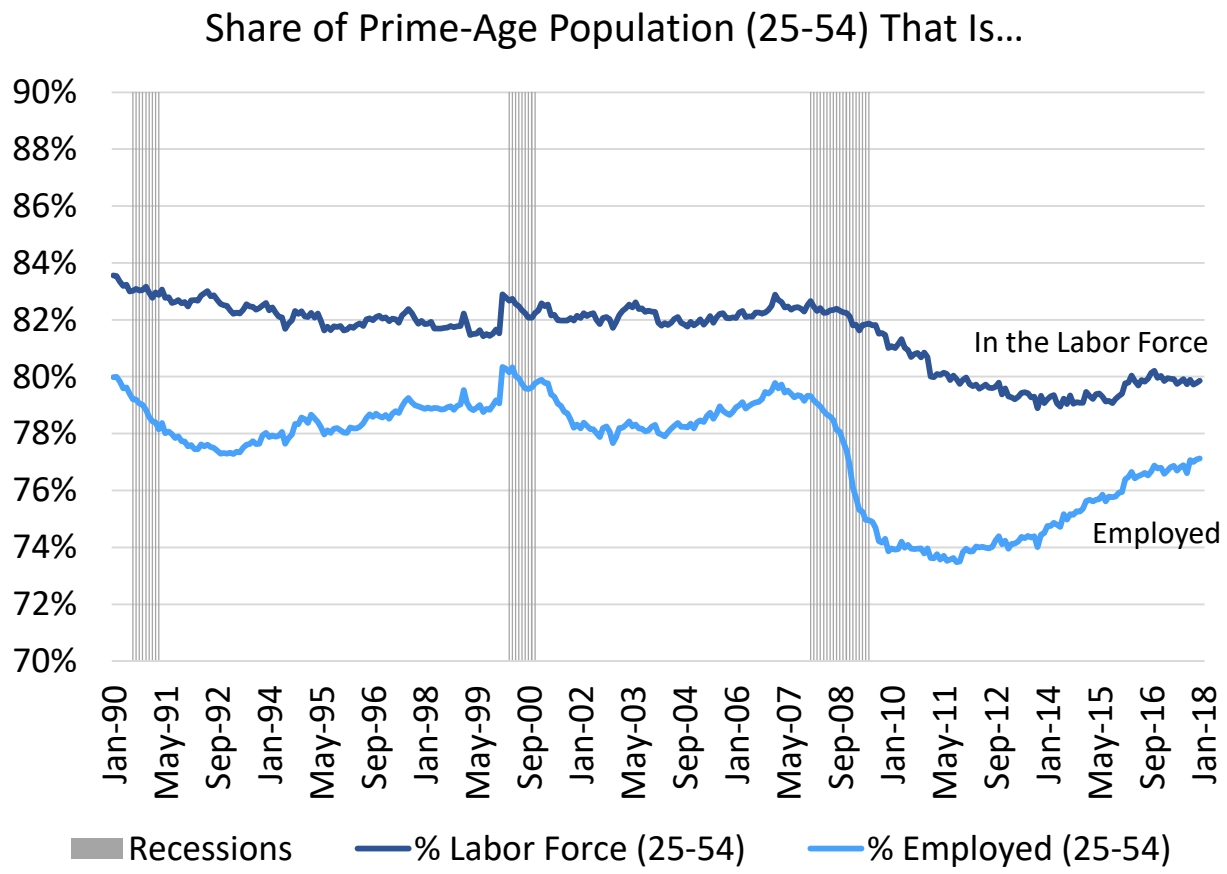
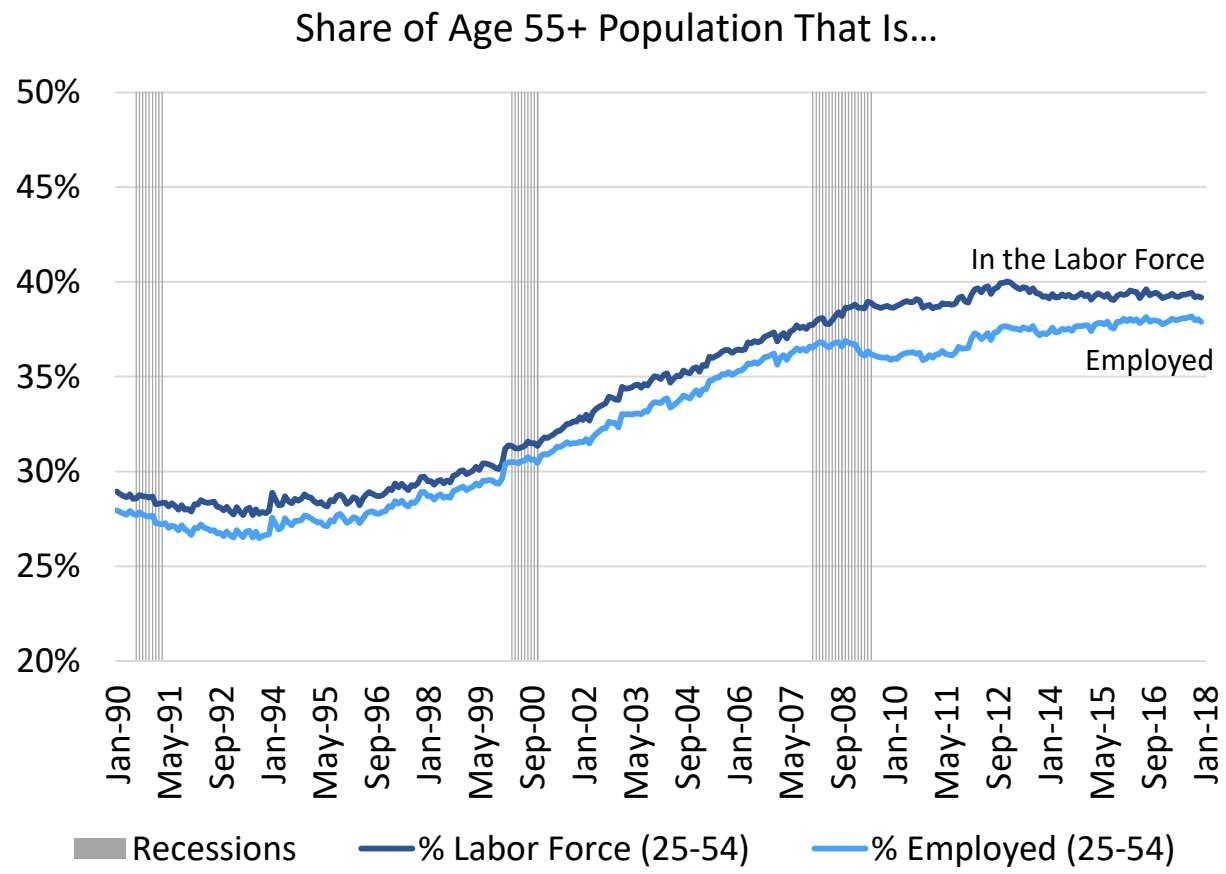
Reserve Supply of Labor

- Another 2% of the prime-age population could get engaged – approximately 2.6 million people
- Participation rates for people age 55+ are rising – buoying the expansion





Source: Moody's Analytics; U.S. Bureau of Labor Statistics (BLS); U.S. Census Bureau (BOC)

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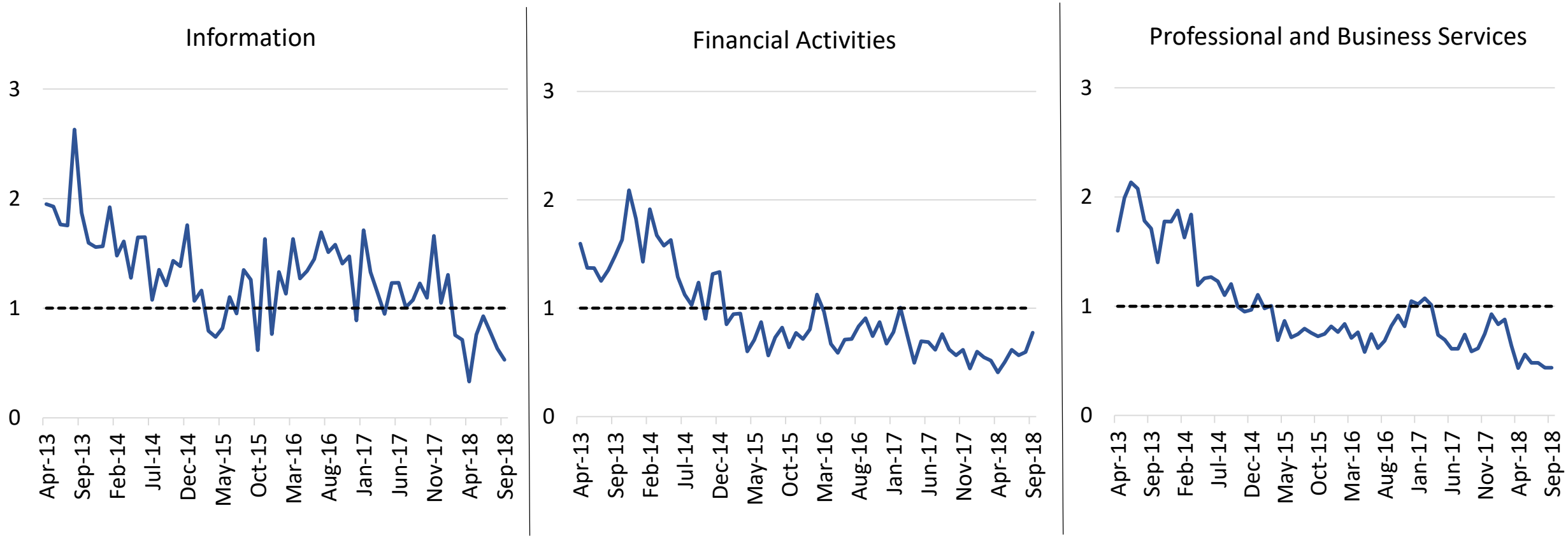
Unemployed Persons per Job Opening: Office-Using Industries



Source: Moody's Analytics; Bureau of Labor Statistics (BLS); Yardi®Matrix

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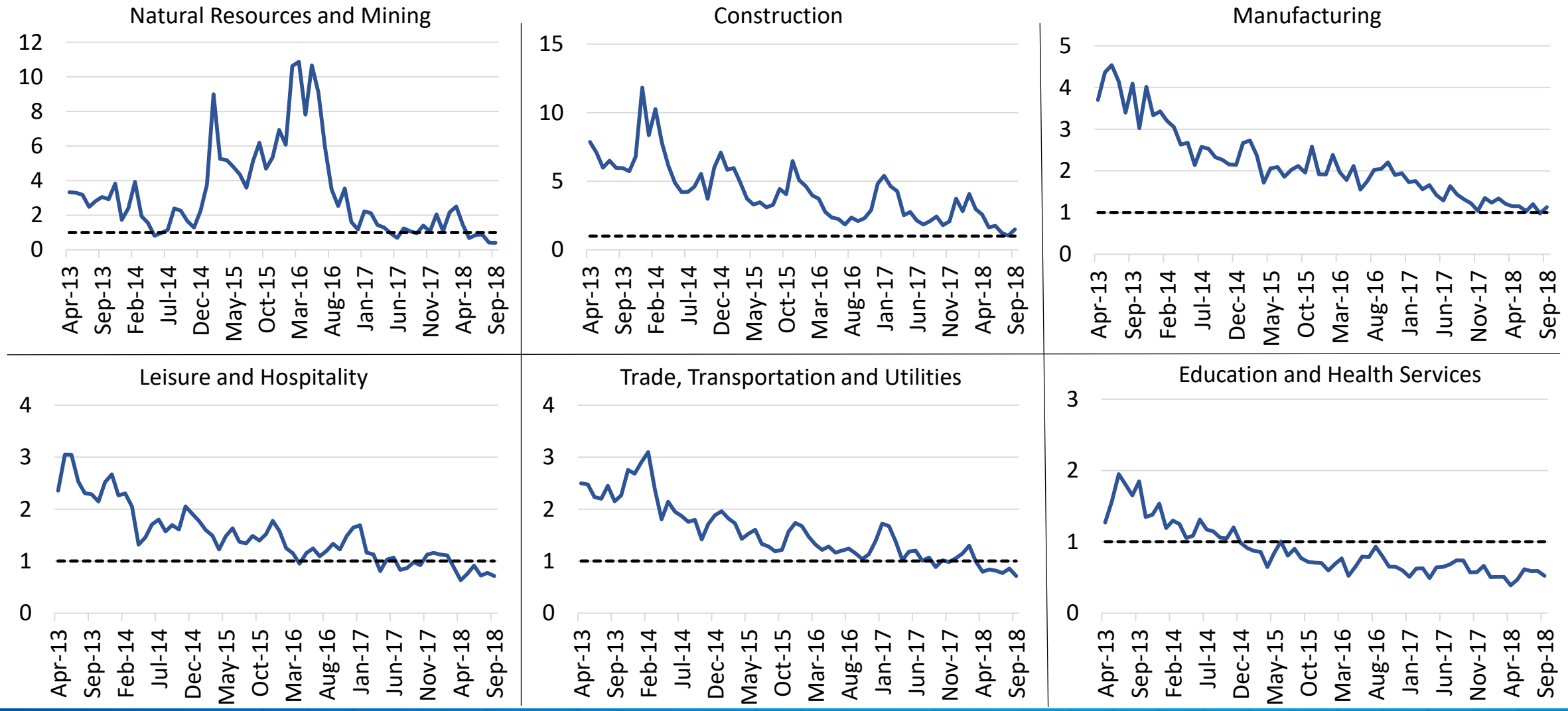
Unemployed Persons per Job Opening: Non Office-Using Industries



Source: Moody's Analytics; Bureau of Labor Statistics (BLS); Yardi®Matrix

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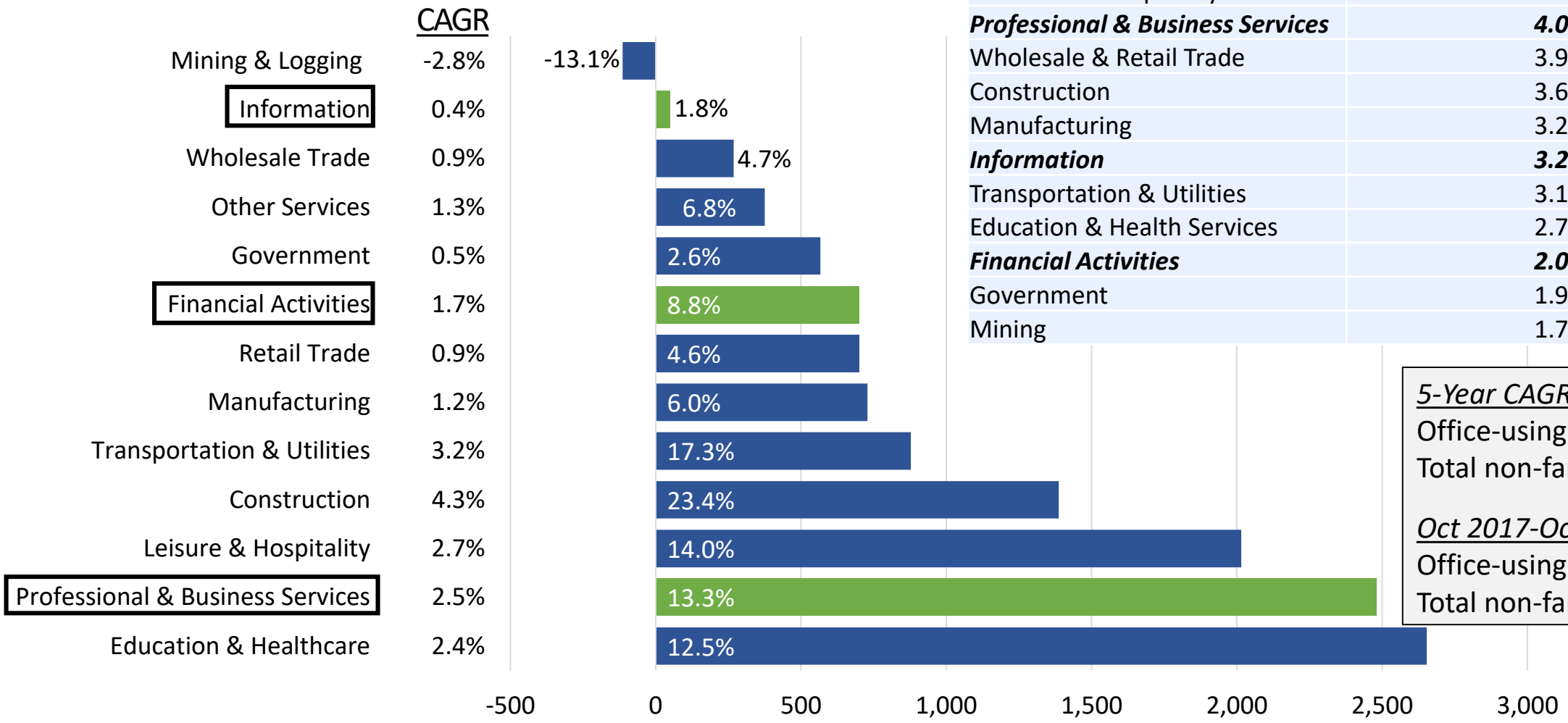
Office-Using Sectors Outpaced Overall Job Growth Over the Last Five Years



Sector	Oct 2018 Unemployment Rate
Leisure and Hospitality	5.4%
Professional & Business Services	***4.0%***
Wholesale & Retail Trade	3.9%
Construction	3.6%
Manufacturing	3.2%
Information	***3.2%***
Transportation & Utilities	3.1%
Education & Health Services	2.7%
Financial Activities	***2.0%***
Government	1.9%
Mining	1.7%

5-Year CAGR:
Office-using sectors: **2.1%**
Total non-farm: **1.8%**

Oct 2017-Oct 2018:
Office-using sectors: **1.9%**
Total non-farm: **1.7%**

*October 2013-October 2018, boxed labels are office-using sectors
Source: Moody's Analytics; Bureau of Labor Statistics (BLS)

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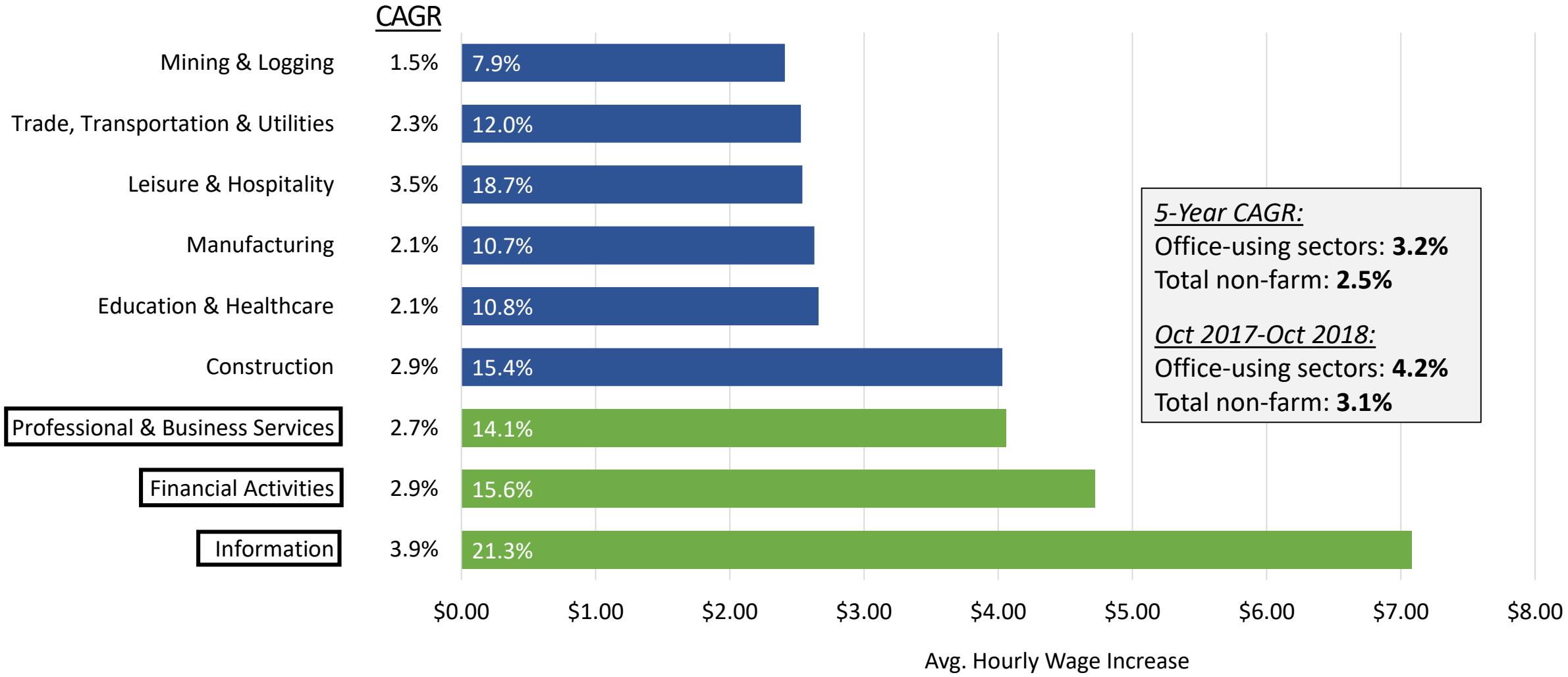
Office-Using Sectors Exhibit the Most Wage Growth October 2013-October 2018



*Boxed labels are office-using sectors

Source: Moody's Analytics; Bureau of Labor Statistics (BLS)

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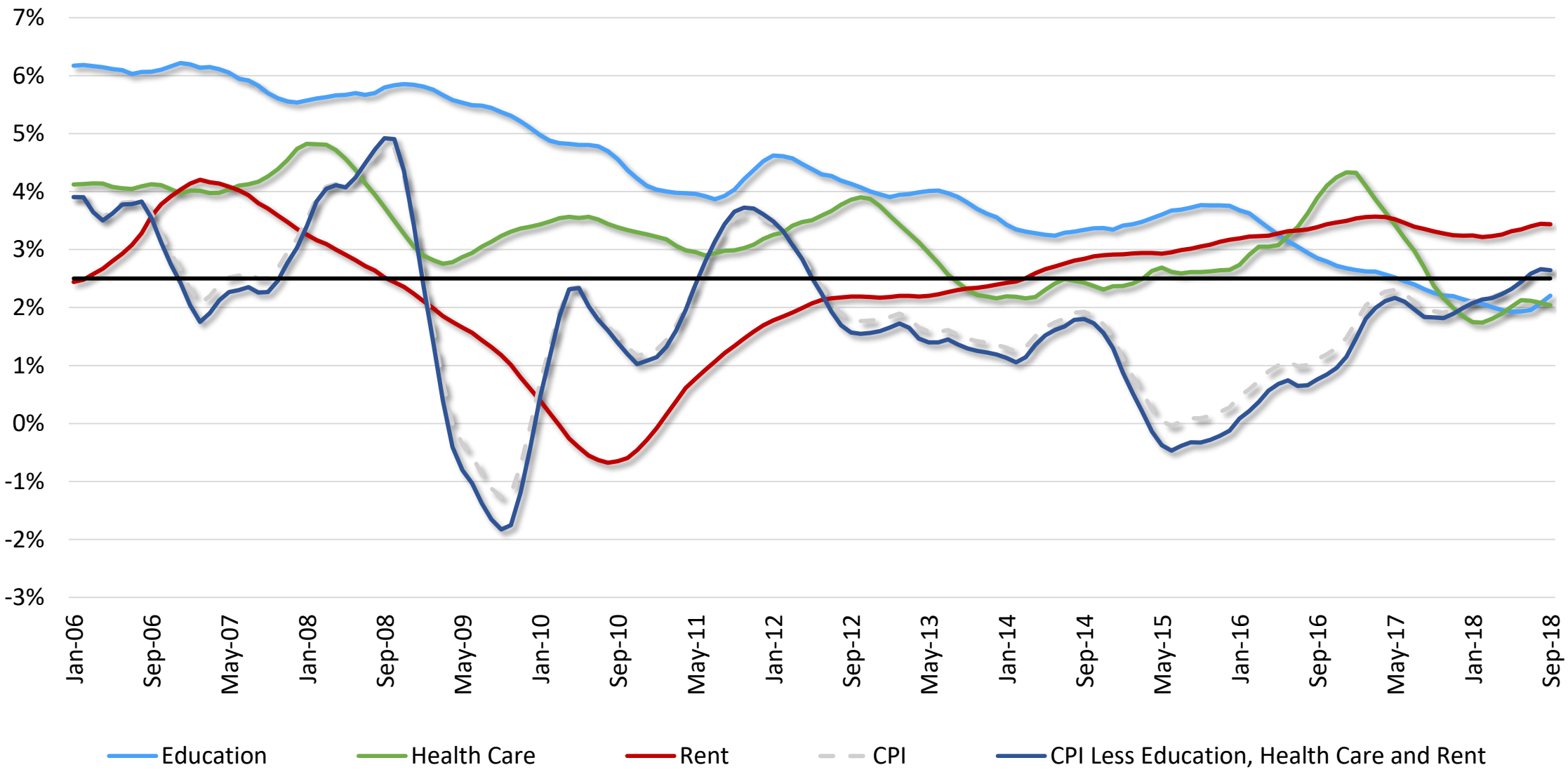
Inflation Rising, But Unlikely to Break Out >2.5%



*YOY 6 month moving avgs. CPI Less Health Care, Education and Rent is an estimate using BLS document "Math calculations to better utilize CPI data"
Source: Moody's Analytics; Bureau of Labor Statistics (BLS)

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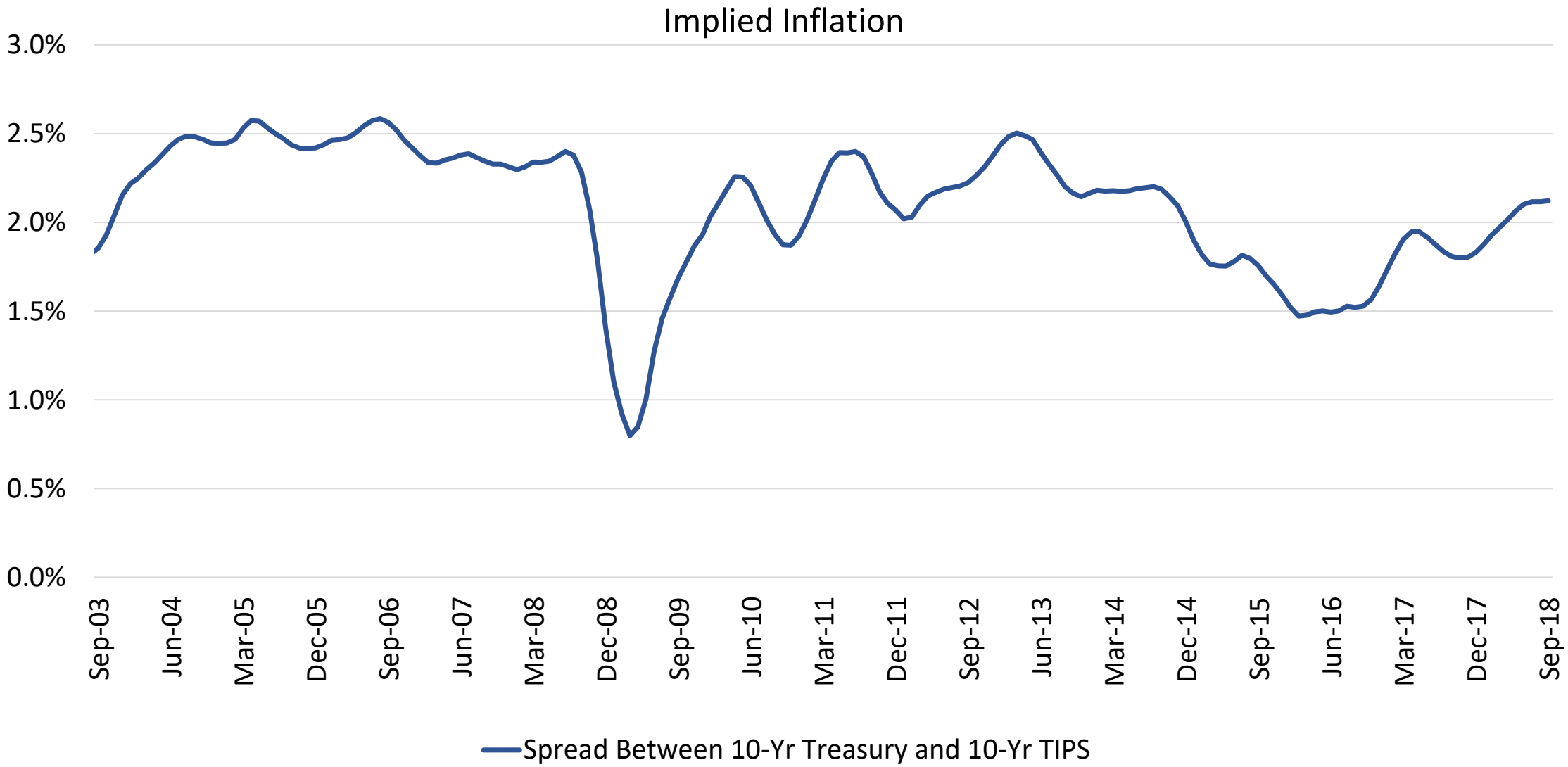
Implied Inflation Has Increased, but Remains Low



Source: Federal Reserve Bank of St. Louis; Moody's Analytics; U.S. Bureau of Labor Statistics (BLS)

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Inflation Moving Up, but Not Sharply

1980's, 1990's, and 2000's:

- Average hourly earnings accelerating from 2% to 4% in 2 ½ years

Now:

- Average hourly earnings have accelerated to just 2.7% in 5 years
- At this rate, won't hit 4.0% for another 9 years

This argues for a very long expansion

Source: Ed Hyman, Evercore ISI

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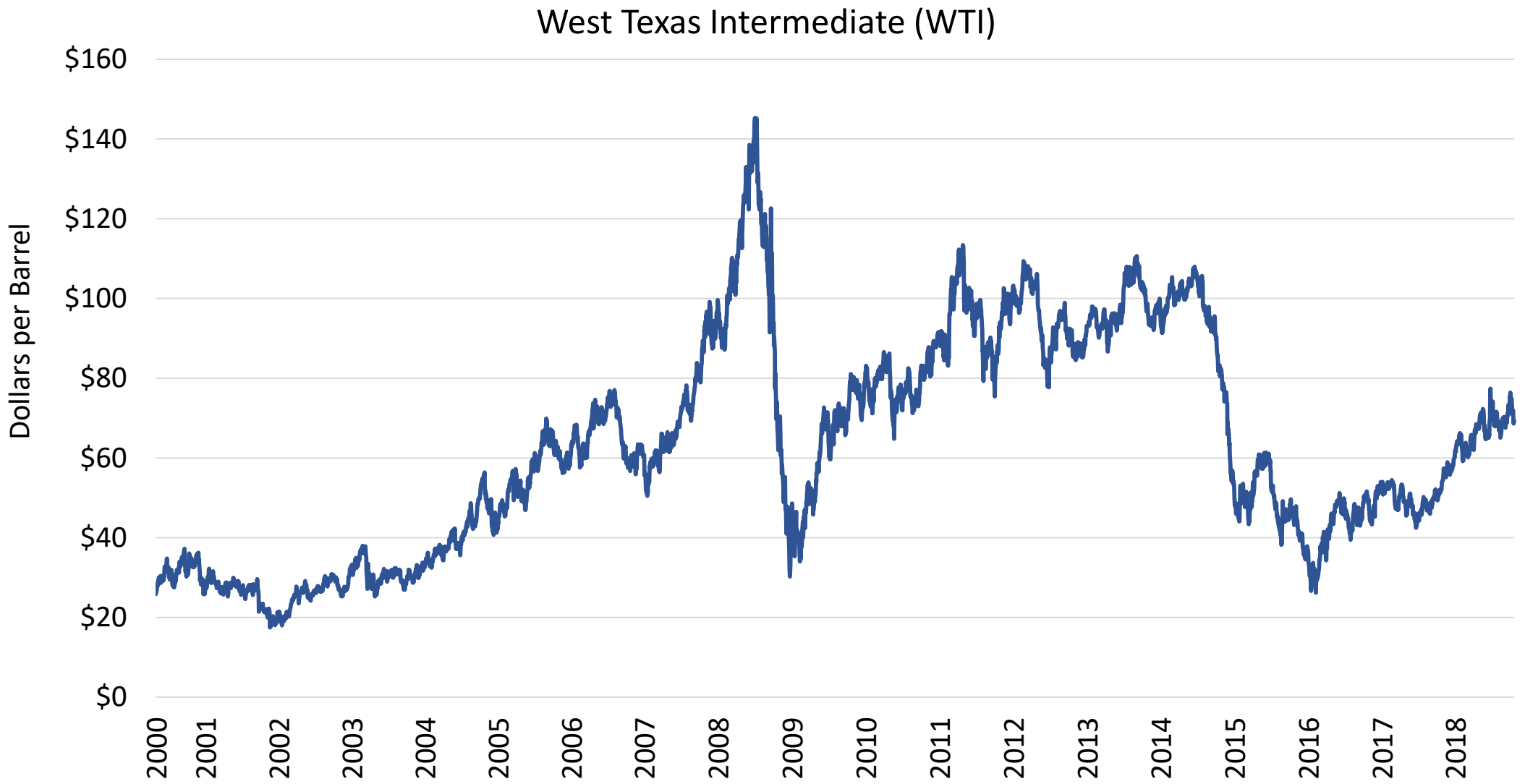
Oil Prices are Rising – Not a Clear Negative Anymore



Source: Federal Reserve Bank of St. Louis

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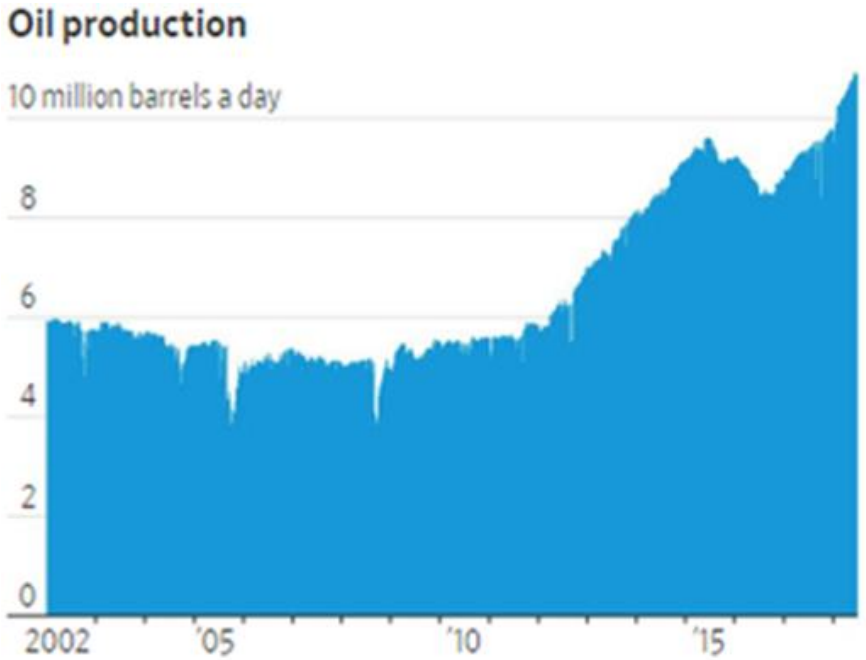
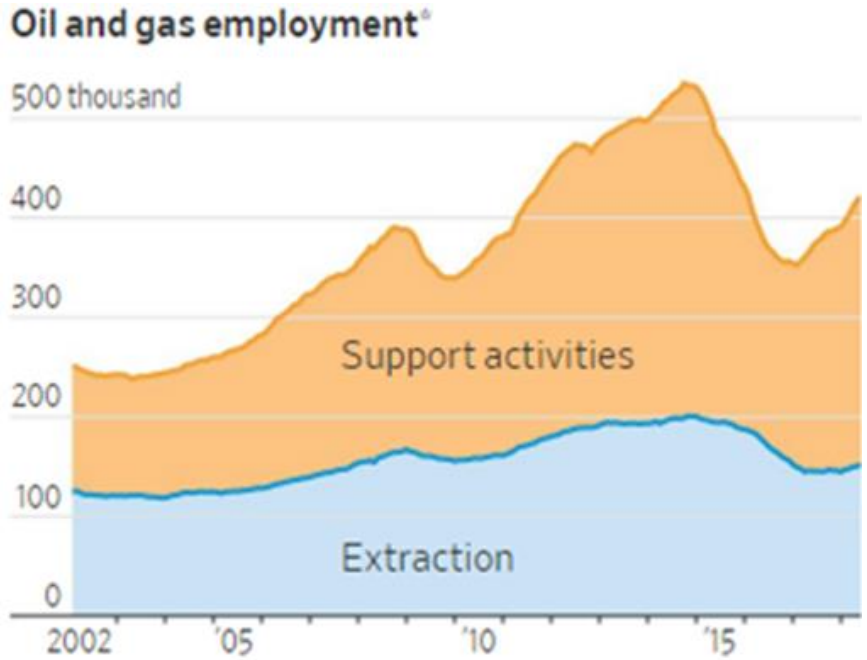
Oil and Gas Industry Subject to Technological Advances- Just Like All Others

Shrinking Workforce

U.S. oil production is at an all-time high even though employment is down from the 2014 peak



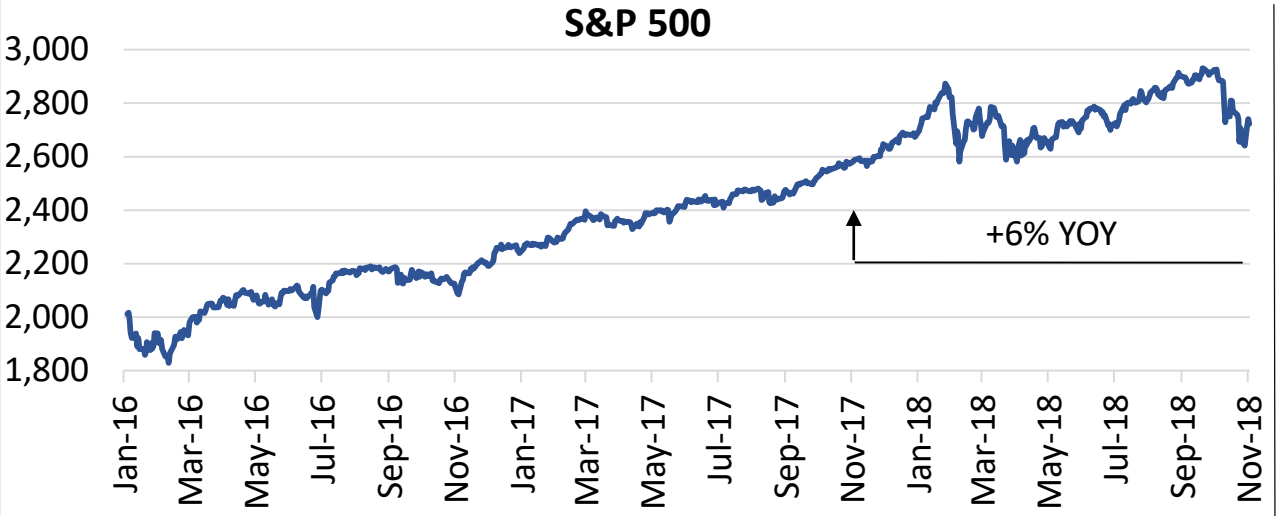


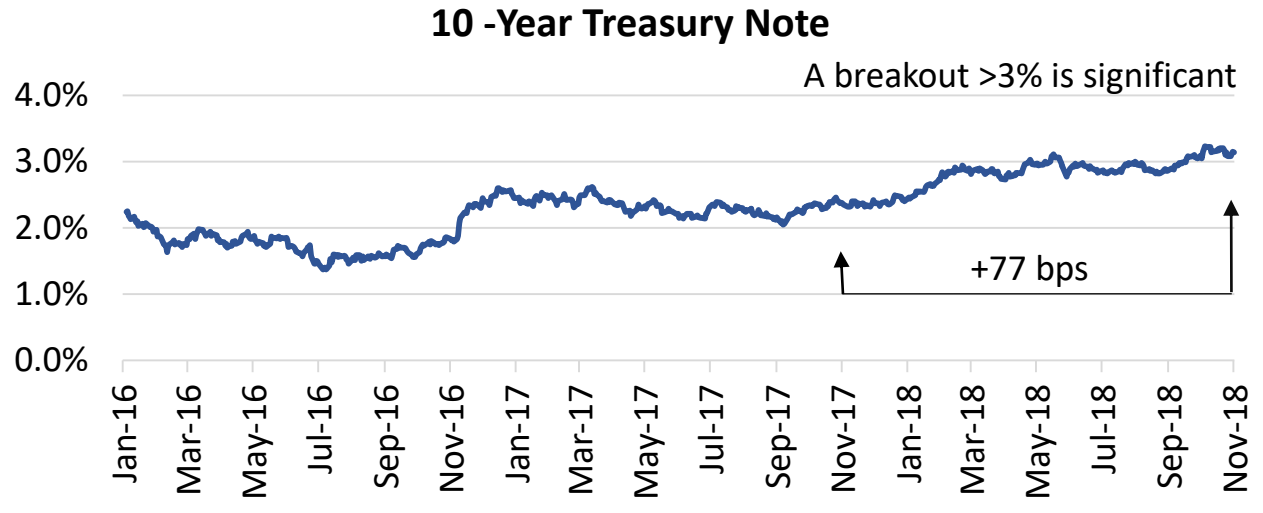
- Tech has transformed labor needs in most manufacturing – now making a splash in the energy business
- One of the last sectors where blue-collared workers could depend on six-figure salaries
- Underground tools capture data and smaller teams of remote technical analysts replacing field workers

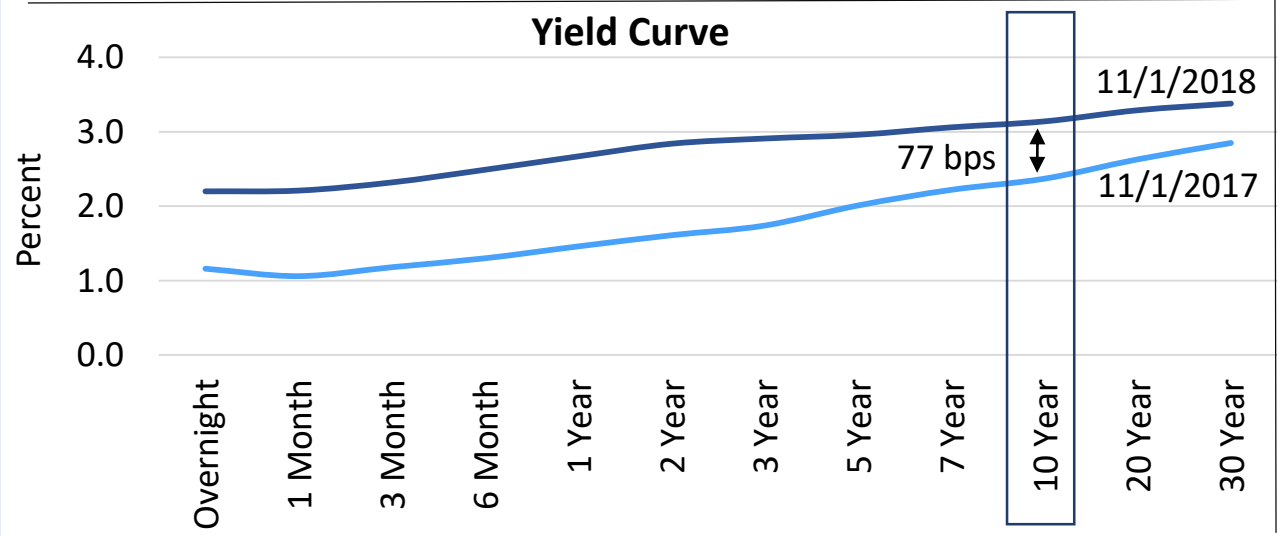
*Support activities include employees of service and drilling companies, while extraction refers to operating and producing companies

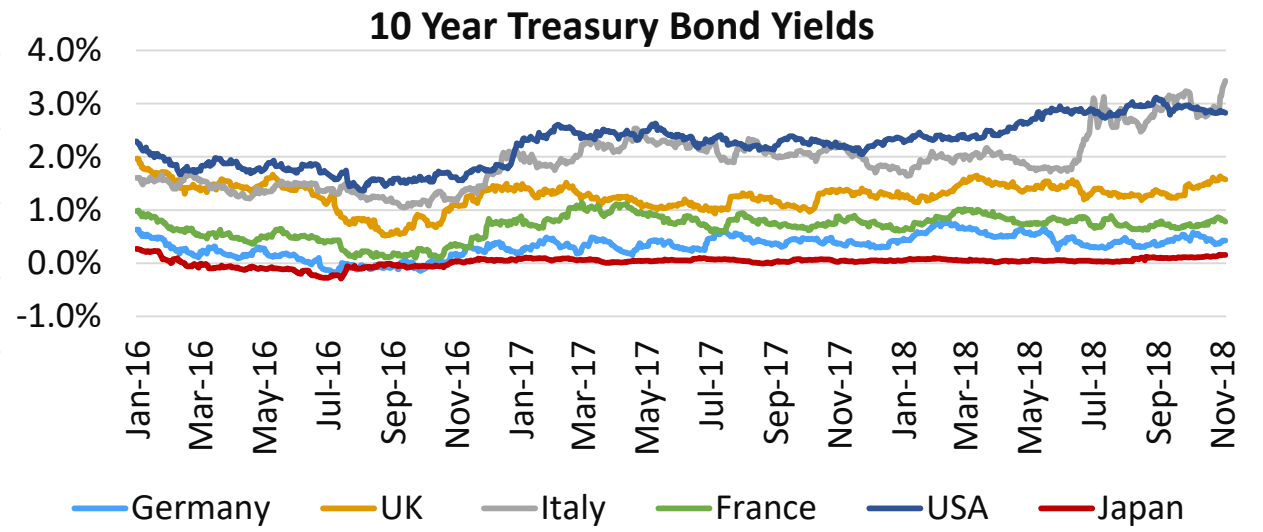
Source: Christopher Matthews, ""Oil's New Technology Spells End of Boom for Roughnecks", Wall Street Journal; Energy Information Administration; Labor Department data via Ingham Economic Reporting

The U.S. Economy is in High Gear – Despite Stock Market Correction









Source: Moody's Analytics; Investing.com

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Watch for These 5 Signs that Presage a Recession

1. Average Hourly Earnings Growth goes from 2.5% to 4.0%
2. Cyclical Sector Share of GDP moves from 24% to 28% of GDP
3. GDP Deflator moves from <2.0% to 2.5%
4. Operating Capacity Utilization Rate moves from 76% to 80%
5. Yield Curve Inverts (10 Yr treasury rate less Fed Funds Rate) from +90bp to >-50bp ➡ NOT YET! Best guess 2020-2021

Source: Yardi®Matrix, Evercore ISI

Timing of the Next Recession

5 Models Developed by Ed Hyman at Evercore ISI

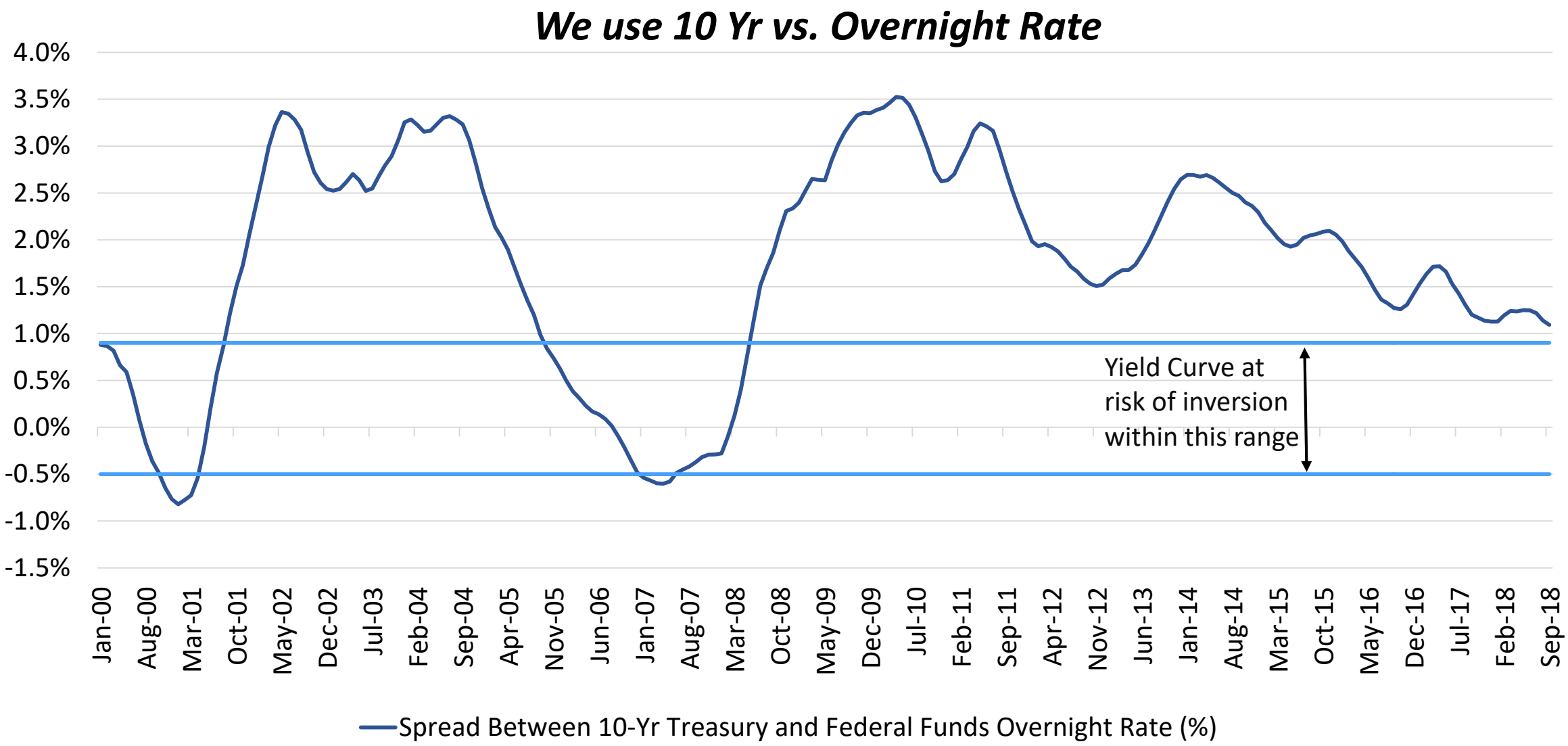
On track to reach recession-signal level in…

1. Average Hourly Earnings – ***9 years***
2. Cyclical sectors % GDP – ***6 years***
3. OECD Leading Economic Index – ***5 years***
4. Housing starts – ***3.5 years***
5. Fed funds – ***2.5 years***

Based on the average of the above 5 models, the next recession will begin in 5.2 years, or at the end of 2023, with a range of 2021-2027

Source: Ed Hyman, Evercore ISI

There's Some Debate About Which Yield Curve to Use



*Data is based on 6-month rolling averages

Source: Moody's Analytics; U.S. Board of Governors of the Federal Reserve System (FRB)

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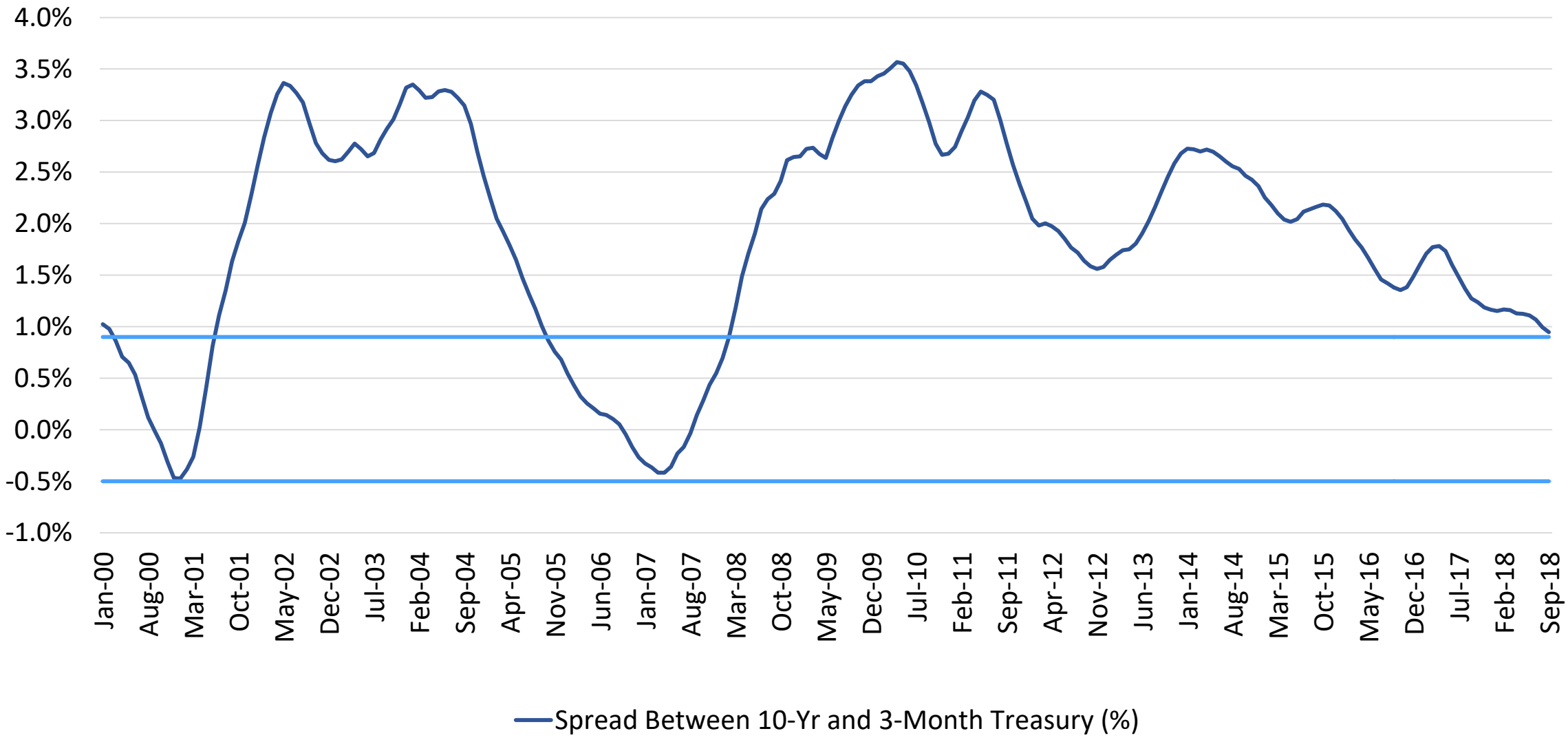
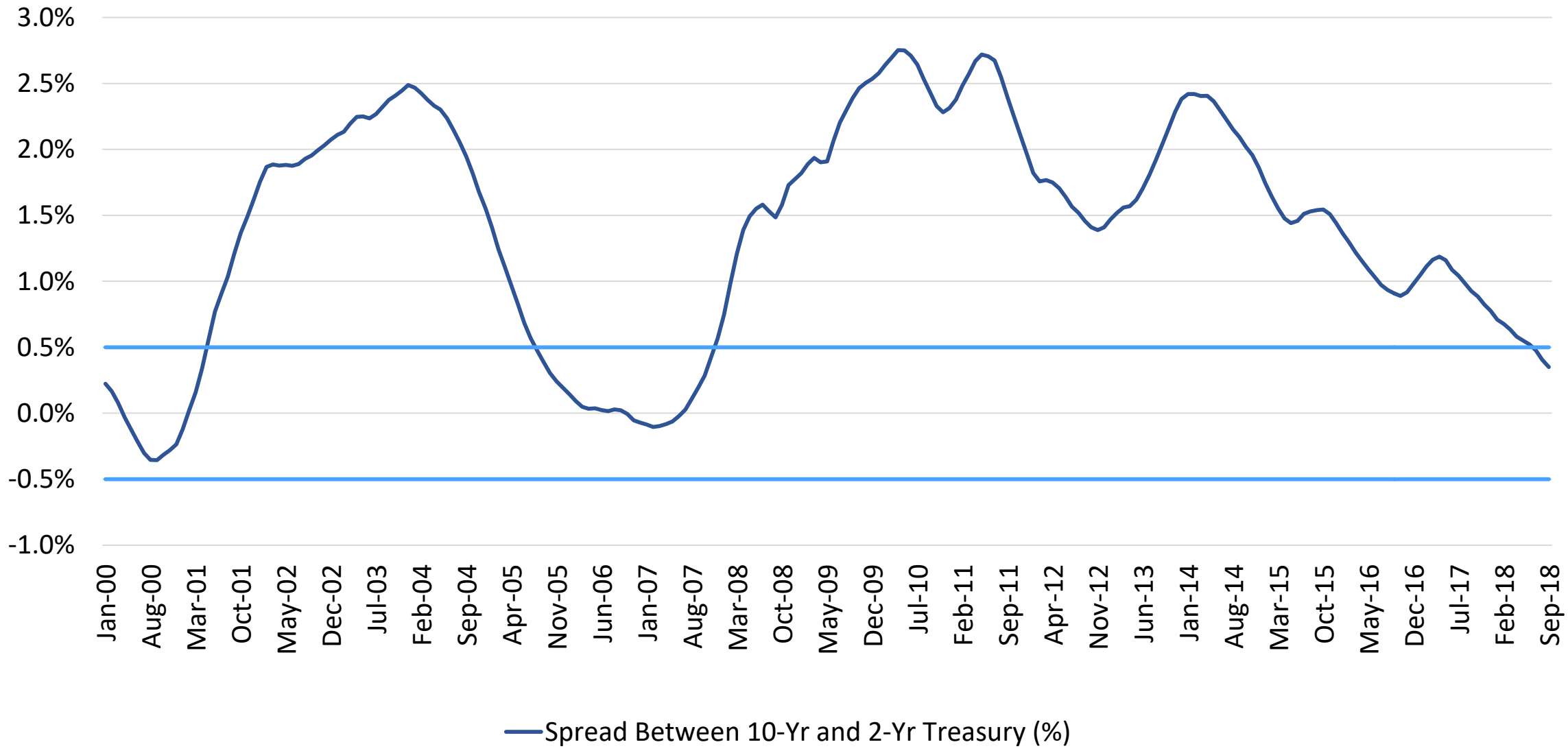
U.S. 10-Year Treasury and 3-Month Treasury Spread



Source: Moody's Analytics; U.S. Board of Governors of the Federal Reserve System (FRB)

U.S. 10-Year Treasury and 2-Year Treasury Spread



Source: Moody's Analytics; U.S. Board of Governors of the Federal Reserve System (FRB)

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U.S. Federal Policy Mix is Mildly Pro-Growth – Shifting Away From Consumers Towards Producers

Pro-Growth

- Tax Reform
- Regulatory Relief
- Executive Orders
  - Energy
  - Finance
  - Labor Costs

Generally Positive Progress

Pro-Growth but Slow

- Infrastructure
- Education Reform
  - German Model
- Healthcare Reform

Progress in Tone, but Not Yet Substantive

Anti-Growth

- Immigration Control
- Trade Renegotiation
  - President Trump announced U.S. will impose tariffs on steel and aluminum imports

Recent Tariff Move a Potential Drag on Growth

Source: Yardi®Matrix

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So What?

- The U.S. economy is strong
- Employment and wage growth are good
- How much slack is left?
  - Productivity
  - Labor force participation

} Both need to, and are, rising

- Inflation rising but not a lot, so the 10 yr rate is the binding constraint on the yield curve
- Fiscal policy is mildly pro-growth
  - Capital still needs to be deployed

Source: Yardi®Matrix

Commercial Real Estate Fundamentals and Emerging Solutions to Affordability

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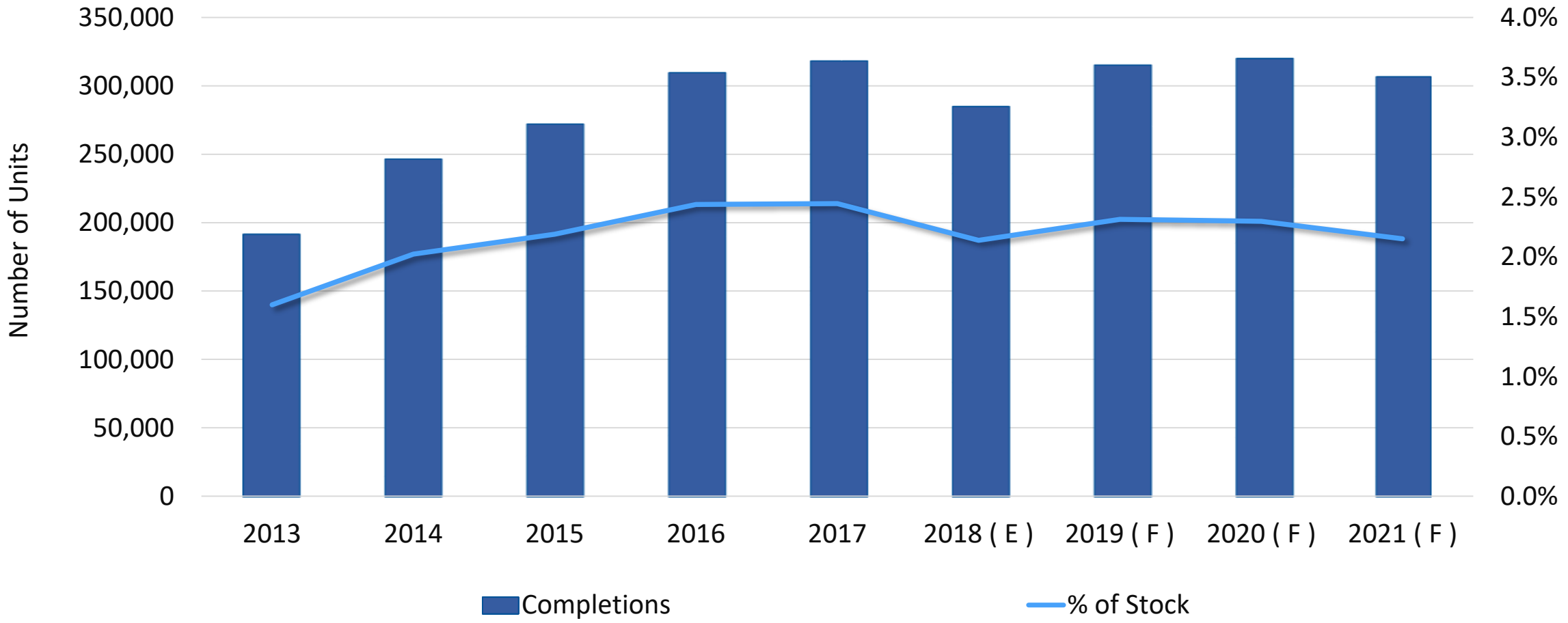
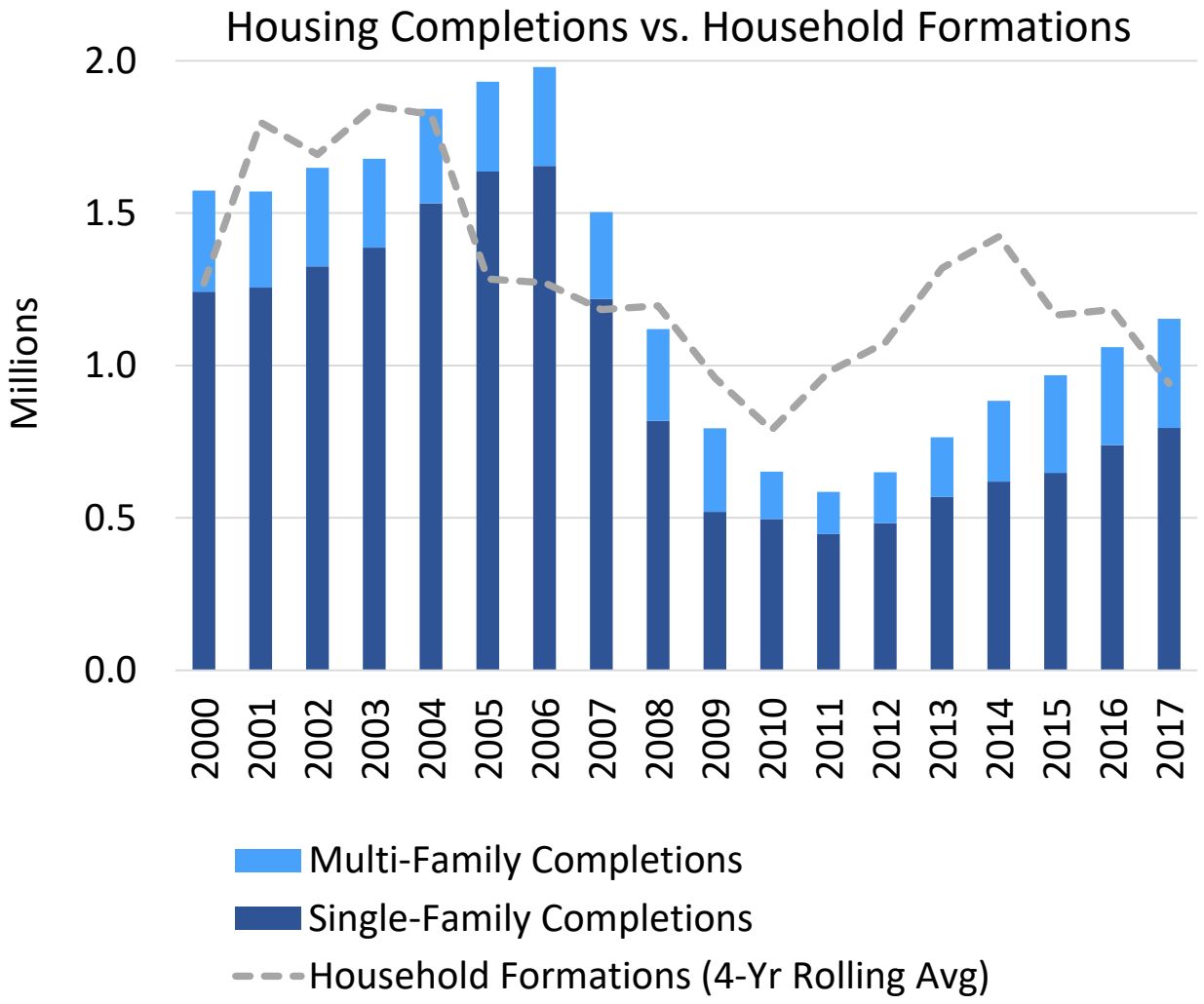
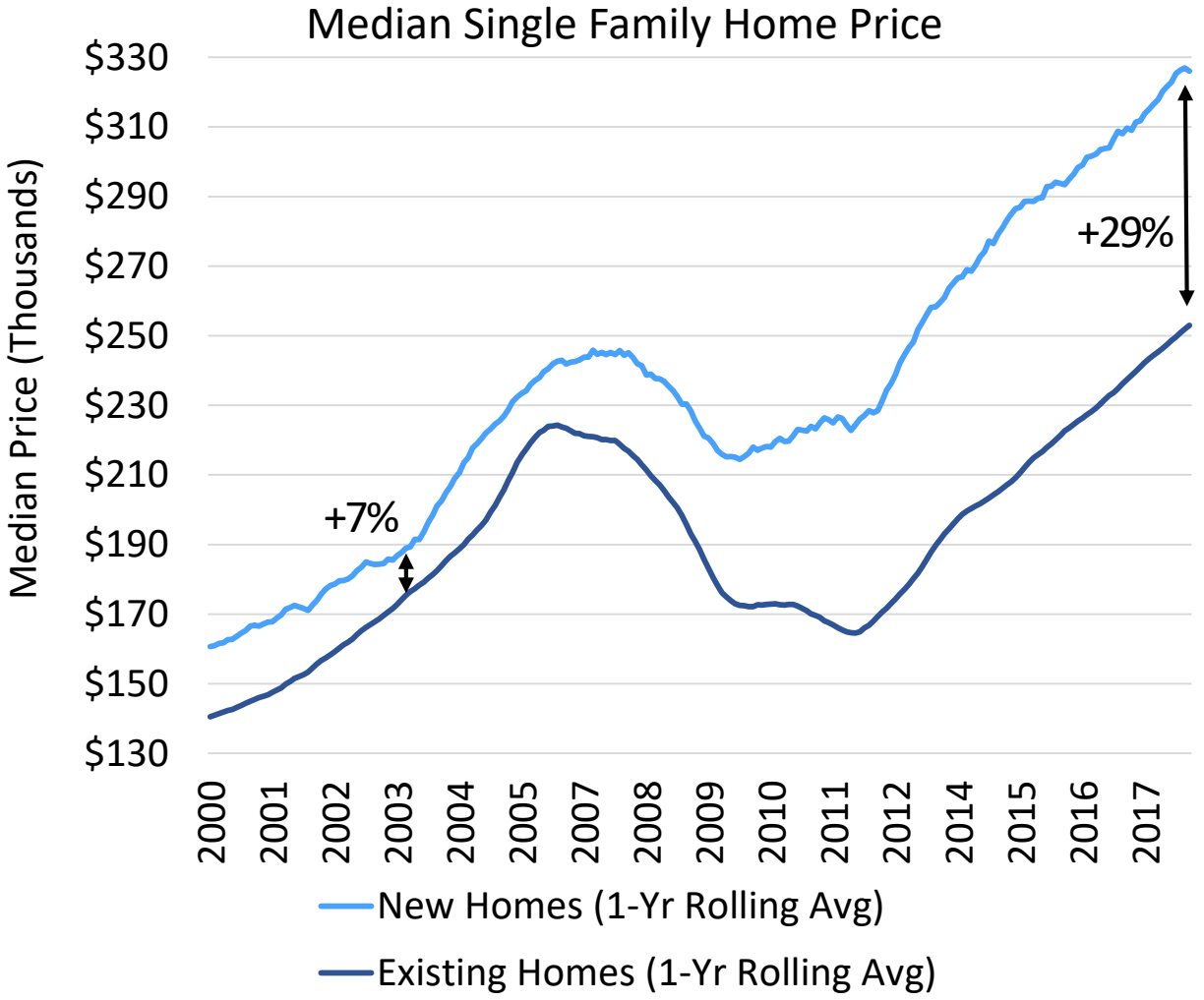
Demand is Not a Problem, so Attention Turns to Supply-Multifamily Supply Has Leveled Out; Construction Delays and Financing are a Factor



Source: Yardi®Matrix

Construction Just Catching Up to HH Formation; Builders Focusing on Higher Priced Single-Family Homes





Source: Moody's Analytics; National Association of Realtors (NAR); U.S. Census Bureau (BOC)

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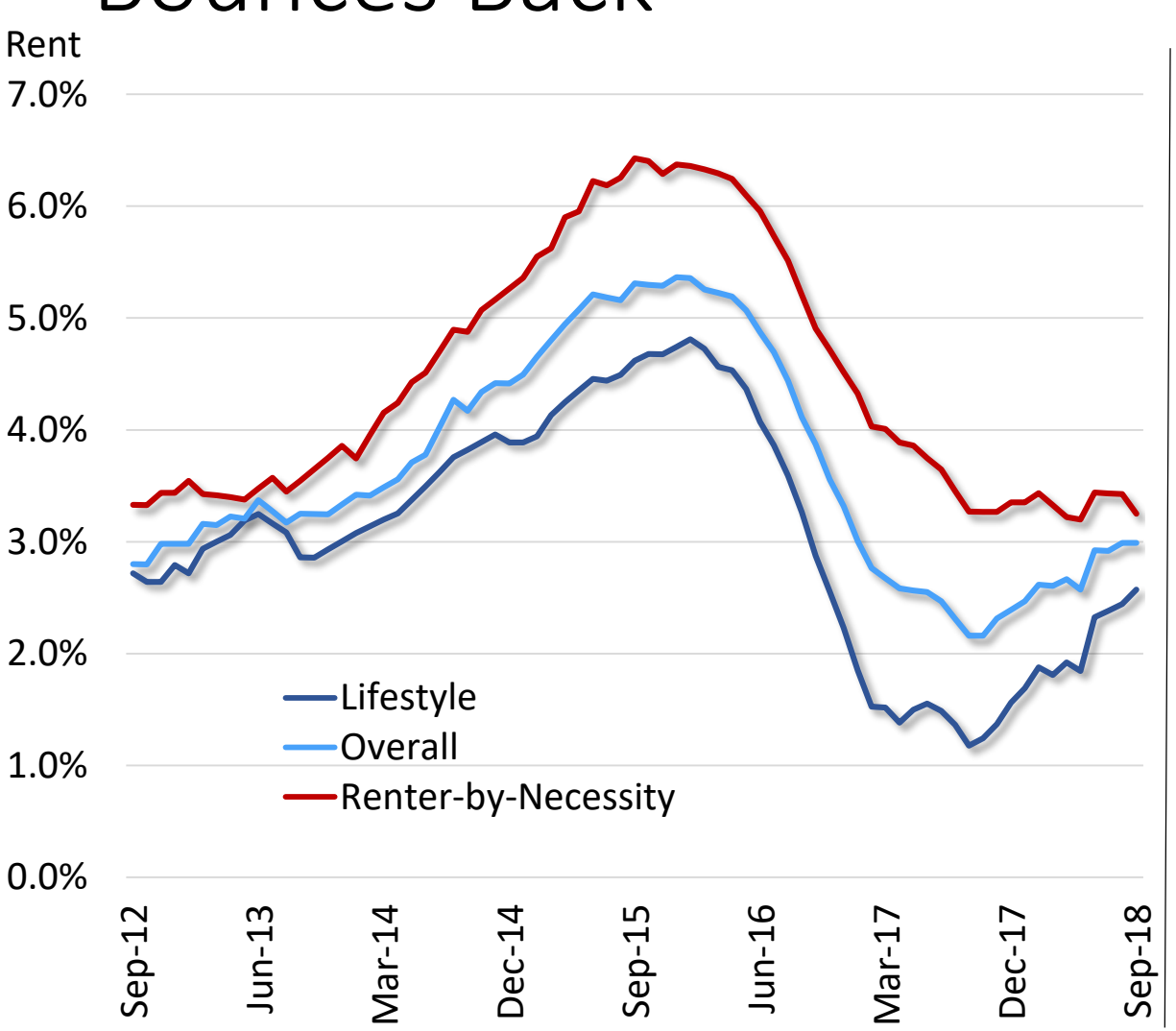
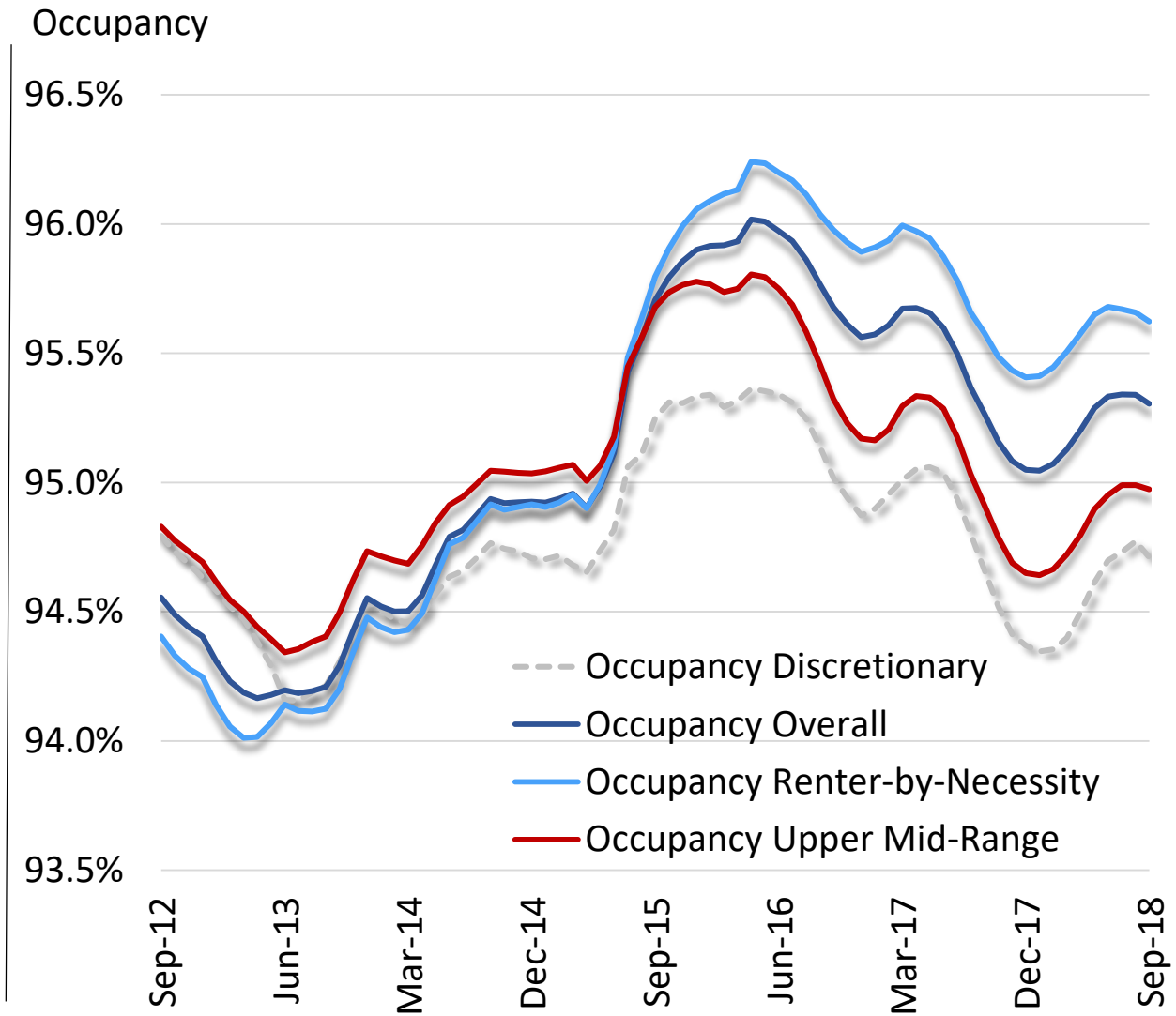
Rent Growth Has Rebounded While Occupancy Bounces Back





Source: Yardi®Matrix

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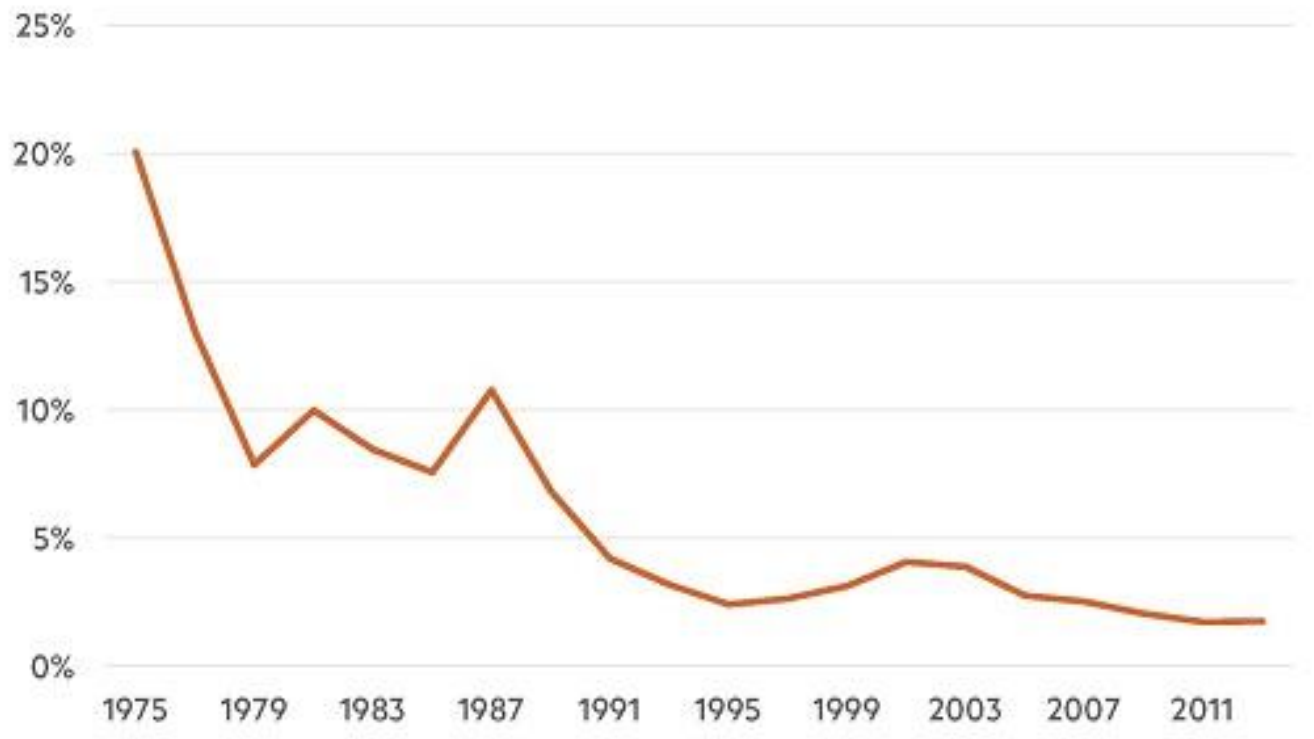
There are Fewer New Apartments Affordable to Median-Income Residents

- The share of all apartments that are affordable to median-income households and were no more than five years old ranged from about 10-20 percent in most of the 1970s and 1980s

- It fell to an average of 3.1 percent in the 1990s and 2000s and has slipped even further to only 1.8 percent in the current decade (data through 2013)

FIGURE 4

New Apartment Share of All Apartments Affordable to Median-Income Households



Source: AHS; NMHC

*Affordable defined as rent no more than 30% of income

Source: National Multifamily Housing Council (NMHC), "Did We Ever Build Apartments for the Middle Market?"; American Housing Survey (AHS)

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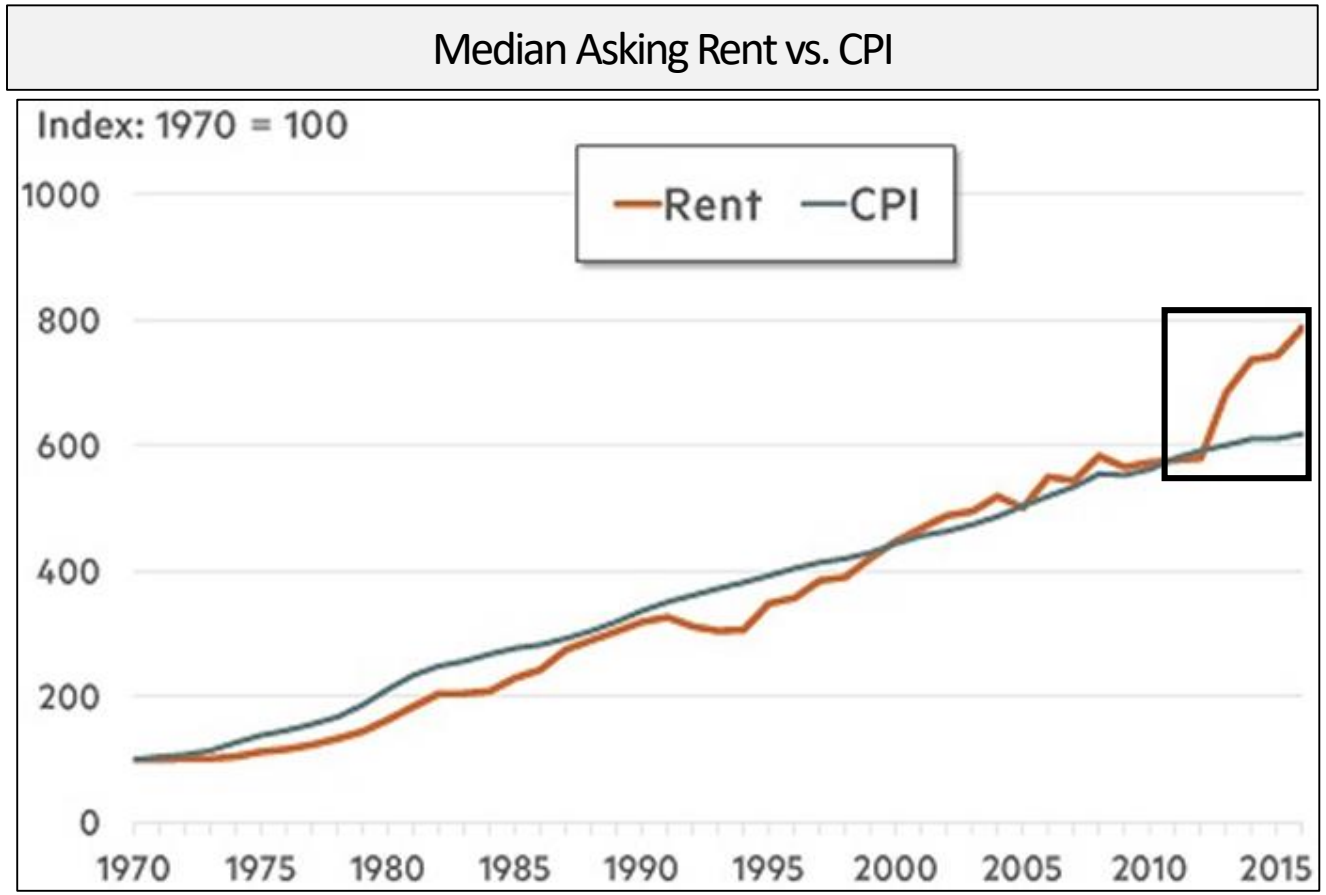
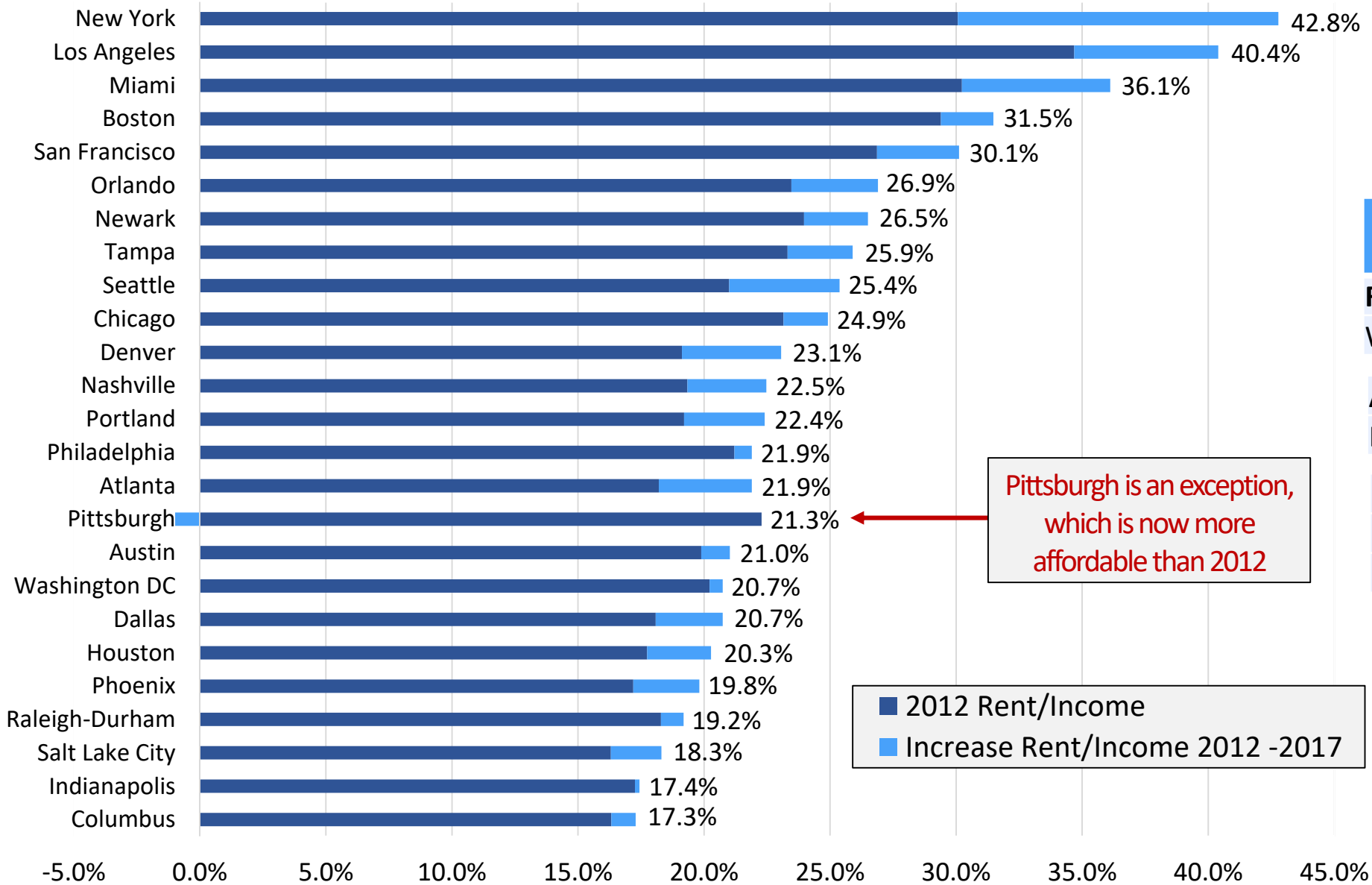
Median Asking Rent Rising Faster Than Inflation

- Between 1970-2012, the periods in which the median rent grew more slowly than overall inflation were balanced by periods in which it grew faster
- Since then, the median asking rent has risen much more rapidly than inflation



Source: National Multifamily Housing Council (NMHC), "Did We Ever Build Apartments for the Middle Market?"; U.S. Census Bureau (BOC); U.S. Bureau of Labor Statistics (BLS)

Markets Are Less Affordable Than 5 Years Ago



Pittsburgh is an exception, which is now more affordable than 2012

Average Multifamily Rent in Secondary Tech Markets Compared to the Nearest Gateway Cities

Market	Avg. Rent Sept 2018
Raleigh-Durham	**$1,145**
Washington DC	$1,762
Austin	**$1,337**
Los Angeles	$2,266
Seattle	**$1,840**
San Francisco	$2,658
Los Angeles	$2,266
Denver	**$1,520**
San Francisco	$2,658
Los Angeles	$2,266
Nashville	**$1,218**
Washington DC	$1,762
Chicago	$1,502

Source: Yardi®Matrix; Moody's Analytics; U.S. Census Bureau (BOC); CoreLogic, Inc.

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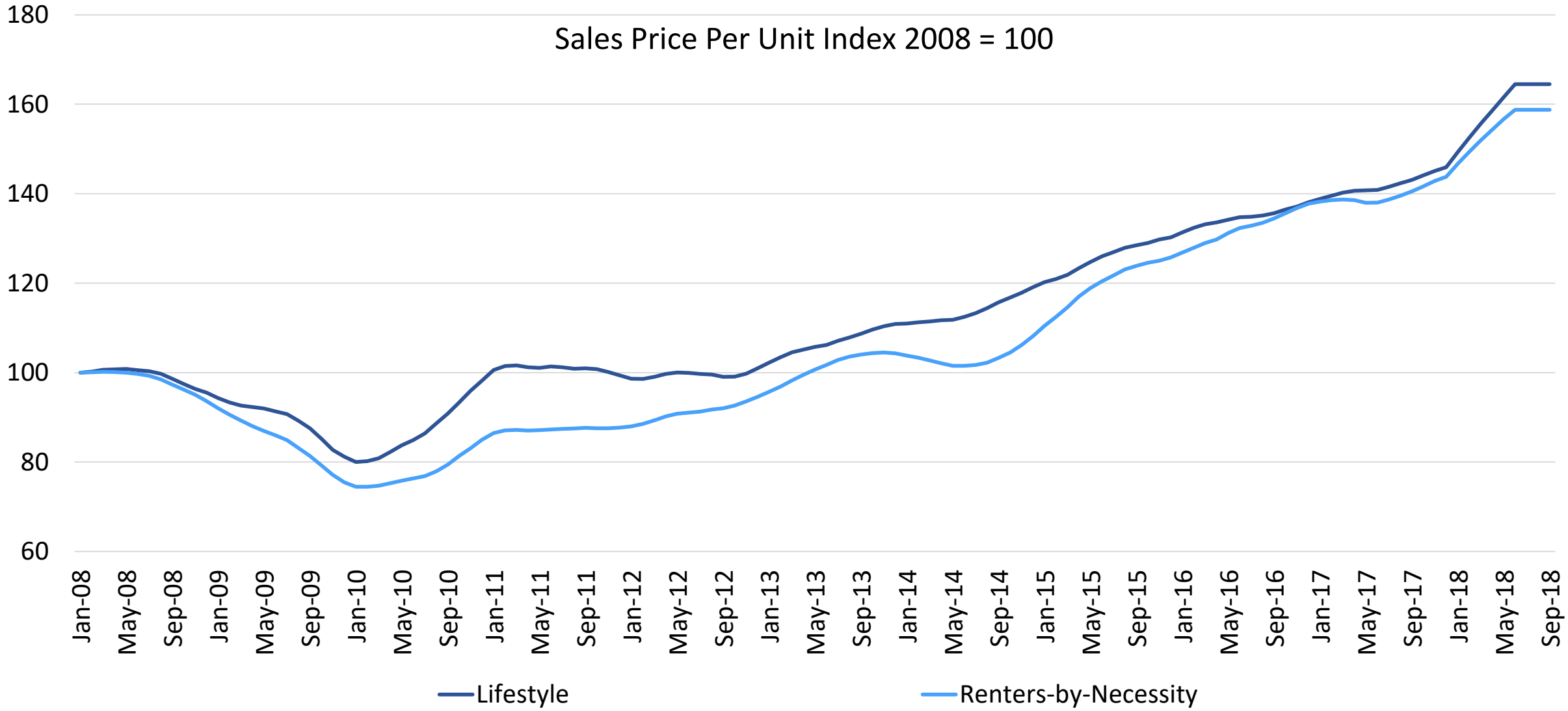
National Multifamily Values Keep Rising



Source: Yardi®Matrix

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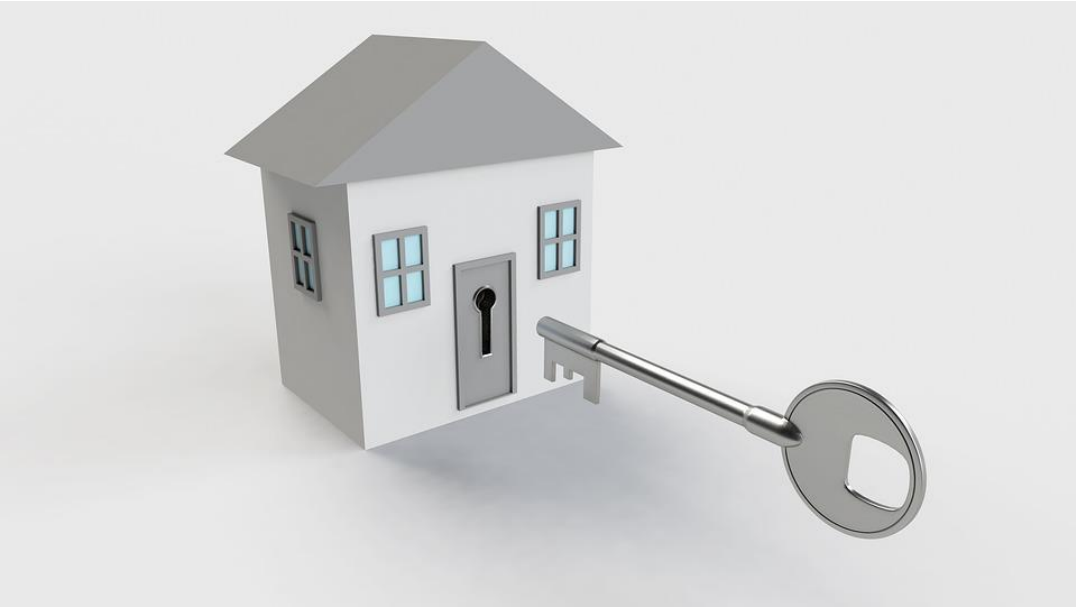
Policy Responses to Affordability Issue

Command/Mandate Oriented

- Repeal of Costa-Hawkins (CA)
- Inclusionary Zoning



Market Oriented

- Co-Living – Reduces Space Needs
- Airbnb – Monetizes Unused Time
- Streamlined Zoning
- Freddie Mac Loan Payments
- HUD Policy Changes
- Modular/Standardized Construction
- Opportunity Zones

Source: Yardi®Matrix

Case Study: Niido Powered by Airbnb

- Airbnb-branded apartment buildings encourage homesharing in properties

- Every Niido property has a MasterHost available 24/7 to assist with homesharing needs and comes fully equipped with:
  - Keyless entry systems, bike-sharing, community rooms, swimming pool, on-site package receiving, 24-hour security, cleaning, linen services, high-speed WiFi, cable TV, and event programming

- The first Niido property is ***Domain in Kissimmee, FL***

Domain in Kissimmee, FL

niido | POWERED BY airbnb

Source: Olivia Zaleski, “Surprise, You Live in a Giant Airbnb”, Bloomberg Businessweek; niido.com

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Case Study: Niido Powered by Airbnb

Domain in Kissimmee, FL

Property Characteristics from Yardi Matrix:

- Completed in 2017
- Currently 65.7% occupied
- 324 units total:
  - 108 one bedroom
  - 180 two bedroom
  - 36 three bedroom

Niido Calculator:

- By sharing a one bedroom Niido Orlando apartment on Airbnb for one day a month, you can cover 7.1% of your rent
- The landlord (Niido) takes a 25% cut from whatever revenues the tenant earns from renting their apartment on Airbnb

	Average Rent Sept 2018
Orlando	$1,325
Celebration Submarket	$1,504
Subject Property	$1,146-$1,855

*Calculations are for estimate purposes

**Reflects 25% Niido service fee. An Airbnb host fee of 3% may also apply

Source: Yardi®Matrix; niido.com

Case Study: “Rent By Bedroom” – X Social Communities

- PMG developing 10,000+ unit pipeline of X Social Communities in Chicago, Miami, Ft Lauderdale, Denver, Orlando, Phoenix
- Projects include mix of market rate and "Rent By Bedroom" units
- "Rent By Bedroom Rent" / Coliving = Private bedroom/bathroom in furnished 2-4 bedroom suite with shared kitchen and living area
- Couch and TV, dining table & chairs, cookware, bed and mattress included, along with in-unit laundry
- Kitchen and living areas professionally cleaned every two weeks
- Each member signs their own (typically 12 mo) lease and is billed separately for their share of utilities

MIAMI

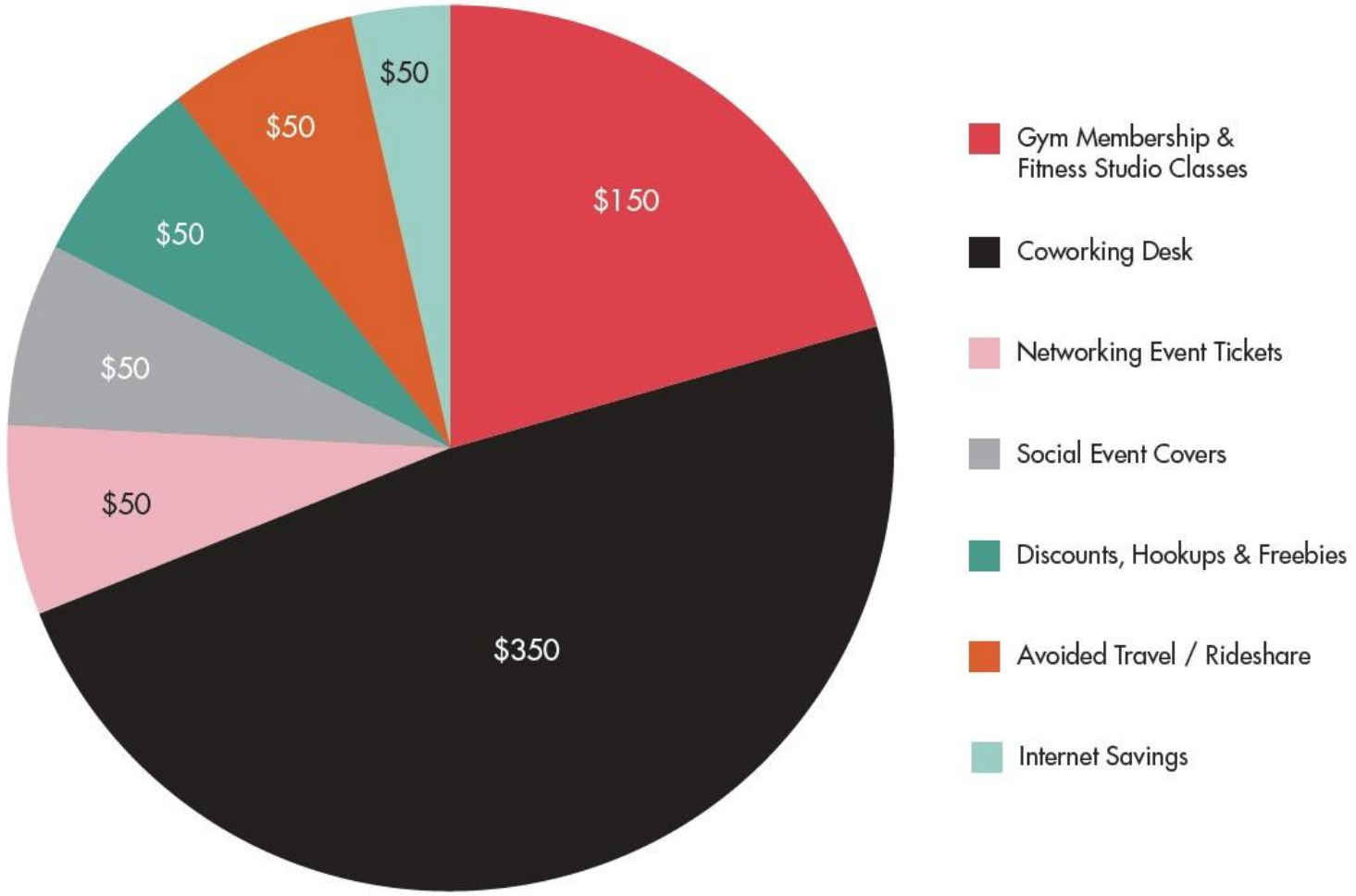
Source: xmiami.co

YARDI

Case Study: “Rent By Bedroom” – X Social Communities

Comparative Cost Analysis: X Social Communities Monthly Member Savings

- Rents starting in the $1,200's (Miami)
  - Most attainable way to get into a new construction Class A building in the best location
  - Typical entry-point is $1,800+
- Rent includes access to gym, coworking, social lounge, pool, and community events
- Members save $700+/mo on services by living at X Miami



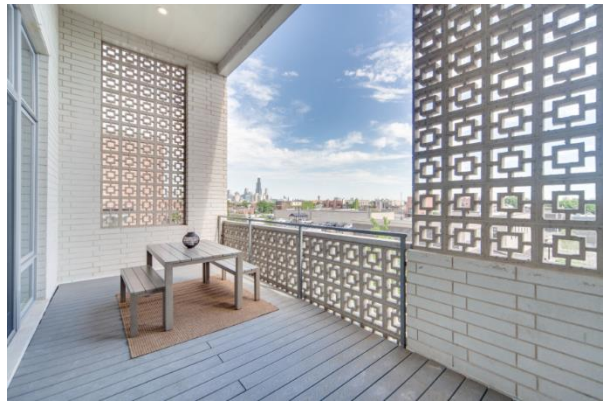
Source: xmiami.co

Case Study: Coliving with Common

- Currently in 5 cities, with 21 homes and 600+ members
- Rent a private bedroom, and all members in the unit have access to shared spaces
- All furniture, linens, cleaning supplies, kitchenware and utilities included with rent
- Weekly cleaning services for shared spaces
- Free on-site laundry with all necessary supplies
- Free high-speed WiFi
- Allows transfers to another room or home within the Common community

common

Chicago: Damen




Source: common.com

YARDI

Coworking Trend Provided a Model for Coliving

Coworking, Telecommuting and Outsourcing

Telecommuting

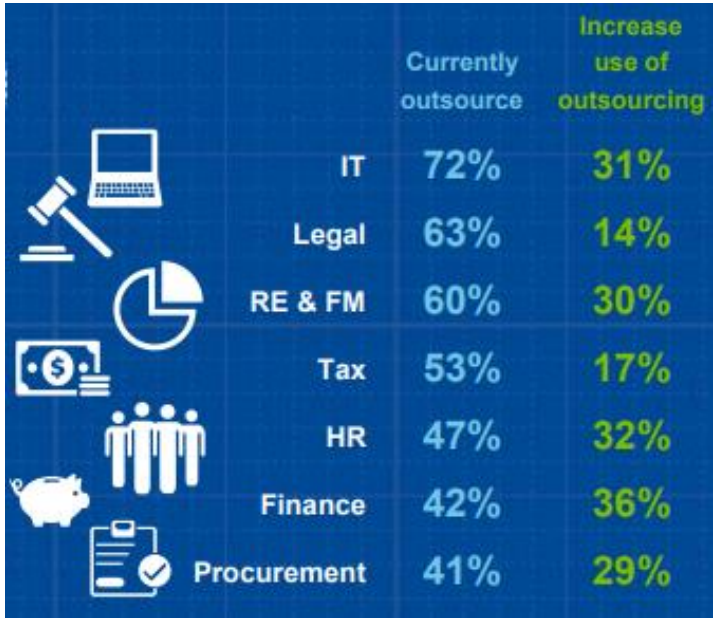
- Work-at-home population has grown by 115% since 2005
  - Nearly 10x faster than the rest of the workforce
- 3.7 million employees (2.8% of workforce) now work from home at least half the time

Small but growing
Impacts demand at the margins

Outsourcing

- Companies outsource to cut costs, focus on core business, and solve capacity issues

What are your current and future outsourcing strategies for the various business functions?



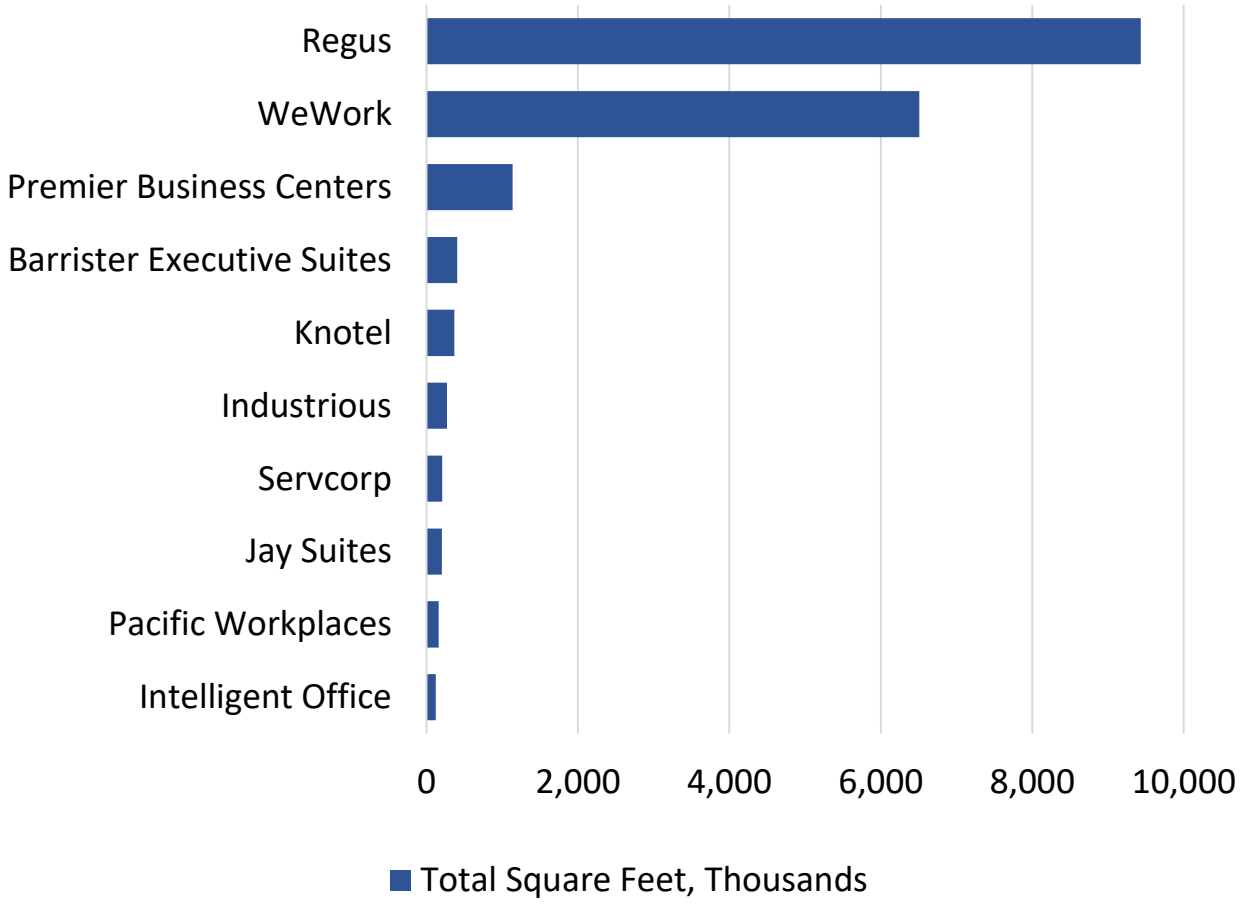
2016 Global Outsourcing Survey by Deloitte

*Telecommuting data as of June 2017
*Outsourcing data as of Jan 2016

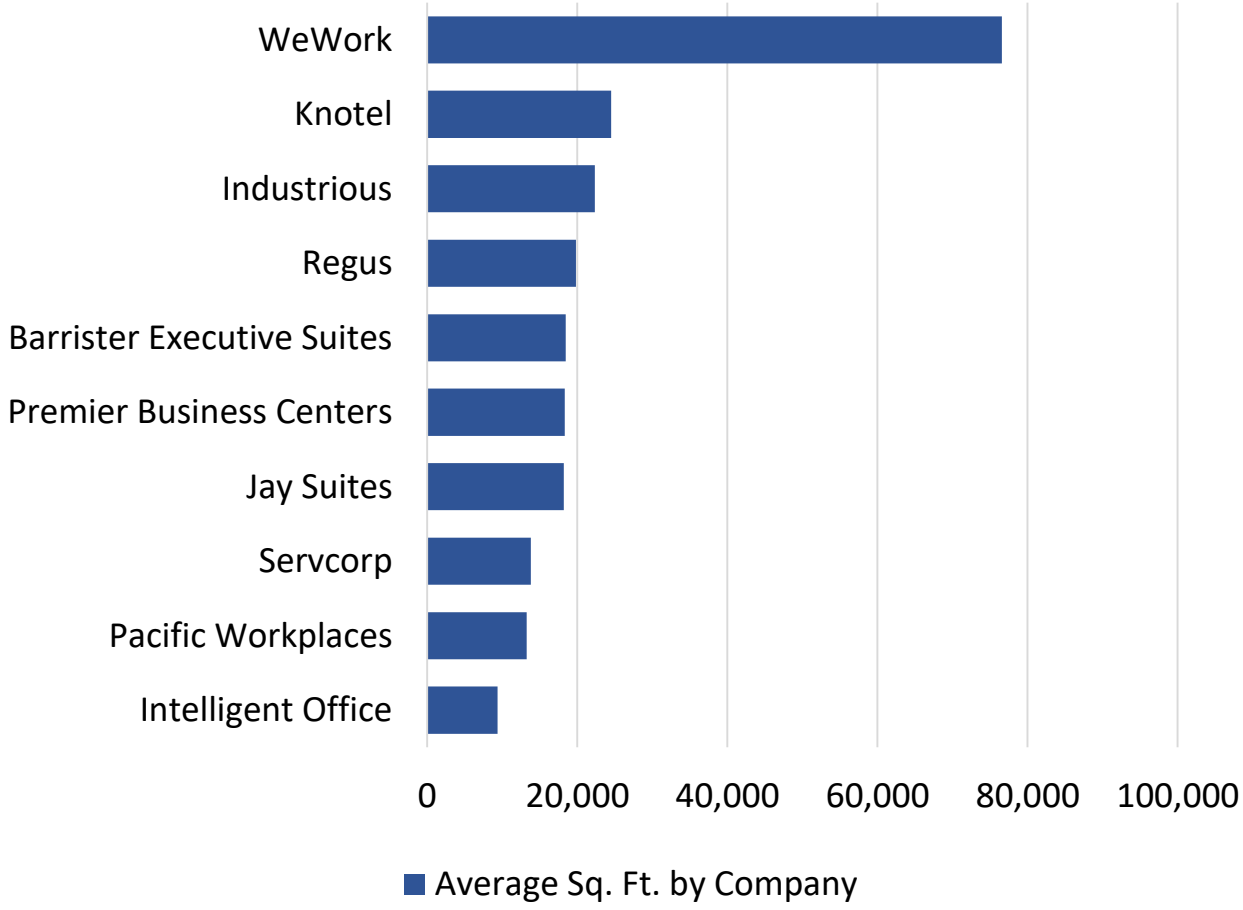
Source: GlobalWorkplaceAnalytics.com; 2016 Global Outsourcing Survey by Deloitte; Yardi®Matrix

Two Industry Giants Dominate Coworking, but CBRE Just Entered with *Hana*

Regus had the Most Space



While WeWork had the Biggest Spaces



Source: Yardi®Matrix, as of January 2018

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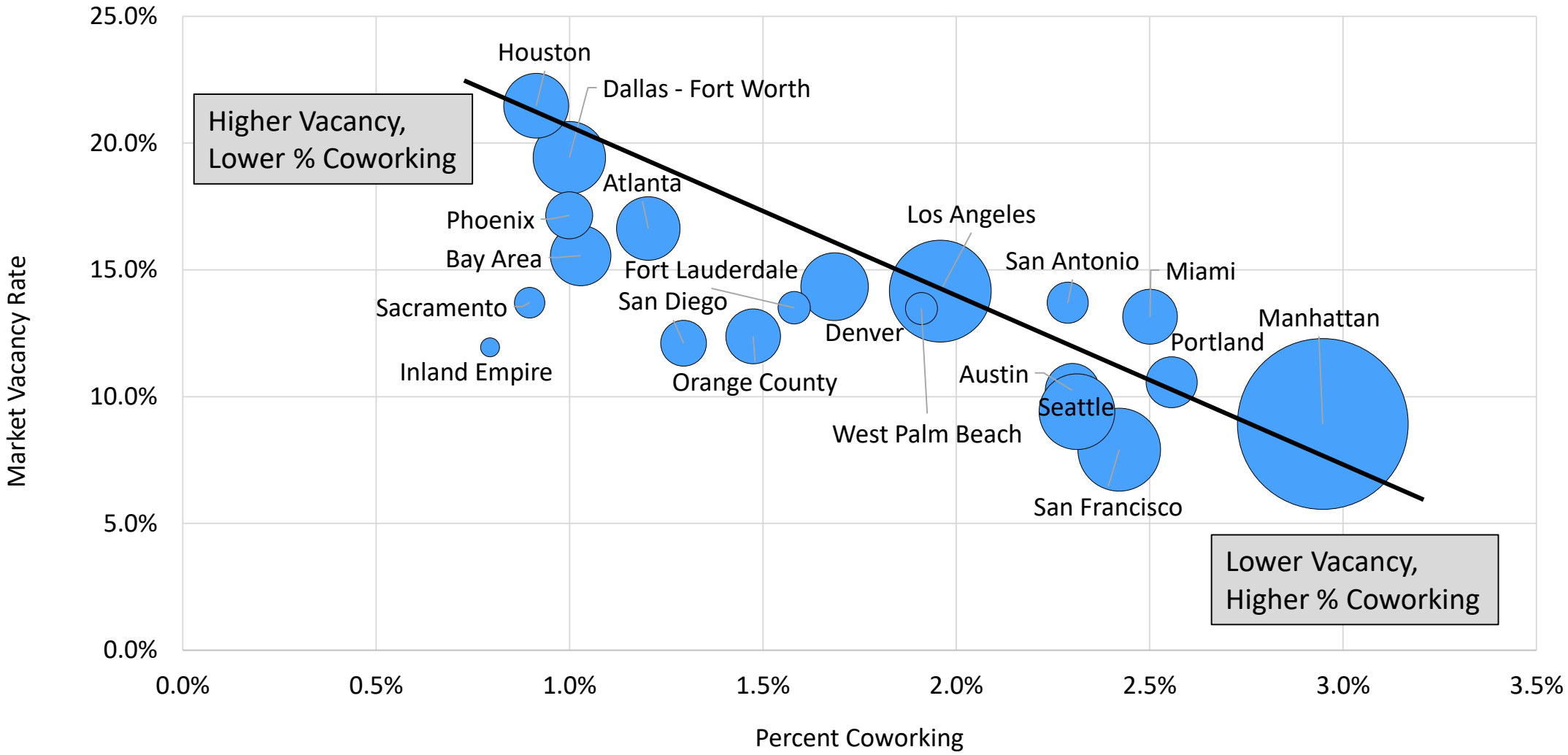
Markets with Lower Vacancy Rates Have Higher Proportion of Coworking Space



Source: Yardi®Matrix, as of October 2018

Medium-Term 2-5 Year View of the Geography of Jobs and Highlights of Growing Secondary Tech Markets

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Evolving Trends in Emerging Tech Hubs

Gateway Cities	Known Tech Hub Cities	Generally Overlooked Markets
San Francisco/Bay Area	Portland	Phoenix
Los Angeles	Seattle	Salt Lake City
Chicago	Denver	Indianapolis
Washington DC	Austin	Columbus
New York/New Jersey Metro	Dallas	Tampa
Boston	Houston	Orlando
Northern Virginia	Nashville	Pittsburgh
Montgomery County	Atlanta	Philadelphia
	Miami	
	Raleigh	

Blue Text = Amazon HQ2 Finalist

*Toronto is a finalist for the Amazon HQ2 but is not included in this analysis

Source: Yardi®Matrix

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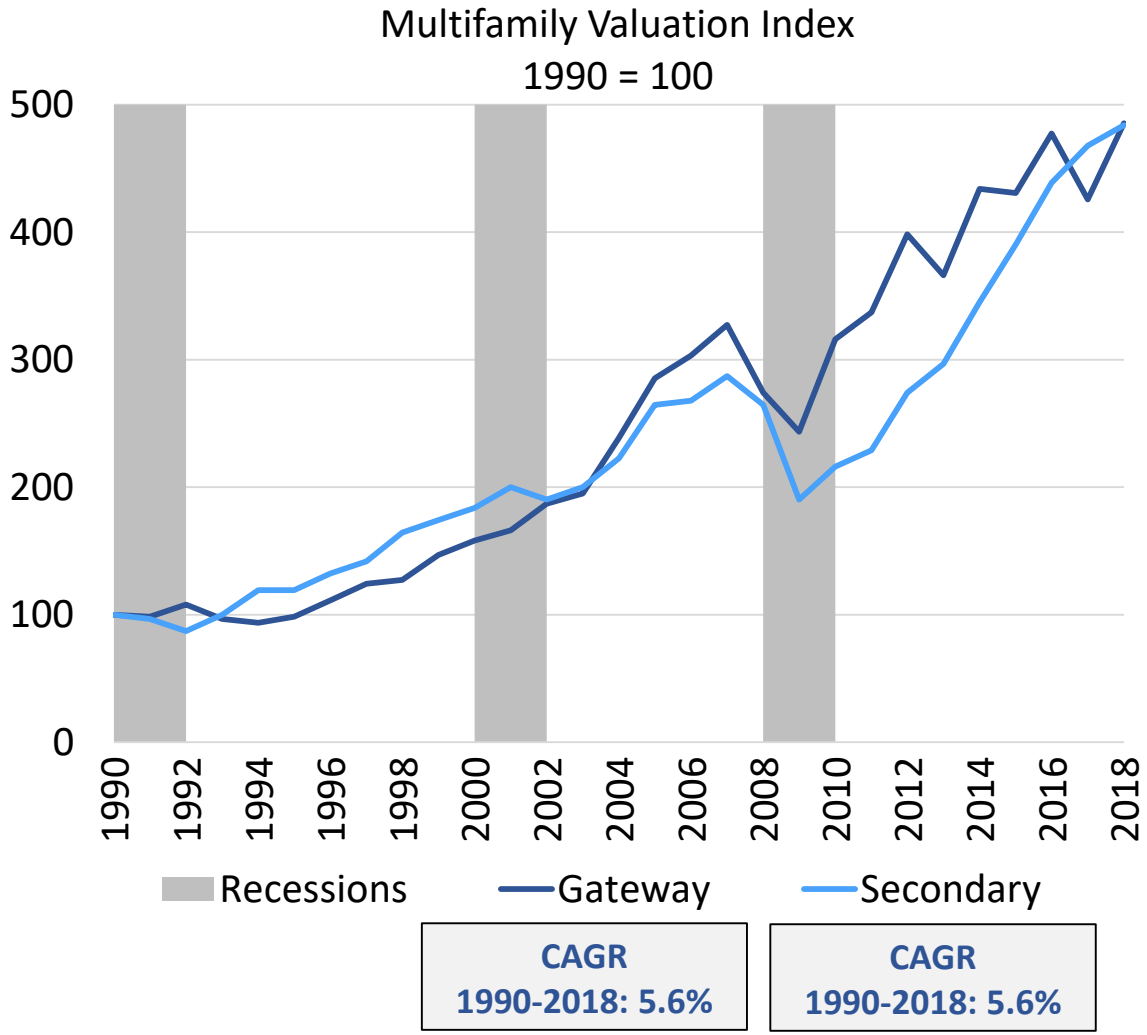
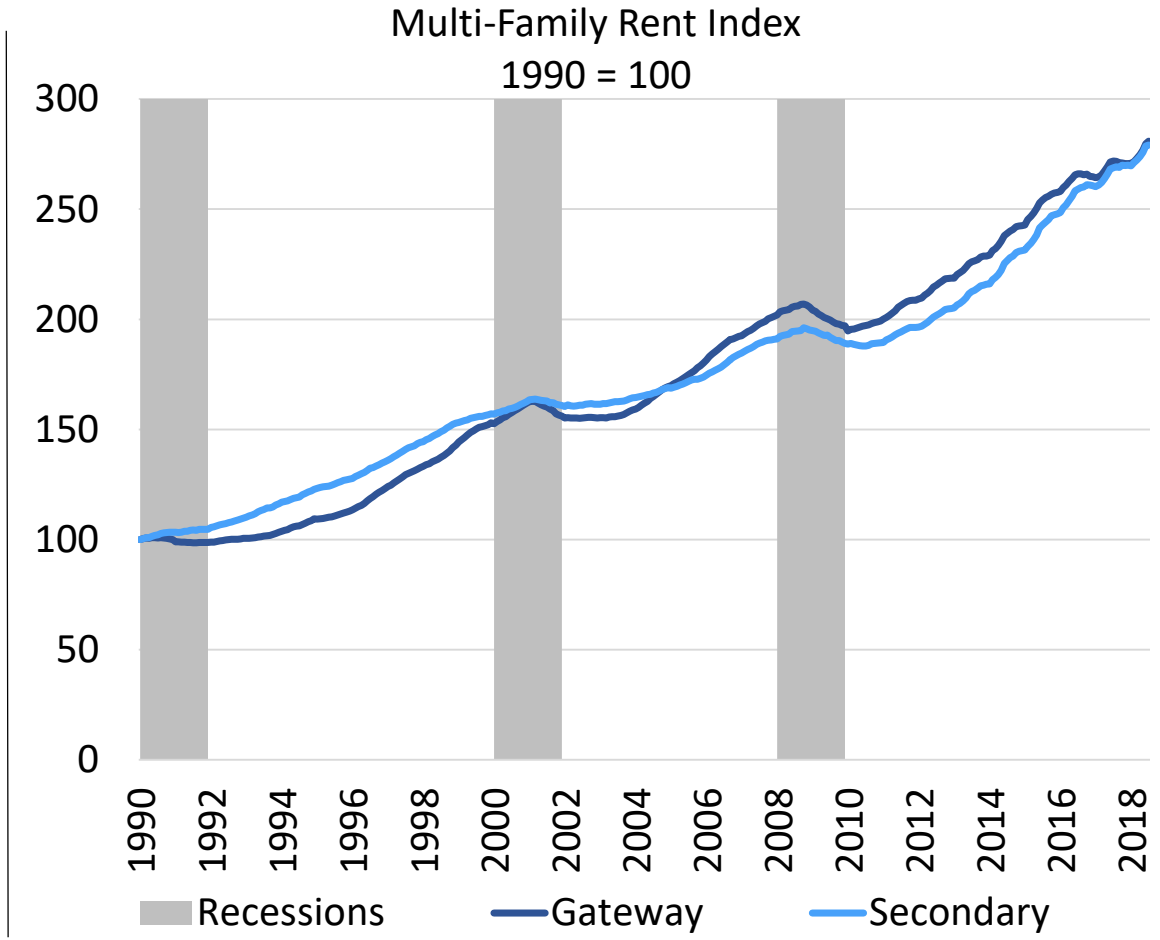
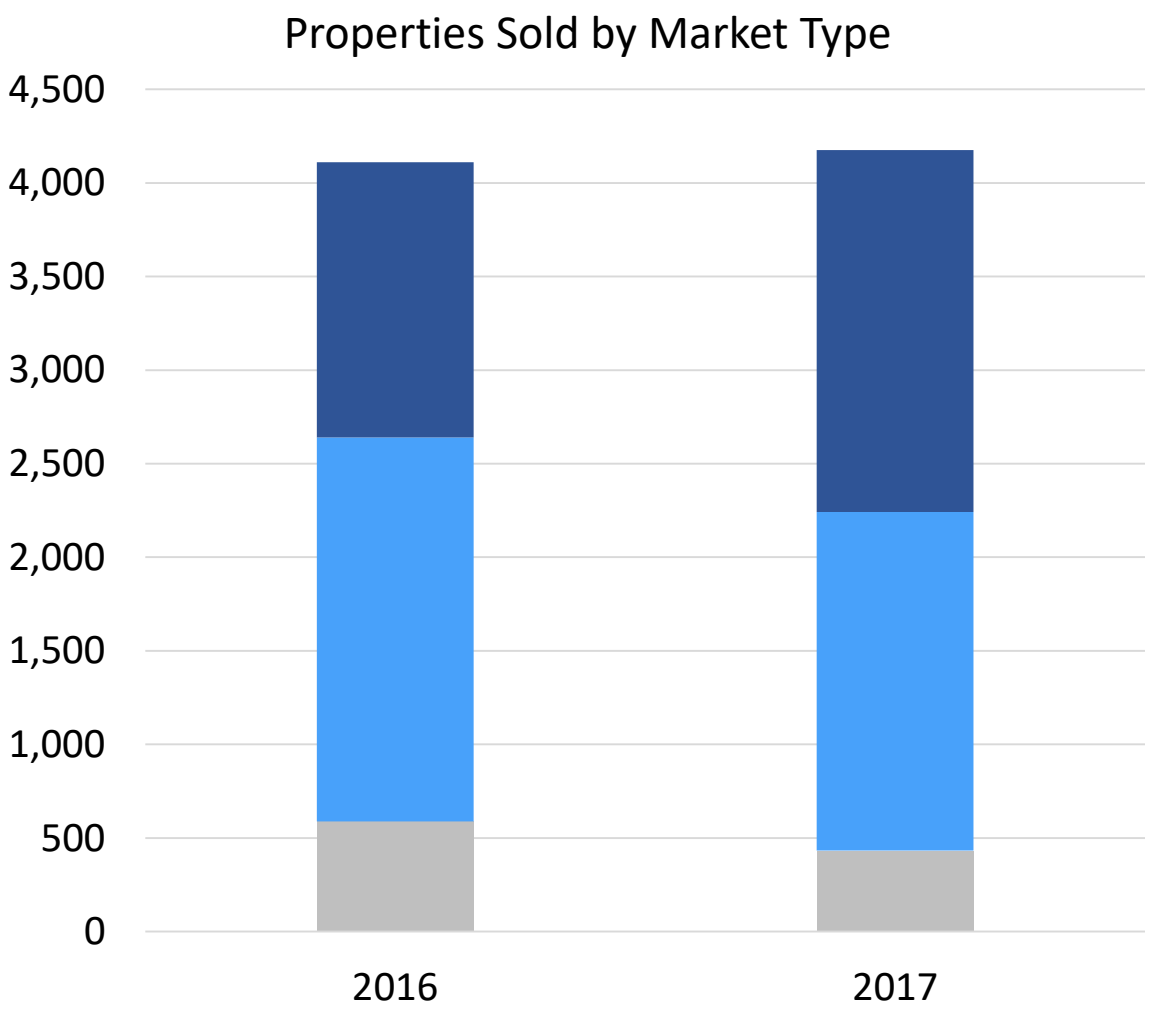
In Multifamily, Secondary and Gateway Markets Perform Similarly Over Time, Except During a Downturn

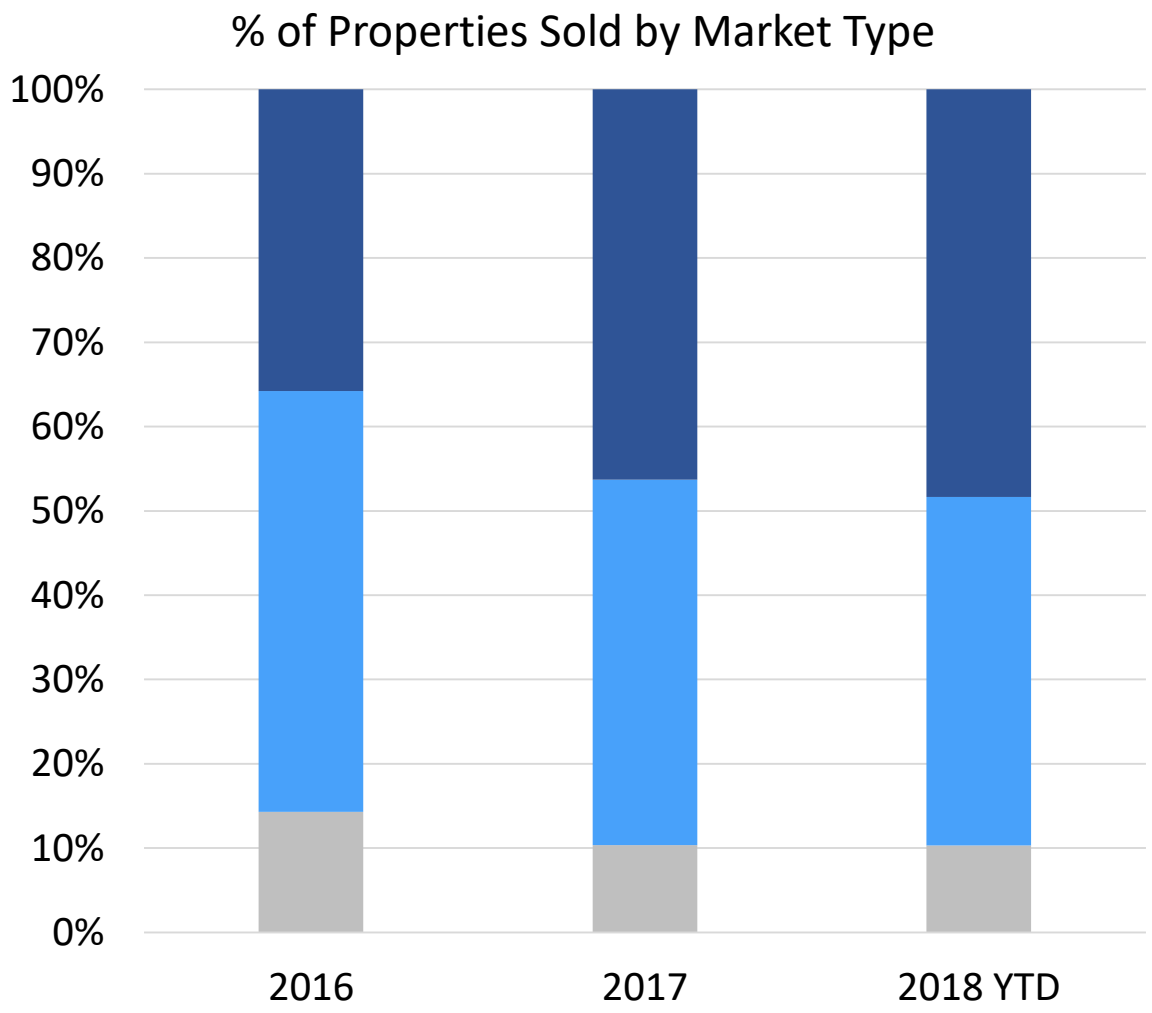




*Gateway = avg of "gateway cities", Secondary = avg of "known tech hub cities" and "generally overlooked markets" on the slide "The Amazon 20...Plus"
Source: Yardi®Matrix

Sales Have Shifted to Secondary and Tertiary Markets





Primary Secondary Tertiary

*Gateway = avg of "gateway cities", Secondary = avg of "known tech hub cities" and "generally overlooked markets" on the slide "The Amazon 20...Plus"
Source: Yardi®Matrix

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Job Growth is Happening in Secondary Cities

At this stage in the economy, companies are relocating and expanding in markets where their money will get them further

Charles Schwab

- Relocated jobs from San Francisco to lower-cost states like Texas and Colorado
- Consolidated Denver-area employees and newly relocated employees into a $230 million campus in Lone Tree, CO
- Light rail currently being extended in part to accommodate employees and other residents drawn to the area

KPMG

- Developing $400 million, 55-acre learning, development and innovation campus in Lake Nona outside of Orlando
- Create 330 new jobs and 800,000 sq. ft. for meeting, classroom, residential and dining

Market	Emp. Growth 2018 YTD	Trend From Prior Year	Market	Emp. Growth 2018 YTD	Trend From Prior Year
Phoenix	3.2%	Accelerating	Philadelphia	1.5%	Accelerating
Orlando	2.7%	Accelerating	Columbus	1.5%	Accelerating
Houston	2.7%	Accelerating	Portland	1.5%	Decelerating
Las Vegas	2.6%	Accelerating	Charlotte	1.5%	Decelerating
Reno	2.5%	Decelerating	Washington D.C.	1.4%	Accelerating
Raleigh	2.4%	Accelerating	Minneapolis	1.4%	Accelerating
Dallas	2.4%	Accelerating	San Diego	1.3%	Accelerating
Seattle	2.3%	Accelerating	Kansas City	1.2%	Accelerating
San Jose	2.3%	Accelerating	Nashville	1.2%	Decelerating
Jacksonville	2.3%	Accelerating	East Bay Area	1.0%	Decelerating
Inland Empire	2.1%	Decelerating	Tampa	1.0%	Accelerating
Salt Lake City	2.1%	Accelerating	San Francisco	0.9%	Stable
Austin	1.9%	Accelerating	Los Angeles	0.9%	Decelerating
Boston	1.8%	Accelerating	New York	0.8%	Decelerating
Atlanta	1.8%	Accelerating	Chicago	0.6%	Accelerating
West Palm Beach	1.8%	Accelerating	St. Louis	0.6%	Accelerating
Miami	1.8%	Accelerating	Detroit	0.6%	Decelerating
Fort Lauderdale	1.7%	Accelerating	North Central Florida	0.5%	Accelerating
Denver	1.6%	Accelerating	Sacramento	0.0%	Decelerating
Boise	1.6%	Decelerating	Orange County	0.0%	Decelerating
Indianapolis	1.6%	Accelerating	Milwaukee	-0.3%	Decelerating

Source: Moody's Analytics; Bureau of Labor Statistics; kpmg.com; denverpost.com

Population Growth is in Secondary Markets

With the exception of Washington DC, secondary and tertiary markets are the only ones seeing stable or rising population growth since 2015

Market	2015 Pop. Growth	2016 Pop. Growth	2017 Pop. Growth	Overall Trend
New York	0.6%	0.4%	0.2%	Decelerating
Los Angeles	0.5%	0.3%	0.1%	Decelerating
Chicago	0.0%	-0.1%	-0.1%	Falling
Houston	2.6%	2.0%	1.4%	Decelerating
Washington DC	1.0%	1.0%	1.1%	Stable
Philadelphia	0.2%	0.2%	0.3%	Stable
Atlanta	1.7%	1.6%	1.5%	Decelerating
Dallas	2.2%	2.2%	2.1%	Decelerating
Boston	0.7%	0.6%	0.6%	Decelerating
Phoenix	2.0%	2.0%	1.9%	Decelerating
San Francisco	1.3%	0.9%	0.6%	Decelerating
Tampa	2.0%	2.1%	1.8%	Decelerating
Seattle	1.7%	1.9%	1.6%	Decelerating

Market	2015 Pop. Growth	2016 Pop. Growth	2017 Pop. Growth	Overall Trend
Denver	2.1%	1.6%	1.3%	Decelerating
Miami	1.2%	1.1%	0.6%	Decelerating
Newark	0.2%	0.3%	0.4%	Rising
Orlando	2.7%	2.6%	2.3%	Decelerating
Portland	1.7%	1.7%	1.2%	Decelerating
Pittsburgh	-0.3%	-0.3%	-0.3%	Steady/Negative
Austin	3.0%	3.0%	2.7%	Decelerating
Columbus	1.2%	1.2%	1.6%	Rising
Indianapolis	0.8%	0.9%	1.1%	Rising
Nashville	2.1%	2.2%	1.8%	Decelerating
Raleigh	2.4%	2.5%	2.3%	Decelerating
Salt Lake City	1.2%	1.6%	1.4%	Decelerating

Although population is falling in Pittsburgh, the greater downtown's population expanded by 22% between 2010 and 2016

Source: Moody's Analytics; U.S. Census Bureau (BOC); Pittsburgh Downtown Partnership

Tax Reform Will Likely Accelerate Existing Migration Patterns

- Gateway markets already losing population, and tax reform will make it worse
  - New cap on the deduction for state and local taxes will accelerate migration out of gateways
  - Deduction for state and local taxes capped at $10,000/family
  - Top earners in states with high income taxes will owe more
- States to benefit: Florida, Nevada, Texas, Washington (no income tax)
- Past 10 years:
  - 3.5 million net Americans relocated from highest-tax states to lowest-tax states
- Past 3 years:
  - Texas and Florida gained a net $50 billion in income and purchasing power from other states
  - California and New York have surrendered a net $23 billion
- Next 3 years (prediction):
  - California and New York will lose on net about 800,000 residents
  - Roughly twice the number that left from 2014-2016

ALEC-Laffer State Economic Outlook Rankings, 2018

Based upon equal-weighting of each state's rank in 15 policy variables

Rank	State	Rank	State
1	Utah	26	Kansas
2	Idaho	27	Louisiana
3	Indiana	28	Nebraska
4	North Dakota	29	Iowa
5	Arizona	30	West Virginia
6	Florida	31	Kentucky
7	North Carolina	32	Maryland
8	Wyoming	33	South Carolina
9	South Dakota	34	Alaska
10	Virginia	35	New Mexico
11	Georgia	36	Delaware
12	Tennessee	37	Washington
13	Nevada	38	Pennsylvania
14	Texas	39	Rhode Island
15	Colorado	40	Connecticut
16	Oklahoma	41	Oregon
17	New Hampshire	42	Maine
18	Michigan	43	Montana
19	Wisconsin	44	Minnesota
20	Alabama	45	Hawaii
21	Ohio	46	New Jersey
22	Arkansas	47	California
23	Missouri	48	Illinois
24	Mississippi	49	Vermont
25	Massachusetts	50	New York

Source: ALEC.org: Rich States, Poor States: Alec-Laffer State Economic Competitiveness Index: Arthur Laffer, Stephen Moore and Jonathan Williams; The Wall Street Journal: So Long California. Sayonara, New York: Arthur Laffer and Stephen Moore

States That Spend & Tax Less Have Higher Growth Rates

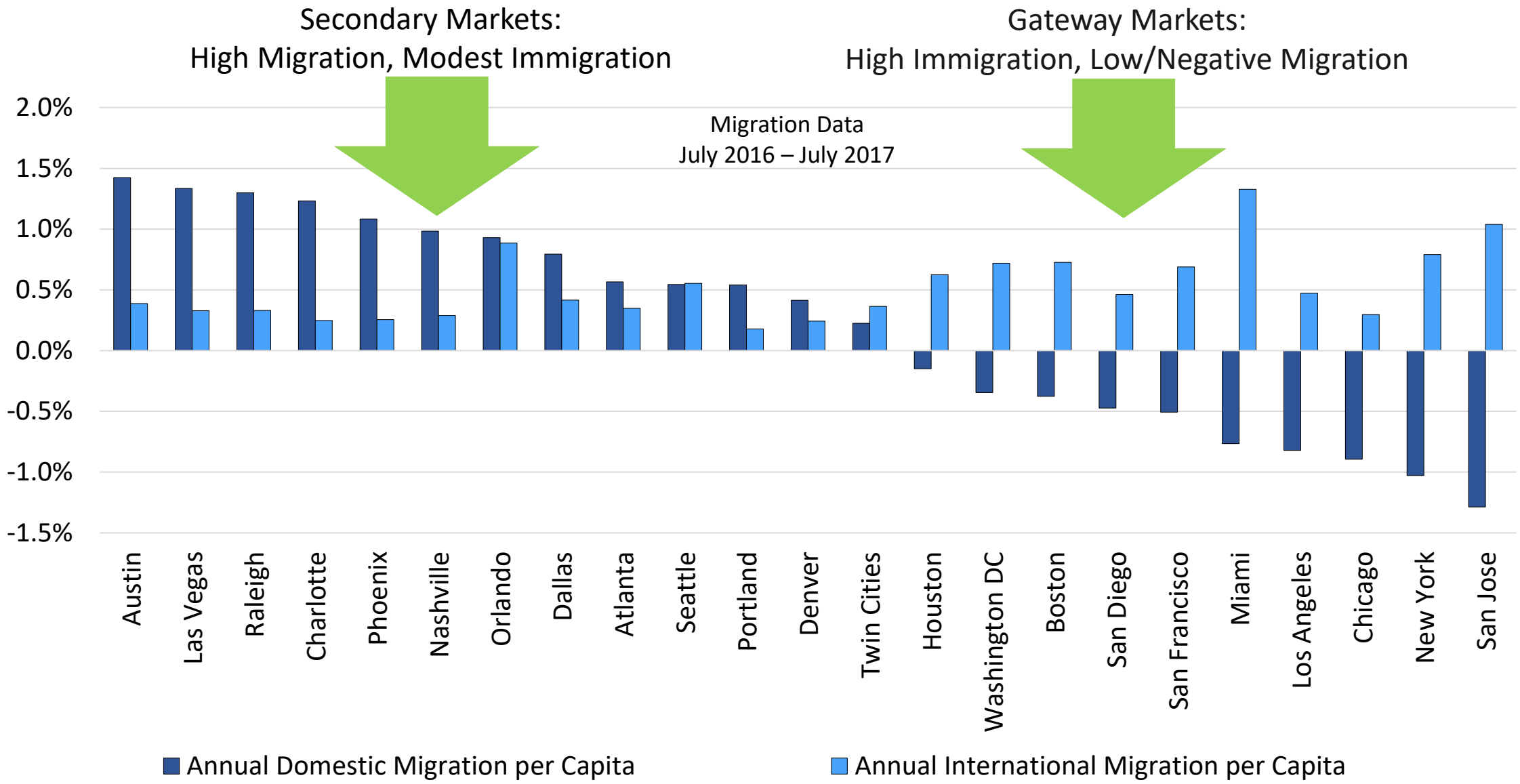
ALEC-Laffer State Economic Performance Rankings, 2006-2016

Rank	State	State GDP	Domestic Migration	Non-Farm Payroll
1	Texas	6	1	2
2	Washington	3	7	5
3	North Dakota	1	16	1
4	Utah	5	13	3
5	Colorado	13	5	4
6	Oregon	10	10	12
7	South Carolina	14	6	15
8	South Dakota	4	22	9
9	Montana	8	18	11
10	Tennessee	15	9	14
11	North Carolina	21	3	17
12	Idaho	22	14	6
13	Nebraska	2	29	13
14	Georgia	26	8	16
15	Massachusetts	9	41	8
16	Oklahoma	25	12	22
17	Florida	39	2	19
18	Iowa	7	30	29
19	New York	12	50	7
20	California	11	49	10
21	Hawaii	18	33	21
22	Minnesota	19	37	18
23	Virginia	28	27	20
24	Kentucky	29	23	26
25	Arizona	42	4	34

Rank	State	State GDP	Domestic Migration	Non-Farm Payroll
26	Maryland	16	42	23
27	New Hampshire	30	26	27
28	Delaware	36	19	31
29	Arkansas	34	20	32
30	Indiana	20	39	28
31	Louisiana	48	15	25
32	Kansas	23	38	30
33	Nevada	49	11	35
34	Missouri	31	34	33
35	Pennsylvania	17	44	37
36	Alabama	38	17	44
37	Wisconsin	24	40	36
38	Vermont	35	28	39
39	Alaska	50	31	24
40	West Virginia	33	24	49
41	Maine	43	25	43
42	Ohio	27	45	40
43	Wyoming	47	21	50
44	Mississippi	37	36	46
45	New Mexico	44	32	45
46	Illinois	32	48	41
47	Michigan	40	47	38
48	Rhode Island	45	35	48
49	New Jersey	41	46	42
50	Connecticut	46	43	47

Source: ALEC.org: Rich States, Poor States: Alec-Laffer State Economic Competitiveness Index: Arthur Laffer, Stephen Moore and Jonathan Williams; The Wall Street Journal: So Long California. Sayonara, New York: Arthur Laffer and Stephen Moore

Immigration is Key to Gateway Population Growth



Source: U.S. Census Bureau (BOC); Yardi® Matrix

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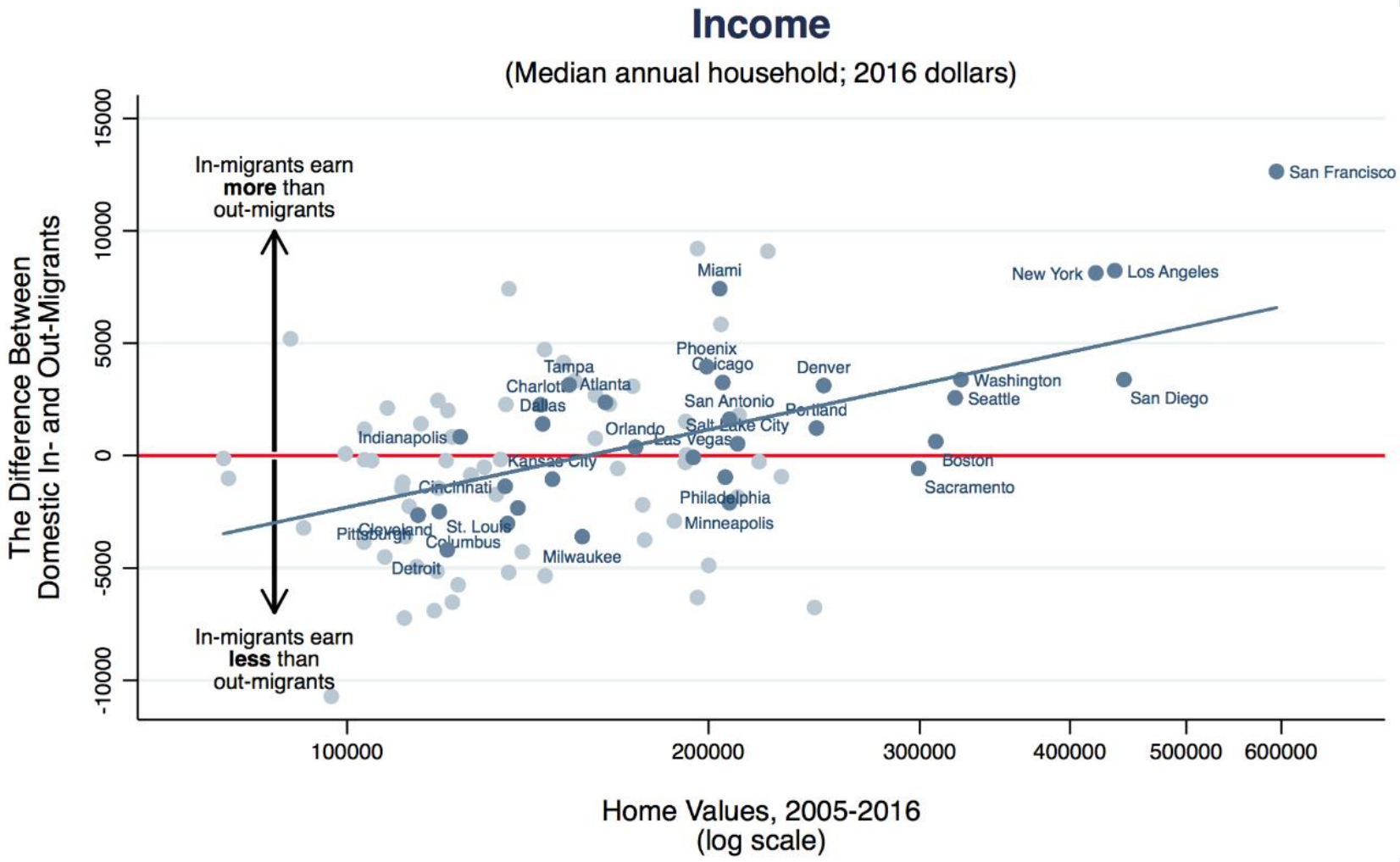
In-Migrants in Gateways Earn More Than Out-Migrants

- Sustains expensive housing price appreciation above any rise in incomes

- In-migrants typically:
  - Have more earners per household
  - Are younger
  - Are less likely to own a home than out-migrants

- Transient Class:
  - People arrive in expensive metros as young adults, but are priced out and leave at the point of raising children



Source: Issi Romem, buildzoom.com; U.S. Census (ACS); Zillow

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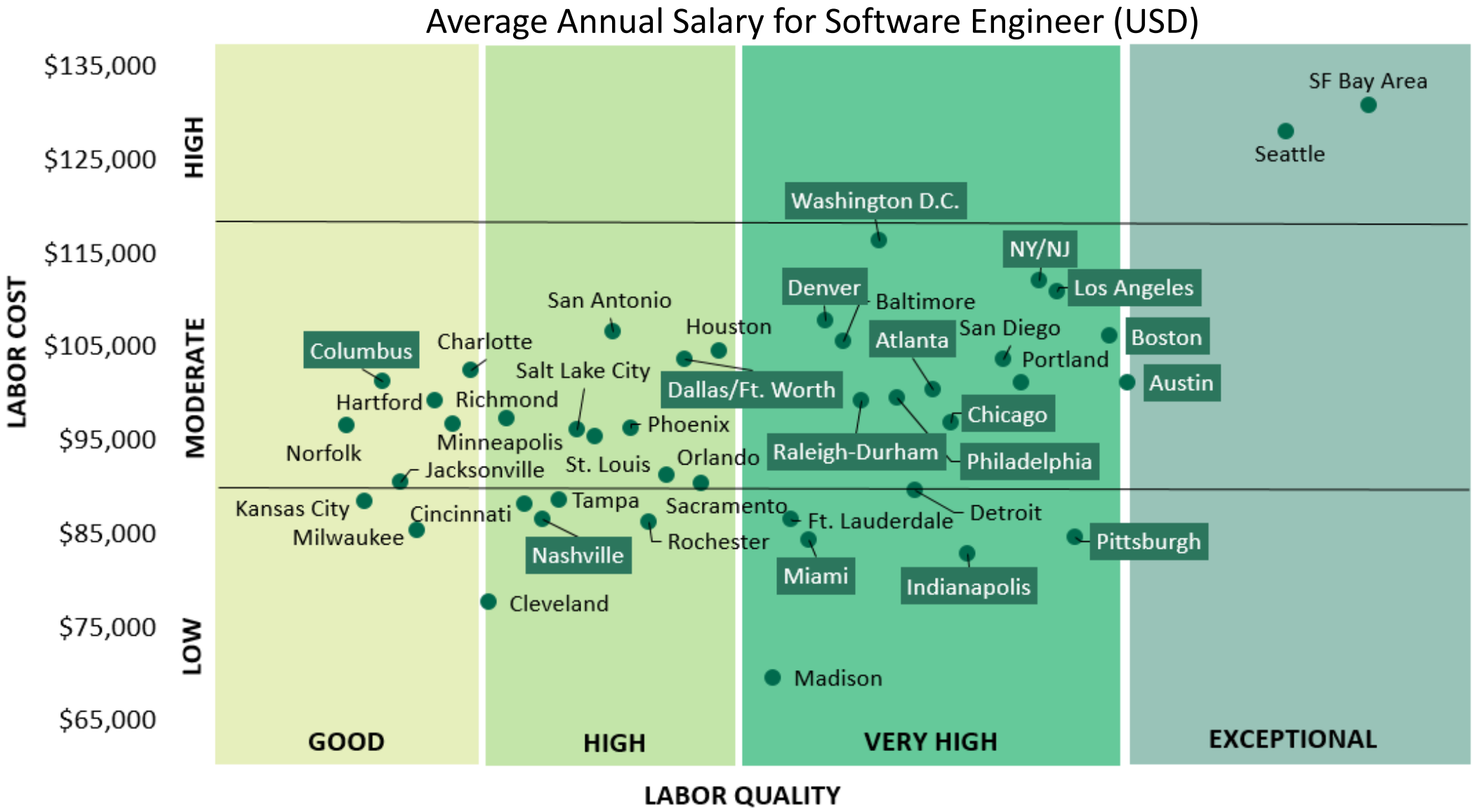
Tech Talent Quality vs. Cost Analysis



*Boxed markets are part of the Amazon 20 finalists

Source: CBRE Research, 2018; CBRE Labor Analytics; U.S. Bureau of Labor Statistics (BLS); Statistics Canada, April 2018; U.S. News & World Report

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Tech Talent Quality vs. Cost Analysis

	GOOD	HIGH	VERY HIGH	EXCEPTIONAL
HIGH COST				• Seattle • San Francisco/Bay Area
MODERATE COST	• Minneapolis • Charlotte • Richmond • Hartford • Jacksonville • Columbus • Norfolk	• Houston • Sacramento • Dallas/Ft. Worth • Orlando • Phoenix • San Antonio • St. Louis • Salt Lake City	• Austin • Boston • Los Angeles • NY/NJ • Portland • San Diego • Chicago • Atlanta • Philadelphia • Washington D.C. • Raleigh-Durham • Baltimore • Denver	
LOW COST	• Cleveland • Milwaukee • Kansas City	• Rochester • Tampa • Nashville • Cincinnati	• Pittsburgh • Indianapolis • Detroit • Miami • Ft. Lauderdale • Madison	

*Blue markets are part of the Amazon 20 finalists

Source: CBRE Research, 2018; CBRE Labor Analytics; U.S. Bureau of Labor Statistics (BLS), April 2018; Statistics Canada, April 2017; U.S. News & World Report

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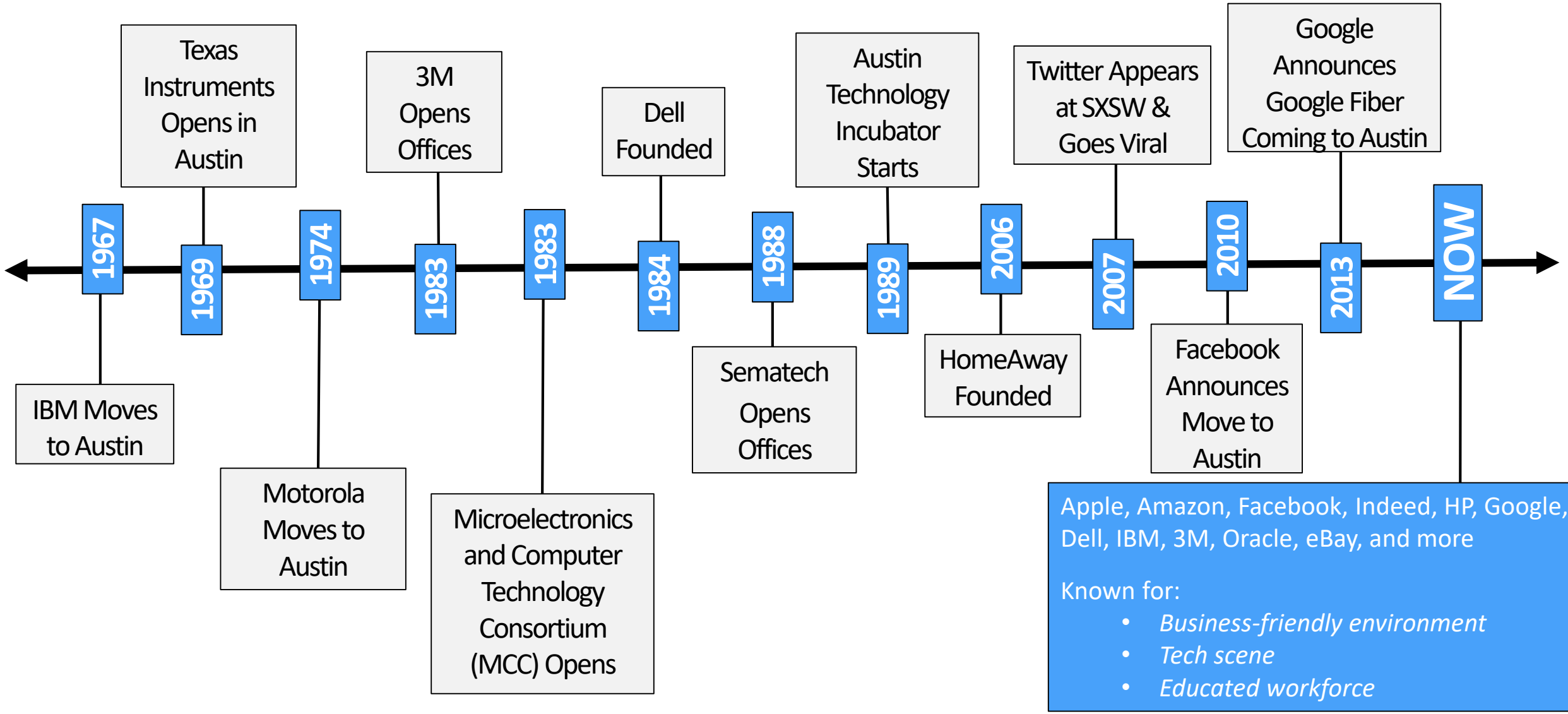
Timeline for Austin Shows Tech Development Takes Time



Source: unitedwayaustin.org

YARDI

Phoenix, AZ

- Arizona's promise to keep the driverless car industry free of regulations has attracted many companies:
  - Waymo, Uber, Lyft, General Motors, Intel…
  - Phoenix residents are test-riding Waymo's vehicles as passengers
  - Waymo has self-driven more than 5 million miles across all locations since 2009
  - Uber's self-driving trucks are conducting regular freight halls in AZ through the Uber Freight network

- Advanced Manufacturing
  - Industry leaders manufacturing in Phoenix– Intel, Microchip, Freescale Semiconductor, Honeywell, JDA Software, and Frito Lay
  - Since 1979, Intel has invested more than $20 billion in Arizona to develop advanced high-tech manufacturing capacity
  - Intel announced a $7 billion expansion slated to bring 3,000 new jobs to Phoenix

MICROCHIP freescale semiconductor Honeywell

Pivot Manufacturing HJC Instant BioScan REAL-TIME MICROBIAL DETECTION

Source: waymo.com; nytimes.com; ttnews.com; azcommerce.com; Intel.com

Orlando, FL

Lake Nona

- 17 square mile master-planned community – one of the country's fastest growing
- More than 12,000 residents and more than 10 million sq. ft. of residential and commercial facilities
- Health and life sciences cluster
- Lake Nona Town Center
  - 3.8 million sq. ft. campus
  - 80,000 sq. ft. of retail, restaurant, and entertainment

Johnson & Johnson

- $18 million expansion of its existing 17,000 sq. ft. development and training center
- New regional headquarters
- Create 25 position by Dec 31 2020 that pay an average annual wage of $100,000

Source: multihousingnews.com; bizjournals.com

What Helps a City Reach its Critical Point to Succeed?

All existing tech markets have these characteristics to some degree

Public and Private Partnerships

Friendly Business Environment

Community and Amenities that Retain and Draw in Talent

Educated Workforce

*A workbook of major U.S. markets is available to clients upon request

Source: Yardi®Matrix

What's Going on in Columbus?

Public and Private Partnerships

- Many public and private entities partnered for massive development along both sides of the Scioto River
  - Columbus Downtown Development Corporation (CDDC), Columbus Center of Science and Industry (COSI), State of Ohio, civic and community leaders
- Public and private entities are also teaming to revitalize the previously struggling Milo-Grogan area

Friendly Business Environment

STATE RANK – #14

- State and city tax credits and incentive packages encouraging retention and expansion of companies in the Columbus area, including Koorsen Fire & Security (25 jobs), Matic Insurance Services (50 jobs), Accenture plc (200 jobs)

Community and Amenities that Retain and Draw in Talent

- Open parks, walkways and bike paths, restaurants, museums, a band shell, fountain, carousel, etc. along both sides of the Scioto River
- Development of an 18-hour mixed-use district, with 1,700 residential units, 800,000 sq. ft. of office, 150,000 sq. ft. of restaurant and retail space, and a 150-room boutique hotel

Educated Workforce

University	Approx. Enrollment 2017
Ohio State University	66,444
Ohio University	29,712
Miami University	19,452
Kent State University	28,972
University of Dayton	10,803

Source: Yardi®Matrix; insideindianabusiness.com; iedc.in.gov; multihousingnews.com; forbes.com; columbusddc.com

YARDI

What's Going on in Columbus?

- Accenture Plc named Columbus one of 14 U.S. innovation hubs for the global IT consulting firm
  - Adding 200 jobs by end of 2020
- Koorsen Fire & Security
  - Adding 14,000 sq. ft., 25 jobs, and $1 million to payroll
  - Ohio Tax Credit Authority approved a 0.991%, five-year tax credit
- Matic Insurance Services Inc.
  - $400,000 expansion of call center into administrative office – 50 new jobs by 2020
  - Utilizing state and city incentive packages
- JP Morgan Chase, Honda, Huntington Bank – large employers
- Milo-Grogan area near downtown is emerging thanks manufacturing hub
  - Public-private partnership transforming the neighborhood
  - New housing, improved infrastructure and neighborhood, job training and employment resources
- Development along the Scioto River
  - Accessible urban amenity for Downtown's residents, professionals and visitors
  - Center of Science and Industry and National Veterans Memorial and Museum
  - Scioto Peninsula Park and Garage – 6.5-acre park and 600-space underground parking garage
  - 18-Hour Mixed-Use District
    - Planned 1,700 residential units, 800,000 sq. ft. of office, 150,000 sq. ft. of restaurant and retail, hotel
  - Franklintown – multimillion-dollar housing, retail and office developments in the works
  - Scioto Mile
    - Reconnected downtown to the Scioto River with parks, boulevards, bikeways, and pedestrian paths
    - John W. Galbreath Bicentennial Park – 15,000 sq. ft. fountain, band shell, restaurants
    - Scioto Greenways – 33 acres of new urban greenspace
    - Columbus Commons – 6 acre park: gardens, performance stage, carousel, outdoor reading room, NEOS play system, Bocce ball courts, two cafes

Average Rent Compared to Nearest Gateway Cities

Market	Avg. Rent – Sept 2018
Columbus	**$951**
Chicago	$1,502
Washington DC	$1,762

7,576,592 passengers flew in and out of John Glenn Columbus International Airport in 2017

79,828,183 passengers flew in and out of O'Hare International Airport in 2017

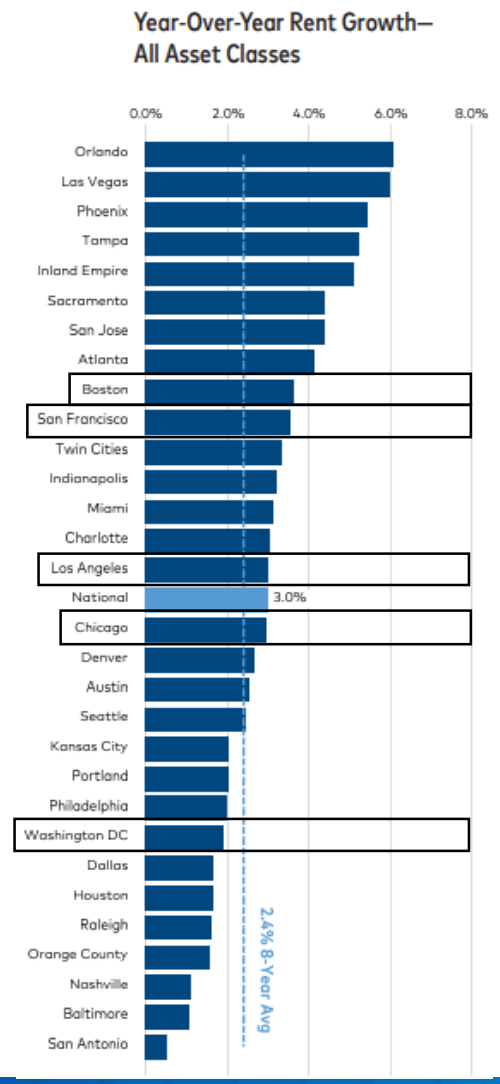
23,928,248 passengers flew in and out of Ronald Reagan Washington National Airport in 2017

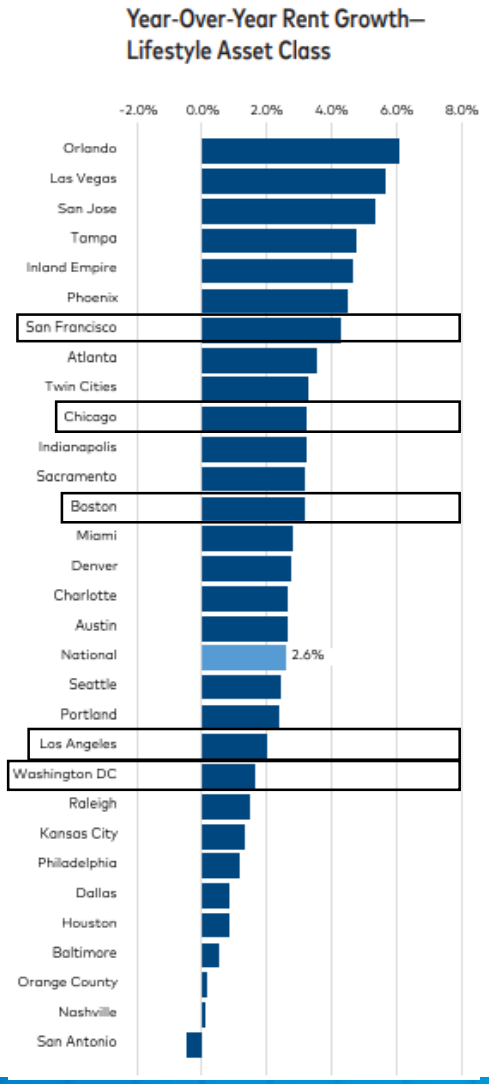
35 multifamily transactions valued at $393 million in 2017

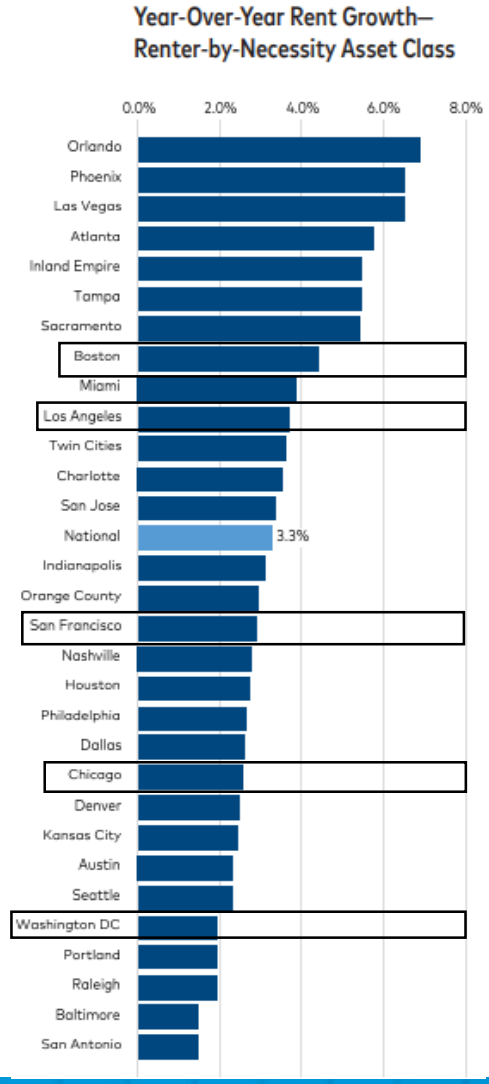
Source: bizjournals.com; columbusceo.com; flycolumbus.com; Yardi®Matrix; osu.edu; usnews.com; kent.edu; miamioh.edu; columbusunderground.com; columbusmonthly.com; cosi.org; columbusddc.org ; Infinite Impact; flychicago.com; mwaa.com

YARDI

In Multifamily, Gateway Cities Haven't Moved Together This Year







*As of September 2018
Source: Yardi®Matrix

YARDI

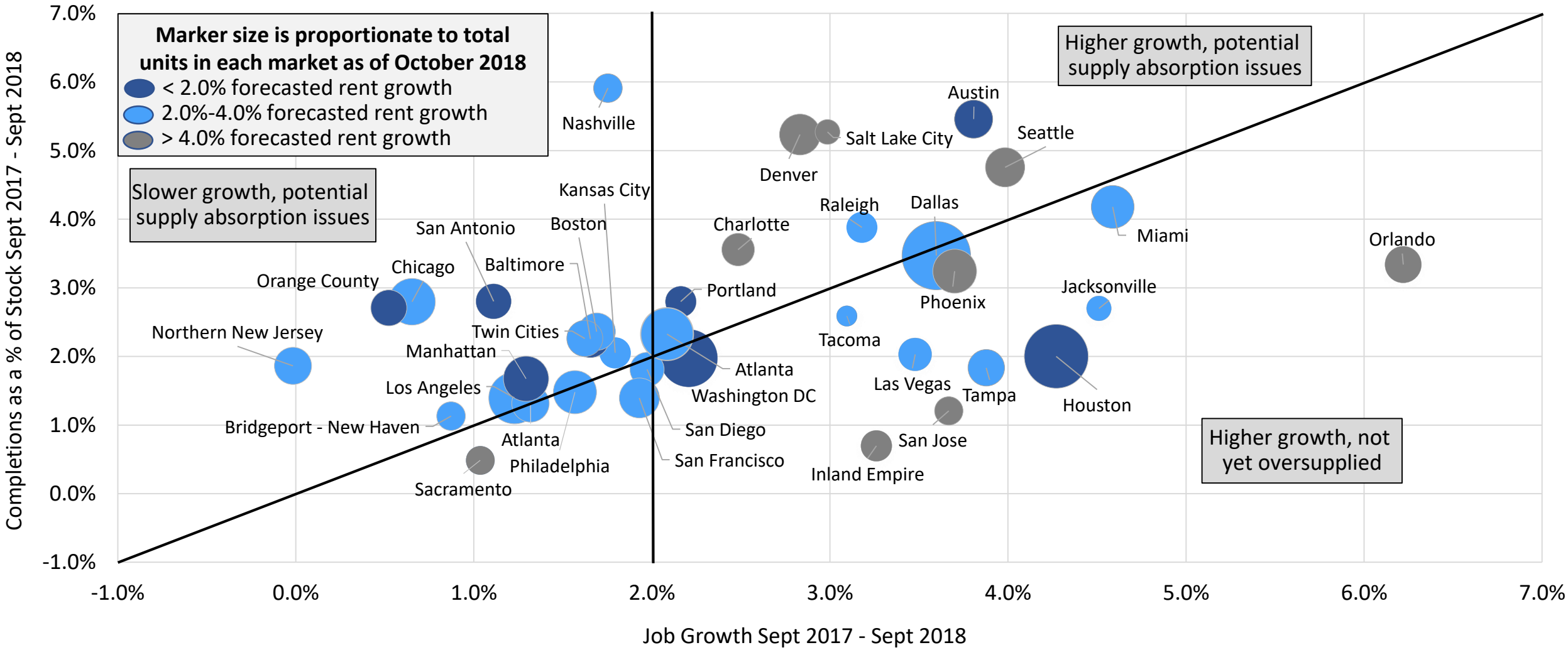
Our 2018 Forecasted Multifamily Rent Growth Compared to Actual YTD Rent Growth

Market	YoY Rent Growth Sept 2018	Forecast Rent Growth Year-End 2018	Difference: Our Forecast vs. Sept Actual
Orlando	6.1%	5.1%	1.0%
Las Vegas	**6.0%**	**3.6%**	**2.4%**
Phoenix	5.4%	5.6%	-0.2%
Tampa	**5.2%**	**3.9%**	**1.3%**
Inland Empire	5.1%	4.5%	0.6%
Sacramento	**4.4%**	**6.5%**	**-2.1%**
San Jose	**4.4%**	**3.1%**	**1.3%**
Atlanta	**4.1%**	**2.8%**	**1.3%**
Boston	3.6%	2.8%	0.8%
San Francisco	3.5%	3.0%	0.5%
Twin Cities	3.3%	4.0%	-0.7%
Indianapolis	3.2%	2.7%	0.5%
Miami	3.1%	3.0%	0.1%
Los Angeles	**3.0%**	**4.3%**	**-1.3%**
Charlotte	3.0%	2.7%	0.3%

Market	YoY Rent Growth Sept 2018	Forecast Rent Growth Year-End 2018	Difference: Our Forecast vs. Sept Actual
Chicago	2.9%	3.3%	-0.4%
Denver	2.6%	3.0%	-0.4%
Austin	**2.5%**	**1.0%**	**1.5%**
Seattle	**2.4%**	**4.7%**	**-2.3%**
Philadelphia	2.0%	2.4%	-0.4%
Kansas City	2.0%	2.2%	-0.2%
Portland	2.0%	1.4%	0.6%
Washington DC	1.9%	1.4%	0.5%
Dallas	**1.7%**	**3.1%**	**-1.4%**
Houston	1.7%	1.8%	-0.1%
Raleigh	1.6%	2.3%	-0.7%
Orange County	1.6%	1.7%	-0.1%
Nashville	1.1%	1.8%	-0.7%
Baltimore	1.1%	1.7%	-0.6%
San Antonio	**0.5%**	**1.8%**	**-1.3%**

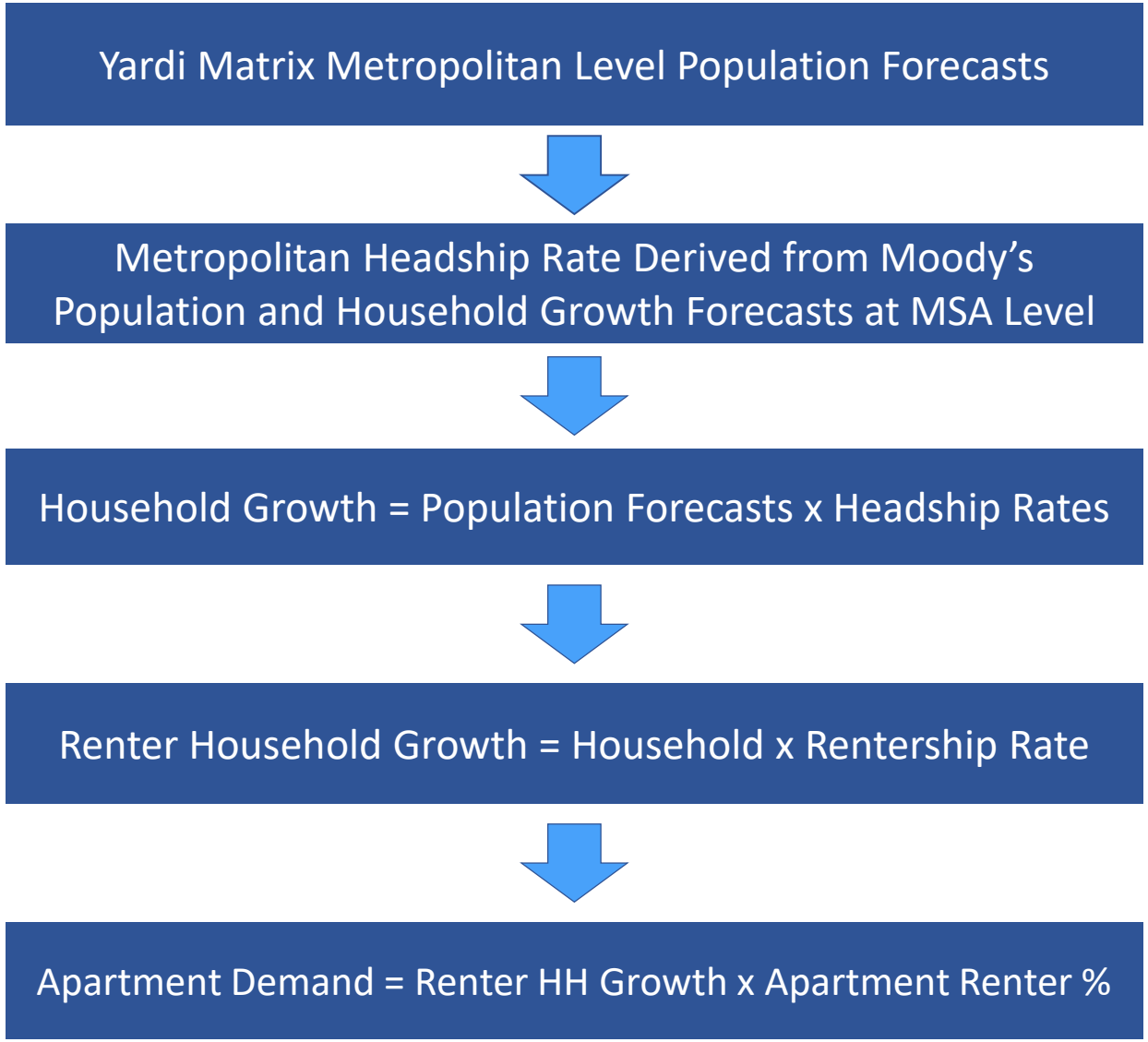
Source: Yardi®Matrix

Though We Expected a Bumpy 18-24 Months in Multifamily, It's Been a Bit Better Than We Thought



Source: Yardi®Matrix

Metropolitan Demand Forecast Methodology



Key Assumptions

- 10 basis point annual homeownership increase in secondary markets, flat homeownership in primary markets
- 50 basis point annual obsolescence of apartment stock
- 50% haircut in planned units being delivered for 13 markets with most excess 5 year supply

Potential Further Catalysts

- Tax reform migration impact
- Increased demand for apartments from migrants vs. existing apartment renter share

Source: Yardi®Matrix

Secondary Tech Cities at Risk of Multifamily Oversupply in the Next Two Years (Margin of Error +/- 1.0%)

Market	Current Inventory (000's units)	2-Year Supply Growth	2-Year Demand Growth	Net %	Excess Units
Denver	**252**	**9.7%**	**4.5%**	**(5.2%)**	**13,692**
Seattle	**231**	**9.0%**	**4.4%**	**(4.6%)**	**11,192**
Charlotte	**163**	**7.0%**	**2.7%**	**(4.3%)**	**7,190**
Dallas	**709**	**5.4%**	**2.2%**	**(3.3%)**	**23,953**
Phoenix	**295**	**4.5%**	**1.9%**	**(2.6%)**	**7,876**
Miami	**275**	**8.3%**	**5.7%**	**(2.5%)**	**7,756**
Kansas City	149	4.3%	2.3%	(2.1%)	3,286
Atlanta	424	3.6%	1.6%	(2.0%)	8,736
Pittsburgh	89	2.5%	0.8%	(1.7%)	1,531
Boston	214	6.1%	4.5%	(1.6%)	3,805
Portland	147	4.8%	3.4%	(1.4%)	2,306
Washington DC	510	4.5%	3.3%	(1.1%)	6,727
Twin Cities	199	3.3%	2.3%	(1.0%)	2,095
Orlando	204	4.2%	3.3%	(1.0%)	2,253
San Antonio	189	3.1%	2.3%	(0.8%)	1,816

Market	Current Inventory (000's units)	2-Year Supply Growth	2-Year Demand Growth	Net %	Excess Units
St Louis	120	2.5%	1.8%	(0.7%)	978
Baltimore	217	1.9%	1.4%	(0.4%)	1,114
Philadelphia	288	2.3%	2.0%	(0.3%)	1,006
Tampa	206	3.2%	3.4%	0.2%	10
Cincinnati	108	1.6%	1.9%	0.2%	(157)
San Francisco	248	5.7%	6.1%	0.4%	(274)
Detroit	208	0.9%	1.3%	0.4%	(752)
Las Vegas	169	1.8%	2.3%	0.5%	(661)
Chicago	333	3.9%	4.6%	0.7%	(1,328)
San Diego	181	3.2%	4.2%	1.0%	(1,516)
New York	1,000	4.3%	5.4%	1.1%	(10,384)
Sacramento	128	1.3%	2.6%	1.3%	(1,486)
Houston*	629	1.0%	2.6%	1.6%	(8,974)
Inland Empire	150	1.5%	3.8%	2.3%	(3,281)
Los Angeles	410	5.7%	9.2%	3.5%	(13,047)

*Demand is a function of renter households growth and apartments as a % of the rental market

Source: Moody's Analytics; U.S. Bureau of Labor Statistics (BLS); Yardi®Matrix

YARDI

Tech Hub and Tertiary Markets Will Have the Most Multifamily Rent Growth Over the Next Couple Years

Market	YoY Sept 2017-2018	2019 (F)	2020 (F)
Reno	9.2%	8.2%	7.3%
Sacramento	4.4%	6.5%	6.2%
Tacoma	4.7%	5.9%	5.4%
Central Valley	3.8%	5.2%	4.5%
Spokane	3.7%	5.2%	4.0%
Eastern Los Angeles County	4.0%	5.0%	5.0%
Eugene	4.5%	4.8%	4.6%
Salt Lake City	2.7%	4.7%	4.5%
Inland Empire	5.1%	4.6%	4.4%
Central Coast	5.7%	4.5%	4.2%

Market	YoY Sept 2017-2018	2019 (F)	2020 (F)
Boise	5.8%	4.5%	3.4%
Las Vegas	6.0%	4.1%	3.5%
Orlando	6.1%	4.1%	4.0%
Colorado Springs	2.4%	4.1%	3.9%
North Central Florida	4.7%	4.0%	3.8%
Phoenix	5.4%	4.0%	3.0%
Suburban Twin Cities	3.5%	3.9%	3.5%
Suburban Atlanta	4.9%	3.9%	3.8%
San Fernando Valley	3.2%	3.8%	3.7%
Tucson	4.5%	3.8%	3.8%

	2018 (F)	2019 (F)	2020 (F)
National	2.8%	2.8%	2.7%

*Full market forecast on 133 markets and submarkets available for clients
*Data ranked by 2019 forecast values
Source: Yardi®Matrix

YARDI

Tertiary Markets and a Couple Gateway Markets Will Have the Least Multifamily Rent Growth Over the Next Couple Years

Market	YoY Sept 2017-2018	2019 (F)	2020 (F)
Corpus Christi	1.4%	0.5%	0.4%
Amarillo	0.9%	0.6%	0.4%
El Paso	3.0%	0.6%	0.5%
Manhattan	1.2%	0.8%	1.1%
McAllen	1.2%	1.0%	1.2%
Northern Virginia	1.6%	1.0%	1.6%
Columbus GA	3.2%	1.2%	1.3%
Central East Texas	-0.5%	1.2%	1.5%
Oklahoma City	0.8%	1.3%	1.1%
Baltimore	1.1%	1.3%	1.4%

Market	YoY Sept 2017-2018	2019 (F)	2020 (F)
Tulsa	0.7%	1.3%	1.4%
Jackson	1.8%	1.4%	1.1%
Toledo	3.6%	1.4%	1.4%
Baton Rouge	-1.7%	1.5%	1.9%
Omaha	2.2%	1.5%	1.5%
Fort Lauderdale	3.8%	1.6%	1.8%
Washington DC	2.1%	1.6%	1.5%
Mobile	1.9%	1.6%	2.0%
South Bend	3.8%	1.7%	1.7%
Lexington	1.7%	1.7%	1.5%

	2018 (F)	2019 (F)	2020 (F)
National	2.8%	2.8%	2.7%

*Full market forecast on 133 markets and submarkets available for clients
*Data ranked by 2019 forecast values
Source: Yardi®Matrix

YARDI

Over the Next Five Years, The Risk of Oversupply in Multifamily is Less Concerning

Market	Current Inventory (000's units)	5-Year Supply Growth	5-Year Demand Growth	Net %	Excess Units
Seattle	**231**	**14.3%**	**10.0%**	**(4.3%)**	**11,017**
Charlotte	**163**	**9.4%**	**6.4%**	**(2.9%)**	**5,326**
Dallas	**709**	**6.6%**	**4.5%**	**(2.2%)**	**17,247**
St Louis	120	6.6%	4.6%	(2.0%)	2,711
Phoenix	**295**	**5.4%**	**3.9%**	**(1.5%)**	**4,907**
Miami	**275**	**14.3%**	**13.0%**	**(1.3%)**	**5,228**
Twin Cities	199	6.9%	5.8%	(1.1%)	2,533
Washington DC	510	8.6%	7.6%	(1.0%)	6,860
Pittsburgh	89	3.0%	2.2%	(0.8%)	815
Boston	214	11.6%	10.8%	(0.7%)	2,409
Denver	252	10.9%	10.3%	(0.6%)	2,912
Cincinnati	108	4.4%	3.9%	(0.5%)	778
Philadelphia	288	5.2%	4.7%	(0.5%)	2,047
Kansas City	149	5.9%	5.4%	(0.5%)	1,108
Atlanta	424	4.1%	3.9%	(0.2%)	1,887

Market	Current Inventory (000's units)	5-Year Supply Growth	5-Year Demand Growth	Net %	Excess Units
San Francisco	248	14.0%	14.2%	0.2%	1,053
San Antonio	189	4.8%	5.1%	0.3%	197
Portland	147	6.8%	7.3%	0.5%	(187)
Baltimore	217	2.7%	3.4%	0.7%	(997)
Orlando	204	6.2%	7.4%	1.2%	(1,860)
Detroit	208	1.3%	3.5%	2.2%	(4,234)
Sacramento	128	3.8%	6.2%	2.3%	(2,679)
Tampa	206	5.2%	7.6%	2.4%	(4,131)
Las Vegas	169	2.9%	5.3%	2.4%	(3,569)
New York	1,000	9.9%	13.1%	3.2%	(30,173)
Chicago	333	7.8%	11.5%	3.7%	(10,166)
Houston	629	1.6%	5.8%	4.1%	(23,739)
San Diego	181	4.3%	9.9%	5.7%	(9,586)
Inland Empire	150	2.1%	9.1%	6.9%	(9,874)
Los Angeles	410	14.5%	21.9%	7.4%	(27,171)

***Markets with severe shortages will elicit a greater supply response**

*Demand is a function of renter households growth and apartments as a % of the rental market

Source: Moody's Analytics; U.S. Bureau of Labor Statistics (BLS); Yardi®Matrix

YARDI

Technology's Impact on the Future of Real Estate

- Position where wealth is created and where the value of "place" will increase
- With a focus on live/work/play then "fulfill"/store

Technologies

Energy
- Batteries
- Solar

Electric & Autonomous Vehicles
- Lithium-Ion Batteries
- LIDAR Sensors

*IoT/Sensors
- Smart Office & Smart Home
  - Amazon Echo
  - Nest Thermostat

*Artificial Intelligence/Robotics
- Drones
- Virtual Realty

"Taken-for-Granted" Tablestakes

Connectivity – Building Level
- 1G Connectivity, 40x High Speed
- Mobility
- Security

Connectivity – WiFi
- 5G Connectivity required for IoT and AV – rolls out in 2020
- 4G rolled out in 2009

Collaboration
- Mobile apps
- Connectivity and free-up trapped resources

*Focus today on these two

Source: Yardi®Matrix

The Yardi Matrix View- A Sharpshooter's Game Short-Term, Back to Intellectual Hubs Longer-Term

- **<u>Tech Hubs are Emerging both in Formerly Non-tech Metros and Traditionally Overlooked Cities:</u>**
  - Cost advantages and Emerging Intellectual Hubs are shifting the geography of jobs
    - The longer the expansion goes on the more established the intellectual critical mass becomes
    - Tax reform will likely accelerate these trends
    - But the process does take time, allowing multiple entry points for investors
    - Many of these cities have had modest levels of new supply and institutional investor interest

- **<u>Advances in The Internet of things (IoT) and Artificial Intelligence (AI), and the 5G network which is its underpinning, drive-</u>**
  - The ability to have self correcting and self learning processes which will streamline production (reduce costs)
  - The ability to leverage data to create new products, services, and create new "gatekeepers" to consumer $
    - Both of these will pressure mid-skill jobs, widening again the issues of income distribution

- **While it's a SHARPSHOOTER'S game for the next few years……In the Longer Term (5-10 years) we return to Intellectual Capital Hubs in gateway, primary, and secondary cities as having the most attractive fundamentals**

Source: Yardi®Matrix

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Long-Term View of New Technologies Emerging

YARDI

What is the Internet of Things?

- Network of physical objects that contain embedded technology to sense, communicate, and interact with the external environment
- Started with internet ➡ then mobile ➡ now internet of things
- **Industrial IoT** and **Consumer IoT**
  - Headlines on Consumer IoT…but Industrial IoT will get picked up faster
  - Intersection between Industrial IoT and Consumer IoT is ***Multifamily***

Certain decisions need to be made instantaneously at the "things" level before even making it to the cloud

The "Things"	Stage 1	Stage 2	Stage 3	Stage 4
Devices, machines, people, tools, cars, animals, clothes, toys, environment, buildings, etc.	Sensors/Actuators (Wired/Wireless)	Internet Gateways, Access Points, DAQ, Control (Data Aggregation, A/D, Measurement, Control)	Edge IT (Analytics, Pre-Processing)	Data Center/Cloud (Analytics, Management, Archive)
Real Time	Early Life	In Motion	At Rest	Archived

Source: Yardi®Matrix; Attunity,Inc., "Discover the Power of the Industrial Internet of Things", YouTube; Google Developers, Laurence Moroney, Kaz Sato, "Machine Learning Models + IoT Data = A Smart World", YouTube; Bosch Software Innovations, Dr. Tom Bradicich, "The 7 Principles of the Industrial IoT", YouTube; TEDx Talks, Jordan Duffy, "The Internet of Things|Jordan Duffy|TEDxSouthBank"; YouTube

YARDI

Rapid Growth in IoT Devices Will Continue

2008

About a decade ago, you'd only have 1-2 devices connected to internet

Today

Today: computer, tablet, smart phone, video game console, smart tv, etc.

End of 2018

IHS Technology – there will be ~31 billion connected IoT devices by the end of this year

2020

By 2020, ~50 billion objects connected to internet

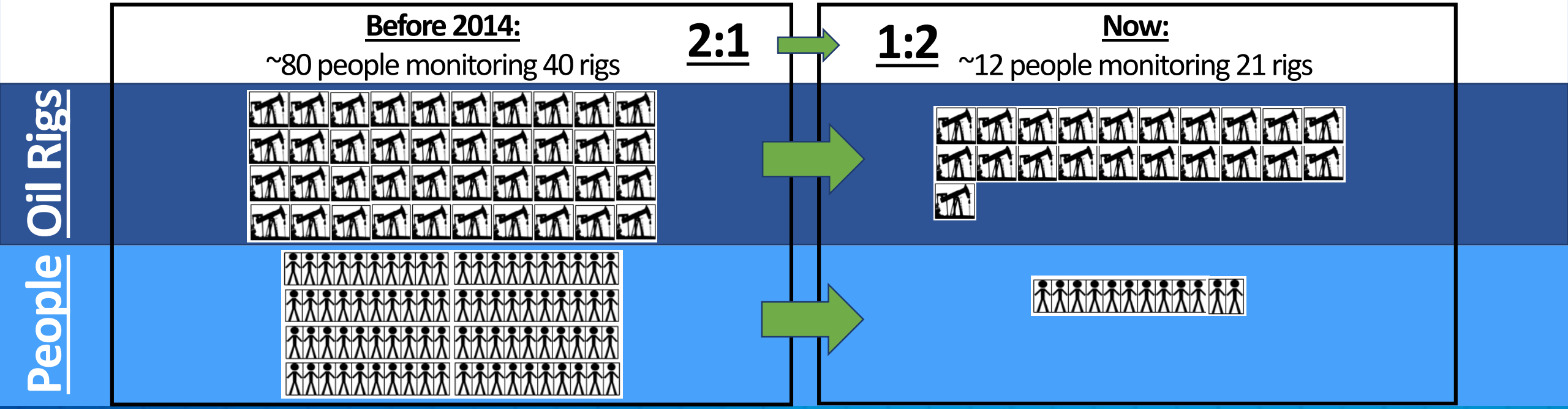
~7.6 billion people alive in 2020…so 6.6 object connected per person

- Each of BMW's self-driving cars logs 40 terabytes of data every day
  - 20 times the amount of information recorded by an Airbus A380 as it crosses the Atlantic
- With the rapid growth and adoption of IoT devices, there is even greater growth in data, computing power, storage, etc.
- The need for high-powered data centers will continue to explode

Source: Yardi®Matrix; Fw:Thinking, Jonathan Strickland, "What is the Internet of Things?", YouTube; Horatiu Boeriu, "BMW: 'Fully autonomous cars may never be allowed on the roads'", bmwblog.com; Pixabay

Industrial IoT in “Digital Oil Fields”

- Industrial IoT being used to control oil drills and monitor the earth’s crust
- Underground tools capture data and small teams of technical analysts located remotely are replacing laborers
- Baker Hughes (GE Company) focused on recruiting high-tech workers, increasingly from Silicon Valley
- Devon Energy Wellcon Center Example:
  - Small team of engineers and scientists monitor every well the company is drilling and fracking in the U.S.
  - Drilling and construction ***costs down***, but ***production rates up***

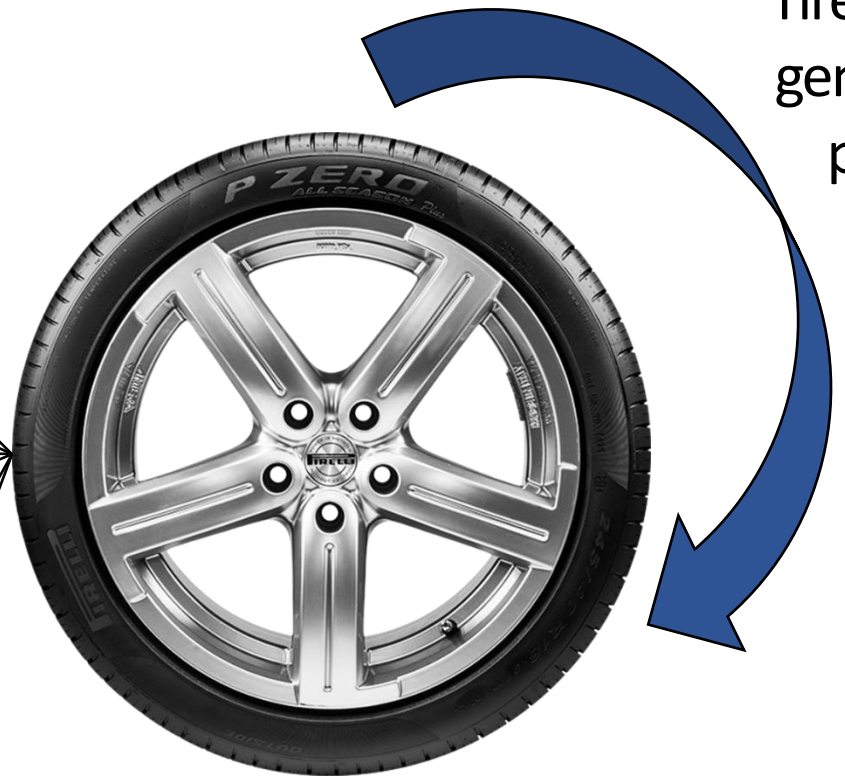


Source: Yardi®Matrix; Christopher Matthews, “Oil’s New Technology Spells End of Boom for Roughnecks”, Wall Street Journal; Pixabay

Commercial IoT in Everyday Objects – Intelligent Tires

Sensors Measure:

- Tire Pressure
- Temperature
- Axil Load
- Tread Depth
- Wheel Alignment
- Road Conditions



Tire movement can generate energy to power sensors

Goodyear showcased the latest advances on its intelligent tire prototype at the 2018 Geneva International Motor Show

Complete tire information system includes tire, sensors and cloud-based algorithms that work together to communicate in real-time with fleet operators via mobile app

Source: Yardi®Matrix; Silent Sensors, "Silent Sensors | IoT and the Internet of Tyres", YouTube; Pirelli.com; "Goodyear Demonstrates its Intelligent Tire Prototype on the Road", Goodyear Corporate

YARDI

Shelter, Transportation, and Energy Become Software Platforms…and They Will All Connect

- Everything within your home will eventually be connected to one platform
  - Example scenario:
  - Your house recognizes you and unlocks the front door
  - Your living room taps into a cloud-based profile of preferences like climate control, music, lighting
  - Your refrigerator tells you what is inside, makes recommendations for meals, and orders groceries

- Car will connect to manufacturer and dealer
- Manufacturer can use data to improve design, manufacturing process, and pinpoint common denominators if issues arise
- Car can use platform to order replacement parts, offer service appointment times to service the vehicle, and provide directions to the nearest dealer
  1. Streamlined inventory mgmt for dealer
  2. Better, safer car for manufacturer
  3. Driver back on the road safer and quicker

- Sensors can monitor panel performance and provide real-time insight to mgmt teams
- Companies can use data from sensors to gain more granular oversight over installations
- Data analysis tools can give organizations the opportunity to use data from the past and present to more accurately predict future outcomes
- Eventually, Solar panels adjust automatically to the position of the sun throughout the day

Source: Yardi®Matrix; Fw:Thinking, Jonathan Strickland, "What is the Internet of Things?", YouTube; IBM Think Academy, "How it Works: Internet of Things", YouTube; Pixabay; "Benefits of IoT For Solar Power", opengear.com; "How IoT is Enabling New Opportunities in Solar Energy Harvesting Projects", embitel.com

YARDI

Cities With Labor Flexibility Could Provide Higher Service with Fewer Employees

Barcelona Smart City

One of the most IoT integrated smart cities in the world

Smart Parking

- Sensors show drivers where available parking spots are located
- **+ $50 million/year in revenue**

Smart Lights

- Sensors tell lights when they need to be on
- **- $37 million/year in energy costs**

Smart Gardens

- Sensors tell where to water and when
- **- $58 million/year in water costs**

Source: Yardi®Matrix; TEDx Talks, Jordan Duffy, "The Internet of Things|Jordan Duffy|TEDxSouthBank"; YouTube; Pixabay

YARDI

Multifamily Industry Focused on IoT in Three Areas

1- Building Access: Security cameras, door cameras, smart locks, key card readers, automatic doors

2- Smart Sensors/Other Industrial Control Systems: Smart thermostats, moisture sensors, water leak detectors, smoke detectors, light/motion sensors

3- Convenience: Voice assistants, Bluetooth speakers, smart appliances, connected outlets/light switches, automated blinds

In-Unit IoT

- Can be used as an amenity – increase lead conversions/drive rental premium
- IoT devices will eventually become expected by residents – shrinking rental premiums
- 433.1 million smart home devices sold globally in 2017, up 27.6% from 2016
  - 18.5% CAGR projected through 2022, representing almost a billion devices

Facility IoT

- Create building operational efficiencies – Sensors throughout property for real-time asset monitoring
- Automate property functions, such as energy consumption
  - Lighting sensors – automate closing window blinds during peak sun exposure
  - Temperature sensors – regulate temperature more effectively
  - Humidity sensors – turn a fan on in spaces with poor ventilation

Source: Yardi®Matrix; July 2018 White Paper "Smart Communities: The Internet of Things & the Apartment Industry", by Gate 15, NMHC Staff and NMHC Members

YARDI

IoT in Office: Case Study

Building Details:

- 1144 Fifteenth in Denver's LoDo district
- 40-story high-rise completed in March 2018

IoT Technology:

- Leak detectors throughout building, along with system lining basement walls to detect water
    - Helps management figure out where leaks occur
- Maintenance machine in building analyzes several metrics
    - Tenants can control their lease space through their machines
        - Ex: automatic shading feature
    - Public spaces and restrooms include sensors to track movement and reduce energy usage
    - Smart elevator system
        - When a floor is selected on the elevator screen, system optimizes the movement of elevator cars to maximize the amount of people moving around – reduces energy load

Source: Yardi®Matrix; IvyLee Rosario, "Denver's New Heights", cpexecutive.com

YARDI

Matrix Expert National Operating Data

12-Month Period Ending Sept 2018	Atlanta	Austin	Boston	Chicago	Denver	Los Angeles	Manhattan	Miami	San Diego	San Francisco	Seattle	Washington DC
Total Operating Income	$20.88	$34.68	$41.00	$25.64	$23.83	$32.15	$59.90	$32.52	$28.25	$52.00	$38.77	$36.29
Payroll	$0.96	$1.07	$1.07	$1.21	$1.00	$1.46	$3.04	$1.67	$0.79	$1.61	$1.25	$1.49
Marketing & Advertising	$0.08	$0.05	$0.08	$0.07	$0.06	$0.06	$0.22	$0.08	$0.06	$0.11	$0.04	$0.07
Repairs & Maintenance	$2.03	$2.48	$2.98	$2.89	$2.23	$3.12	$4.61	$3.35	$2.35	$4.10	$3.14	$2.94
Administrative	$1.09	$0.90	$1.25	$1.22	$0.73	$1.56	$2.12	$1.22	$1.00	$2.02	$1.09	$1.15
Management Fees	$0.65	$0.97	$0.94	$0.73	$0.78	$0.88	$1.39	$0.97	$0.76	$1.37	$0.83	$1.02
Utilities	$1.81	$1.97	$3.06	$1.30	$1.64	$2.45	$3.14	$1.98	$1.68	$2.75	$1.64	$2.05
Real Estate & Other Taxes	$2.30	$7.06	$6.83	$5.48	$4.40	$2.99	$12.25	$3.82	$2.57	$5.03	$3.12	$5.60
Insurance	$0.16	$0.19	$0.24	$0.22	$0.18	$0.58	$0.49	$0.83	$0.36	$0.94	$0.41	$0.22
Other Operating Expenses	$0.11	$0.23	$0.58	$0.08	$0.05	$0.34	$1.24	$0.11	$0.19	$0.20	$0.28	$0.30
Total Operating Expense	$9.19	$14.92	$17.02	$13.21	$11.08	$13.43	$28.50	$14.03	$9.76	$18.12	$11.80	$14.84
Net Operating Income	**$11.69**	**$19.76**	**$23.99**	**$12.43**	**$12.76**	**$18.72**	**$31.40**	**$18.49**	**$18.49**	**$33.88**	**$23.68**	**$21.44**
Cap Rate (October 2018)	**6.3%**	**7.4%**	**6.1%**	**6.2%**	**5.6%**	**5.0%**	**3.9%**	**5.3%**	**6.1%**	**5.6%**	**5.7%**	**6.1%**

Source: Yardi®Matrix Expert

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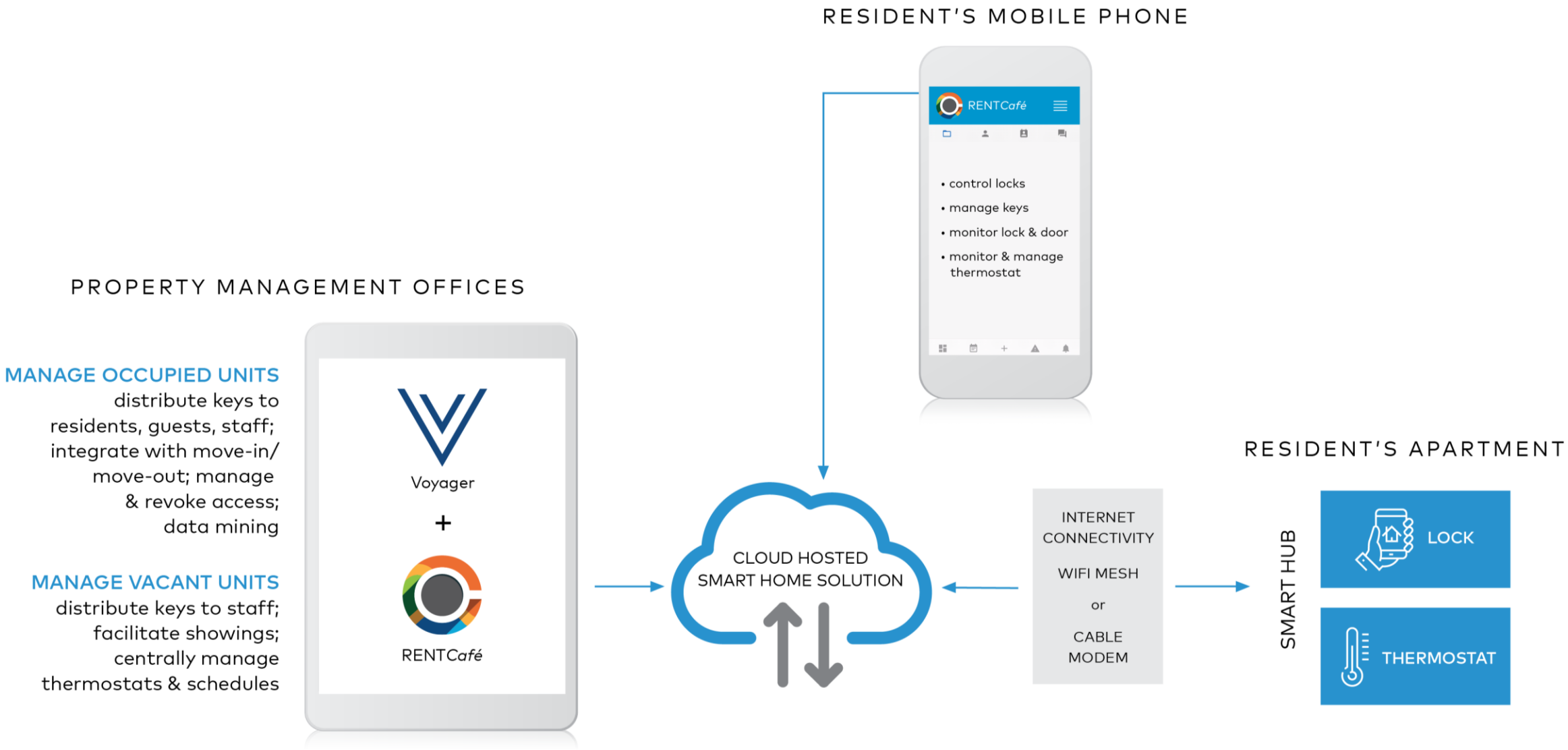
Yardi Smart Home



Source: Yardi®Systems; Yardi®Matrix

Implications for Industrial and Consumer IoT

Industrial IoT is about cutting/reducing costs
Consumer IoT is for generating revenue and creating new capabilities

Middle skill jobs will be automated the fastest
Why? IoT removes the need for people to be involved in processes

IoT in Smart Warehouses

- Sensors can produce data about product inventories, shipment locations, ambient temperatures, retail purchase rates
- Organizations can automatically restock inventories, predict product arrival times/potential delays, warn about spoilage or other quality control issues, and react to changes in demand

Safer, More Cost-Effective Fleet Operations – Sierra Wireless

- Compliance with environmental and safety regulations
- Optimized maintenance and logistics
- Monitor driver performance and vehicle status for better safety and fuel consumption
- Scheduled preventative maintenance to improve vehicle valuation

Source: Yardi®Matrix; SierraWireless.com; CloudTransformation.com

What is Artificial Intelligence?

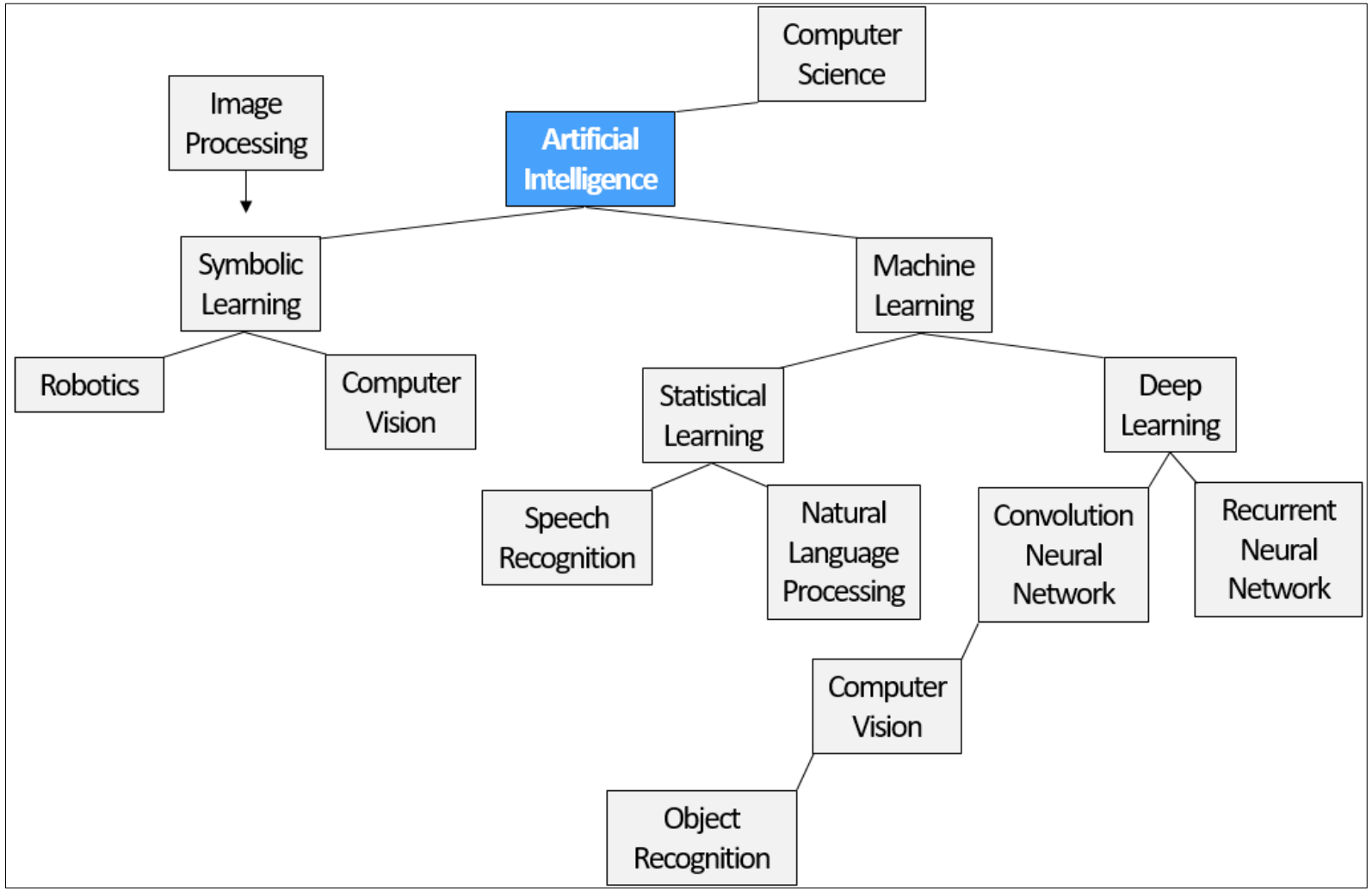
Different Levels of AI

Starting now with machine learning

Next, go from training machines to understand data to having algorithms and machines train themselves

Eventually, machine will talk to human with speech and output an answer

Many Technologies Have to Come Together



Source: Yardi®Matrix; Raj Ramesh, "What is Artificial Intelligence? In 5 Minutes", YouTube

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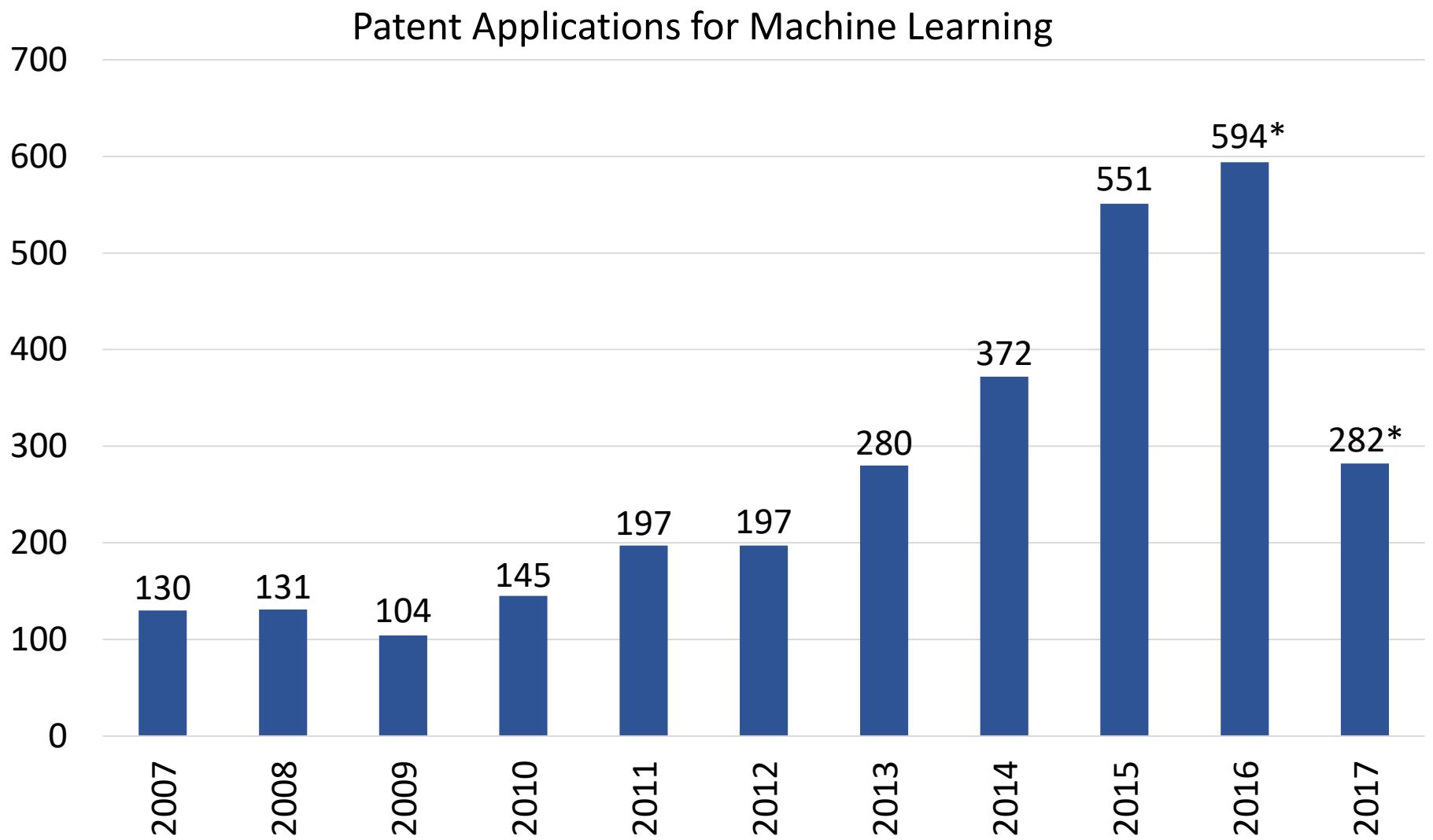
Companies are Rushing to Patent AI Technology



*Data for 2016 and 2017 are incomplete because of 18-month lag in publication; applications become public 18 months after filing

Source: Yardi®Matrix; Tom Simonite, "Despite Pledging Openness, Companies Rush to Patent AI Tech", wired.com; U.S. Patent filings via Webb, Short, Bloom, and Lerner, National Bureau of Economic Research

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AI Paving the Way for Model-Driven Businesses

- Models are being used to improve crop yields in agriculture
- In 2013 Monsanto bought The Climate Corp. (TCC) and uses model-driven farming to produce more-resilient crops
- Monsanto's models predict optimal places for farmers to plant based on:
  - Historical yields
  - Weather data
  - Tractors equipped with GPS and other sensors
  - Field data collected from satellite imagery, which estimates where rainfall will pool and subtle variations in soil chemistry

Do you see AI around you now? YES!

NETFLIX

- Recommendation model worth ~$1 billion/year in revenue
- Any time a customer accepts or rejects a recommendation, the algorithm improves
- Drives 80% of content consumption

amazon

- Product recommendations drove ~35% of revenue by 2013

Source: Yardi®Matrix; Steven Cohen and Matthew Granade, "Models Will Run the World", Wall Street Journal; Netflix; Amazon; Pixabay

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Artificial Intelligence in Multifamily

- A form of AI has been used in multifamily for 18 years as revenue management software programs

- AI applications for managing assets
  - Data shows how and when facilities and amenities are used, facilitating decisions about future developments
  - Data used to create predictive maintenance programs can inform facility maintenance decisions
  - Improve property management performance by freeing onsite staff to spend more time with applicants and residents

- AI applications for making investment decisions
  - Machine learning algorithms identify opportunities by finding assets with potential for value creation
  - Will consider various factors, including the property's condition, how it's being managed, the surrounding neighborhood, etc.
  - Can drastically reduce underwriting time

Source: Yardi®Matrix; FPOSmart Machines by Wendy Broffman; Dharmendra Sawh; July 2018 White Paper "Smart Communities: The Internet of Things & the Apartment Industry", by Gate 15, NMHC Staff and NMHC Members; Pixabay

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Yardi Elevate

- Goal is to go beyond just presenting data and have software make recommendations
- Putting the framework in place to be able to use AI to lower cost, balance risk, drive value and recommend actions to promote efficiency
- Clean, rich, diverse, data that represents large enough portion of the market to be meaningful
- Pulls data from four products bundled together and sold as a suite – will employ AI and products will “talk” to each other
  - ***Asset Intelligence***
  - ***Forecast Manager***
  - ***Asset Intelligence***
  - ***Yardi Matrix***

MULTIFAMILY

ASSET INTELLIGENCE

In-depth analytical insights into your operations and competitive environment with machine learning recommended actions to meet your financial and operational goals.

MULTIFAMILY

FORECAST MANAGER

Bring together actual historic unit-level performance data with market outlooks and deep business intelligence measures for an accurate revenue forecast.

MULTIFAMILY

RENTMAXIMIZER™

Revenue management that empowers leasing staff to close high-value leases and raise in-place rents while reducing vacancy loss and turn costs.

MULTIFAMILY

YARDI® MATRIX

The real estate industry’s most robust research platform for deep market data and complete intelligence for acquisitions, benchmarking and market valuations.

Source: Yardi®Systems; Yardi®Matrix; FPOSmart Machines by Wendy Broffman; Dharmendra Sawh; Yardi.com

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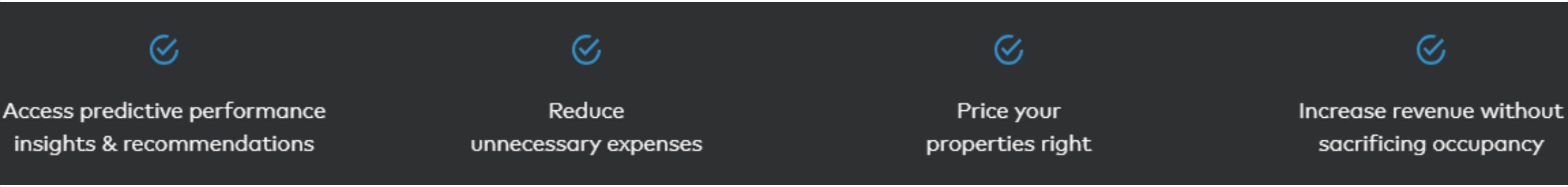
Yardi Elevate

Yardi machine learning applications:

- Just in Time (JIT) Marketing Program & Multi-Touch Lead Attribution
  - Pinpoint which marketing sources are producing best leads and determine ROI
  - Score each lead and predict which have the highest probability of conversion
  - Create better forecasts of renewals
    - Incorporate more info – resident's rent burden, work order history, etc.
  - Look at spending on advertising and make recommendation on spending levels if more or less leads are needed to fill forecasted vacancies
- Also considering machine learning for resident screening and procurement
- Eventually, IoT will work with machine learning to leverage data from metered utilities
  - Technology already used in Yardi Pulse – commercial energy management program



Source: Yardi®Systems; Yardi®Matrix; FPOSmart Machines by Wendy Broffman; Dharmendra Sawh; Yardi.com

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Implications for Artificial Intelligence

- Artificial intelligence will primarily impact higher-skilled jobs
- Low skilled jobs with high human interaction – need societal acceptance of machinery before service industries become automated
- However…*Robotics are Close*
  - Sensors are getting more powerful and smaller – you can put it on an exoskeleton
  - Ex: Robots doing guided tours through rental properties, allows agents to manage properties online
  - The robot has potential to get so good that low-skilled jobs get eliminated too

Artificial Intelligence in Logistics

- Typical fulfillment center has human pickers walking 15 miles/day to assemble orders
- inVia Robotics – robots autonomously navigate warehouse, pull from shelves, deliver to stationary human picker
- Models consider item popularity and probability of association (ex: putting sunglasses near sunscreen) to adjust warehouse layout automatically and minimize miles robots must travel
- Every order provides feedback and improves productivity across the system

AI for Rent

- You can rent an AI platform and just use your data (Google/Microsoft)
- Do you want to deal with developing your own AI solutions, or just rent from someone else?
- Can become a revenue stream for companies with strong AI platforms

Source: Yardi®Matrix; Steven Cohen and Matthew Granade, "Models Will Run the World", Wall Street Journal; Pixabay

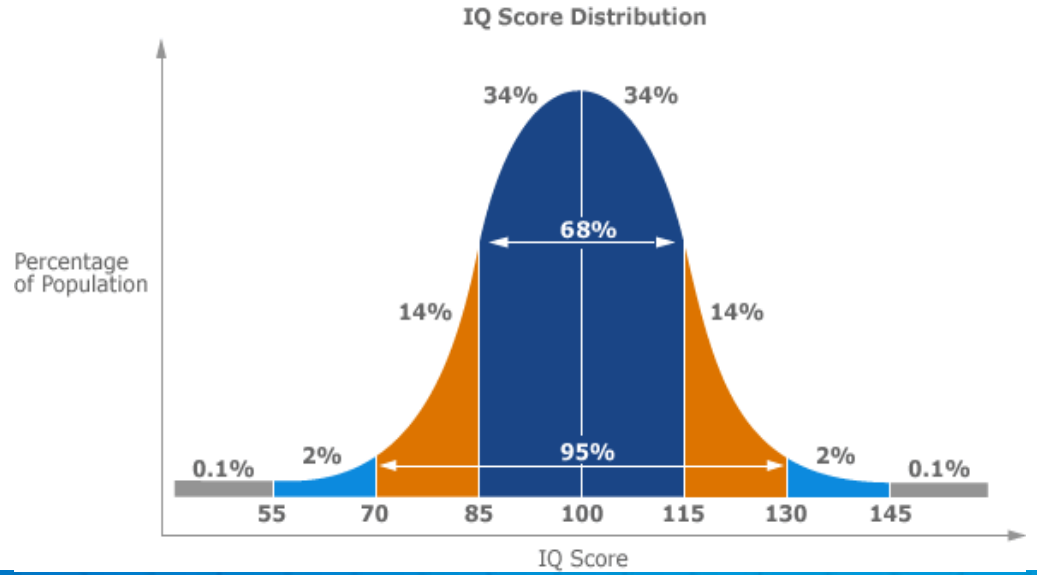
A Hurdle for IoT and AI – It Can All Be Hacked!

- Regulatory burden is so high, people will look to third party providers to manage security of their IoT and AI networks
- What is considered "private" and what isn't?
  - It's a fluid definition
  - Aggregating and anonymizing data is private, but not as useful
  - Valuable when it can be tied to an individual, but then it's not private
- Countries with large military establishments – U.S., China, Russia, Israel – will be best positioned with managing security

Source: Yardi®Matrix; Pixabay

Overall Implications – All Levels of Jobs Will Eventually be Impacted

- Immediate impact likely in middle wage/middle skill jobs (IoT)
- Highly skilled job affected next (AI)
- Once society accepts machinery in the service industry, lower-skilled jobs will be impacted (Robotics)
- McKinsey Global Institute:
  - Automation will displace 400-800 million jobs by 2030, requiring ~375 million people to switch job categories entirely

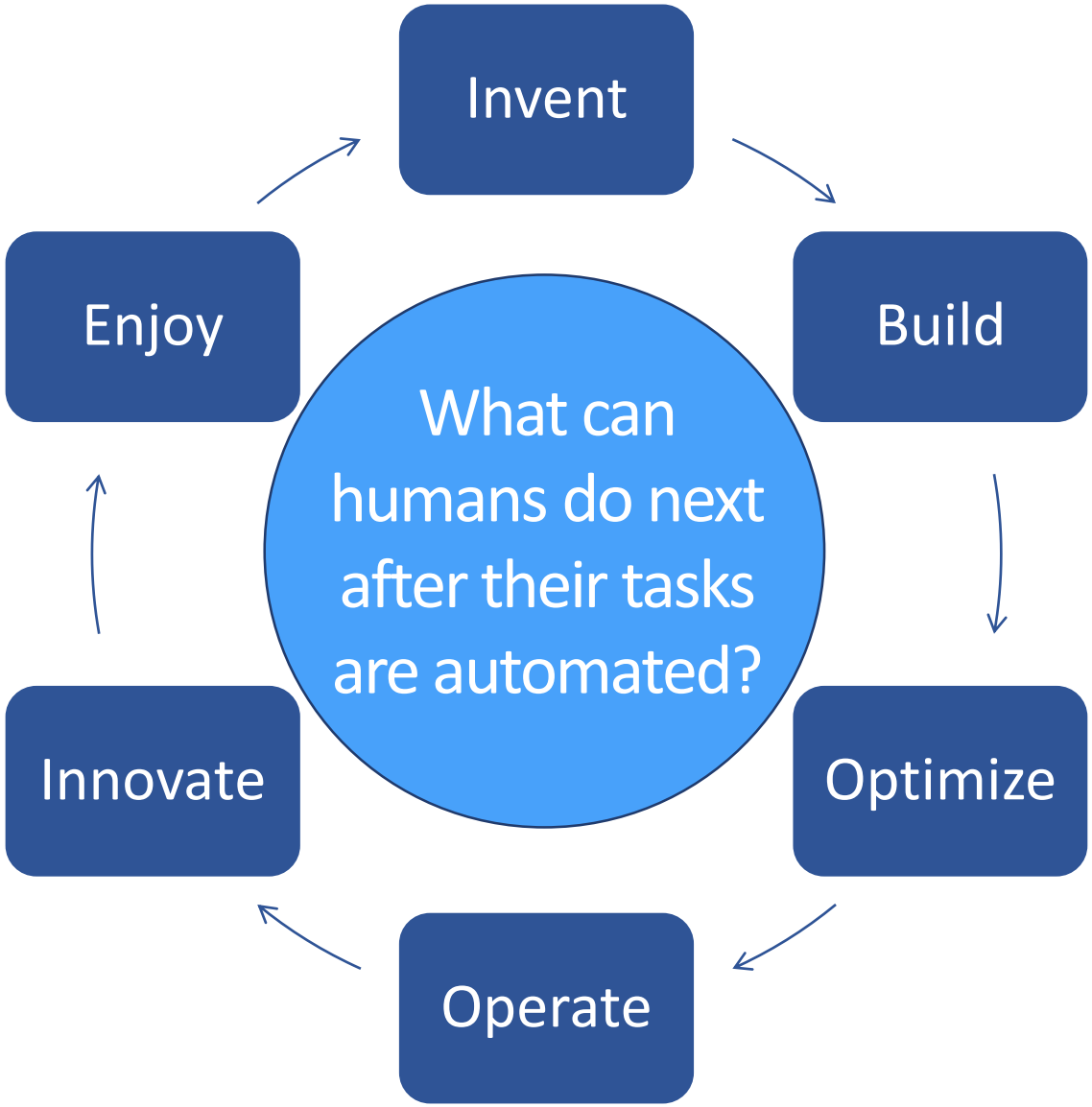


Source: Yardi®Matrix; purestonepartners.com; Calum McClelland, "The Impact of Artificial Intelligence-Widespread Job Losses", iotforall.com; McKinsey Global Institute; iqcomparisonsite.com

The Bottom Line: A Case for Intellectual Capital Nodes

We cannot replace our need to:

- create new things
- improve them
- build interpersonal relationships



Source: Yardi®Matrix; TEDx Talks, Jordan Duffy, "The Internet of Things|Jordan Duffy|TEDxSouthBank"

Contact Information

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