



## TEXAS

The Real Estate Center at Texas A&M noted in their February Summary that “A strong U.S. economy and stable energy prices supported growth in the Texas economy. The state accounted for 39 percent of national crude oil production and 84 percent of its exports. The employment expansion extended its 20-month streak, adding more than 70,000 jobs this year alone. Economic opportunities continued to attract both international and domestic migration to Texas. Population growth is essential to expand the talent pool and tax base, but it increases pressure on the local infrastructure and already constrained housing market. Decreased housing affordability, energy price volatility, and trade uncertainty remained the greatest headwinds to the Texas economy.”

## AUSTIN

“Austin economic activity accelerated in February. The Austin Business-Cycle Index grew at its fastest pace since late 2015, bolstered by strong employment growth over the first two months of this year. The unemployment rate increased slightly but remained near a two-decade low. Regional real estate indicators point to robust housing growth. Census data for 2017 suggest that Austin’s population growth was well above the state average.” – April 2018 – Austin Economic Indicators

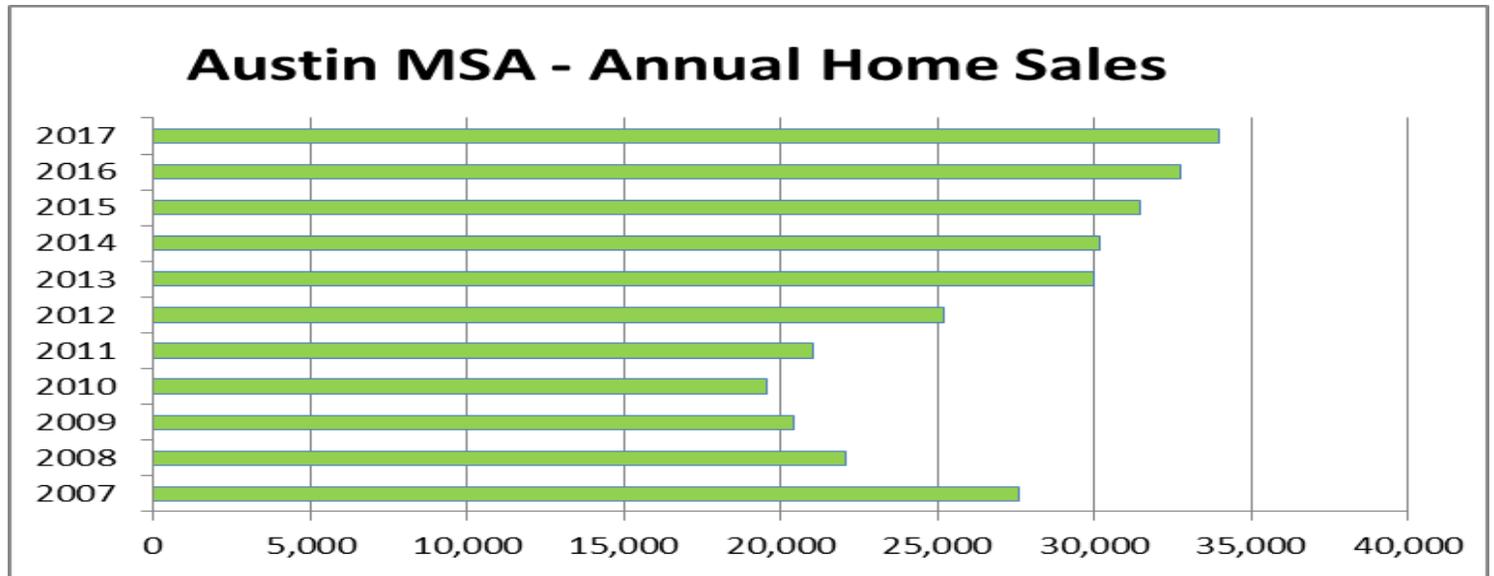


## UNITED STATES

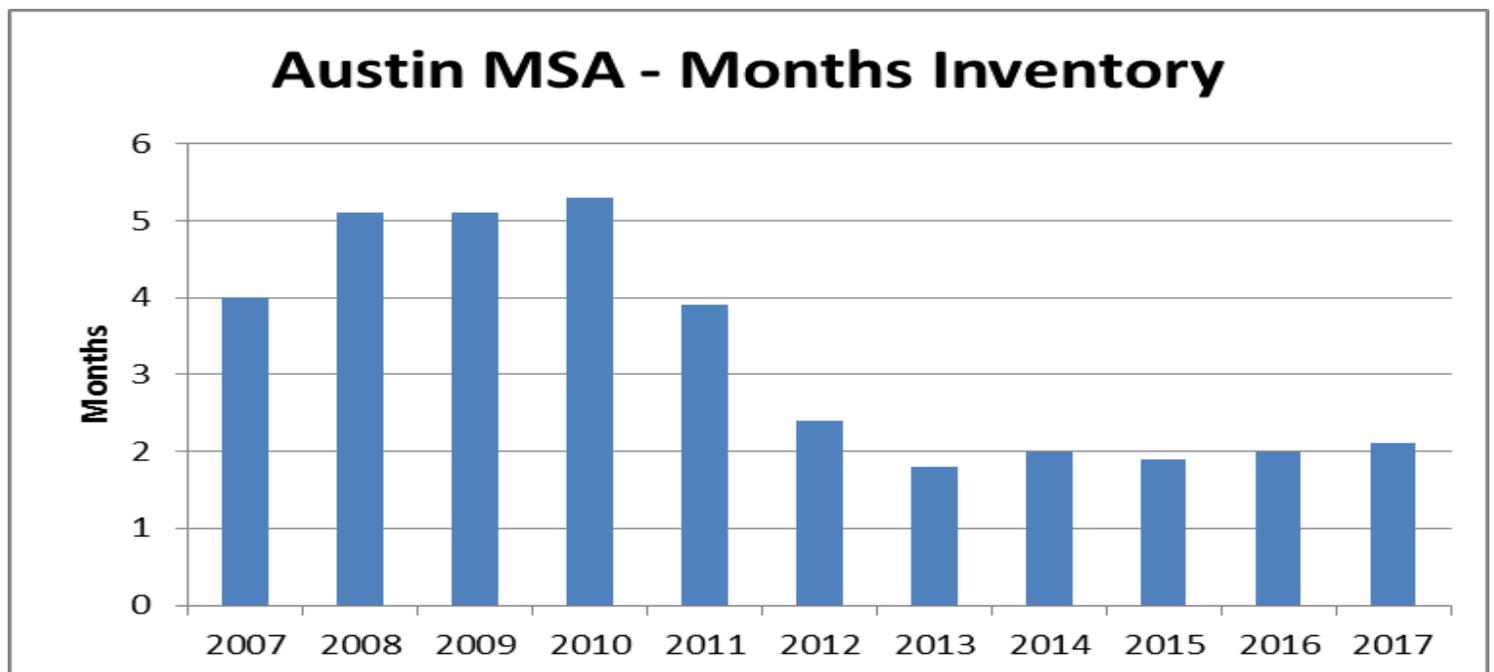
“The U.S. economic outlook has slightly improved since January, owing to strong gross domestic product (GDP) and employment growth. Forecast GDP growth has ticked higher as recent changes to federal tax law have provided fiscal stimulus. Inflation expectations have remained firmly anchored, with inflation gradually rising in recent months.” - Research Department at the Federal Reserve Bank of Dallas

## HOUSING – ANNUAL AUSTIN MSA SALES AND MONTHS INVENTORY

On the next couple of pages are the Austin MSA Annual Home Sales, Months Inventory, Sales Price, and Price Distribution graphs. The graphs highlight the reality of the Austin housing market (high demand + low inventory = higher prices).

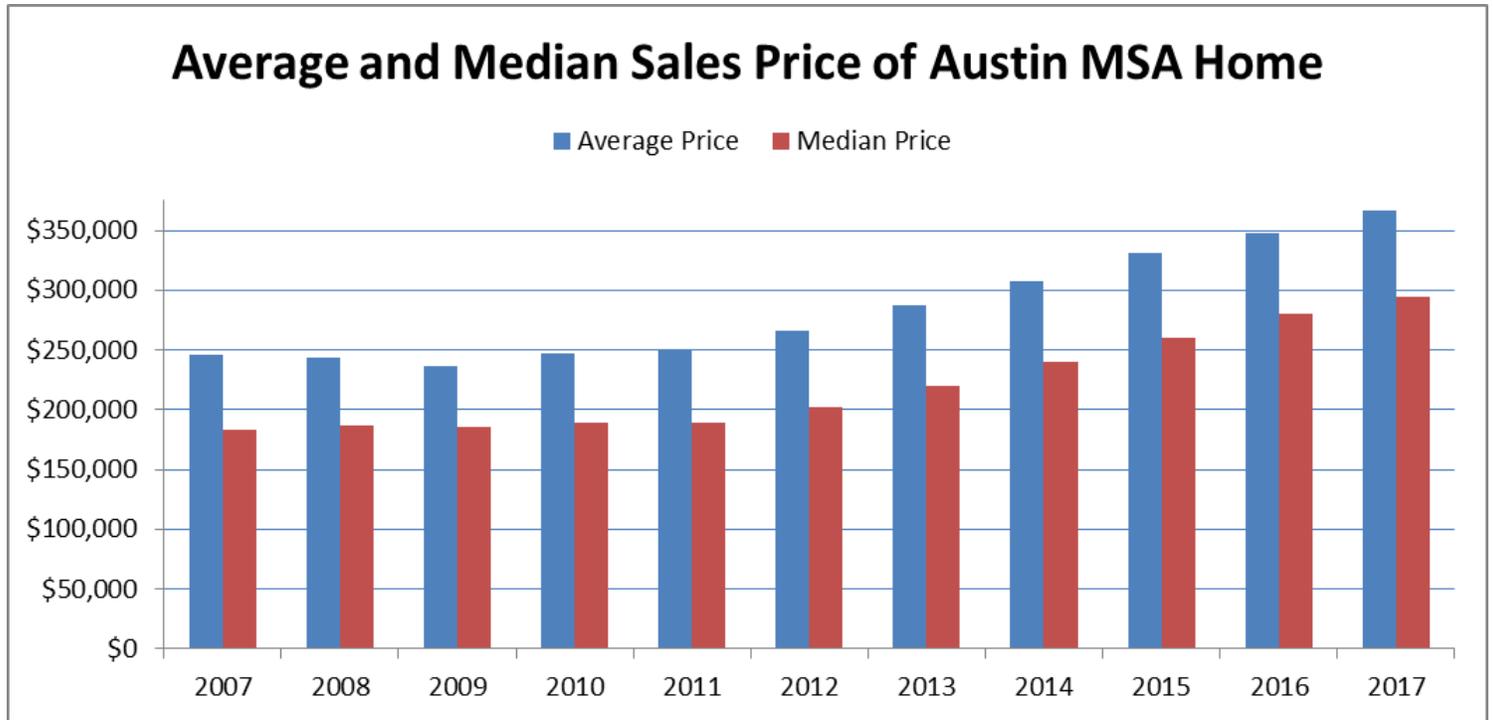


Source: Real Estate Center at Texas A&M University

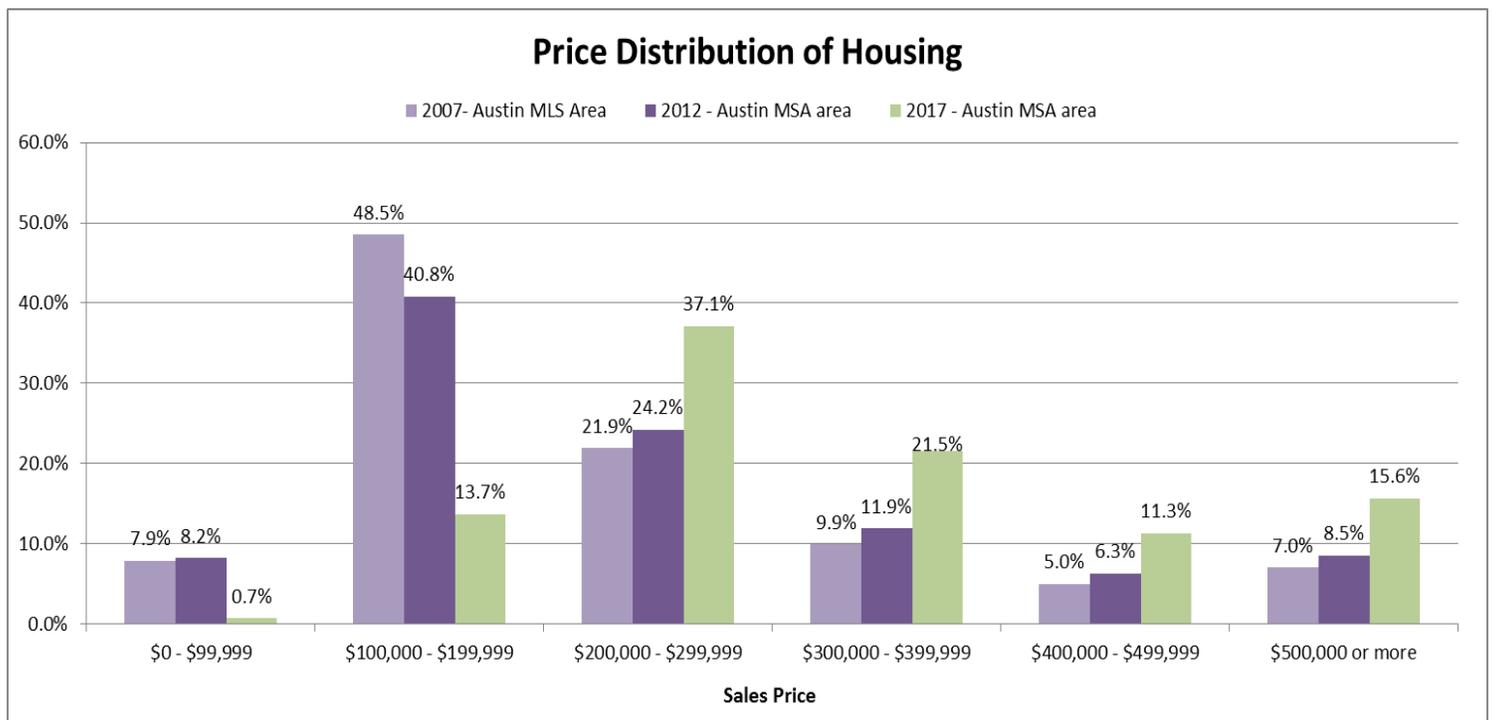


Source: Real Estate Center at Texas A&M University

## HOUSING – AUSTIN MSA SALES PRICE AND PRICE DISTRIBUTION



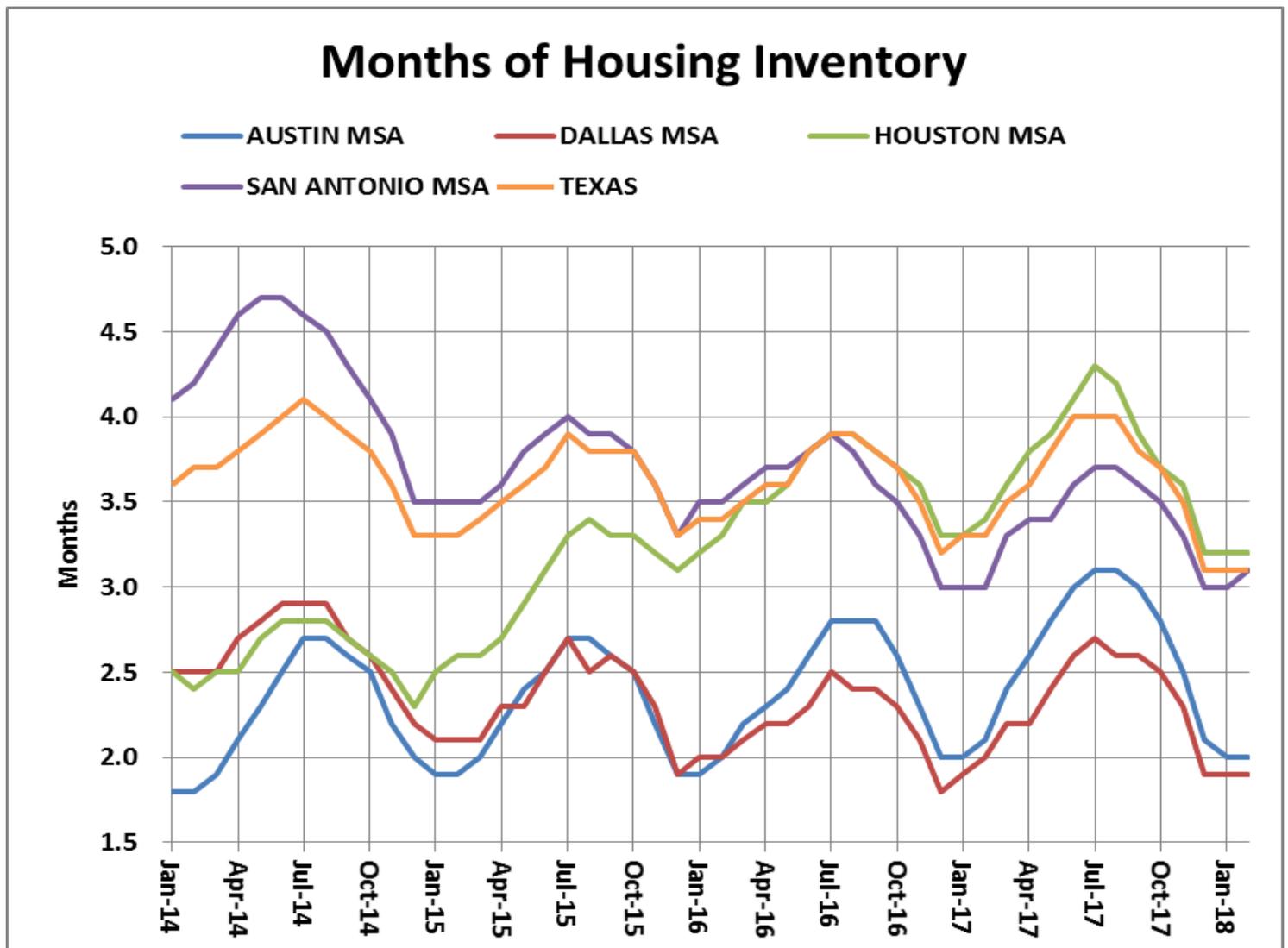
Source: Real Estate Center at Texas A&M University



Source: Real Estate Center at Texas A&M University  
Percentages may not equal 100% due to rounding

## HOUSING – INVENTORY

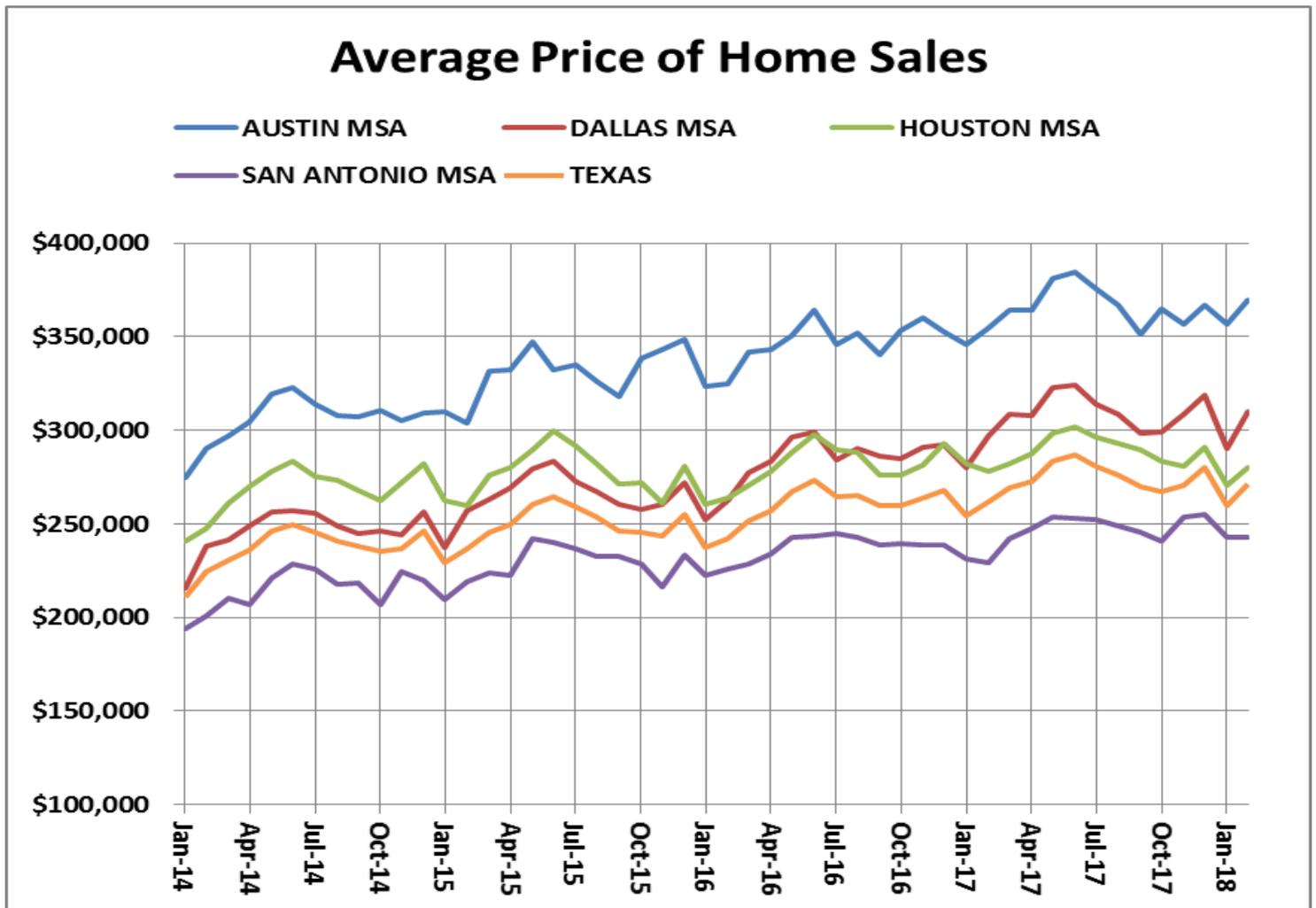
The Austin MSA's months of housing inventory was 2.0 in February 2018. The Real Estate Center has estimated that “seasonally adjusted; around 6.5 months of inventory is considered a balanced housing market in which neither sellers nor buyers dictate prices.”



Source: Real Estate Center at Texas A&M University

## HOUSING – AVERAGE SALES PRICE

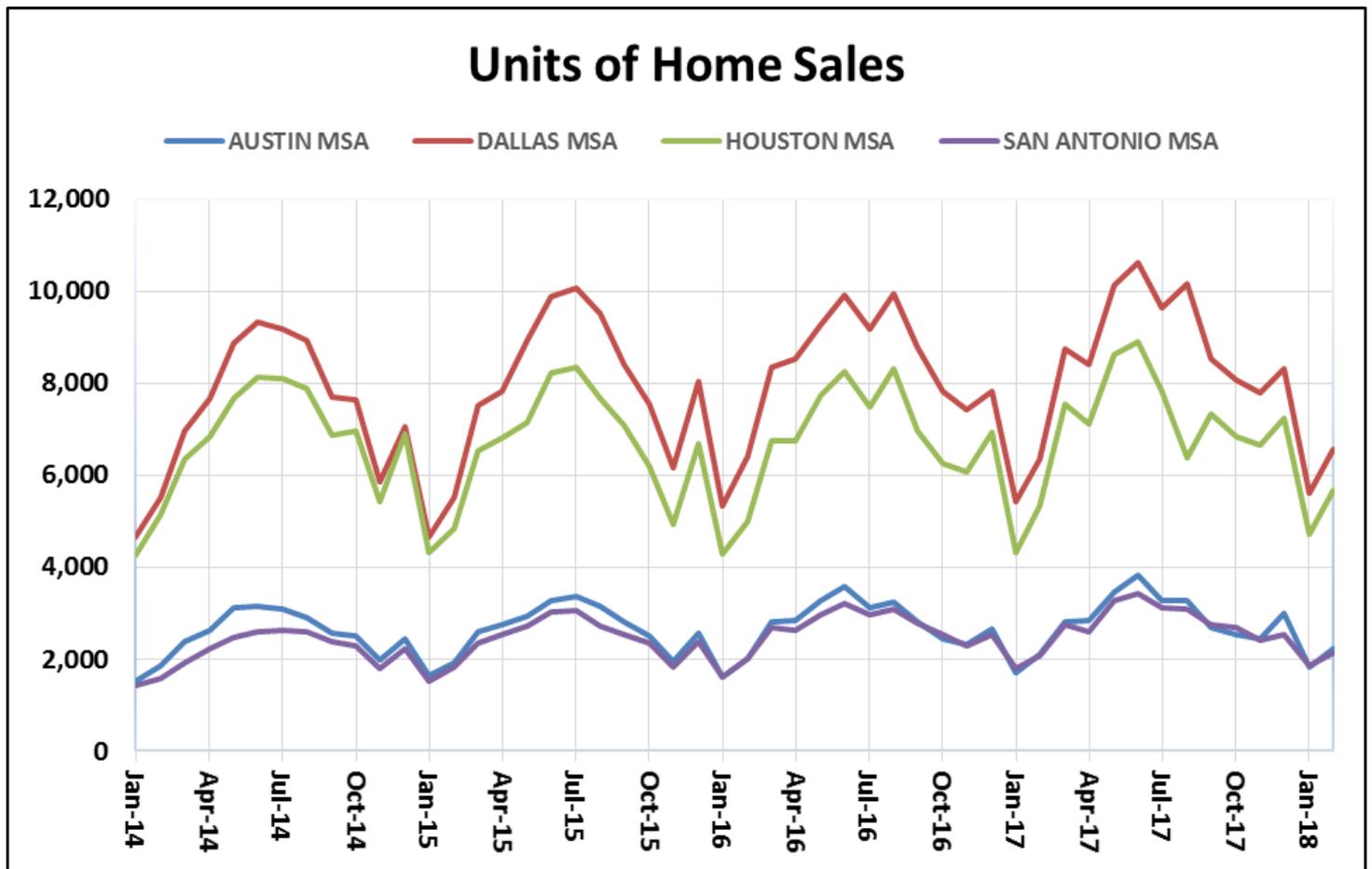
For a single-unit of residential housing in the Austin MSA, the **average sales price in February 2018 increased [year-over-year] from \$354,813 to \$369,384**. The average price per square foot rose from \$171.67 to \$180.34.



Source: Real Estate Center at Texas A&M University

## HOUSING – HOME SALES

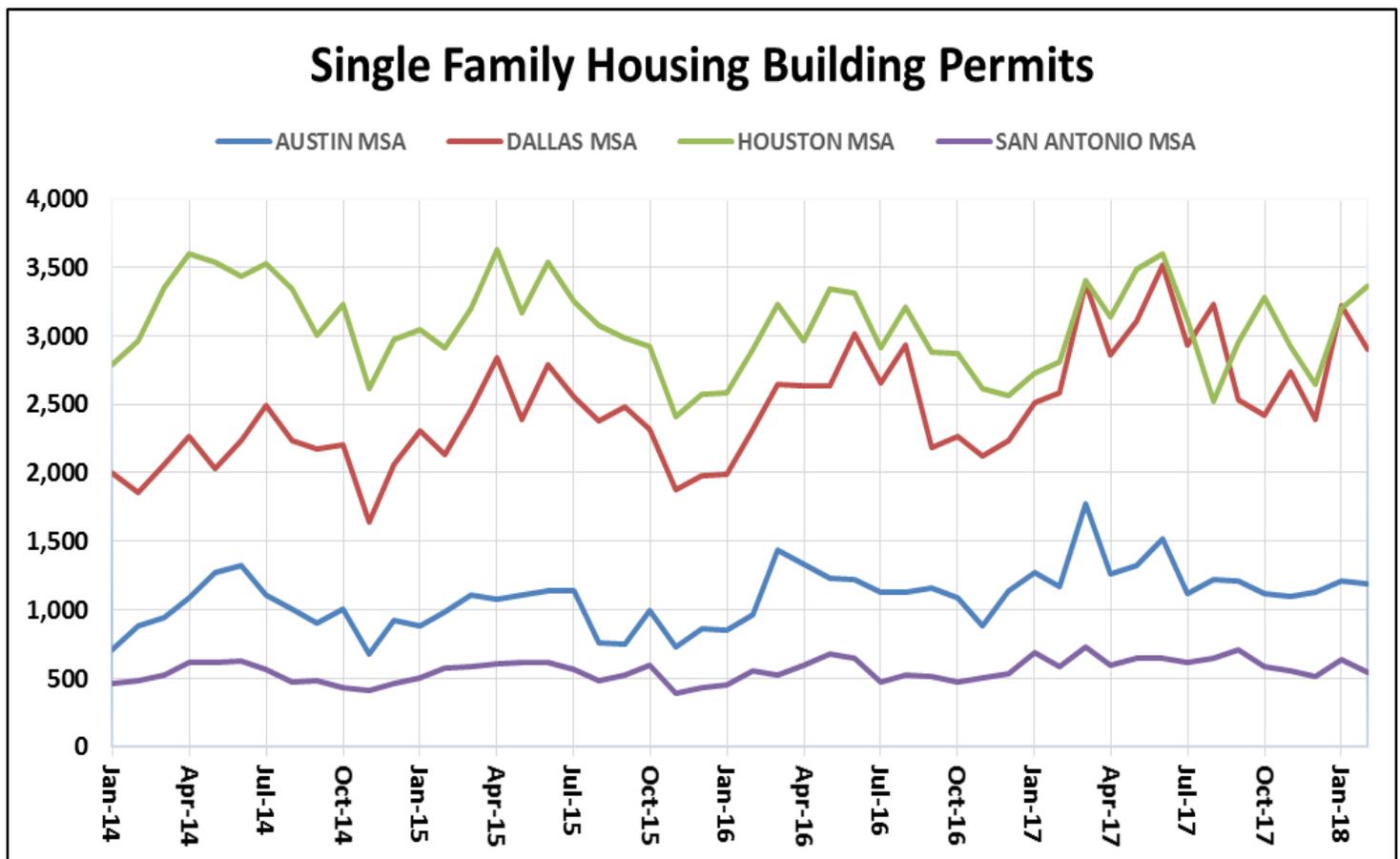
Austin MSA’s “Sales volume for single-unit residential housing increased 6.07% YoY from 2,093 to 2,220 transactions. Year-to-date sales reached a total of 4,050 closed listings. Dollar volume rose from \$742.62 million to \$823.03 million.” – February Housing Report for Austin-Round Rock – Real Estate Center



Source: Real Estate Center at Texas A&M University

## HOUSING – SINGLE FAMILY BUILDING PERMITS

“The number of statewide monthly single-family housing construction permits (unweighted) ticked down 2.6 percent but maintained upward momentum. **Texas led the U.S. in permits issued and accounted for more than 17 percent of the national total.** Houston remained the national metropolitan leader, issuing 3,363 non-seasonally adjusted monthly permits, followed by Dallas-Fort Worth (DFW) at 2,897. Data revisions corrected Fort Worth's January boom down from 60.3 to 50.3 percent, but levels stayed elevated this month. Austin permits ticked down to 1,186 but moved from eighth to sixth in the national ranking. In contrast, the trend deepened in San Antonio (545) as permits slid 25.5 percent since September 2017. Despite leading the nation in single-family housing construction, additional growth is warranted as statewide permits per capita remained more than 36 percent below 2006 levels.” – Texas Housing Insight – Real Estate Center March 2018

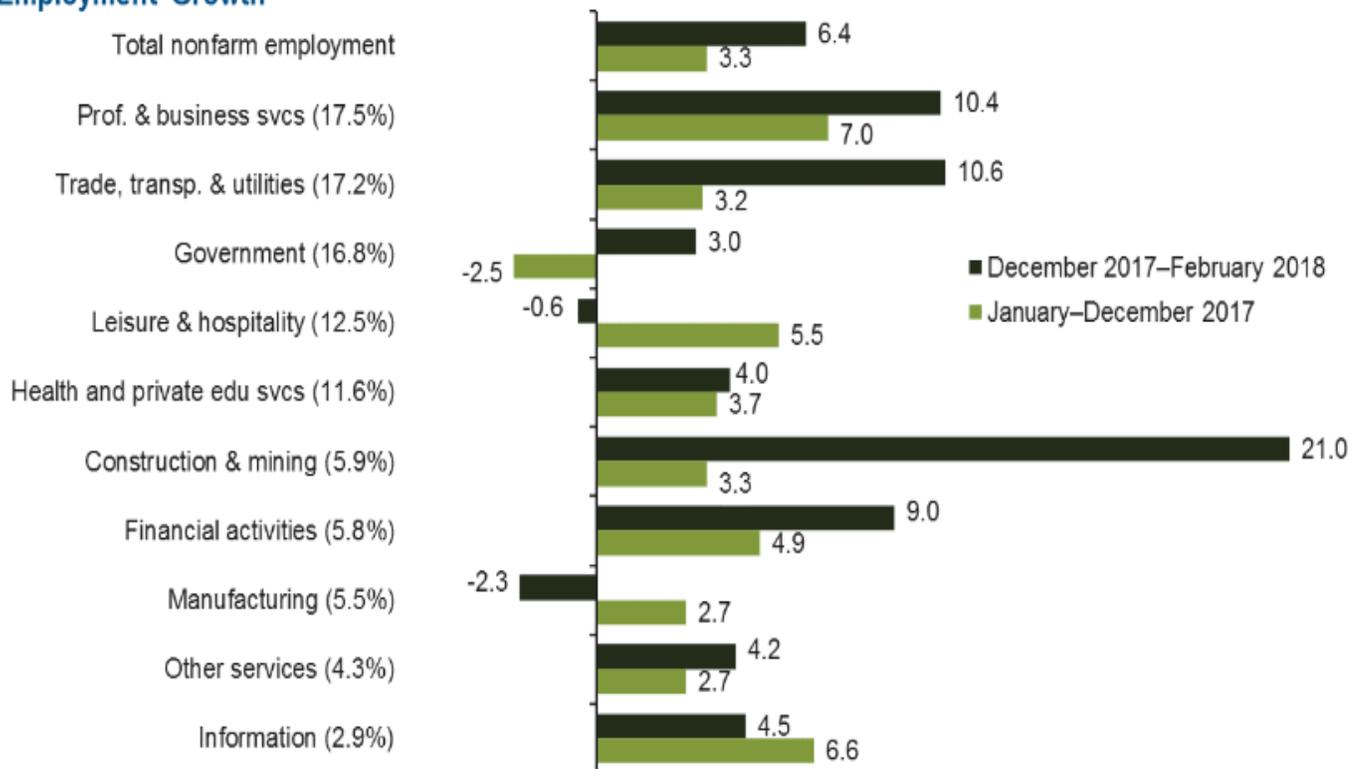


Source: Real Estate Center at Texas A&M University

## JOBS – GROWTH RATE – AUSTIN

**“Austin jobs grew at a robust 6.4 percent annualized rate over the three months through February.** Growth was broad based, with the exception of declines in leisure and hospitality—due to a slowing in food services jobs—and manufacturing—due to a decline in computer and electronics-related jobs. Construction and mining led overall growth, adding 3,000 jobs over this time. Trade, transportation and utilities expansion was driven largely by a surge in wholesale trade, and with similar strong growth in professional and business services, these two industries added a combined 9,100 jobs. Health care, financial activities and government saw healthy growth as well.” - Austin Economic Indicators - Dallas Fed – April 2018

### Employment Growth



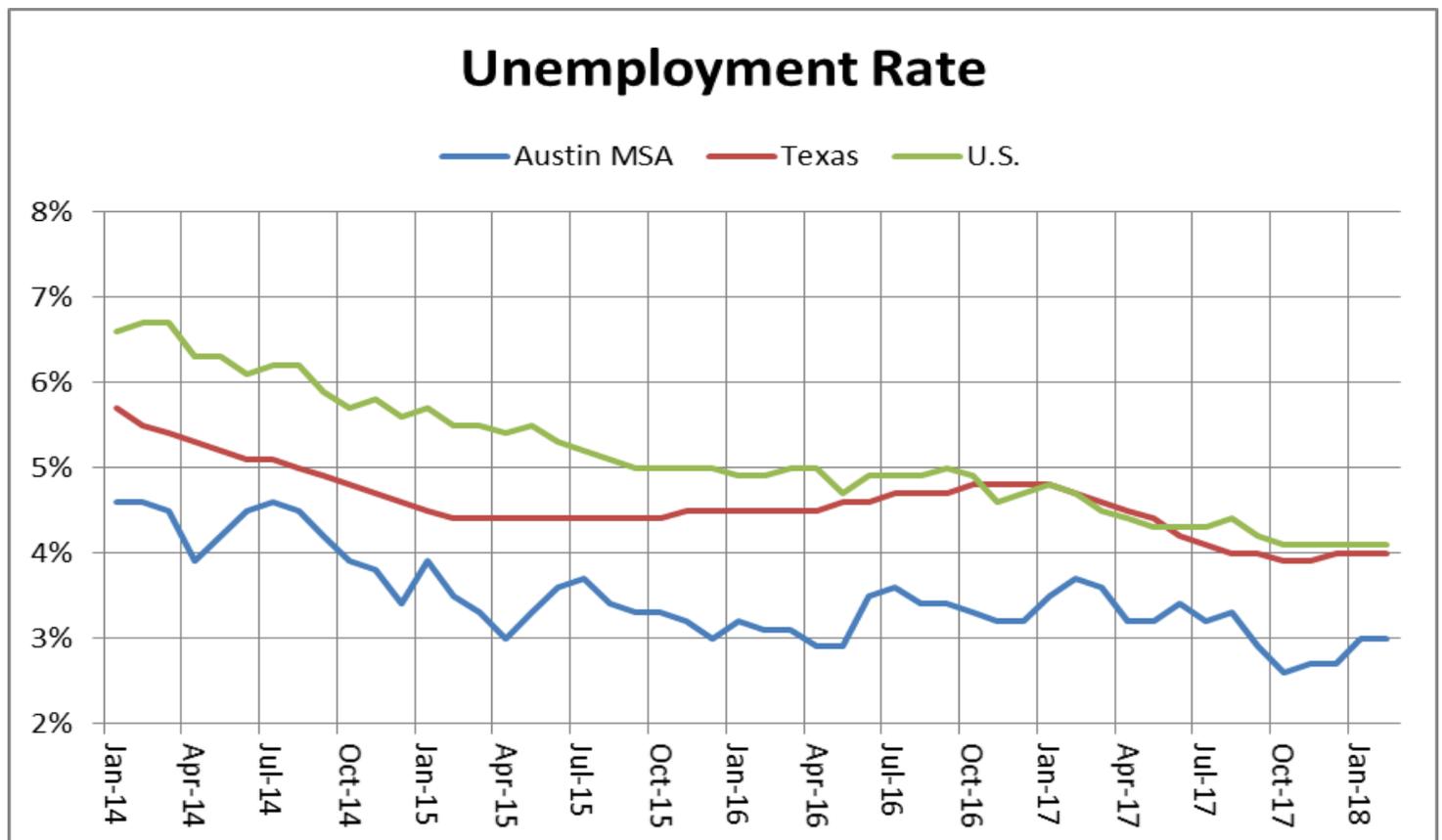
NOTES: Data show seasonally adjusted and annualized percentage employment growth by industry. Numbers in parentheses represent share of total employment and may not sum to 100 due to rounding.

SOURCES: Bureau of Labor Statistics; Texas Workforce Commission; adjustments by the Dallas Fed.

## JOBS - UNEMPLOYMENT RATES – AUSTIN MSA, TEXAS, U.S.

“The **Texas unemployment** rate held steady at **4.0 percent** for the third consecutive month in February, near a four-decade low. Unemployment ticked up in Austin, Dallas, Fort Worth and San Antonio last month but was stable in El Paso and Houston.” – Texas Economic Update – Federal Reserve Bank of Dallas – March 2018

“**Austin’s unemployment** rate was **3.0 percent** in February, up from an 18-year low of 2.7 percent in October. This increase was due to a surge in the local labor force, which grew at an 8.6 percent annualized rate in the first two months of 2018—significantly faster than last year’s 3 percent. The State and **U.S.** jobless figures held steady at 4.0 and **4.1 percent**, respectively.” - Austin Economic Indicators - Dallas Fed – April 2018

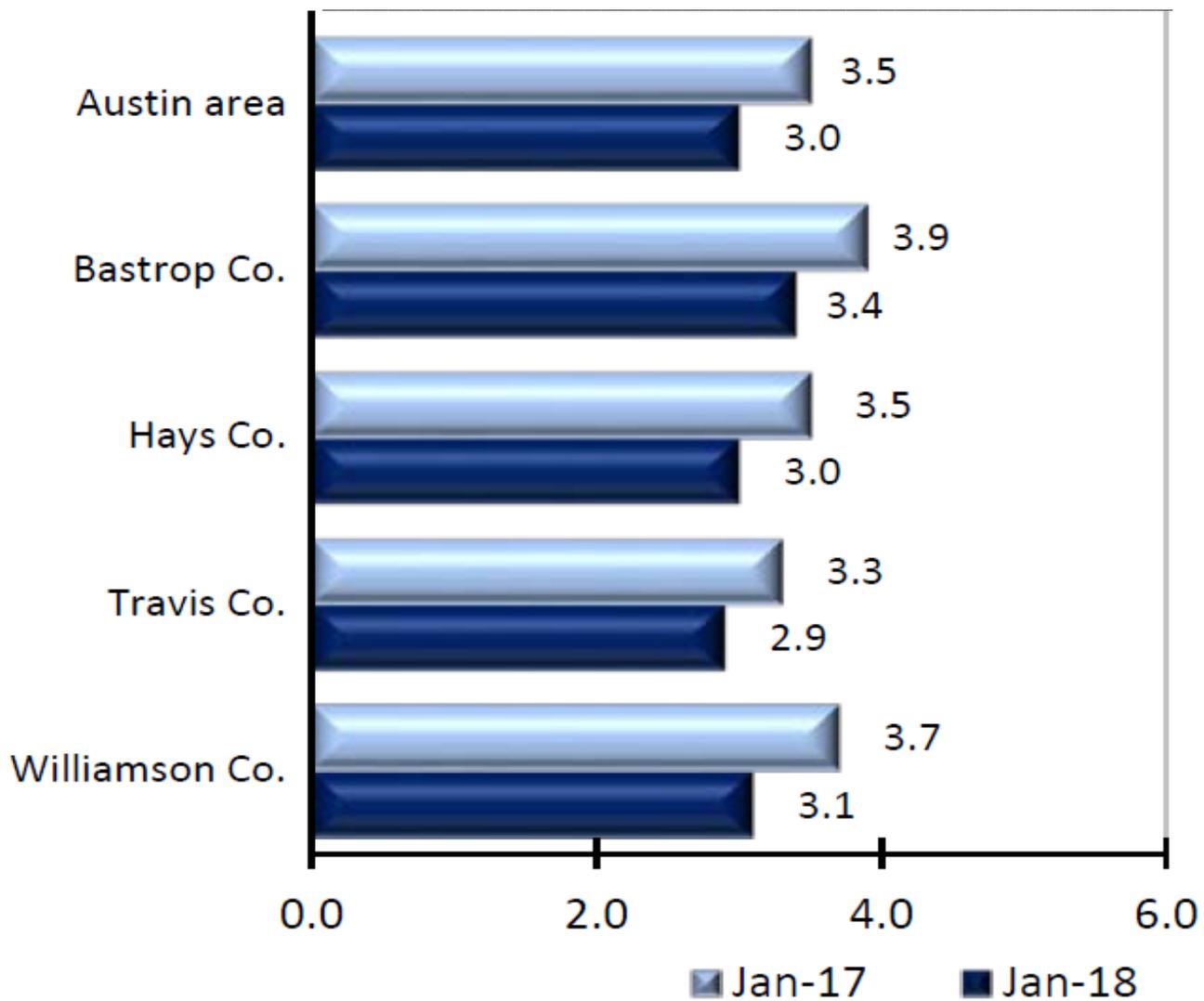


*Note: U.S. and Texas seasonally adjusted, Austin MSA not seasonally adjusted.  
Source: Bureau of Labor Statistics*

## JOBS - UNEMPLOYMENT RATE – AUSTIN AREA

Below is a chart taken from the March 20, 2018, Austin Area Economic Summary prepared by the U.S. Bureau of Labor Statistics. It graphically shows that unemployment rates throughout the Austin area have declined compared to prior year.

### Unemployment rates



Source: U.S. BLS, Local Area Unemployment Statistics.

## JOBS – NONFARM EMPLOYMENT BY INDUSTRY

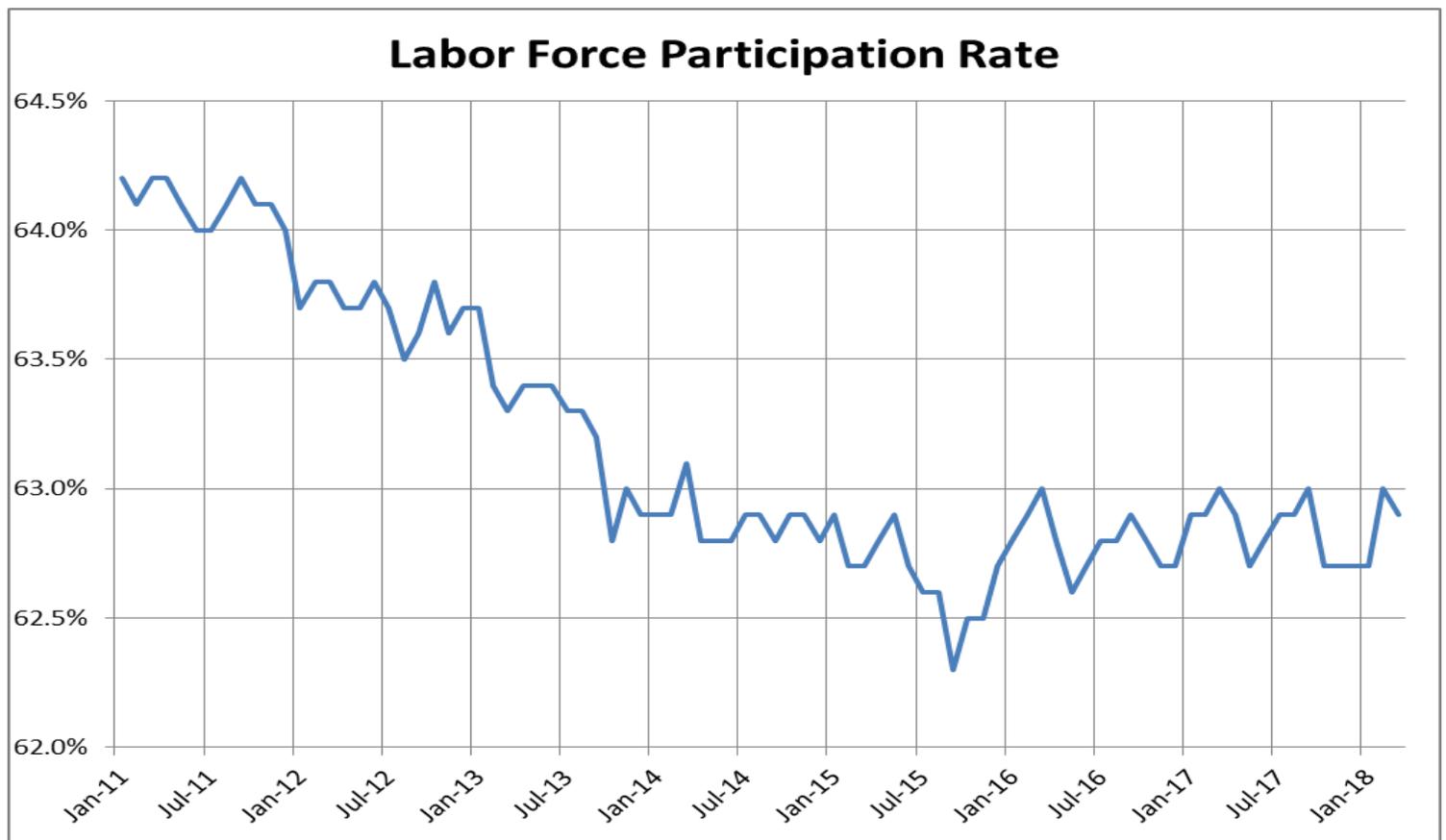
The chart below shows the year-over-year changes in employment by major industry sector. The total **Austin area nonfarm employment has increased by 36,900 jobs (3.7%)** from prior year.

Austin area employment (numbers in thousands)	Jan. 2018	Change from Jan. 2017 to Jan. 2018	
		Number	Percent
Total nonfarm	1,045.2	36.9	3.7
Mining, logging, and construction	61.8	2.9	4.9
Manufacturing	57.7	2.0	3.6
Trade, transportation, and utilities	181.0	6.0	3.4
Information	30.6	1.3	4.4
Financial activities	60.8	2.9	5.0
Professional and business services	181.4	12.5	7.4
Education and health services	121.0	3.1	2.6
Leisure and hospitality	125.9	6.4	5.4
Other services	45.8	2.6	6.0
Government	179.2	-2.8	-1.5

Source: U.S. BLS, Current Employment Statistics.

## JOBS – LABOR PARTICIPATION RATE

“The Labor Department’s Bureau of Labor Statistics reported on Friday that 155,178,000 Americans were employed in March, just 37,000 fewer than February’s record 155,215,000. However, **the number of women, age 16 and over, employed in March reached an all-time high of 72,548,000**, which is 18,000 more than February’s record. The number of employed men, ages 16 and over, dropped 55,000 from February’s record high. The nation’s unemployment remained at 4.1 percent in March for a sixth consecutive month, and that is an 18-year low. The labor force participation rate has been stuck at or near the 62.7-63.0 percent level for the past four years.” – CNS News



Source of Data: Bureau of Labor Statistics

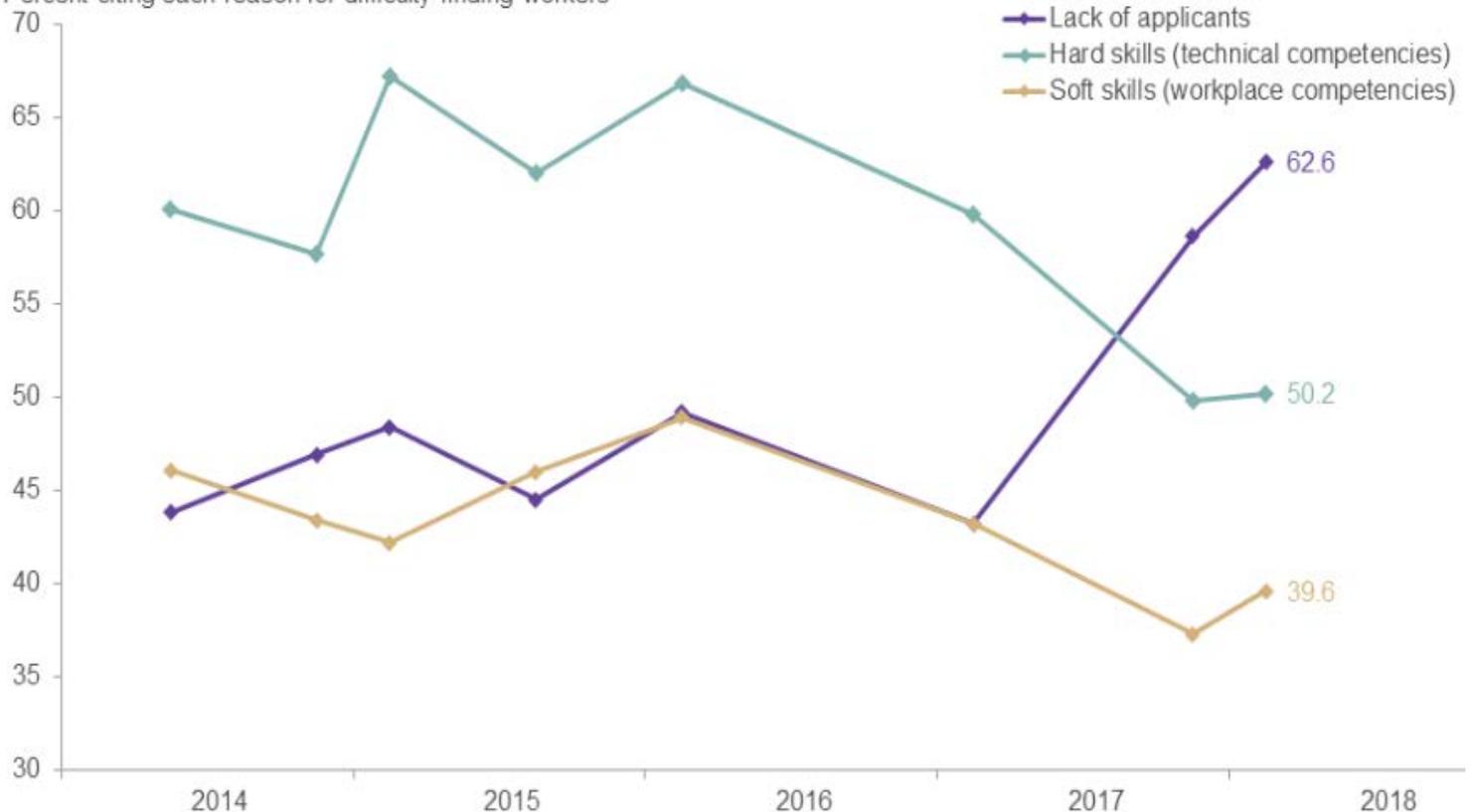
The **labor force participation rate**, as defined by the Bureau of Labor Statistics (BLS), is “the percentage of the population [16 years and older] that is either employed or unemployed [that is, either working or actively seeking work].”

## JOBS – LACK OF QUALIFIED WORKERS

“Tightness in the Texas labor market was corroborated by the supplemental questions to TBOS (Texas Business Outlook Surveys) in February. More than **half of the 362 executives surveyed said they planned to increase employment over the next six to 12 months**. This was the highest share expecting to increase employment in the 10 times the question has been asked since 2011. Among survey respondents, **64.8 percent reported difficulties finding qualified workers**. The problem persisted across skill levels but was concentrated among mid-skill positions, which typically require some college or technical schooling. Nevertheless, lack of applicants is the main issue firms have faced when trying to fill vacant positions since 2017. This suggests that consistent low unemployment along with a skills mismatch could restrain employment growth going forward.” – Texas Economic Update - Dallas Fed – March 2018

### Lack of Available Applicants Has Become Largest Hiring Difficulty

Percent citing each reason for difficulty finding workers



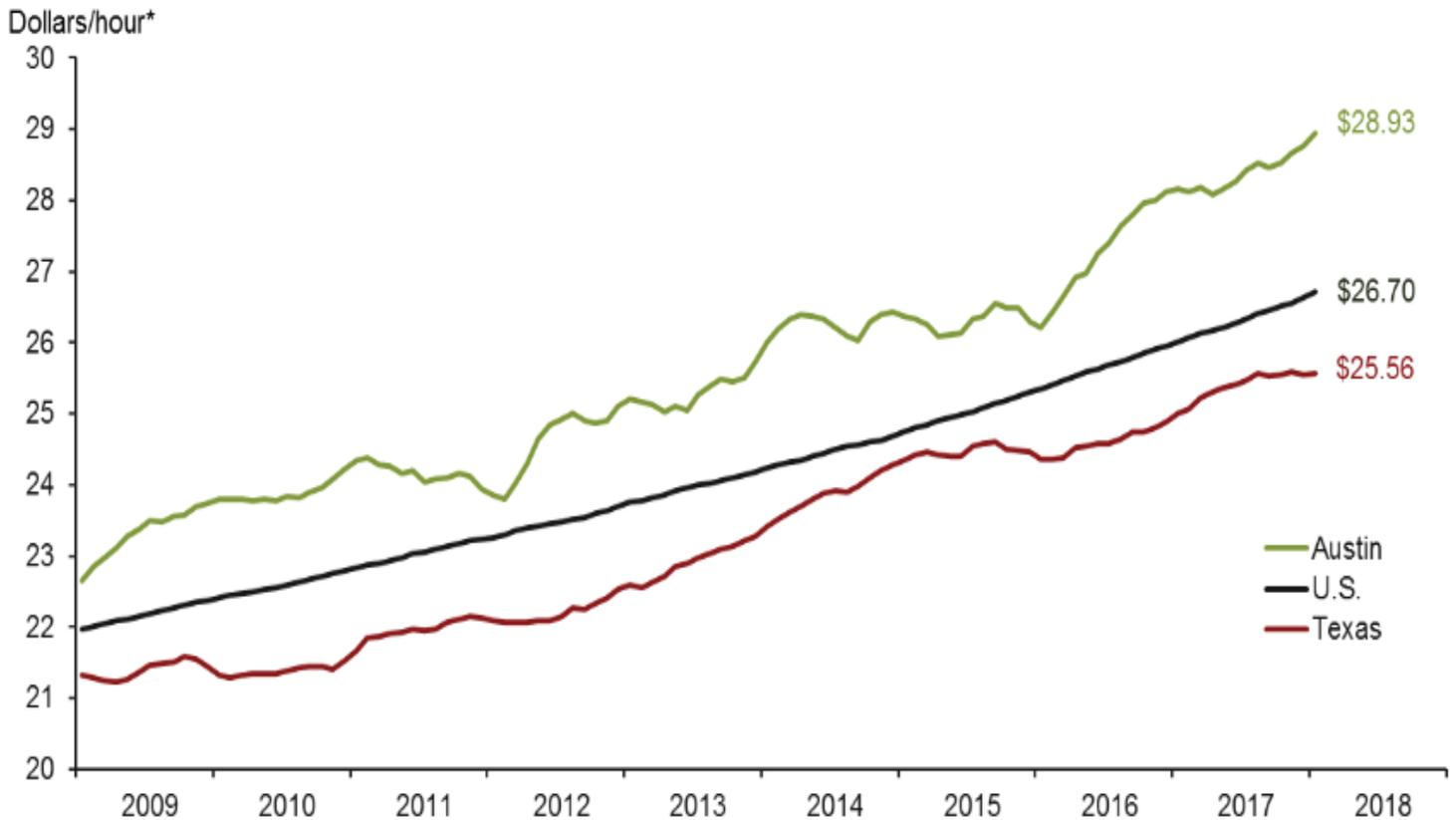
NOTES: This special question is asked occasionally as a supplement to monthly Texas Business Outlook Surveys (TBOS). The question is only posed to respondents who reported difficulty finding qualified workers. Last data point is February 2018.

SOURCE: Federal Reserve Bank of Dallas TBOS.

## JOBS - HOURLY WAGES – AUSTIN

“Hourly wages in Austin rose to a new high in February, and the three-month average of \$28.93 was well above the U.S. and Texas averages. While year-over-year growth of 2.7 percent was comparable to the nation and above the State’s 2.3 percent, wages over the three months through February accelerated in Austin to a 5.9 percent annualized pace, compared with just 2.9 percent nationally and 0.4 percent statewide. The significant growth in the high-paying professional and financial services sectors in recent months was a contributing factor.” - Austin Economic Indicators - Dallas Fed – April 2018

### Private-Sector Average Hourly Earnings



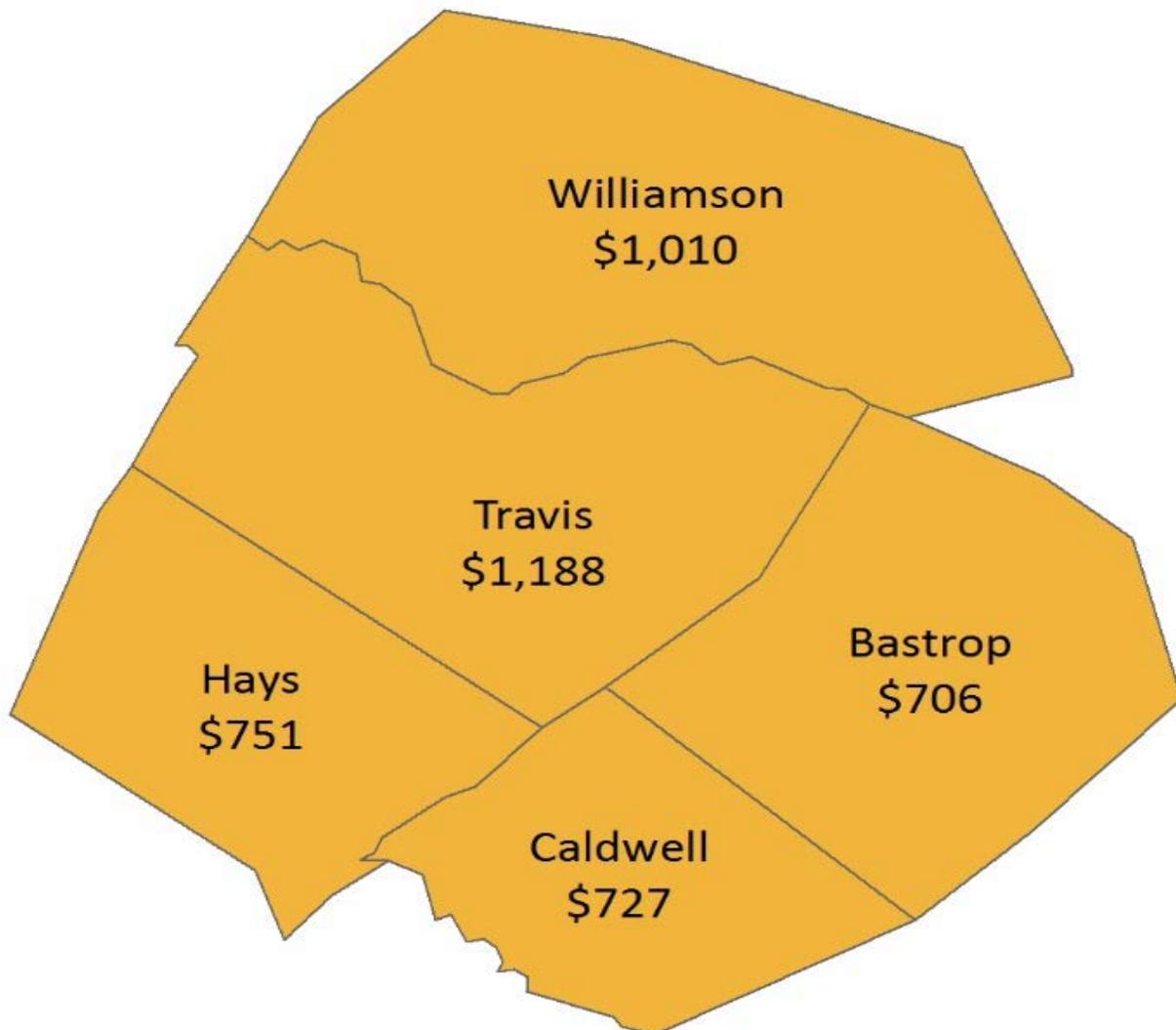
\*Seasonally adjusted, three-month centered moving average.

SOURCES: Bureau of Labor Statistics; Texas Workforce Commission; adjustments by the Dallas Fed.

## JOBS – AVERAGE WEEKLY WAGES BY COUNTY

Below is a chart comparing the average weekly wages for all industries by county. The most recent data for the Austin area is from the 3<sup>rd</sup> Quarter 2017. **Travis County wages** show an **increase of \$14 over the same quarter for the previous year.**

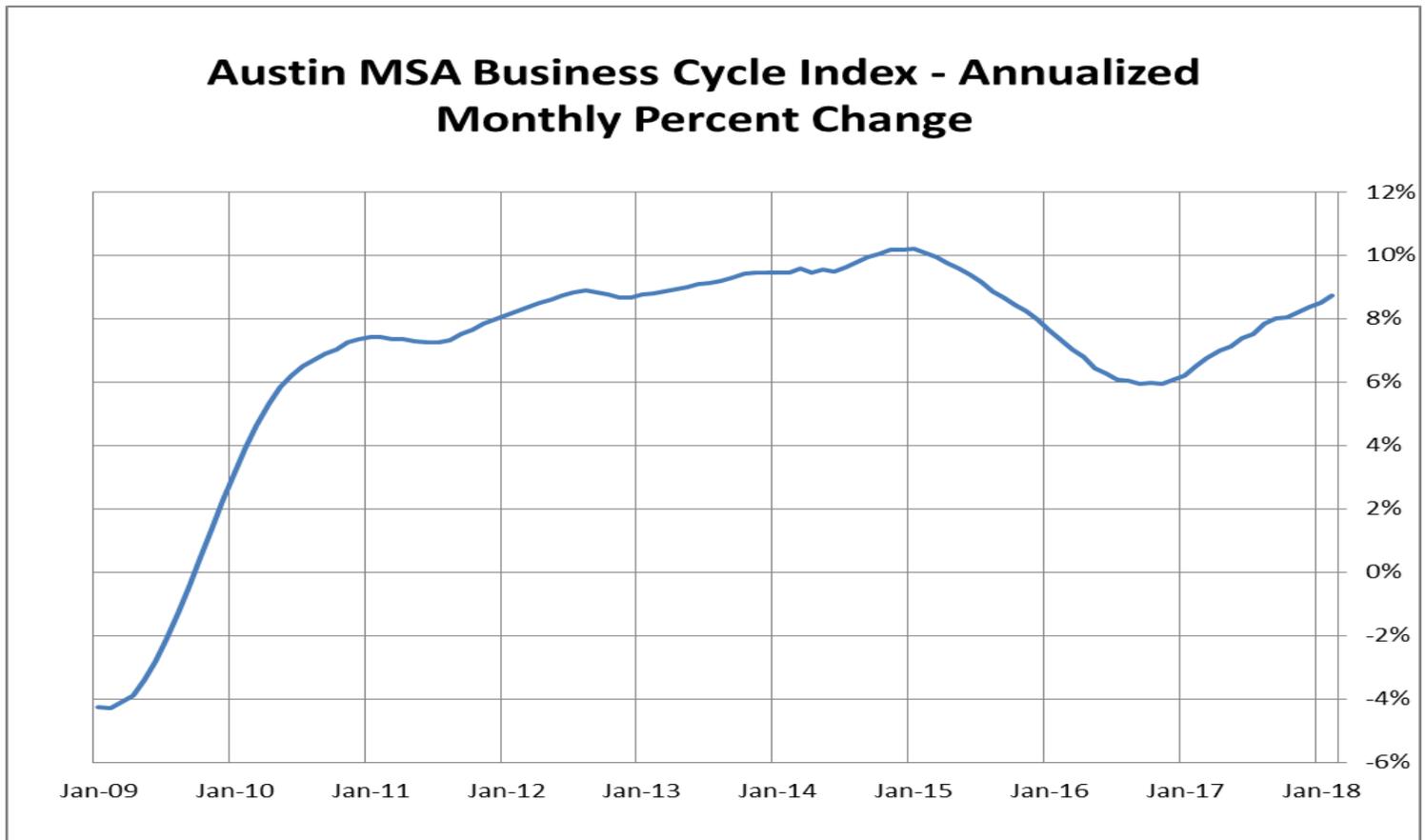
What is included in total wages? “Under most State laws or regulations, wages include bonuses, stock options, severance pay, profit distributions, cash value of meals and lodging, tips and other gratuities, and, in some states, employer contributions to certain deferred compensation plans such as 401(k) plans.” – Bureau of Labor Statistics (BLS)



Source: U.S. BLS, Quarterly Census of Employment and Wages.

## BUSINESS CYCLE INDEX – AUSTIN MSA

“The **Austin Business-Cycle Index** grew at an **8.7 percent** pace in February. This is well above the 6 percent long-term growth rate of the index and last year’s 7.4 percent rate. Job growth of over 7 percent in January and February was a significant boost to the index”– Austin Economic Indicators - Dallas Fed



Source: Federal Reserve of Dallas - Index, 1980 = 100

**Business Cycle Indexes** are meant to reflect broad movements in local economic conditions. The Dallas Fed states that “the [local area] indexes are constructed based on the aggregated movements in the local area unemployment rate, nonagricultural employment, inflation-adjusted wages, and inflation-adjusted retail sales. The weights of the components are statistically optimized for each metropolitan area in order to best capture the underlying cyclical movements in the local area economy.”

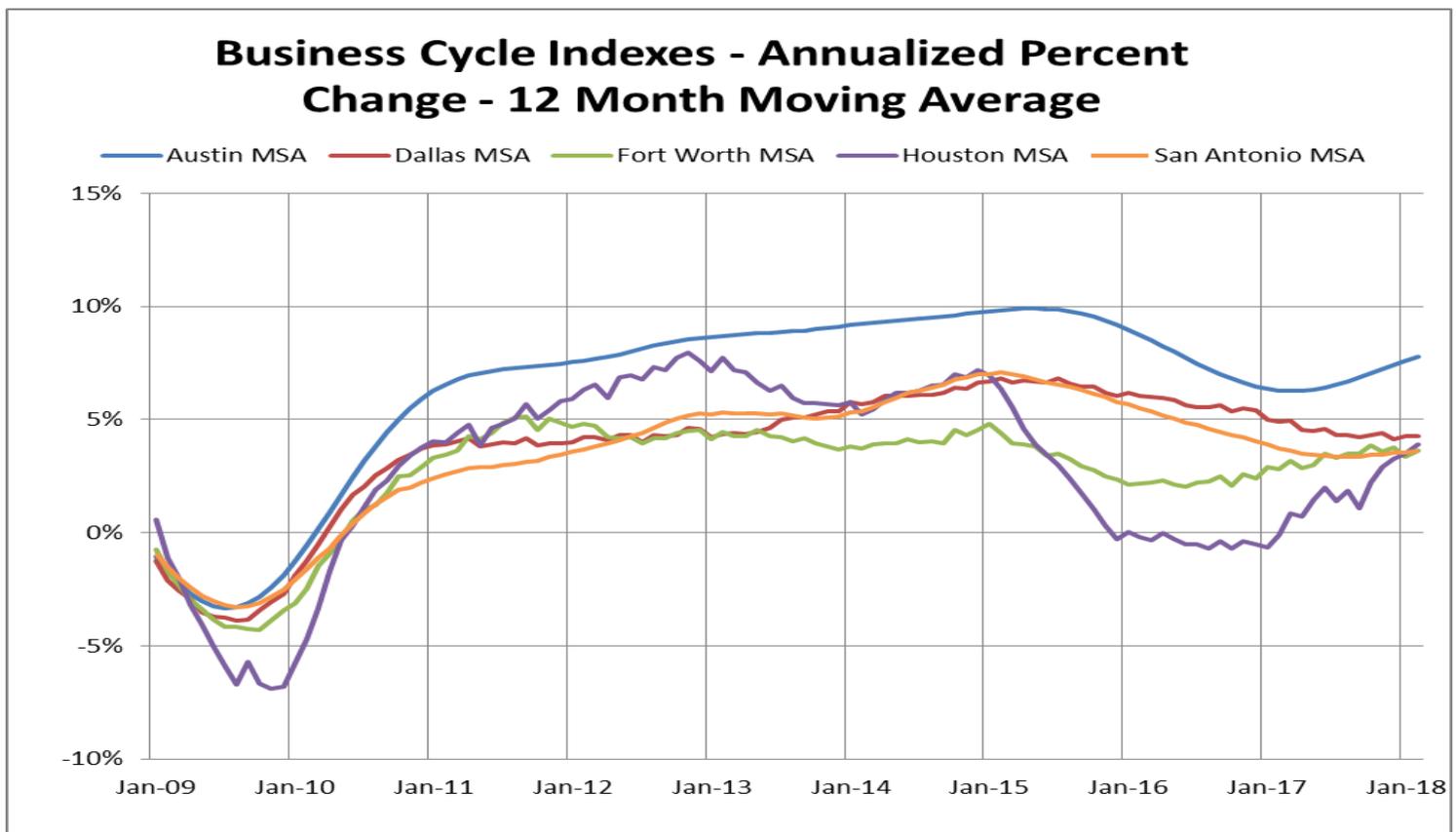
## BUSINESS CYCLE INDEX – MAJOR METROS

In the chart below, a twelve month moving average was incorporated to smooth out short-term fluctuations and highlight longer-term cycles.

“The **Business-Cycle indexes for Dallas and Fort Worth** continued to expand in February. The Dallas index **rose 4.1 percent**, and growth in the Fort Worth index accelerated to **4.4 percent** in February following January’s 2.9 percent increase.” – Dallas Fed – March 2018

“Growth in the **Houston Business-Cycle Index** was **6 percent** over the three months ending in February 2018. The index likely received a significant post-hurricane-Harvey boost. Growth in the index since Harvey has been a robust 7.6 percent—well above its longer-run average of 3.2 percent.” – Dallas Fed – March 2018

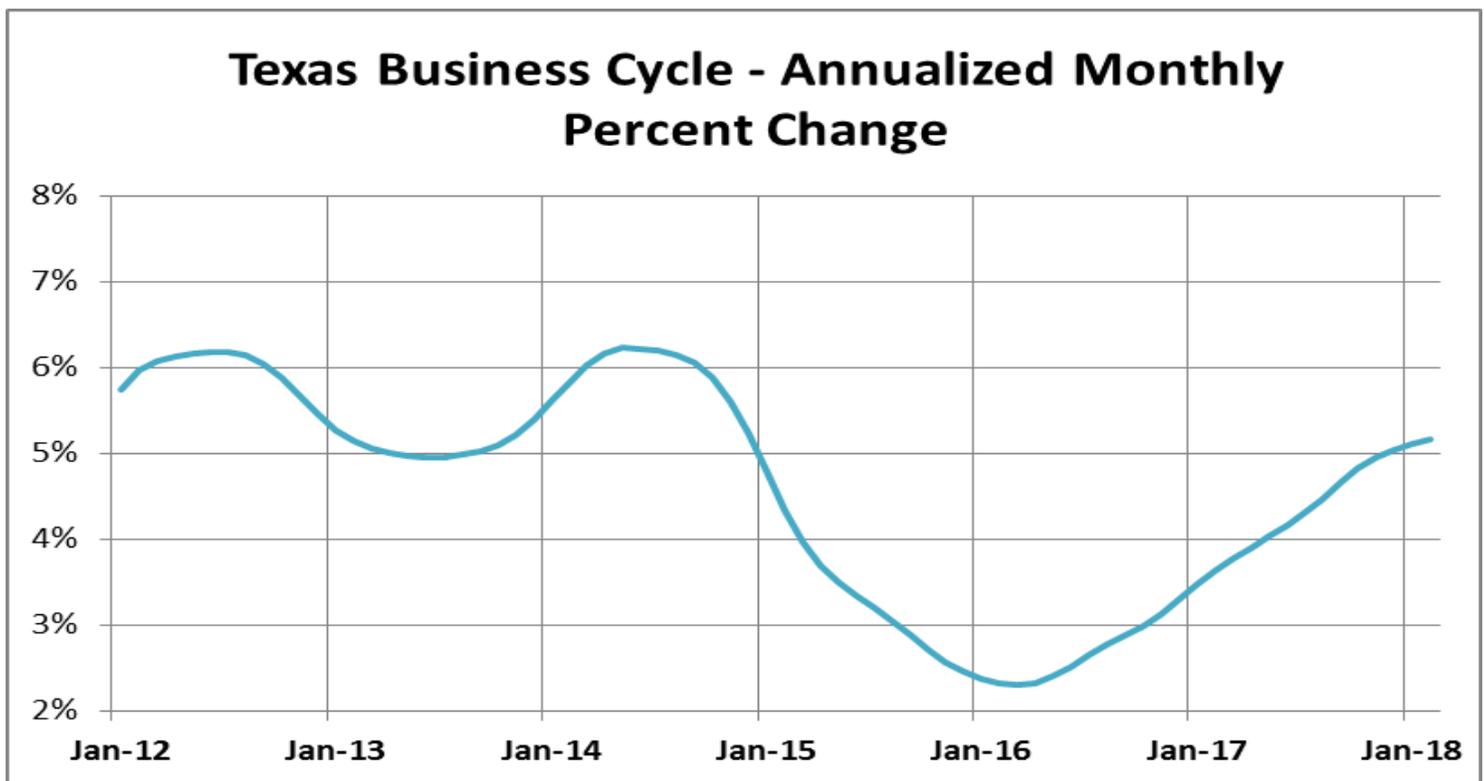
“The **San Antonio Business-Cycle Index** expanded at a **3.4 percent** annualized rate in February, similar to January’s rate. However, this is slightly below the 3.5 percent average rate for 2017. February job growth was positive but weak, and the unemployment rate ticked up slightly. Meanwhile, forward-looking indicators such as help-wanted advertising suggest continued healthy labor demand in the region going forward.” – Dallas Fed – March 2018



Source: Federal Reserve of Dallas - Index, 1980 = 100

## BUSINESS CYCLE INDEX – TEXAS

“The **Texas economy** advanced as the Dallas Fed’s Business-Cycle Index (a measure of current economic activity in the state) posted **5.2 percent quarterly annualized growth**. The metropolitan business cycle indices were positive across the Texas Urban Triangle [Austin, Dallas, San Antonio]. Stagnant wages decelerated the **Houston** index for the second straight month to **5.9 percent**, below its post-Harvey peak of 7.8 percent in December. In contrast, recent wage growth pushed the Fort Worth index above 3 percent after slacking the past three months.” – Outlook for the Texas Economy – Real Estate Center – April 2018

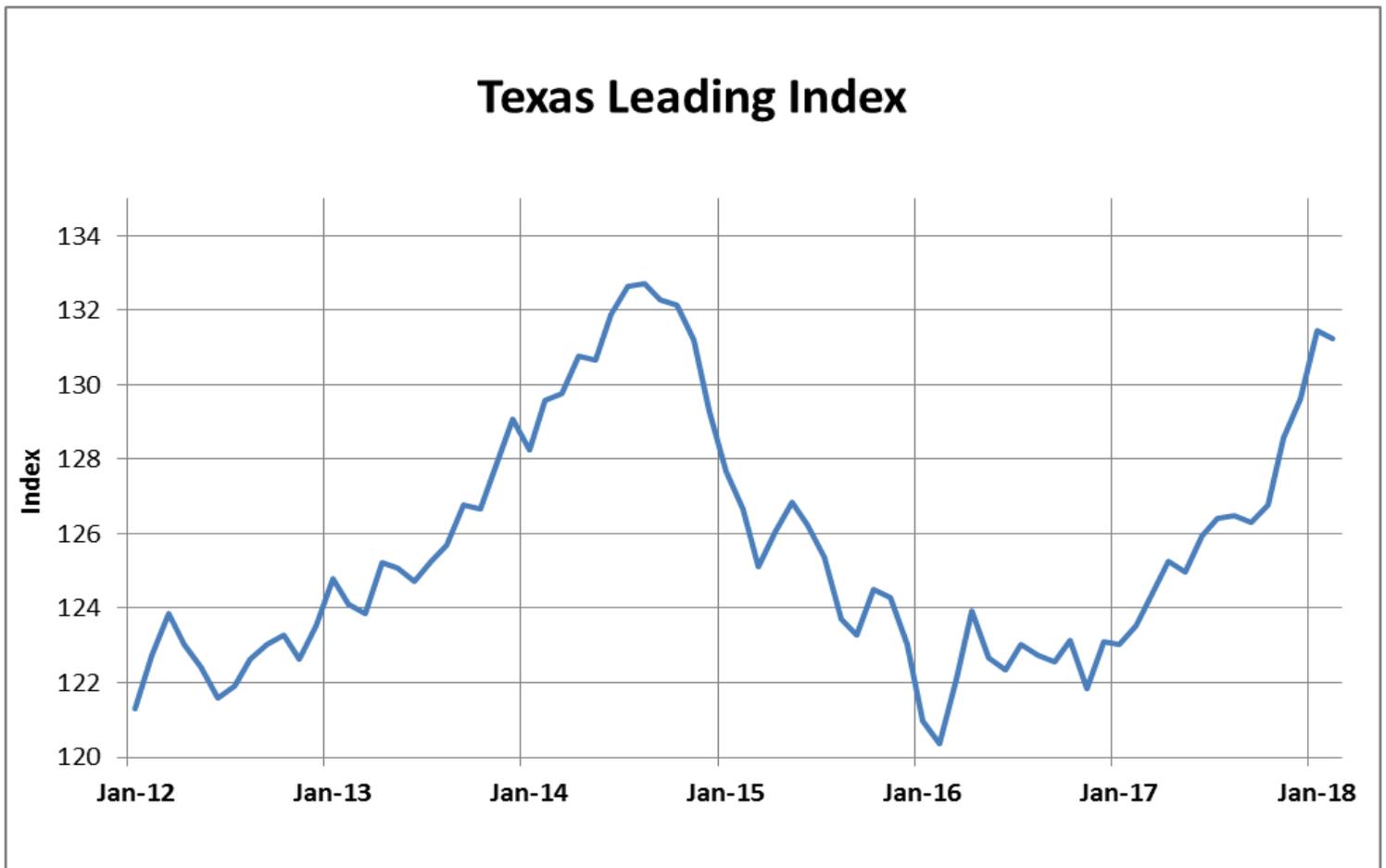


Source: Federal Reserve of Dallas - Index, 1987 = 100

“The **Texas Business-Cycle Index** is a single economic statistic that helps gauge the **current state** of the Texas economy. The Texas Business-Cycle Index is constructed using payroll employment, gross state product and the unemployment rate.”  
– Dallas Fed

## LEADING INDEX – TEXAS

“The **Texas Leading Economic Index** balanced around a **two-year high** amid fewer initial unemployment insurance claims, gains in the U.S. leading index, and declines in the Texas value of the dollar (a weight on Texas export competitiveness).” – Outlook for the Texas Economy - Real Estate Center – Texas A&M University – April 2018

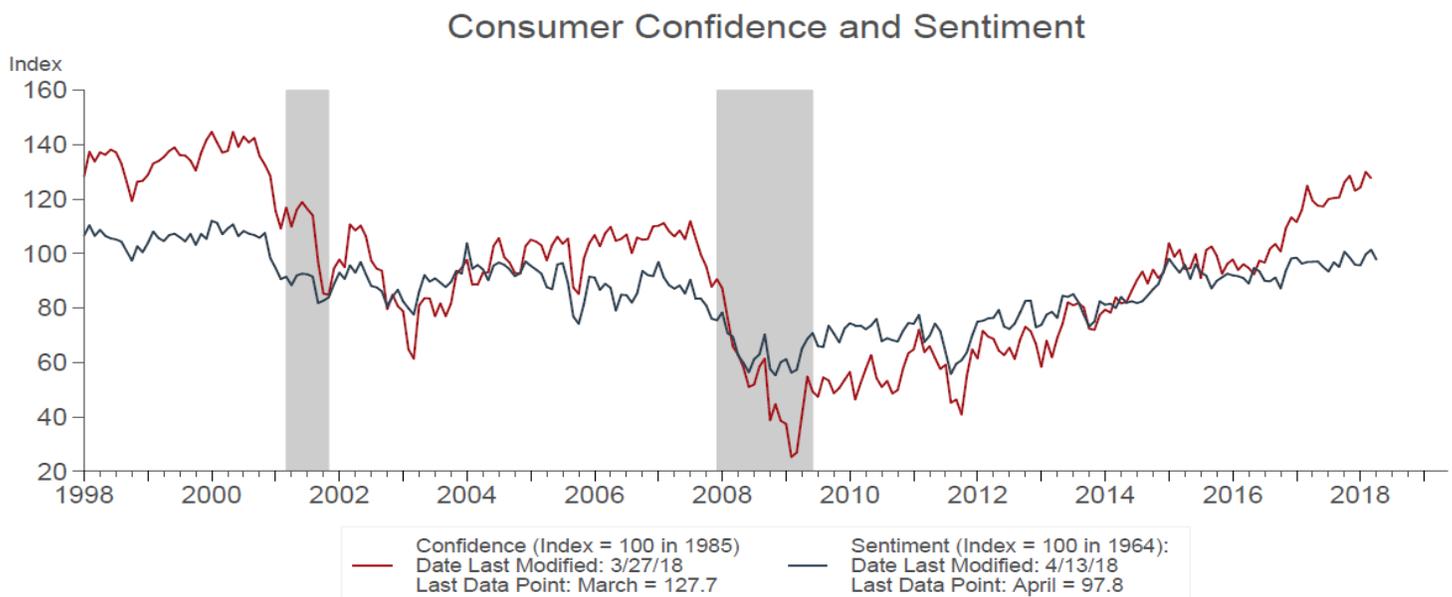


Source: Federal Reserve of Dallas - Index, 1987 = 100

Dallas Fed has defined the **Texas Leading Index** as the “single summary statistic that sheds light on **the future of the State's economy**.” The Texas Leading Index is made up of eight leading indicators that have been shown to change direction – up or down – before the overall economy. The eight indicators used by the Dallas Fed are the Texas value of the dollar, U.S. leading index, real oil price, well permits, initial claims for unemployment insurance, Texas stock index, help-wanted index and average weekly hours worked in manufacturing.

## CONSUMER CONFIDENCE AND SENTIMENT – U.S.

“The Conference Board’s **Consumer Confidence Index** continues increasing, reaching **130.8 in February** from 124.3 in January. February’s value is the **highest since November 2000**. The University of Michigan’s **Consumer Sentiment Index** also increased, from 99.7 in February to **102.0 in March**, both relatively high readings. **Overall, these indicators point to optimism about future growth.**” – Economic Update United States – Federal Reserve Bank of Dallas



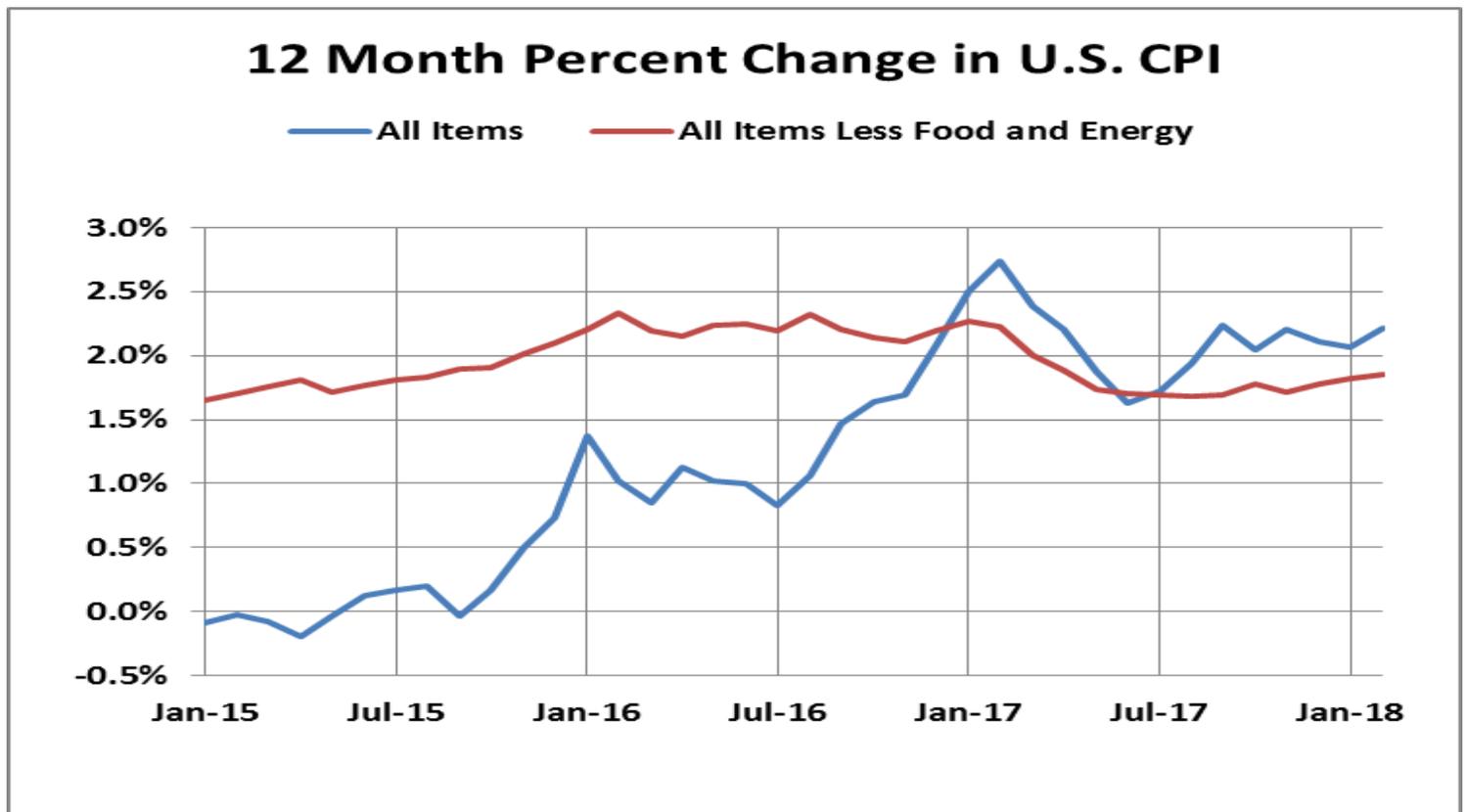
Prepared by Federal Reserve Bank of Dallas

Consumer confidence is measured by two indexes: the Consumer Confidence Index (CCI) and the Michigan Consumer Sentiment Index (MCSI). “The U.S. consumer confidence index (CCI) is an indicator designed to measure consumer confidence, which is defined as **the degree of optimism on the [current] state of the economy** that consumers are expressing through their activities of savings and spending. While index changes of less than 5% are often dismissed as inconsequential, moves of 5% or more often indicate a change in the direction of the economy.” - Wikipedia

The MCSI “s a monthly survey of U.S. consumer sentiment “levels conducted by the University of Michigan. It is based on telephone surveys that gather information on consumer expectations regarding the overall economy. According to the University of Michigan, the surveys ‘have proven to be an accurate indicator of the **future course of the national economy.**’” - Investopedia

## CONSUMER PRICE INDEX

“Along with shelter, apparel, and motor vehicle insurance, the indexes for household furnishings and operations, education, personal care, and airline fares also increased in February. In contrast, the indexes for communication, new vehicles, medical care, and used cars and trucks declined over the month. The **all items index rose 2.2 percent** for the 12 months ending February, a slightly larger increase than the 2.1 percent rise for the 12 months ending January. The **index for all items less food and energy rose 1.8 percent** over the past year, while the energy index increased 7.7 percent and the food index advanced 1.4 percent.” - BLS – Economic News Release

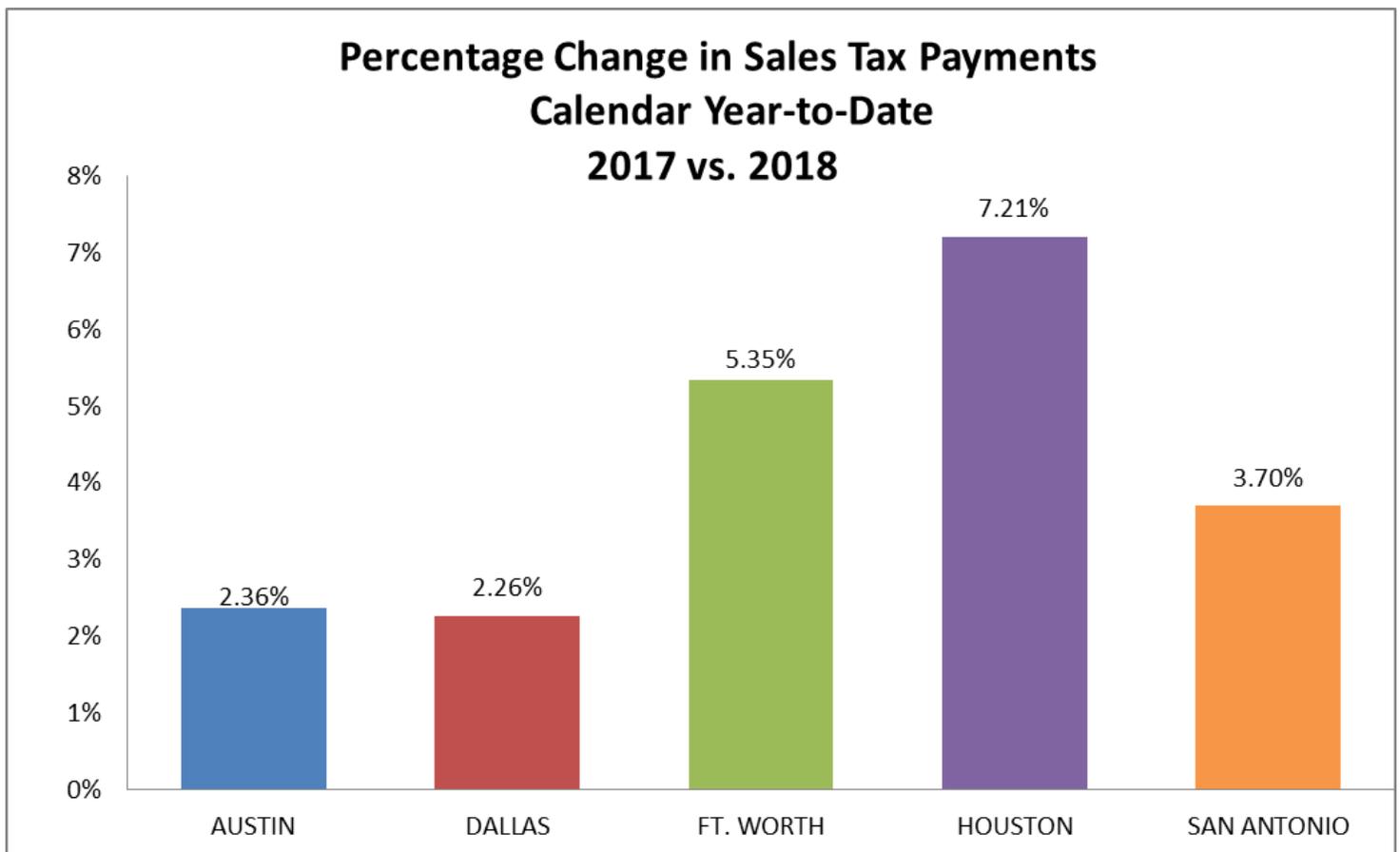


Source: Bureau of Labor Statistics, not seasonally adjusted, 1982-84=100

According to the Bureau of Labor Statistics (BLS), “There are a variety of CPI numbers generated each month. In the graph below, two numbers are compared. The first is the **Official CPI Number** that is reported to the media. It is the broadest and most comprehensive CPI and is called the **All Items CPI for All Urban Consumers**. The second one is called the **All items less food and energy**. The BLS mentions that “Some users of CPI data use this index because food and energy prices are relatively volatile, and these users want to focus on what they perceive to be the ‘core’ or ‘underlying’ rate of inflation.”

## SALES TAX – MAJOR METRO

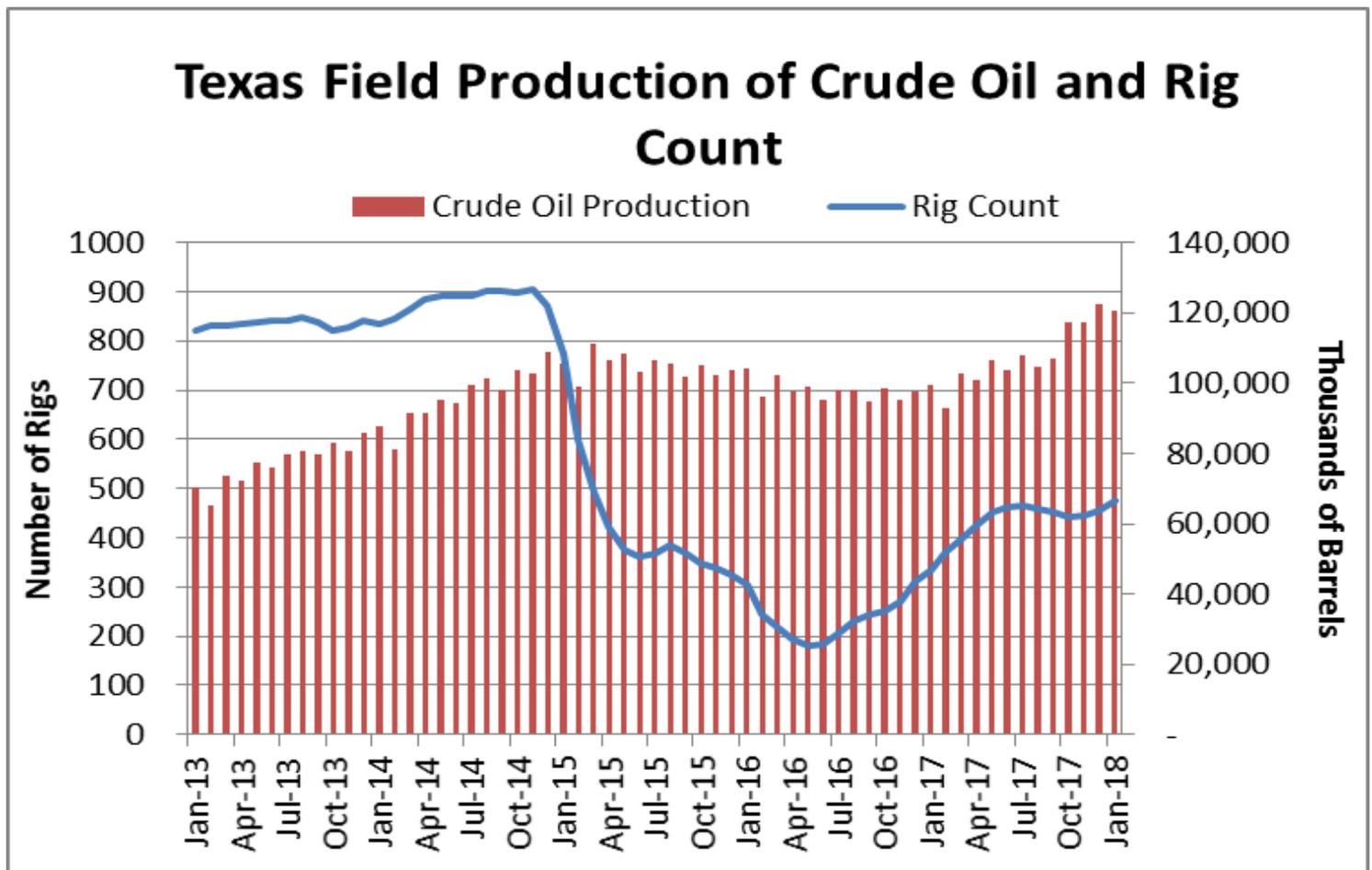
Below is a graph of the 2017 vs. 2018 year-to-date percentage change in Sales Tax Payments made by the State to the five major cities in Texas. Based on the April 2018 report, the increase in **Austin's year-to-date revenue is 2.36% or \$1.7M.**



Source: Texas Comptroller of Public Accounts

## OIL AND NATURAL GAS

“The average West Texas intermediate crude oil spot price ticked down to \$62.23 per barrel but maintained 16.4 percent YOY growth. A stock market correction and persistent U.S. production increases counteracted extended OPEC output cuts. Accelerated drilling activity in the Permian and Eagle Ford Basin lifted Texas’ active rig count to 476, up 28.6 percent YOY. Texas crude oil production accounted for 39 percent of national output at 3.9 million barrels per day, prompting additional pipeline investment in the State. The Henry Hub natural gas spot price receded to \$2.67 per million BTU (British thermal units) as temperatures moderated from January cold fronts.” – Outlook for the Texas Economy - Real Estate Center – Texas A&M University



Source: of Data: Baker Hughes and U.S. Energy Information Administration.

## POPULATION CHANGE

“For every 1,000 Texas residents in 2016, there were an additional 14.3 residents in 2017. Natural increase, measured as births minus deaths, accounted for 7.5 of these new residents, net international migration accounted for 4.0 residents, and net domestic migration accounted for 2.8 residents.”

### Population

Per capita population change\*



\*July 1, 2016, to July 1, 2017, per 1,000 residents in previous year.  
SOURCE: Census Bureau, 2016 and 2017 American Community Survey 1-Year Estimates.

Provided by Federal Reserve of Dallas

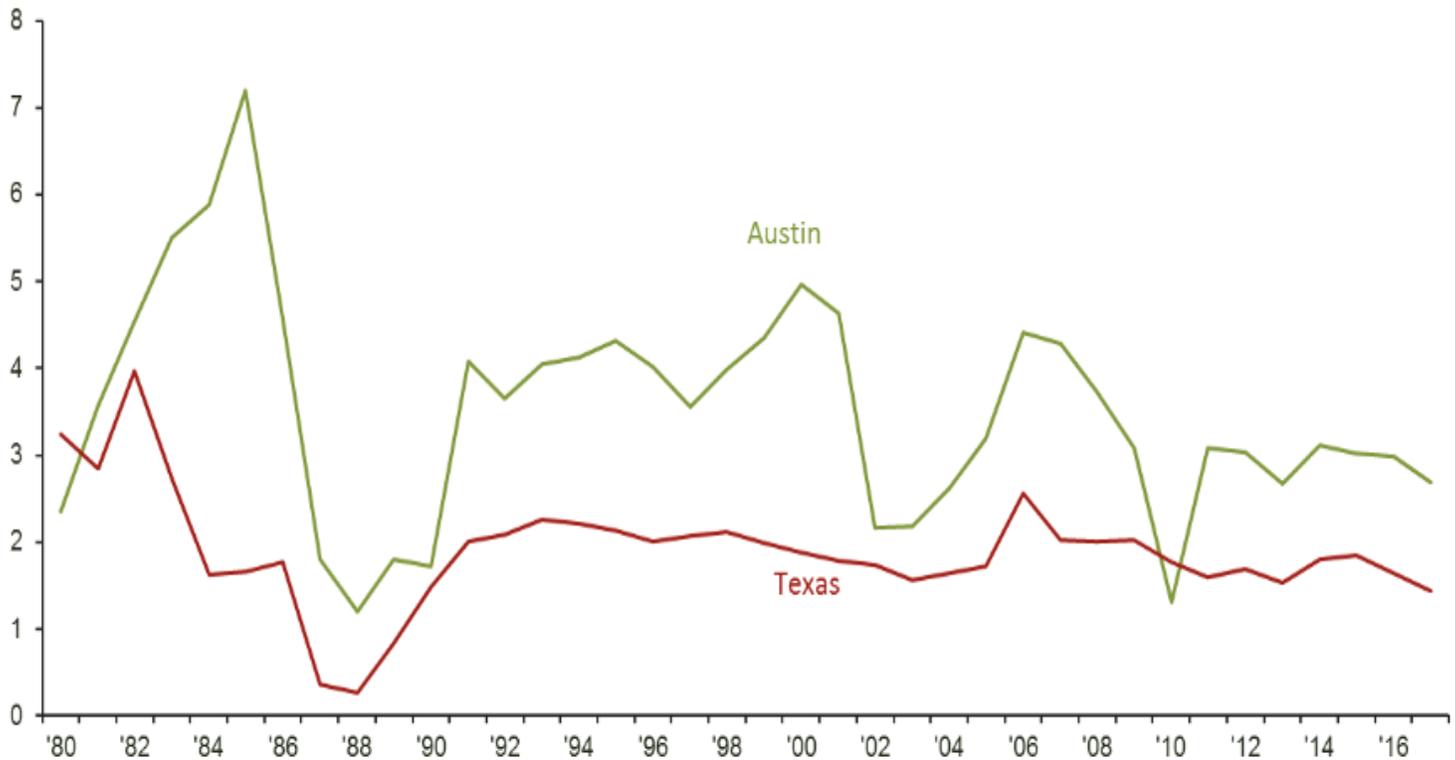
“Austin’s population growth of 26.7 new residents per 1,000 existing residents was the highest per capita population increase among the major Texas metros in 2017. The increase was driven by strong net domestic migration. Houston had the highest per capita natural increase and net international migration among the major metros, though it lost domestic migrants on net during the year. All the major Texas metros had higher rates of natural increase than the U.S., and all but San Antonio and Fort Worth had higher rates of net international migration.” - Texas Economic Indicators – Federal Reserve Bank of Dallas

## POPULATION CHANGE

“Net domestic migration to Texas flourished during and after the Great Recession as the State’s economic health pulled residents away from struggling regions. Recent improvements in the national economy reduced those pull factors, weighing on the State’s overall population growth, while the natural increase (births versus deaths) remained stable.” – Outlook for the Texas Economy - Real Estate Center

### Population Growth

Percent change, year/year



SOURCE: Census Bureau.

“Population expansion in Austin slowed slightly to 2.7 percent in 2017 from 3.0 percent the prior year, below the long-term population growth rate of 3.5 percent since the 1980s. However, this was nearly double the 1.4 percent pace for the State, which has seen population growth slip from a recent high of 1.9 percent in 2015. In comparison, the U.S. has averaged just a 1 percent population increase per year since the early 1980s.” – Austin Economic Indicators – April 2018

## IN-DEPTH – FACIAL RECOGNITION

### WHAT IS FACIAL RECOGNITION?

“A facial recognition system is a computer application capable of identifying or verifying a person from a digital image or a video frame from a video source.” – Wikipedia

### WHAT IS THE DIFFERENCE BETWEEN IDENTIFICATION AND VERIFICATION?

#### Identification Systems

“Identification systems are different from verification systems because an identification system seeks to identify an unknown person, or unknown biometric. The system tries to answer the questions **‘Who is this person?’** or **‘Who generated this biometric?’** and must check the biometric presented against all others already in the database.” – Biometric Update

An example would be identifying an individual from a surveillance photo.

#### Verification Systems

“Verification systems seek to answer the question **‘Is this person who they say they are?’** Under a verification system, an individual presents himself or herself as a specific person. The system checks his or her biometric against a biometric profile that already exists in the database linked to that person’s file in order to find a match.

Because verification systems only need to compare the presented biometric to a biometric reference stored in the system, they can generate results more quickly and are more accurate than identification systems, even when the size of the database increases.” - Biometric Update

An example would be using a smartphone to perform a facial scan to verify that a person has the right to unlock the phone.

## IN-DEPTH – FACIAL RECOGNITION

### WHAT TECHNIQUES ARE USED FOR FACIAL RECOGNITION?

The first task recognition software needs to perform is differentiating between a face and the rest of the background. After this, it uses algorithms to measure the various features of the face and compares it to an existing database.



REUTERS/Bobby Yip Source: [Technology Review](#)

**Traditional Method** – “Some face recognition algorithms identify facial features by extracting landmarks, or features, from an image of the subject's face. For example, an algorithm may analyze the relative position, size, and/or shape of the eyes, nose, cheekbones, and jaw. These features are then used to search for other images with matching features.” – Wikipedia

Traditional methods are limited in their accuracy and usefulness for a variety of reasons. Minor lighting changes can cause failures. If the subject's picture is at too much of an angle, the orientation of the face could lead to errors. Facial expressions such as smiling, frowning and squinting create problems.

**3D Method** – Migrating from the 2D world to 3D provides more accuracy. “Capturing a real-time 3D image of a person's facial surface, 3D facial recognition uses distinctive features of the face -- where rigid tissue and bone is most apparent, such as the curves of the eye socket, nose and chin -- to identify the subject. These areas are all unique and don't change over time.

Using depth and an axis of measurement that is not affected by lighting, 3D facial recognition can even be used in darkness and has the ability to recognize a subject at different view angles with the potential to recognize up to 90 degrees (a face in profile).” – How Stuff Works

## IN-DEPTH – FACIAL RECOGNITION

### WHAT TECHNIQUES ARE USED FOR FACIAL RECOGNITION? (continued)

**Skin Texture Analysis** – “Another emerging trend uses the visual details of the skin, as captured in standard digital or scanned images. This technique, called Skin Texture Analysis, turns the unique lines, patterns, and spots apparent in a person’s skin into a mathematical space.

Surface Texture Analysis, works much the same way facial recognition does. A picture is taken of a patch of skin, called a skinprint. That patch is then broken up into smaller blocks. Using algorithms to turn the patch into a mathematical, measurable space, the system will then distinguish any lines, pores and the actual skin texture. It can identify differences between identical twins, which is not yet possible using facial recognition software alone. Tests have shown that with the addition of skin texture analysis, performance in recognizing faces can increase 20 to 25 percent.” - Wikipedia

**Facial Recognition combining different techniques** - "As every [method] has its advantages and disadvantages, technology companies have amalgamated the traditional, 3D recognition and Skin Textual Analysis, to create recognition systems that have higher rates of success. Combined techniques [have] an advantage over other systems. It is relatively insensitive to changes in expression, including blinking, frowning or smiling and has the ability to compensate for mustache or beard growth and the appearance of eyeglasses. The system is also uniform with respect to race and gender.

**Thermal Cameras** - A different form of taking input data for face recognition is by using thermal cameras, by this procedure the cameras will only detect the shape of the head and it will ignore the subject accessories such as glasses, hats, or make up. A problem with using thermal pictures for face recognition is that the databases for face recognition is limited.” - Wikipedia

## IN-DEPTH – FACIAL RECOGNITION

### HOW DOES APPLE'S FACE ID WORK?

Face ID is the facial scanning system that Apple implemented to replace Touch ID. When you look in a camera, it takes a mathematical model of your face and checks it against an original scan. If they match, your phone will unlock.



Provided by Computerworld – Intel Corporation

The Apple camera captures face data by “projecting and analyzing over 30,000 invisible dots to create a depth map of your face and also captures an infrared image of your face.”

The Apple software “automatically adapts to changes in your appearance, such as wearing cosmetic makeup or growing facial hair. If there is a more significant change in your appearance, like shaving a full beard, Face ID confirms your identity by using your passcode before it updates your face data. Face ID is designed to work with hats, scarves, glasses, contact lenses, and many sunglasses. Furthermore, it's designed to work indoors, outdoors, and even in total darkness.

The probability that a random person in the population could look at your iPhone X and unlock it using Face ID is approximately 1 in 1,000,000 (versus 1 in 50,000 for Touch ID). As an additional protection, Face ID allows only five unsuccessful match attempts before a passcode is required. The statistical probability is different for twins and siblings that look like you and among children under the age of 13, because their distinct facial features may not have fully developed.

Face ID matches against depth information, which isn't found in print or 2D digital photographs. It's designed to protect against spoofing by masks or other techniques through the use of sophisticated anti-spoofing neural networks.

Face ID is even attention-aware. It recognizes if your eyes are open and looking towards the device. This makes it more difficult for someone to unlock your iPhone without your knowledge (such as when you are sleeping).” - Apple

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### HOW IS FACIAL RECOGNITION BEING USED TODAY?

“In China, face recognition is transforming many aspects of daily life. Employees at e-commerce giant Alibaba in Shenzhen can show their faces to enter their office building instead of swiping ID cards. A train station in western Beijing matches passengers’ tickets to their government-issued IDs by scanning their faces. If their face matches their ID card photo, the system deems their tickets valid and the station gate will open. The subway system in Hangzhou, a city about 125 miles southwest of Shanghai, employs surveillance cameras capable of recognizing faces to spot suspected criminals.” – Technology Review

Millions of Chinese already “swipe” their faces on smartphones to authorize payments.” A new twist to this was “On September 1st (2017) Ant Financial, a subsidiary of Alibaba, deployed its “Smile to Pay” system for the first time in a physical store: customers at a healthier version of a KFC restaurant, called KPRO, in Hangzhou, can settle their bill by looking at a screen.” – The Economist



Provided by The Verge



Provided by the Business Insider – Credit:STR/AFP/Getty Images

“College entrance exams across the country [China] use facial and fingerprint recognition to ensure test takers are the real students.” – Business Insider

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### HOW IS FACIAL RECOGNITION BEING USED TODAY? (continued)

“China’s police have been testing sunglasses with built-in facial recognition since at least last month to catch suspects and those traveling under false identities. Police used the sunglasses to check travelers and car registration plates against the government’s blacklist before Parliament’s annual meeting this past weekend. The Chinese government has a list of people who are not allowed to enter the meeting and might face additional enforcement action. The blacklist includes criminals, journalists, political dissidents, and human rights activists, among others.

Previously, the glasses [had] only been tested in [train] stations in Zhengzhou, the capital of Henan Province. By February 8th, police had allegedly caught seven suspects, and 26 travelers using false identities.” – March 2018  
- The Verge



AFP/Getty Images Source: [Business Insider](#)



Alibaba Source: [Business Insider](#)

“Alibaba also has a chain of cashless stores called Hema. Shoppers use their face and phone number to approve payments from their Alipay account.” – Business Insider

“After a spate of kidnappings, some childcare centers only unlock doors to faces registered in its system. One kindergarten has more than 200 security cameras as well as a police station on campus.” – Business Insider

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### WHY DOES CHINA LEAD IN IMPLEMENTATION OF FACIAL RECOGNITION IDENTIFICATION?

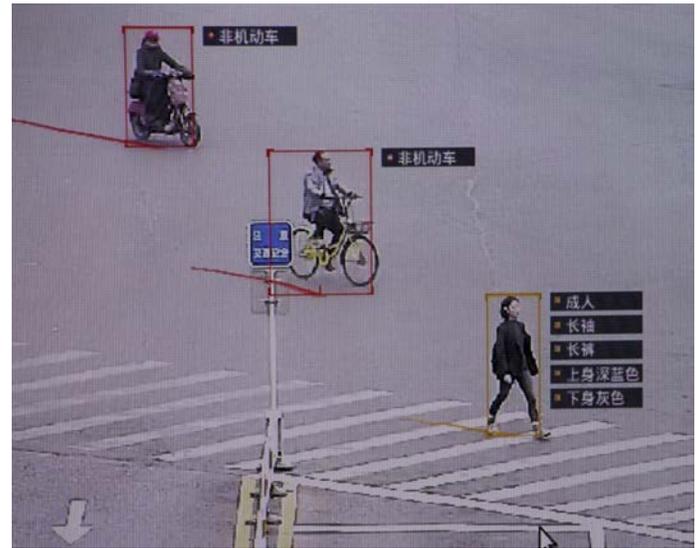
The Chinese government supports the effort.

According to the Washington Post, official documents show that by “2020, China’s government aims to make the video surveillance network ‘omnipresent, fully networked, always working and fully controllable,’ combining data mining with sophisticated video and image analysis[.]”

This government support ensures Chinese corporations developing facial recognition technology are not impeded by privacy concerns and public debate.

The developers have access to “immense amounts of data—photos uploaded by the country’s more than 700 million internet users and a centralized image database of citizens, all of whom must have a government-issued photo ID by age 16.” – WSJ

This large data pool allows the Chinese developed identification systems to be more accurate than their international competitors because in general, the larger the database used to test algorithms, the higher rate of success in proper identification.



REUTERS/Thomas Peter Source: [Wall Street Journal](http://www.wsj.com)

Conclusion: “The intent is to connect the security cameras that already scan roads, shopping malls and transport hubs with private cameras on compounds and buildings, and integrate them into one nationwide surveillance and data-sharing platform.

It will use facial recognition and artificial intelligence to analyze and understand the mountain of incoming video evidence; to track suspects, spot suspicious behaviors and even predict crime; to coordinate the work of emergency services; and to monitor the comings and goings of the country’s 1.4 billion people, official documents and security industry reports show.” –Washington Post

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- Cashless Society 4<sup>th</sup> Qtr 2017
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