Federal Reserve Bank of Dallas

FIRST QUARTER 2019

Southwest Economy

Position as Top Exporting State Exposes Texas to Shifting Trade Policy

PLUS

- Lower Oil Prices, Tight Labor Markets to Restrain Texas Growth in 2019
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Dallas Fed economists expect GDP growth to slow in 2019 primarily due to waning fiscal stimulus, global growth deceleration and slowing job growth due to a tight labor market.

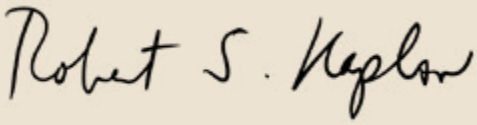
Employment in Texas rose 2.3 percent in 2018, as the state ended the year with a record-low unemployment rate of 3.7 percent, and the U.S. is estimated to have grown gross domestic product (GDP) approximately 3.1 percent. Dallas Fed economists expect GDP growth to slow in 2019 primarily due to waning fiscal stimulus, global growth deceleration and slowing job growth due to a tight labor market. There is an unusually high level of uncertainty embedded in our forecast due to trade uncertainties and other geopolitical risks.

Dallas Fed economists expect Texas job growth will slow to between 1.5 and 2 percent in 2019. This slowing is due to a number of uncertainties as well as the impact of a historically tight labor market.

In "Position as Top Exporting State Exposes Texas to Shifting Trade Policy," Jesus Cañas and Stephanie Gullo assess the state's rapid export growth by measuring the global market shares of the manufactured goods that Texas exports. Texas has a comparative advantage in energy-related products, including petroleum products and petrochemicals, but also in computer equipment and motor vehicle parts, among others. The authors note that tariffs can make Texas producers less competitive domestically and abroad by driving up the costs of intermediate goods imports used in the production process.

Keith Phillips and Judy Teng note in their economic outlook article that one of the biggest constraints facing Texas in 2019 will likely be the tight labor market. The record-low unemployment rate has led to widespread reports of labor shortages, and our Dallas Fed surveys show that 71 percent of employers who cannot find qualified workers say it's due to a lack of applicants.

Dallas Fed economists will continue to produce research that explores key economic trends and discusses their implications. This work has critical implications for how we think about economic growth in our region, the U.S. and the global economy.



Robert S. Kaplan
President and Chief Executive Officer
Federal Reserve Bank of Dallas

Position as Top Exporting State Exposes Texas to Shifting Trade Policy

By Jesus Cañas and Stephanie Gullo

ABSTRACT: Texas enjoys a strong position in world trade, benefiting from its comparative advantage in energy-related manufacturing and intermediate goods exports. As the nation's No. 1 exporting state, Texas faces challenges from shifting trade policies, which tend to erode the cost advantages that benefit the state's leading sectors globally.

Texas is the nation's largest exporting state. With about $260 billion worth of goods exported annually over the past decade, the state has become a powerhouse that benefits from a central geographical location as well as accessible sea and land ports.

Texas exports have soared since the end of the oil bust in late 2016, driven by a large increase in both the volume and price of oil and natural gas exports. Moreover, since 2000, the state has derived 67 percent of its export growth from manufacturing.

However, the state's comparative advantage in the global marketplace has come under growing pressure. A shift in U.S. trade and tariff regulations threatens to directly and indirectly contribute to increasing costs for many leading Texas export sectors that could benefit competitors.

Accounting for 19 percent of U.S. exports, Texas leads California, with a 10.7 percent share, and New York at 4.9 percent in 2018.[1] Texas' annualized 6 percent growth in exports is almost double the U.S. annualized 3.6 percent growth since 2000 (*Chart 1*).

Texas is one of the nation's manufacturing hubs, belying lore of the state as an epicenter of cowboys and cattle. Texas represents 8.4 percent of U.S. gross domestic product, but 9.4 percent of U.S. manufacturing output, second only to California's 13.6 percent share.

Thus, it is not surprising that the bulk of goods exports from Texas, 78.5 percent, in 2018 were manufactured goods. Texas is also the top producer of oil and gas in the country, responsible for more than 4.7 million barrels of oil per day and 22.5 trillion cubic feet of gas. After the removal of a long-standing federal crude oil export ban in 2015, these exports have boomed. Oil and gas represents 18 percent of the state's total goods exports.

By comparison, agricultural and ranching products—including corn, cotton, wheat and soybeans—account for 2 percent.[2]

Manufacturing Across Metros

Houston is a leader in energy-related manufacturing, including machinery and fabricated metal manufacturing and petrochemicals.[3] Dallas and Austin are the computer and electronic components manufacturing centers of the state, while San Antonio and Fort Worth specialize in transportation equipment manufacturing. Fort Worth also boasts a concentration of machinery and fabricated metals production.

Texas offers a central location within North America, a flexible labor market, a low cost of living and an attractive business environment.[4] In addition, Texas shares a border with four of Mexico's most industrialized states. This proximity to Mexico has likely helped Texas manufacturing improve productivity and remain competitive in a globalizing business environment.

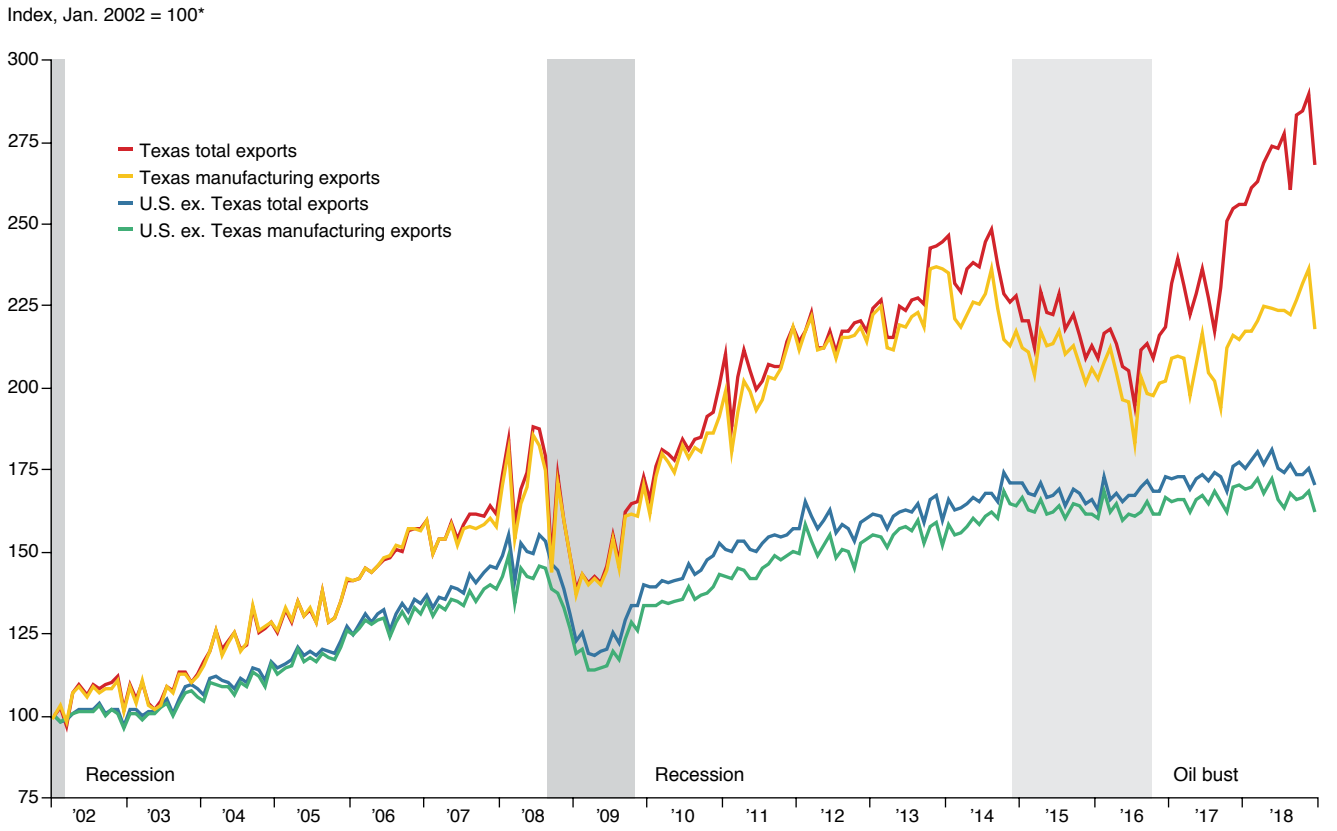
Texas accounts for 1.6 percent of overall world exports, well above the global market share of other U.S. states. The state ranks second in per capita manufacturing exports behind Louisiana.

Diversified Products, Destinations

Manufactured goods accounted for the largest share of the state's exports, 78.5 percent, last year (*Table 1*). Petroleum and coal products was Texas' No. 1 manufacturing export sector, at $55.7 billion and 17.7 percent of the total. Computer and electronic products

CHART 1

Texas Export Growth Almost Double National Rate Since 2000



*Real dollars, seasonally adjusted.

NOTES : Data are through December 2018. Recession shading refers to Texas recessions; oil bust shading refers to peak to trough of Texas oil and gas employment.

SOURCES: Census Bureau; Bureau of Labor Statistics; Texas Workforce Commission; Federal Reserve Bank of Dallas.

($47.9 billion/15.2 percent share) and chemicals ($46.1 billion/14.6 percent share) followed. Transportation equipment and machinery rounded out the top five. These five sectors together represented 62.6 percent of the total.

The second-largest export sector was mining—largely oil and gas—at 18.3 percent of exports. Oil and gas and oil-dependent manufactured goods (petroleum and coal products and chemicals) together make up over half of Texas exports.

Mexico was Texas' No. 1 export destination, receiving 34.8 percent of the state's exports, notably computer and electronic products (23 percent), petroleum and coal products (19 percent) and transportation equipment (10 percent).

The state's No. 2 market destination, Canada, received 8.7 percent of Texas' exports, followed by China at 5.3 percent.

By region, Asia was the second-biggest destination (25.7 percent of exports), followed by Europe (14.4 percent) and Latin America, excluding Mexico (13.7 percent).

Global Comparative Advantage

Comparative advantage refers to potential gains from trade arising from differences in resources or technology that allow a given country to produce a particular good at a lower cost. The revealed comparative advantage (RCA) index, which measures the relative advantage or disadvantage of a country by industry based on that country's export mix, is a widely used method to quantify comparative advantage.

The RCA index is the ratio of two shares: The numerator is a specific good's share of a country's total exports, while the denominator is the share of the same good relative to total world exports.

A country has a comparative advantage in a good if its RCA exceeds 1, and it has a comparative disadvantage if the RCA is below 1. The logic behind RCA is that a country will have a higher share of global exports of a specific good if it has a comparative advantage producing it.

The same methodology can be applied to states. If the RCA for a Texas good exceeds 1, Texas' export share of the product is higher than the world's corresponding share, indicating a comparatively more concentrated production of the item in Texas.

The 17 industries with RCAs greater than 1.1—indicative of a clear competitive advantage—represent two-thirds

of Texas' total manufacturing exports (*Chart 2*). As expected, Texas shows a manufacturing edge in energy-related products; the industry with the highest RCAs is petroleum and coal products. The resin, synthetic rubber, and fibers and filaments industry and basic chemicals round out the top three.

Petroleum products manufacturing is the transformation of crude oil into usable products. Typically, it involves the refining of petroleum into gasoline and diesel. It also includes the production of asphalt coatings and lubricating oils. Basic chemicals manufacturing is the production of petrochemicals such as ethylene, propylene and butadiene—the latter used to make synthetic rubber.

Texas, as the main trade intermediary between the U.S. and Mexico, holds a comparative advantage in intermediate goods exports.[5] Computer equipment and aerospace products and parts have high RCAs and significant export shares. Computer equipment manufacturing includes computers, peripherals and communications equipment as well as intermediate components such as capacitors and resistors.

Companies in the aerospace products and parts manufacturing industry produce aircraft, aircraft components, missiles and space vehicles. Texas also has a comparative advantage in producing motor vehicle parts, fabricated metals, engines and machinery.

TABLE 1 Bulk of Texas Exports Are Manufactured Goods

NAICS description	Billions of dollars	Share of total
Manufacturing		
Petroleum & coal products	$55.7	17.7
Computer and electronic products	$47.9	15.2
Chemicals	$46.1	14.6
Transportation equipment	$25.1	8.0
Machinery ex. electrical	$22.6	7.2
Electrical equipment, appliances and components	$12.4	3.9
Fabricated metal products	$8.3	2.6
Primary metals	$5.7	1.8
Plastics & rubber products	$5.5	1.8
Miscellaneous mfg.	$5.5	1.7
Food products	$5.3	1.7
Paper products	$2.0	0.6
Textile mills	$1.4	0.5
Nonmetallic mineral products	$0.8	0.3
Leather & allied products	$0.7	0.2
Furniture & related products	$0.5	0.2
Beverages & tobacco products	$0.5	0.2
Wood products	$0.5	0.1
Apparel	$0.4	0.1
Printing & related support activities	$0.3	0.1
Textile product mills	$0.3	0.1
Manufacturing total	$247.4	78.5
Mining		
Oil & gas extraction	$57.3	18.2
Mining, ex. oil & gas	$0.3	0.1
Mining total	$57.6	18.3
Agriculture		
Crop production	$5.4	1.7
Animal production & aquaculture	$0.1	0.0
Agriculture total	$5.6	1.8
Total Texas exports	$315.3	

NOTES: All data refer to 2018. Industry values may not add up to total due to rounding. NAICS refers to the North American Industry Classification System. Miscellaneous other categories are not listed but are included in the total. The forestry and logging and fishing, hunting and trapping industries each total less than $500 million and are not included.

SOURCES: Census Bureau; Bureau of Labor Statistics.

Competing with Asia, Europe

RCAs help to identify countries and states with similar comparative advantages, which tend to be direct competitors for export market share. The countries exhibiting RCA patterns that best resemble those of Texas are its likely competitors.[6]

Based on that assumption, Table 2 shows Texas' top five competitors in global manufacturing markets and their top products vis-á-vis the state. Texas competes in manufacturing exports mainly with Asian countries—Japan, Korea and Singapore—followed by Germany and Israel. Texas competes head to head with Asian countries in industrial machinery, electrical and computer components, and motor vehicle parts.

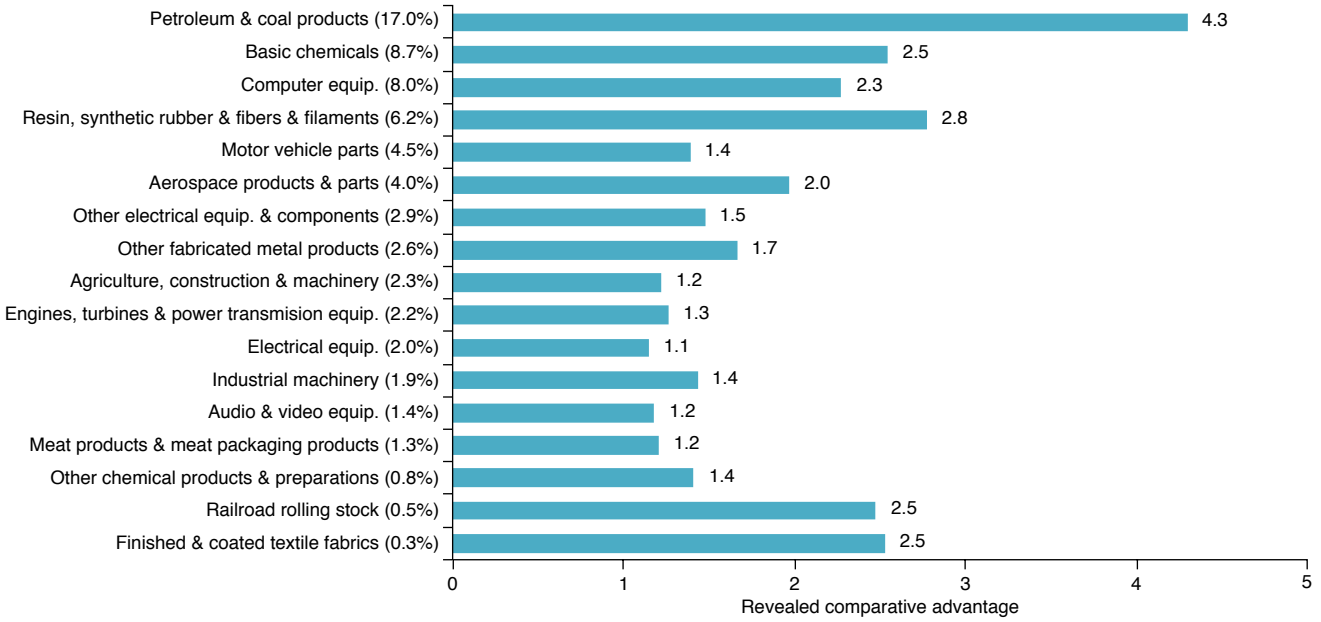
In general, Texas, Germany and Israel vie for market share in the control instruments (transmitters, Ethernet equipment), power transmission, electrical equipment and plastic products industries. Over the past decade, Japan has topped the list of competitors, while Korea has moved up to second place and Singapore has slid to third. Germany and Israel have recently gained relevance as Texas competitors.

Trade Uncertainty, Tariff Impacts

Economists agree that trade has a net positive effect on economic output. However, opening markets to trade remains controversial largely because of its short-term distributional effects,

CHART 2

Texas Has Outsized Concentration in Petroleum and Coal Products Exports



NOTES: The revealed comparative advantage (RCA) index is a measure an entity has in a specific industry that indicates its relative strength; shown are all industries with an RCA greater than 1.1 (indicating a comparative advantage) in 2016. Numbers in parentheses are the share of Texas exports in 2016.

SOURCES: Census Bureau; UN Comtrade; authors' calculations.

which often bestow a relatively small benefit on a large number of consumers while harming a small number of workers by a large amount.

For Texas, trade openness has been favorable on net given that Texas exports have thrived, particularly since implementation of the North American Free Trade Agreement (NAFTA) in 1994.[7] Texas intermediate goods exports gained global competitiveness due to the state's proximity to Mexico's maquiladora industry, the backbone of U.S.–Mexico intra-industry trade.

Conversely, disrupting the U.S.–Mexico trade relationship could adversely affect Texas manufacturing's world market standing. For example, the recently renegotiated (though not ratified) redo of NAFTA—dubbed the U.S.–Mexico–Canada Agreement—proposes stricter rules of origin for the automotive sector along with higher wage requirements that together would likely raise production costs and reduce the competitiveness of motor vehicle parts exports.

Tariff increases involving electronic components imported from China diminish the competitiveness of the computer and electronic products industry. Tech product manufacturers use China-made components, whose cost has increased as much as 25 percent. Tariffs make it harder for Texas to compete for market share against Japan, Korea and Singapore, which may be utilizing the same electronics supply chain, absent the tariff.

Steel and aluminum tariffs directly disrupt Texas manufacturing. Metal fabrication, for example, frequently involves welding, cutting, forming and machining pipes and perforation tools destined for the oil and gas industry. Texas' eighth-largest export is fabricated metals, and additional tariff costs could be passed on to petroleum products firms that depend on now-costlier infrastructure.

Additionally, steel and aluminum tariffs render equipment makers in industrial, agricultural and construction machinery industries less competitive when facing Germany and Israel in the global arena.

Retaliatory tariffs imposed on U.S. goods sent abroad present another cost. In total, retaliatory tariffs have been applied on more than $120 billion worth of goods, representing around 8 percent of U.S. exports.[8]

The future direction of Texas manufacturing exports hinges on trade policy.

The state is poised to draw further benefit from its location and resources, gaining market share worldwide in its industries of comparative advantage. However, disadvantageous trade policies could cause the state to lose ground to its competitors, perhaps curbing manufacturing employment and the state's prosperity.

Cañas is a senior business economist and Gullo is a research analyst in the Research Department at the Federal Reserve Bank of Dallas.

Notes

[1] Exports are measured by origin of movement, or the state from which the merchandise starts its journey to a port of export. For example, goods produced in Chicago and sent directly for export through the port of Houston are measured as Illinois' exports, but if the same goods are first sent to a warehouse in Dallas for further processing or packaging, they would be considered

TABLE 2 Industry Breakdown Among Top Texas Export Competitors

Japan	Japan RCA	Texas RCA
Industrial machinery	3.5	1.4
Motor vehicle parts	2.1	1.4
Engines, turbines & power transmission equip.	1.8	1.3
Navigational, measuring, medical & control instruments	1.5	1.0
Electrical equip. & components not elsewhere specified	1.5	1.5
Korea	**Korea RCA**	**Texas RCA**
Resin, synthetic rubber & fibers & filaments	2.1	2.8
Electrical equip. & components not elsewhere specified	1.9	1.5
Communications equip.	1.5	1.0
Petroleum & coal products	1.5	4.3
Basic chemicals	1.2	2.5
Singapore	**Singapore RCA**	**Texas RCA**
Petroleum & coal products	3.0	4.3
Industrial machinery	2.3	1.4
Resin, synthetic rubber & fibers & filaments	1.8	2.8
Aerospace products & parts	1.6	2.0
Computer equip.	1.4	2.3
Germany	**Germany RCA**	**Texas RCA**
Aerospace products & parts	2.0	2.0
Engines, turbines & power transmission equip.	1.7	1.3
Motor vehicle parts	1.6	1.4
Agriculture, construction & machinery	1.6	1.2
Electrical equip.	1.5	1.1
Israel	**Israel RCA**	**Texas RCA**
Aerospace products & parts	2.3	2.0
Navigational, measuring, medical & control instruments	1.6	1.0
Industrial machinery	1.5	1.4
Plastics products	1.5	1.1
Basic chemicals	1.1	2.5

NOTES: Countries shown are Texas' top five 2016 competitors. RCA refers to revealed comparative advantage index, a measure an entity has in a specific industry. Only industries that make up over 1 percent of Texas exports and that have 2016 RCAs greater than 1 for both the country and Texas are included. Among these industries, each country's top five industries by 2016 RCA are shown.

SOURCES: Census Bureau; UN Comtrade; authors' calculations.

Texas exports. For more information, see "State Export Data: Origin of Movement vs. Origin of Production," by Andrew J. Cassey, *Journal of Economic and Social Measurement*, vol. 34, no. 4, 2009, pp. 241–68.

[2] Trade in services represents 34 percent of U.S. exports but isn't discussed here because data by state are unavailable.

[3] "At the Heart of Texas: Cities' Industry Clusters Drive Growth," Federal Reserve Bank of Dallas Special Report, second edition, December 2018.

[4] *Ten-Gallon Economy: Sizing up Texas' Economic Growth*, by Pia M. Orrenius, Jesus Cañas and Michael Weiss, eds., New York: Palgrave MacMillan, 2015.

[5] See "Intra-Industry Trade with Mexico May Aid U.S. Global Competitiveness," by Jesus Cañas, Aldo Heffner and Jorge Herrera Hernández, Federal Reserve Bank of Dallas *Southwest Economy*, Second Quarter, 2017.

[6] We compute Spearman's rank correlation coefficients, which measure the strength of association between two ranked variables, involving Texas' and each country's RCA indexes for each manufacturing sector. For more information, see note 4, "Texas Comparative Advantage and Manufacturing Exports," by Jesus Cañas, Luis Torres and Christina English, pp. 159–78.

[7] See "Texas Border Cities Illustrate Benefits and Challenges of Trade," by Jesus Cañas, Federal Reserve Bank of Dallas *Southwest Economy*, Fourth Quarter, 2016.

[8] See "Which U.S. Communities Are Most Affected by Chinese, EU, and NAFTA Retaliatory Tariffs?" by Joseph Parilla and Max Bouchet, Brookings Institution, October 2018.

A Conversation with Tom Luce

Civic Leader Seeks to Bolster Texas Attributes by 2036 Bicentennial

Tom Luce, a Dallas attorney, has been involved in a variety of state, federal and civic projects. He played a key role in Texas education reform in the 1980s and served as an undersecretary for education during the George W. Bush administration. He is currently leading Texas 2036, which aims to create a policy roadmap for Texas as it heads toward its bicentennial.

Q. Many know you for your work on behalf of public education reform in Texas. What did you learn from that effort?

I learned several valuable lessons that continue to influence how I approach policy development. First, I learned the power of bringing data to a policy conversation. Without data, you're just another person with an opinion. But if you can really show people data indicating what is happening, they're more likely to focus on the real problem at hand.

Second, I learned that changing policies that actually change lives takes a long time. If you make a change in the K–12 education system, it's going to be five, 10, 15 years before the students in the system today graduate. This means you have to be thinking long term. If you think about how long it takes to get a road built or a dam constructed or change a health care delivery model, the same holds true for other policy areas as well.

I also learned that the successful adoption of a policy is really only part of the equation; you also have to pay close attention to implementation of that policy, both in agency rulemaking and in enforcement.

In 1983, I wrote the legislation that ultimately passed and banned social promotion in Texas. But you know what happened? Social promotion continued because the mechanisms for defining what that meant to thousands of educators was not transparent. I also learned the value of focusing on incremental yet persistent progress.

We made a number of important changes in education in the early '80s in Texas. Those changes were sustained and advanced over the next 20 years, and we saw continuous, positive growth in student achievement across five governors from two political parties. Progress didn't happen overnight, but it happened and our state was the better for it.

Q. In your time working to achieve policy reforms in the state, what have been the most significant challenges?

Data have always been a big challenge, both the lack of available, trustworthy data to inform policymaking and a lack of the utilization of available data by both policymakers and state agencies. I would also say keeping a broad coalition active and focused on achieving and sustaining success over time.

There are so many competing priorities, and it is easy once some sort of policy victory or defeat has occurred for people to drift off toward other issues they are interested in, leaving some core challenges without the broad base of advocates needed to ensure sustained action.

Finally, I would also say that the "tyranny of the urgent" is a big challenge. Legislators in Texas have a lot to do in a short period, and so too often the larger, looming problems that may not be felt yet, but will be here soon, go unaddressed.

Q. What is Texas 2036 and why is it important? Who is behind it?

Texas 2036 is a nonpartisan, nonprofit organization dedicated to ensuring Texas remains the best place to live and work through the state's bicentennial, in 2036 [as the Texas Republic], and beyond. I founded the organization a couple of years ago based upon my belief that we have some serious storm clouds gathering on the horizon but, if we act now, we can adjust course and overcome the challenges.

These are not challenges that can be easily addressed. They are large and systemic and have long timelines, which means there has to be a coordinating force that is working toward long-term, integrated and collaborative solutions; that's the role that Texas 2036 plays.

As I've traveled around the state sharing the data we've collected and the vision for what we want to accomplish, the response has been overwhelmingly positive; people understand we've got challenges up ahead and want to do their part to ensure future generations have the same opportunities they did. I'm grateful that many individuals, foundations and companies in Texas, who we've acknowledged at texas2036.org/support, have generously enabled our work.

Q. What has the Texas 2036 effort told you about what the state could be like in two decades?

Texas is going to continue growing, and our population will likely surpass 40 million residents, with the majority of that growth occurring within the state's Hispanic population. That population growth is going to require substantial job creation—around 6 million jobs—if

Texas has a unique and incredible legacy since its founding nearly 200 years ago, and I want to focus on what we want Texas to be like for its third century.

we are going to keep unemployment where it is today.

To put that in context, that is roughly the number of jobs that exist in the Dallas–Fort Worth and Houston metro areas today. Those jobs are going to require a much higher level of education on average than jobs do today.

Approximately 65 percent of jobs that will exist then will require a national training certificate, a two-year degree or a four-year degree, which our state is currently not doing a great job of helping students achieve. Today, about 22 percent of our high school graduates achieve one of these milestones within six years of graduating from a Texas public high school.

Increases in state health care expenditures have outpaced tax base growth and, if left unchecked, could consume as much as 75 percent of the state budget in 2036; this leaves little money for other priorities, like education and infrastructure.

On the infrastructure front, we need to make sure we have the transportation and technical infrastructure to ensure that people can access jobs and that goods and services can be moved around and exported from the state. At our present pace, we aren't going to have the infrastructure to sufficiently support anticipated growth.

Q. What do you see as Texas' greatest strengths? What makes Texas different?

Texas has so many things going for it: the diversity of people and industry; the abundance of natural resources; its strategic location in the middle of the U.S., North America and Central/South America and large coastline accessible for international trade; and tremendous business and philanthropic leadership. But I think the state's greatest asset is really the spirit of my fellow Texans.

Back in 1982, then-Gov. [William P.] Clements established the Texas 2000 Commission, which focused on ensuring the success of the state in the year 2000. If you go back and look at the priorities the commission members set, they were extremely successful in achieving them, and all of us in Texas today greatly benefited from their work.

In the preface of their report, they said, "Rather than yield the future to a course of events imposed from outside, we are confident that Texans will choose to rely on a great, longstanding asset: the determination to shape their own destinies." I think that sums up well who we are as Texans and why I am confident that we'll be able to address the challenges before us.

Q. With the biennial session of the Legislature under way, what advice can you offer lawmakers?

This is a very big state with many needs and not much time during the legislative session to address them. On day one, lawmakers face the "tyranny of the urgent," which often, though not always, is focused on issues that are not necessarily the most important for the long-term growth and health of our state. That said, I hope to see more conversations in Austin that are based on quality data.

The last thing I'd encourage our representatives in Austin to do is to really think about the long term. Be assertive in addressing future issues now but also evaluate success not on a two- or four-year cycle but over time and hold state agencies accountable for the implementation of policy over time.

Q. As one of Texas' senior statesmen, what do hope your legacy will be?

That's one of the nicest ways someone has ever called me old. But, seriously, I hope that my seven grandsons have children (sooner rather than later and at least one girl) who get to grow up in Texas and have the same opportunities for a quality education and an affordable cost of living and to begin a career, launch a business and start a family like I did in my early 20s.

That's really the driving force behind Texas 2036—ensuring the prosperity and quality of life of this great state for the generations to come. Texas has a unique and incredible legacy since its founding nearly 200 years ago, and I want to focus on what we want Texas to be like for its third century.

Lower Oil Prices, Tight Labor Markets to Restrain Texas Growth in 2019

By Keith R. Phillips and Judy Teng

ABSTRACT: Texas' economy should expand in 2019, though at a slower rate than in the prior year. A decline in oil prices in late 2018, tight labor markets and the possibility of restrictive U.S. trade and tariff policies weigh on the outlook for the state.

Expected slowing in the energy, manufacturing and construction sectors along with continued tight labor markets will likely result in a deceleration of Texas job growth this year.

Leading indicators suggest a 2019 increase of between 1 percent and 2 percent, following an estimated 2.3 percent expansion in 2018.[1] Labor markets are anticipated to remain very tight, with the unemployment rate hovering around the historically low levels reached at year-end 2018.

The Texas economy began to slow in fourth quarter 2018, and leading indicators and business outlooks weakened following strong growth earlier in the year, as indicated in the Federal Reserve Bank of Dallas business surveys. Oil prices peaked in early October, and in late January, they slipped to near the minimum price that producers need for new drilling to begin.

Outlooks from survey respondents improved at the start of 2019, though uncertainty surrounding future trade policy and tariffs remained elevated. Meanwhile, firms throughout the state scrambled to hire qualified workers.

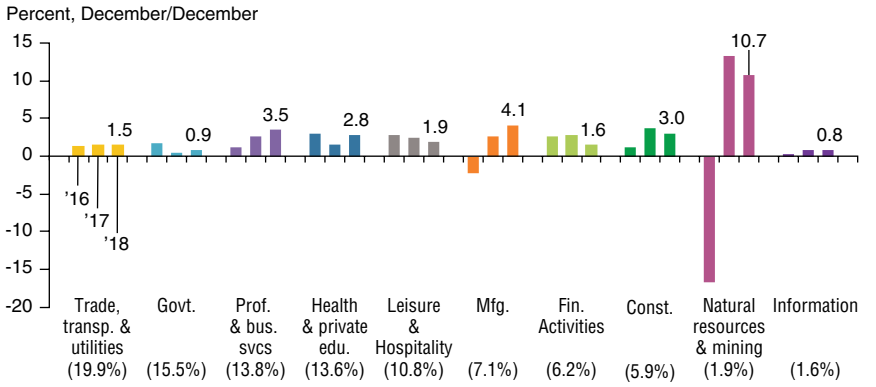
Goods Producers Shine

While job growth was broad based across industries in 2018, goods-producing sectors performed particularly well (*Chart 1*). Construction-sector employment continued its upward trend, expanding a strong 3.0 percent, or 22,000 new jobs.

Job growth in mining (principally oil and gas) slowed slightly from 2017 but remained the strongest sector for a second consecutive year. Manufacturing jobs rose 4.1 percent—the best rate of growth since 2011 and the third highest since 1984.

Residential construction was robust through most of 2018. But three indicators of homebuilding activity weakened late in the year. The five-month moving average of single-family housing construction permits in the state steadily increased through September but fell

CHART 1 Texas 2018 Job Growth Broad Based Across Industries



NOTE: Numbers in parentheses show share of total state nonfarm employment accounted for by each sector. Job growth data are current as of March 1, 2019.

SOURCES: Bureau of Labor Statistics; adjustments by the Federal Reserve Bank of Dallas.

slightly through November, the latest month for which data are available. Multifamily permits and overall home starts also rose through most of the year before declining sharply in September and October. Starts rebounded slightly, while multifamily permits continued to decline in November.

Historically high rainfall across the state in September and October sharply curtailed construction starts.

Rising mortgage rates and tariffs on imported building materials likely also played a role in residential softness.

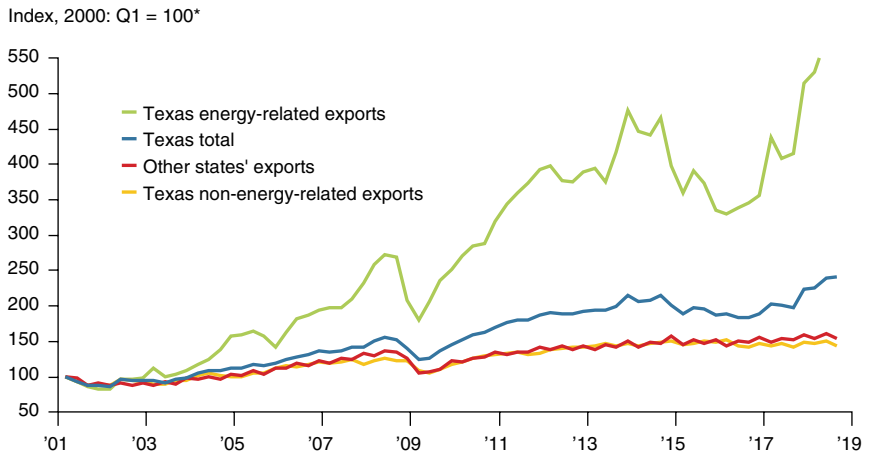
Heightened home-price appreciation over the past six years has reduced housing affordability across the state's large metro areas. The percentage of homes sold that a family earning the median income could afford dropped in the 2012–18 period, from 73 percent to 55 percent in Austin; from 72 percent to 46 percent in Dallas; from 71 percent to 58 percent in Houston; and from 73 percent to 55 percent in San Antonio, according to the National Association of Home Builders-Wells Fargo Housing Opportunity Index.

The manufacturing sector enjoyed a historically strong year in 2018, though production growth slowed sharply near year-end. According to Dallas Fed Texas Business Outlook Survey (TBOS) contacts, tariffs implemented during the year and ongoing uncertainty regarding future tariffs weakened manufacturing growth in the last four months of the year.

Of company executives responding to the Texas Manufacturing Outlook Survey (TMOS) in September, 35 percent said tariffs had negatively affected their firms, while 5 percent cited a positive net impact. Survey contacts also noted that weakening global demand, a stronger dollar and tight labor markets also played a role in the slowing.

While oil prices fell in fourth quarter 2018, the state's oil and gas industry also expanded strongly during the year. The average monthly rig count increased by 19 percent, as West Texas Intermediate oil prices rose from an average of $51 per barrel in 2017 to $65 per barrel in 2018.

CHART 2 Global Demand Propels Texas Energy-Related Exports



*Seasonally adjusted, real dollars.
SOURCE: Federal Reserve Bank of Dallas.

Oil production increased from 3.5 million barrels per day in 2017 to more than 4.4 million barrels per day last year—the highest level since the Energy Information Administration data series began in 1981. Texas oil output made up 41 percent of the nearly 12 million barrels per day produced in the U.S. (as of latest-available figures, for November), the highest U.S. output since 1970.

Strong global demand aided energy production and energy-related manufacturing (*Chart 2*). Despite a strong increase in the Texas value of the dollar in 2018, which made Texas exports relatively more expensive for foreign buyers, exports climbed throughout the year.

Petroleum products, chemicals and oil and gas production have been key sources of the strength of Texas exports, with oil exports playing a key role since a federal ban on them ended in December 2015. Oil exports increased 37.4 percent for the first three quarters of 2018, while non-energy-related exports increased just 2.0 percent.

Appreciation of the dollar relative to the currencies of Texas' export partners affects oil exports less than non-energy related exports. Since oil is priced in dollars around the world, dollar appreciation raises the cost of oil outside the U.S., reducing world consumption, but it does not specifically affect the price of Texas oil relative to oil from other countries. Moreover, since oil is a major input in refining and petrochemicals, appreciation of the dollar raises the relative costs of production outside of the U.S. and offsets much of the relative cost increases of Texas refined products and petrochemicals.

Broad Regional Job Growth

Job growth was broad based across the large metropolitan statistical areas—with growth picking up notably in regions with higher concentrations of goods-producing sectors—consistent with the analysis by industry (*Chart 3*).

For example, activity accelerated in Houston as a center of energy and energy-related manufacturing, and in Fort Worth, with a high concentration in manufacturing. Dallas and San Antonio, which grew rapidly in 2015 and 2016 (despite the energy downturn), slowed over the past two years, indicating the effects of labor market constraints.

Austin was an exception. Despite strong growth over the previous three years and with an unemployment rate that averaged 2.9 percent in 2018, job gains continued at a healthy pace last year. Historically, Austin has had the highest net domestic in-migration rate of large Texas metros, which has provided labor for additional growth. In 2018, the Austin labor force expanded 3.3 percent—the strongest perfor-

mance among large metros—aided by young workers drawn to its tech presence and popular culture environment.

Labor Availability Constraints

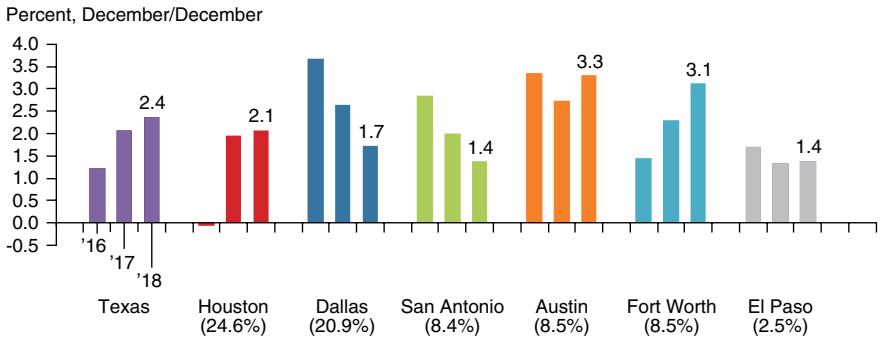
Texas job growth was slower than expected last year, reflecting a lack of available workers. The 2.3 percent increase in jobs in 2018, up from 2.1 percent in 2017, was weaker than last year's forecast of 2.9 to 3.9 percent.[2] Historically tight labor markets suppressed job growth.

The Texas unemployment rate fell to 3.7 percent in the final three months of 2018, the lowest since the data series began in 1976. A total of 66 percent of business contacts responding to the TBOS special questions in November noted they had difficulty hiring qualified workers (*Chart 4*).

While the number of businesses reporting trouble finding qualified workers has been elevated the past two years, at year-end 2018, a record share of firms responded that they increased wages and benefits to recruit and retain employees. More notably, a sharply higher number noted difficulty hiring due to a lack of applicants.

Migration to the state alleviates tight labor markets and speeds up job growth.[3] Statewide, however, after a surge in net migration since 2005, a slight slowing occurred in 2015–16 with the oil bust.

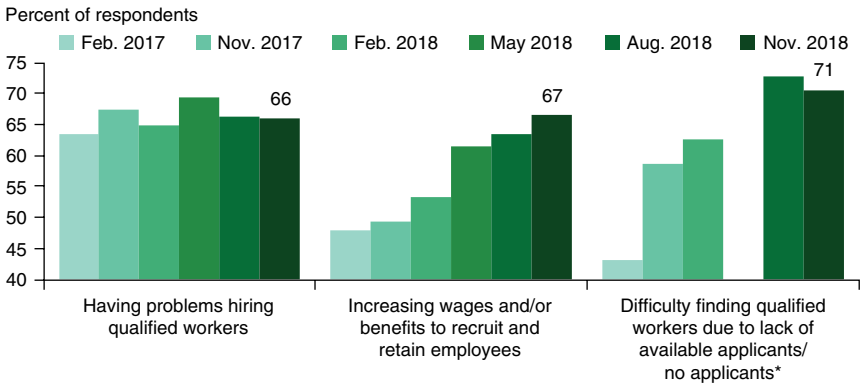
CHART 3 Texas Job Growth Broad Based Across Metros Since 2017



NOTE: Numbers in parentheses show share of total state nonfarm employment accounted for by each metro. Data are current as of March 1, 2019.

SOURCES: Bureau of Labor Statistics; Federal Reserve Bank of Dallas.

CHART 4 Texas Firms Experiencing Shortage of Workers



*Percent of respondents is taken as a percent of those who answered "Yes" to the question: "Are you having problems finding qualified workers when hiring?"

SOURCE: Federal Reserve Bank of Dallas Texas Business Outlook Surveys.

The sharp decline in the energy sector likely resulted in fewer energy workers coming to the state and more energy workers leaving. As the Texas economy recovered in 2017–18, migration remained slightly suppressed, as a strong national economy provided opportunities elsewhere, and many labor markets tightened.

Thus, with most of the country growing at above-average rates, Texas, nonetheless, experienced the largest numerical population gain among the states in 2017–18.

Delayed Oil Price Impacts

The Texas rig count was generally flat in the fourth quarter, and employment in the mining sector increased at an annualized rate of 14.2 percent, despite fourth-quarter oil price weakness.

Past data suggest that the impact of softer prices has yet to be felt. The Texas rig count moves closely with the oil price, with a three-month lag. This is likely because oil and gas companies usually wait to ensure a change in price is not short term, generally have six-month drilling contracts with oilfield service companies and cannot immediately change drilling plans.

This past relationship suggests that the rig count would begin declining by mid-January 2019. Weekly data show that the Texas rig count peaked in the week that ended Jan. 4, at 534 rigs and two months later had declined by 31 rigs.

The impact of oil price changes on drilling activity can also change based on technological developments and supplies of drilling equipment and labor that can affect the cost of drilling. These can affect the breakeven price—the level below which a firm loses money drilling a new well.

Based on the Dallas Fed's Energy Survey for first quarter 2018, the breakeven oil price for new drilling in the Permian Basin in West Texas ranged from $20 to $75 per barrel, with an average of about $50 per barrel. For those drillers with breakeven prices above $55 per barrel, new drilling activity in 2019 is anticipated to be greatly reduced unless prices remain above early first-quarter levels.

2019 Economic Outlook

One way to gauge the Texas outlook is through the Dallas Fed energy, manufacturing and service sector surveys. Respondents to the fourth-quarter Dallas Fed energy survey reported a deteriorating outlook for the first time since first quarter 2016. While more firms said they were increasing planned capital expenditures than said they would lower them, the difference was small—the narrowest since second quarter 2016 when the sector was coming out of the last slump.

Overall, Texas companies reported a sharp weakening of business conditions at the end of 2018, according to the TBOS. However, outlooks improved in January and February.

The Dallas Fed forecasting model, which uses recent momentum in job growth and movements in the Dallas Fed's Texas Leading Index (TLI), predicts job growth between 1 and 2 percent in 2019. Changes in the TLI, which consists of eight economic indicators that tend to change directions prior to movements in the overall economy, have reflected growth expectations in TBOS and the Energy Survey. The leading index declined sharply in fourth quarter 2018, though it rebounded in January.

For the three months that ended in January, the TLI declined, suggesting weaker growth this year. Four of the index's eight components weighed negatively on the index, led by falling oil prices (*Chart 5*). The rebound in the energy sector over the past two years has been an important source of strength in the Texas economy, and the oil price decline may cause the sector to slow sharply, although a collapse is not expected.[4]

The increase in the Texas value of the dollar, which weights the real exchange rates of the dollar with foreign currencies based on the countries to which Texas exports, will likely continue to damp non-energy-related Texas exports. As the dollar rises in value, the cost of goods produced in Texas increases relative to the same goods produced in other countries, depressing international demand for products produced in the state.

Broad leading indicators of the labor market also weakened. The help-wanted index declined slightly, suggesting that firms may be curtailing plans to hire new workers. Initial claims for unemployment insurance rose, a sign that more workers leaving jobs may expect not to immediately find new employment.

The U.S. leading index was unchanged, amid heightened uncertainty in the national economy toward the end of 2018. Continued growth in the U.S. economy is vital for growth in Texas.

Mildly positive changes in the average weekly hours worked in manufacturing, permits to drill oil and gas wells, and the Texas stock index slightly offset the negative signals. Significant stock market gains in January counterbalanced much of the impact of a sharp year-end sell-off. Still, the very slight gain overall suggests that future, discounted corporate profits are expected to grow more slowly in 2019 than last year; this is due in part to uncertainty about economic growth attributable to a weakening of the global economy and lingering tariff and trade concerns.

Main Risks to Outlook

Many potential issues may change the trajectory of the economy in 2019. Unexpected declines in world oil demand or increases in world supply can drive crude oil prices below breakeven prices for more companies, further curtailing drilling activity.

Labor markets are historically tight in both Texas and the U.S. With a relatively unchanged labor force participation rate over the past three years in Texas and slower labor force growth, tight job markets are expected to continue restraining employment growth.

Also, international trade policy negotiations this year present a high degree of uncertainty for many industries. Since Texas is the nation's No. 1 exporting state, a significant trade disruption would likely reduce growth more than is currently projected.

Phillips is an assistant vice president and senior economist, and Teng is a research assistant in the San Antonio Branch at the Federal Reserve Bank of Dallas.

Notes

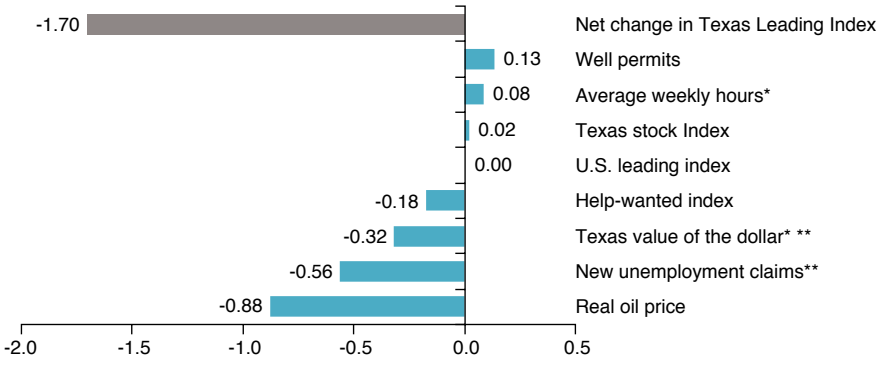
[1] The job growth numbers reported are based on early-benchmarked employment data produced by the Dallas Fed. See, "DataBasics, Early Benchmarking," Federal Reserve Bank of Dallas.

[2] See "Texas Economy Starts 2018 Firing on All Cylinders" by Keith Phillips and Christopher Slijk, Federal Reserve Bank of Dallas *Southwest Economy*, First Quarter, 2018.

[3] See "Gone to Texas: Migration Vital to Growth in the Lone Star State" by Pia Orrenius, Alexander T. Abraham and Stephanie Gullo, Federal Reserve Bank of Dallas *Southwest Economy*, First Quarter, 2018.

[4] For more analysis on the Texas energy outlook, see "Dallas Fed Energy Survey Suggests Oil Price Drop Won't Cause Sector Collapse in 2019," by Michael D. Plante and Kunal Patel, *Dallas Fed Economics*, Feb. 14, 2019.

CHART 5 Negative Contributions Dominate, Send Index Lower
(Net contributions to change in Texas Leading Index)



*This component has been estimated by the Federal Reserve Bank of Dallas for the latest month.
**These components are inverted in the Texas Leading Index.
NOTE: Three-month percent change through January, seasonally adjusted.
SOURCE: Federal Reserve Bank of Dallas.

Abundant Sunshine Not Enough to Power Texas Residential Solar Energy

By Benjamin Meier and Jesse Thompson

The Texas electricity market doesn't shine in residential solar energy despite plentiful sunlight. While Texas is No. 1 in wind power, its residential solar capacity per capita was less than one-third that of the U.S. average in 2017 (*Chart 1*).

One advantage of solar electricity generation is a reduction in greenhouse gas emissions, which have been tied to climate change.

Hot Texas summers and population growth continue to drive record electricity demand. Converting sunlight that would otherwise heat attics into power would seem to hold promise for homeowners.[1] However, compared with other states with similar sunlight penetration, Texas has been slow to adopt residential solar.

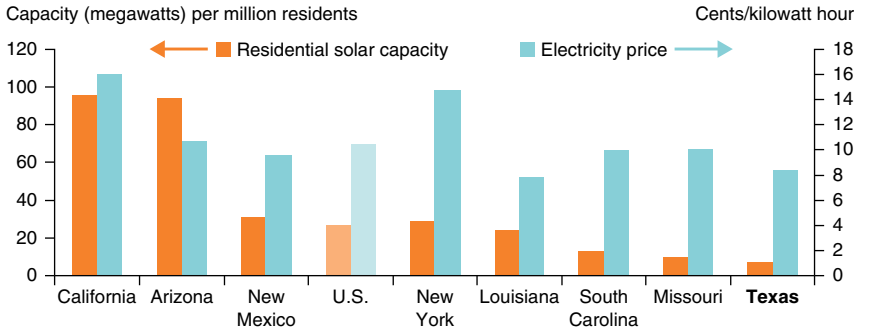
Solar energy, while experiencing robust growth in recent years, still only provides 0.5 percent of Texas' total electricity generation, with residential solar supplying a meager 0.1 percent of total generation. Small-scale residential solar capacity accounted for 15.6 percent of the more than 13,500 megawatts of new net generation capacity added in 2017.

Variety of Factors

Texas is one of only two states in the nation that do not require utility companies to purchase excess energy from residential solar panels, a process called net metering. It allows homeowners to pay only for the net energy they consume or receive a credit if they generate a surplus.

Low electricity prices is another reason Texas homeowners haven't installed solar panels. In fact, even with net metering, the rate at which utilities buy back electricity from homeowners is below the national average. Texas' average price for electricity is 8.38 cents per kilowatt hour, 20 percent less than the U.S. average. The comparatively inexpensive electricity translates into a relatively longer repayment period to recoup an initial residential solar investment, which nationally averages $17,000.[2]

CHART 1 Texas Trails Many States in Residential Solar Capacity



NOTES: Data shown are 2017 average small-scale net metered installed capacity and average retail electric price by state. U.S. capacity is calculated from sum of states.

SOURCES: Energy Information Administration, U.S. Census Bureau.

Renewable Energy Targets

Texas' low renewable energy generation requirements may also have hindered adoption. States that lead in residential solar capacity, such as Arizona and California, have adopted renewable energy production targets of 15 percent or more of total power sold, as well as established solar-specific minimum generation targets to reduce carbon emissions.

A high target increases demand among electricity companies for renewable energy that they may be unable to generate on their own. In those cases, companies can often turn to a market mechanism called renewable energy credits (RECs), electronic credits that can be bought and sold among producers and homeowners to meet renewable energy requirements.

Texas set its first renewable energy target to reduce emissions in 1999 and has since increased its goal three times, most recently in 2006. However, even Texas' highest renewable energy target, at 10,000 megawatts by 2025, amounted to only 9.1 percent of total generation (relative to 2006 capacity). It also did not include a solar-specific requirement.

Additionally, when Texas created its REC market in 1999, homeowners with solar systems couldn't participate, precluding a revenue stream that could encourage home solar panel investment.

Meanwhile, homeowners in states with more residential solar installations often can benefit from an array of government incentives, including direct subsidies, income tax credits and cash rebates. Texas only excludes solar installations from property tax assessments.

Notes

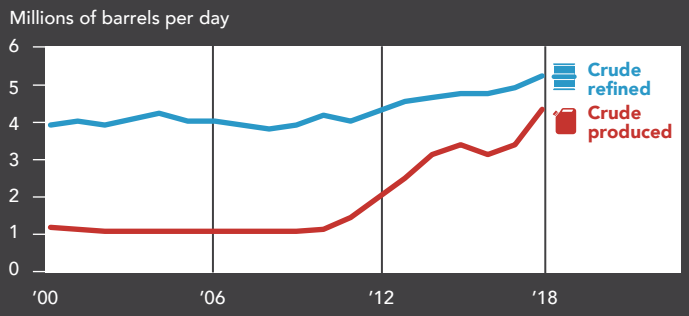
[1] "Citywide Impacts of Cool Roof and Rooftop Solar Photovoltaic Deployment on Near-Surface Air Temperature and Cooling Energy Demand," by Francisco Salamanca, Matei Georgescu, Alex Mahalov, *Boundary-Layer Meteorology*, vol. 161, no. 1, 2016, pp. 203–221.

[2] "Solar Industry Research Data," Solar Energy Industries Association, accessed Feb. 15, 2019, www.seia.org/solar-industry-research-data.

Shale Revolution Boosts Texas Refiners' Competitiveness

Design: Emily Rogers; Content: Jesse Thompson

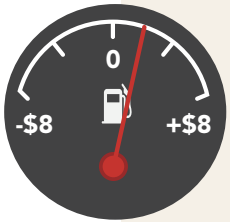
Shale Oil Production Helps Texas Refine Record Amounts of Crude Oil



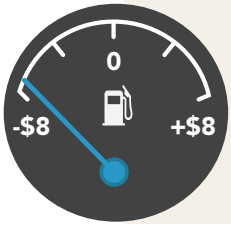
Where do U.S. refiners get their oil?

- 53% U.S.
- 22% Canada
- 16% OPEC
- 4% Mexico
- 3% Rest of the World
- 2% Colombia

Increased shale production cuts prices of domestic oil and natural gas, materials used in refining processes that produce gasoline and other products.



2000–07
Domestic oil costs **$2 more*** than international



2010–18
Domestic oil costs **$7 less*** than international

*Prices are per barrel. International refers to the Brent benchmark; domestic refers to the West Texas Intermediate benchmark.

Natural gas prices more than halved

2000–07 **$6.85**

2010–18 **$3.32**

If Texas were a country, it would rank second in the world in refining capacity.

World Crude Oil Refining Capacity
LEADERBOARD

Russia China Texas
2015

Texas China Russia
2018

NOTES: Natural gas prices refers to the Henry Hub spot price for natural gas. Leaderboard rankings are based on country refining capacity for Jan. 1, 2015, and Jan. 1, 2018.
SOURCES: Energy Information Administration; Oil and Gas Journal, Worldwide Refining Survey.

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SNAPSHOT

Economy Booms in Midland–Odessa

The Permian Basin economy, at the heart of U.S. oil production, has boomed as oil output expanded. Even as oil prices softened beginning in fourth quarter 2018, oil production reached a record of 3.94 million barrels per day in January, up from 3.87 million the previous month.

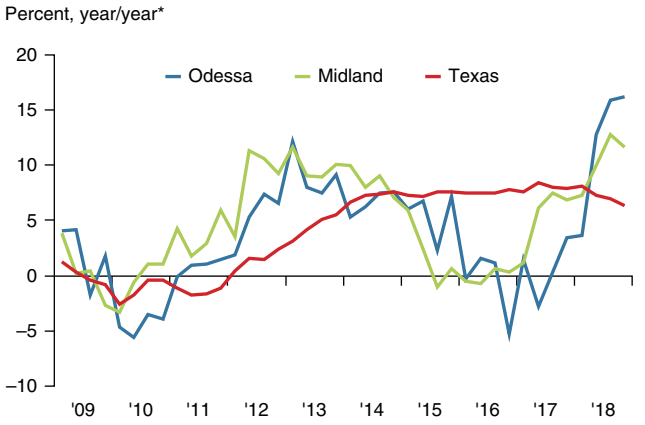
Despite widespread reports of labor shortages, Midland–Odessa employment increased 7.5 percent in 2018, well above Texas' job growth of 2.3 percent.

The local housing market has been tight with the influx of workers. Single-family home inventories in Midland and Odessa were under two months in January, well below the six months that is considered balanced, and the apartment occupancy rate approached 96 percent for 2018.

Fourth-quarter existing-home prices rose 16.2 percent in Odessa and 11.6 percent in Midland from the year before. State home price growth averaged 6.3 percent in 2018, according to the Federal Housing Finance Agency repeat sales index.

—Adapted from Permian Basin Economic Indicators, March 1, 2019

CHART 1 Permian Cities' House Prices Soaring



*Quarterly, seasonally adjusted.
SOURCE: Federal Housing Finance Agency.

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