Federal Reserve Bank of Dallas

THIRD QUARTER 2018

Southwest Economy

New Technology Boosts Texas Firms' Output, Alters Worker Mix

PLUS

PRESIDENT'S PERSPECTIVE

Technology-enabled disruption means technology is increasingly replacing workers. It also means old business models are being replaced by new models for delivering goods and services at lower prices and potentially better convenience. This powerful trend was the subject of a Federal Reserve System conference co-hosted by the Dallas and Atlanta Federal Reserve Banks earlier this year.

As a follow-up to the conference, the Dallas Fed surveyed more than 300 Texas firms to understand how technology has impacted their businesses. Emily Kerr, Pia Orrenius and Christopher Slijk detail the results in their article headlining this quarter's *Southwest Economy*, "New Technology Boosts Texas Firms' Output, Alters Worker Mix."

Companies provided insight into new technologies they were adopting and their impact on operations and costs. Most firms said they adopted technology to boost productivity and keep up with competitors. Most also said technology had not reduced the numbers of workers they employed but did affect the types of workers they needed.

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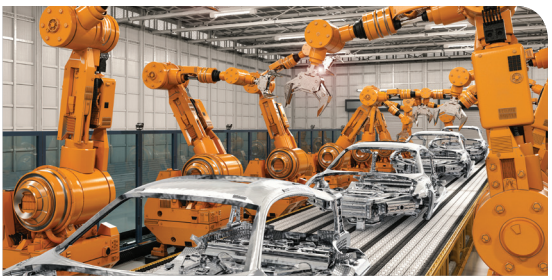
Our work in this area suggests that education and skills training are critical to helping workers adapt to this trend. For example, community leaders can form partnerships to more effectively improve early childhood literacy, college readiness, and skills training at our high schools and community colleges.

Also in this quarter's issue, Jason Saving discusses reasons for rising property taxes in his article, "Texas Property Taxes Soar as Homeowners Confront Rising Values." Although property tax rates have generally not increased in recent years, property tax revenue has grown at a near 7 percent annual rate, mostly due to a 40 percent appreciation in the median value of a single-family home in Texas over the past six years.

As this issue reflects, we at the Dallas Fed are dedicated to producing economic research and analysis that provide insights on key issues important to our region and our nation. Through this work, we hope to make sound monetary policy decisions and inform other policymakers in a manner that improves the economic prospects for our region and nation.

Robert S. Kaplan

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



New Technology Boosts Texas Firms' Output, Alters Worker Mix

By Emily Kerr, Pia Orrenius and Christopher Slijk

ABSTRACT: A Federal Reserve Bank of Dallas survey of manufacturing and services firms in Texas found that as companies adopt new technologies, the number of workers is little changed though the employees' skill levels shift. While some manufacturers see tighter margins as a result of technology and globalization, service sector firms may realize increased pricing power.

Technological change is the economy's greatest opportunity and its greatest challenge. It affects almost every aspect of economic activity, impacting outcomes for firms and workers. Technological change is also what economists believe drives productivity growth and, thus, higher standards of living.

Nevertheless, such evolution doesn't come easy. During the Industrial Revolution, Luddites famously opposed the introduction of new machines they felt threatened their jobs. When it comes to labor, technology can be a complement, as well as a substitute. Robots and other automated factory tools substitute for labor on the assembly line. However, these technologies complement workers who build, program and repair this type of equipment.

Technological change can also reach beyond the walls of the firm and transform how companies interact with workers and customers. Resulting efficiency gains can lower prices of goods and services to the point that higher demand increases industry employment. Ride-sharing platforms such as Uber and Lyft have significantly lowered the cost of travel, increasing ridership and, hence, vehicle-for-hire employment.

The pace of technological change and adoption varies over time. Research suggests the aging of the labor force is leading to an acceleration in automation technology investment and implementation as a substitute for the slower growth of the prime-aged workforce.[1]

To gain insight into the role of technology in business operations in Texas, the Federal Reserve Bank of Dallas queried more than 300 firms in the manufacturing and service sectors in June. Specifically, companies were asked about the technologies they plan to adopt or have already implemented, why they undertook technological change and the impact they expect on firm employment and pricing power.[2]

Emerging Technologies

The Dallas Fed technology survey looked at the emerging technologies in Texas businesses—the ones only narrowly in use now but on the brink of wider adoption. When asked which technologies firms plan to adopt within the next three years, artificial intelligence was most often cited, followed by 3-D scanning, biometric authentication, blockchain and 3-D printing (*Table 1*).

Further analysis shows that significantly more manufacturers than services firms are planning technology adoption in the near future (*Chart 1*). More than one-fifth of manufacturers plan to adopt 3-D scanning, a technology that captures a physical object's exact shape and specifications into a digital 3-D representation.

3-D scanning has tremendous utility in the manufacturing sector for reverse engineering, product development and quality control. Nearly one-fifth of manufacturing firms plan to adopt 3-D printing, a complementary technology for prototyping and design iterations, with additional uses for customization and low-volume production.

A similar 20 percent of firms plan to incorporate robotics into manufacturing processes in the near future, adding to the 20 percent that have already implemented it.

Among service sector firms, artificial intelligence tops the list of emerging technologies, with several companies mentioning the use of machine-learning platforms for analytics and decision insights. Biometric authentication—a technology that can transform access

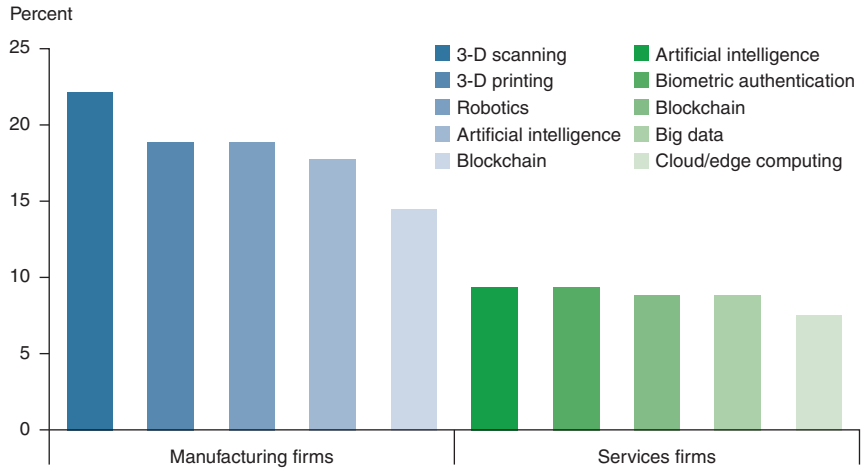
TABLE 1 Top 10 Emerging Technologies Among Texas Firms

	Plan to adopt (%)	In process of adopting (%)	Already adopted (%)
Artificial intelligence (voice recognition, decision trees, autonomous vehicles, etc.)	12	8	5
3-D scanning	11	1	5
Biometric authentication	11	2	8
Blockchain	11	2	1
3-D printing	10	2	7
Big data	10	9	11
Robotics	8	4	10
Cloud computing/edge computing	8	11	42
Virtual reality/augmented reality	6	4	5
Digital currencies (cryptocurrency, bitcoin, etc.)	6	0	2

NOTES: Shown are the top 10 responses to the question, "Which of the following technologies has your firm already adopted? Is your firm in the process of adopting? Does your firm plan to adopt within the next three years?" Data were collected June 12–20, 2018, and 314 Texas business executives responded.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

CHART 1 Manufacturing Leads Services Firms in Technology Adoption



NOTES: Shown are the top five responses by firm type to the question, "Which of the following technologies does your firm plan to adopt within the next three years?" Data were collected June 12–20, 2018, and 224 Texas service sector executives and 90 Texas manufacturing executives responded.

SOURCE: Dallas Fed Texas Business Outlook Surveys.

management for physical and digital resources—is planned for adoption at roughly 10 percent of firms. This is followed closely by blockchain, the decentralized digital ledger technology underpinning cryptocurrencies such as bitcoin, and big data.

In taking stock of the technologies that Texas firms have already adopted, the top responses are not surprising: communication platforms such as email and Skype, social media, high-speed internet, intranet networks and mobile apps. Roughly half or more of firms use these.

Why Firms Adopt New Technology

Adopting new technology is often expensive and disruptive. Firms may require financing, or they may draw on savings. Installation of new equipment may disrupt operations and likely requires retraining workers and spelling out new processes. There is always the risk that the new equipment will not work as intended. Given the high cost and uncertainty, the survey asked firms why they change.

Raising productivity was the No. 1 response, cited as a main reason for technology adoption by two-thirds of firms (*Table 2*). Productivity means doing more with less—producing more output with the same or less input. Services firms secondarily mentioned remaining competitive and/or fending off new market entrants as an impetus, while manufacturing firms disproportionately mentioned lowering costs. More than half of all respondents cited increasing output.

Employment Effects

The Dallas Fed survey next asked how adoption of new technology will affect firm employment over the next five years. Interestingly, technology is not expected to replace workers on net. Only 14 percent of firms said technology adoption will decrease their need for workers, and a similar share said it will actually increase their need for workers (*Chart 2*).

Half of firms expect no impact on employment, and about a quarter of firms said the adoption of technology will change the *type* of workers needed but not the number.

On the manufacturing side, Texas business executives note that production is increasingly automated and technology-dependent, shifting some labor demand from blue-collar workers to programmers, engineers, and robotics and/or computer design specialists.[3]

In the service sector, executives noted a shift to workers who are more technologically adept—conversant in analytics, artificial intelligence platforms and computer programming—and able to handle more sophisticated demands.

Overall Jobs Outlook

Notably, technological adoption has not appreciably changed the overall employment outlook. The majority of

Texas firms surveyed—65 percent—plan to add jobs over the next five years. An additional 26 percent said they would keep employment about the same, and only 9 percent of firms indicated they would decrease employment over the period.

Texas manufacturers are particularly bullish, with 78 percent expecting higher headcounts five years out. Optimism among manufacturers is likely helped by robust conditions in the state's energy industry, bolstered by sustained, relatively high oil prices over the past year or so.

Employment projections vary slightly between large versus small firms. Interestingly, nearly 20 percent of large firms surveyed—ones with at least 500 employees—expect to pare headcounts over the next five years compared with just 7 percent of smaller firms (*Chart 3*). Even still, nearly three-quarters of large firms plan to increase employment.

Broader Trends, Pricing Power

Globalization and technological change are two pervasive forces that define our economic times. Since the fall of the Berlin Wall in 1989 and the end of the Cold War, international trade and exchange have surged. The expansion of global economic activity in developing countries has led to falling poverty and other improvements for some of the world's poorest populations. But there have also been costs. Manufacturers in advanced economies, including the U.S., have sustained steep declines in employment.[4] Thanks to technological improvement, however, manufacturing output has continued to grow.

Against the backdrop of these broader trends in the 21st century, the Dallas Fed survey asked how these long-term industry trends—technological change and globalization—have affected firms' ability to pass on cost increases to customers over the past five years. About half of firms noted there was no net effect on pricing power.

Among the remainder, the breakdown of positive and negative impacts varied between the service sector and manufacturing firms (*Chart 4*). Service sector companies were more likely to report increased pricing power (24 percent) than decreased (19 percent). Respondents pointed to technology as key to their ability to raise prices.

A commercial heating, ventilation and air conditioning company noted: "We have bought some industry-specific customized tools that allow us to complete repairs on equipment much faster than our competitors; we charge for this since there is a benefit of decreased downtime to our customer."

Several services firms also touched upon the significant value in data analytics—an office moving company reported that "technology now allows us to have immediately available metrics to price to a standard and price to demand. … When costs go up, we can model what cost sharing we can push through to our customers." A law firm mentioned that because of cost modeling, it shifted from a billable-hours pricing model to a value-added model, allowing the firm to capitalize on the

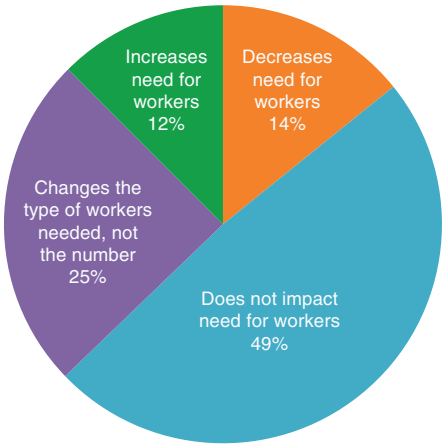
TABLE 2 Firms Adopt Technology Mainly to Raise Productivity

	All Firms (%) (295)	Services firms (%) (209)	Mfg. firms (%) (86)
Raise productivity	66	64	71
Remain competitive/fend off new competitors	53	56	45
Increase output (revenue/sales/production)	53	52	53
Lower costs	40	33	56
Expand into new business lines/markets	19	18	20
Strengthen security and/or protect information	18	19	16
Meet industry standards/government regulations	10	11	7

NOTES: Shown are responses to the question, "What are the main reasons why your firm is adopting these technologies? You may select up to three." Data were collected June 12–20, 2018. Figures in parentheses represent the number of Texas business executives responding.
SOURCE: Dallas Fed Texas Business Outlook Surveys.

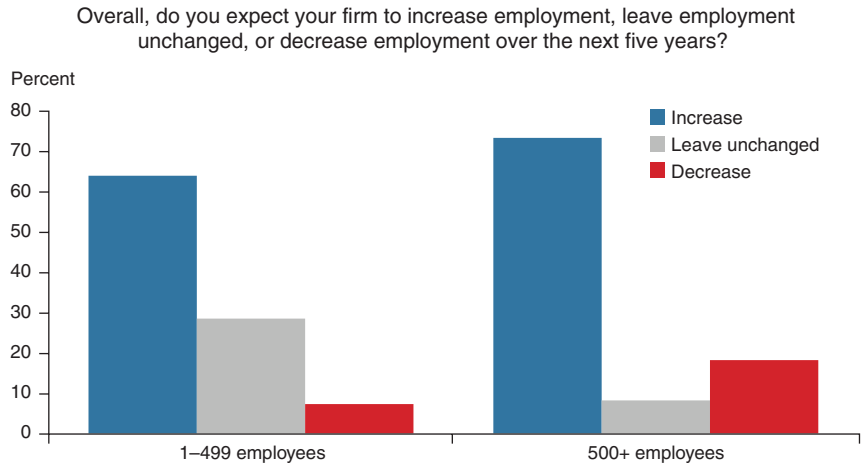
CHART 2 Technology Affects Type, Not Number of Workers Needed

On net, how will the adoption of these technologies affect employment at your firm over the next five years?



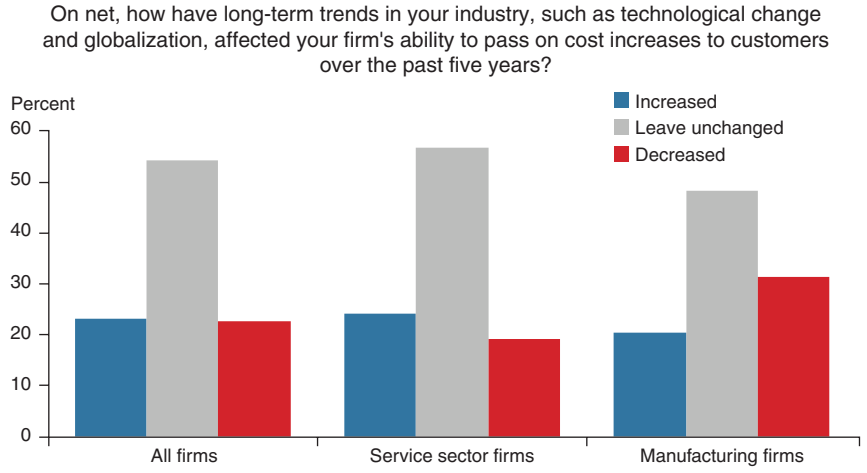
NOTE: Data were collected June 12–20, 2018, and 296 Texas business executives responded.
SOURCE: Dallas Fed Texas Business Outlook Surveys.

CHART 3 Employment Expectations More Polarized Among Large Firms



NOTE: Data were collected June 12–20, 2018, and Texas business executives from 248 small firms and 49 large firms responded.
SOURCE: Dallas Fed Texas Business Outlook Surveys.

CHART 4 Technology, Globalization Lift Pricing Power for Services, Not Manufacturing



NOTE: Data were collected June 12–20, 2018, and 203 Texas service sector executives and 83 Texas manufacturing executives responded.
SOURCE: Dallas Fed Texas Business Outlook Surveys.

time savings of automating repetitive-type work and other business efficiencies technology has prompted.

Conversely, among manufacturers, an outsized share experienced a declining ability to raise prices, a response consistent with greater exposure to international competition and surging imports from China. A textile manufacturer commented, "Our clients are getting very aggressive in sourcing from all corners of the globe." A fabricated metals producer mentioned that "Our domestic customers have many more options to find lower-priced products in the international marketplace than ever before and, with the internet, can find those options easily."

A high-tech producer said, "My customers are being approached by foreign companies to provide products similar to ours. They use that information as leverage to keep my prices low."

Increased Firm Productivity

The June 2018 Dallas Fed technology survey yielded unique insights into what technology Texas firms are adopting and why, as well as how they view their long-term prospects. Firms adopt new technology to increase productivity and, as a result, their long-term employment prospects remain bullish.

Texas firms are not adopting technology to shed workers, although one-quarter of respondents said adopting new technology changes the types of workers needed.

Policymakers and education and workforce experts should take note: Employment will continue growing in Texas firms but the type of skills in demand is evolving. Just as firms must be agile and ready to adopt new technology, workers have to be flexible and attentive to changing job market needs.

Kerr is a senior business economist, Orrenius is a vice president and senior economist, and Slijk is an assistant economist in the Research Department at the Federal Reserve Bank of Dallas.

Notes

[1] "Demographics and Automation," by Daron Acemoglu and Pascual Restrepo, National Bureau of Economic Research, Working Paper no. 24421, March 2018.

[2] For complete results, see www.dallasfed.org/research/surveys/tssos/2018/1806/specquest.aspx. The survey was a follow-up to the conference, "Technology-Enabled Disruption: Implications for Business, Labor Markets and Monetary Policy," held in May at the Federal Reserve Bank of Dallas and cohosted by the Federal Reserve Bank of Atlanta. For conference program and agenda, see www.dallasfed.org/research/events/2018/18ted.

[3] A follow-up anecdotal survey was conducted via email to gather further insights from firms on how technology affects the type of worker needed and how technological change and globalization impact pricing power. Twenty-two business executives submitted responses June 29–July 9, 2018. Comments from this survey are referred to here and as anecdotes in this article.

[4] Since 1990, manufacturing employment in Texas has declined just 10 percent, compared with nearly 30 percent for the U.S. as a whole.

Texas Property Taxes Soar as Homeowners Confront Rising Values

By Jason Saving

ABSTRACT: A precipitous rise in the amount of property taxes Texans pay has accompanied an uncharacteristically large increase in property tax valuations. Because a variety of local jurisdictions provide services that elsewhere are state responsibilities—particularly public education—there are limited ways to rein in rising property taxes across Texas.

Property taxes in Texas have risen markedly in recent years. Complaints about soaring appraisals have become ubiquitous as have calls from the public to "do something" about ever-rising property tax bills. The situation has begged the question of whether these developments have jeopardized Texas' status as a relatively low-tax state, potentially harming long-term economic growth.

Yet Texas is distinctive as one of only seven states without an income tax at either the state or the local level, suggesting that sales and property taxes might be somewhat higher in Texas than elsewhere.

The amount of property taxes has jumped in recent years because of not only tax rate changes, but also rapidly rising home prices—a product of people having more housing wealth. The increase has created a sense that the total state and local tax burden in Texas is no longer competitive with taxes in other states, even as the total burden today remains well below the national average.

Still, property tax rates are comparatively high in Texas and pose a greater burden as personal income rises more slowly than property values, raising questions about both the economic arguments for property taxation and the implications of reducing that burden.

Relatively High Burden

The first step in assessing the property tax situation is determining how much higher property tax rates are in Texas than elsewhere. In 2016, Texas' average property tax rate of 1.86 percent was the sixth-highest in the nation, over 50 percent more than the national median of 1.19 percent (*Chart 1*).[1] For a $250,000 house, this translates into a tax payment of $4,650, compared with the national average of $2,975—a sizable burden in a state whose average income remains slightly below the national average.

An examination of where all of this money goes and who imposes property taxes in Texas sheds additional light. Numerous local taxing entities provide a wide variety of services. School districts are perhaps the best known. Fifty-four percent of Texas property taxes were paid to school districts in fiscal 2015, the last year for which full data are available (*Chart 2A*).

Property taxes are also levied by counties (17 percent of the burden), cities (16 percent), special-purpose districts such as hospital and utility districts, community college districts, water districts, development/improvement districts and emergency-services districts.

Multiple Local Entities

All told, more than 4,000 local government entities collect property taxes in Texas. By law, payments must be based on the current assessed value of property, though there are exceptions for property owners' primary residence (homestead exemptions), land used for designated purposes (such as agriculture, which is sometimes eligible to be taxed at a lower rate) and property owned by certain people (such as seniors, who are sometimes eligible to freeze their payment levels).[2]

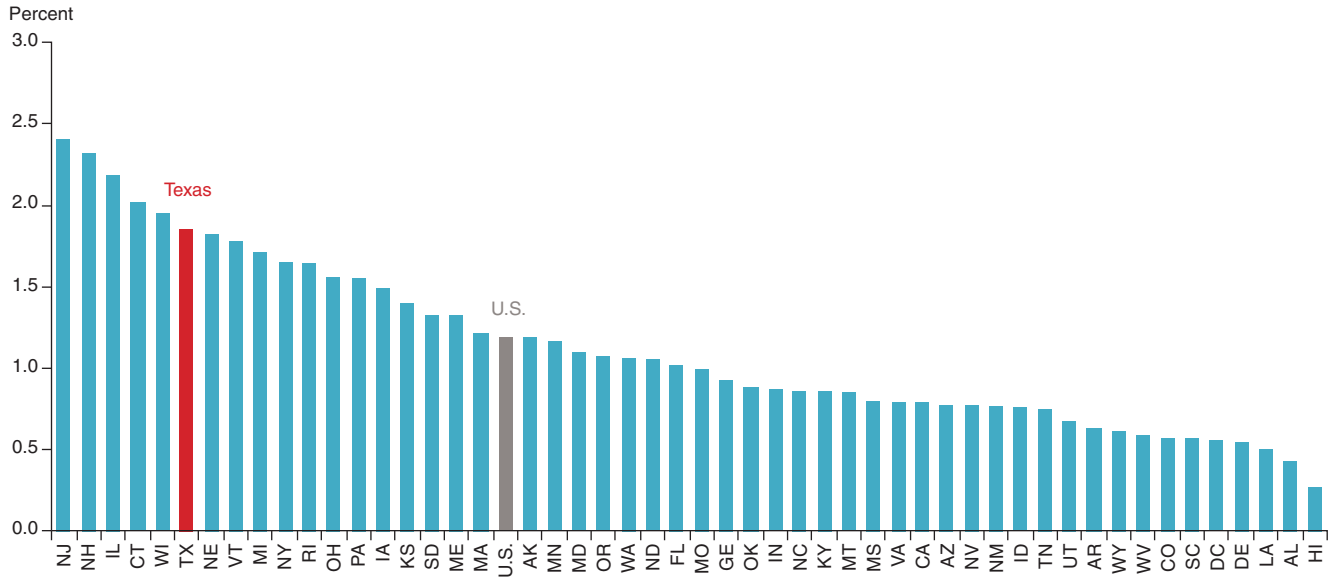
Single-family homes represent 51 percent of the state's total property tax base, with commercial and industrial businesses composing another 35 percent and multifamily residences 6 percent.

In fiscal 2015, property taxes made up about 42 percent of Texans' total state and local tax burden.[3] While less than the 50 percent for sales and use taxes, it is significant (*Chart 2B*).

Property taxes are not only high, but also rapidly rising in the state. Following

CHART 1

Median Property Tax Rate in Texas Exceeds National Average



NOTE: Property tax is calculated by dividing the median real estate taxes paid by the median home price.
SOURCE: Census Bureau, 2012–16 American Community Survey 5-year estimates.

a three-year lull during and immediately after the Great Recession, property tax revenue has grown at a 6.9 percent annual rate since 2012, with the proceeds distributed fairly evenly among schools, counties, cities and other taxing districts (*Table 1*).

While the available data stop at 2015, anecdotal evidence suggests the trend continued in subsequent years. By comparison, household income grew at a 2.7 percent annualized rate in 2012–15 and a 2.9 percent rate in 2016–17, adding to the perception that Texans are increasingly burdened by property taxes.

Rising Property Values

Property tax burdens have increased rapidly in recent years. While it's possible that tax authorities have raised rates so quickly that revenue growth has outstripped home prices, in reality overall property tax revenue growth for Texas jurisdictions has actually trailed real estate price appreciation in recent years. Annual tax revenue growth trailed appreciation by 0.9 percentage points in 2012–15 (and the trend has likely continued). Some jurisdictions no doubt markedly raised their rates, but a better explanation is needed for why property tax revenue increased so quickly.

If higher rates can't fully explain rising property taxes, perhaps increased home valuations can. Chart 3 suggests home values have, indeed, risen rapidly. Over the past six years, the Texas median home price has jumped nearly 40 percent, in line with trends at the national level. But because Texas has historically relied more heavily on property taxes than the national average, Texans are more directly affected than their counterparts who have low or no property taxes.

One other factor of note is that recent home-price movements in Texas have been unusual. Typically, large swings in national home prices yield only modest changes in Texas because the state's lax zoning, plentiful land, flat geography and robust economy have tended to ensure enough supply will be built to keep pace with demand.

The boom–bust cycle of 2002–08 illustrates this phenomenon. Texas home prices barely budged as national home prices appreciated 30 percent in the first few years of the period and then fell about 40 percent. Texas' high property tax rates didn't attract a lot of attention over the period because assessments weren't growing rapidly.

For reasons not fully understood, this pattern has been broken in the aftermath of the Great Recession, with both state and national home prices rising 30 to 40 percent. Does this unusual Texas home-price appreciation signify a change in fundamentals, such that the state will experience boom–bust cycles from which it had been excluded? Or do the housing data simply reflect other, secular forces that are temporarily prompting a rise in Texas home prices that just happens to coincide with the current national housing boom?

Factors such as the Dodd–Frank Wall Street Reform and Consumer Protection Act that affect lending for housing development, the gradual de-localization of housing finance and the appearance of lot-availability constraints in major Texas metros suggest housing markets may more closely follow national home price trends than they once did. Still, it remains far from certain to what degree the next national housing bust might impact Texas real estate prices.[4]

Ranking Texas Taxes

Whatever the long-term outlook, the current cycle of home-price appreciation has dramatically boosted property tax revenue. And with property taxes growing at a rapid pace that is faster than income, it may be tempting to conclude that Texas' low-tax reputation is now more myth than fact. Such a conclusion would be premature, though.

In the last year for which full data are available, Texas' state and local tax burden was 15 percent below the national average, 30 percent below California's and 55 percent below New York's on a per capita basis (*Chart 4*). The differences are even starker when only the state portion of the burden is considered.

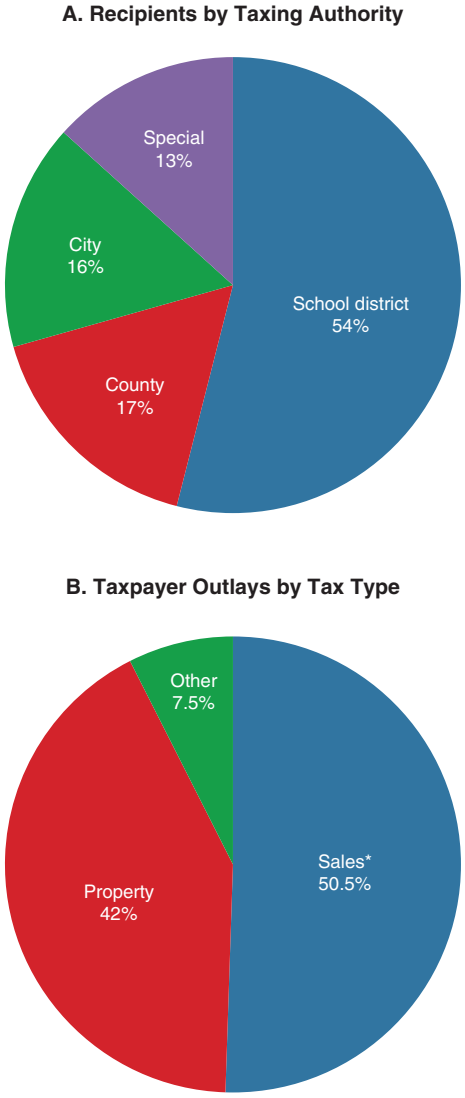
However, the local portion of that tax burden tells a different story. Texas' per capita local tax burden ($2,116 per year) is actually slightly higher than the national average and, perhaps surprisingly, higher than that in high-tax California. Measuring the total local tax burden rather than median property taxes alone, as seen in Chart 1, reveals that Texas property taxes are indeed high by comparison with other states that may levy other types of local taxes. This comparative Texas burden may be why property taxes have become a focal point of attention in recent years.

Why, then, are there so many types of local jurisdictions in Texas and why do they need to raise so much revenue?

There are a couple of reasons. First, Texas has historically delegated significantly more responsibilities to localities than other states, allowing cities, counties and school districts to provide services that are elsewhere handled at the state level. Such decentralization stems from a historic distrust of any single center of power. This is visible in requirements that are unnecessary in other states, such as the election (versus appointment) of executive branch officials and public referendums to ratify some legislative measures.

As a corollary, Texas transfers a relatively small amount of state revenue to localities, requiring local jurisdictions to raise revenue themselves. In Texas, local governments receive only 23 percent of their revenue from the state; in only six other states do localities receive a smaller percentage (*Chart 5*). The U.S. average is 30 percent. Buffeted by the combination of more responsibility and less state support, the local tax burden in Texas is relatively high.

CHART 2 School Districts Receive Half of Texas Property Tax Revenue; Property Tax Share Large for Individual Taxpayers



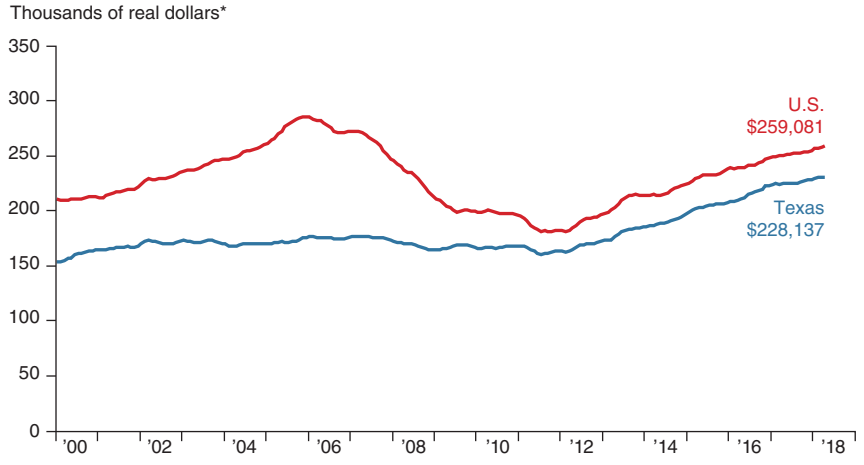
NOTES: Property tax data are from fiscal year 2015. Shares are based on the taxable value assigned.
SOURCE: Texas Comptroller of Public Accounts.

Local Property Taxation

This doesn't mean the property tax specifically should be the vehicle through which local revenue is raised, though some economic arguments favor locally administered property taxes. A central argument from the economic literature is that houses can't readily be moved from one jurisdiction to another, which makes tax avoidance less of an issue than it would be for, say, a locally imposed income tax.

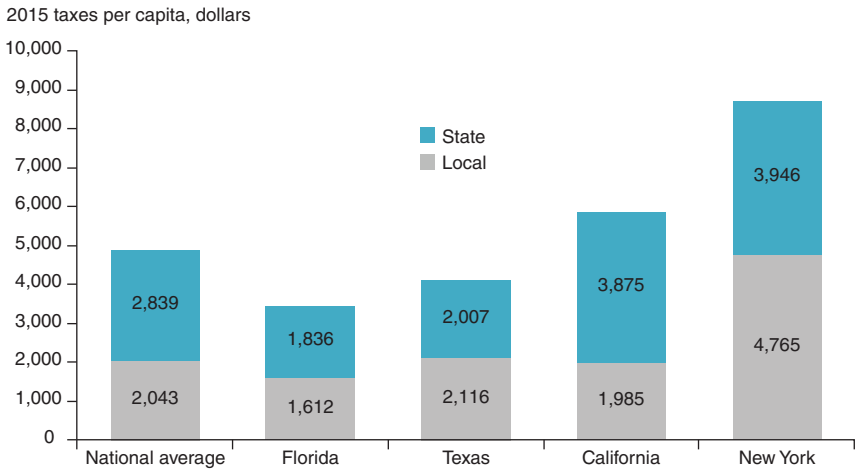
Another argument is that property taxes don't directly discourage productive activity as income taxes sometimes do. This by no means implies it is impossible to have a dynamic local area with such taxes in place, as California's Silicon Valley demonstrates. Neverthe-

CHART 3 Texas Median Home Values Have Risen Dramatically Since 2012, in Sync with Nation



*Four-month moving average; seasonally adjusted.
NOTE: Data are through April 2018.
SOURCES: Multiple Listing Service; Texas A&M Real Estate Center.

CHART 4 Total Texas Tax Burden Below U.S. Average; Local Taxes Alone Tell a Different Story



SOURCES: Census Bureau; Bureau of Economic Analysis.

less, efficiency arguments suggest income taxes are more appropriate at the federal level, while property taxes may be more effectively assessed locally.

Nonetheless, property taxes hit only one type of asset—housing wealth—and therefore discriminate against people who choose to spend their money on a larger house rather than, for example, better cars or travel. Is it fair to tax the one person more heavily than the other just because their housing preferences are different? It's also possible that property taxes discourage housing consumption to some degree, though this effect is likely much smaller when it comes to housing than it would be for, say, a tax on stamp/coin collections. There are tax benefits associated with homeownership, after all, and people cannot easily do without housing.

Local property taxes also enable some jurisdictions to spend more than others on public services, if they so choose. To be sure, it is efficient for individuals to be able to compare jurisdictions and live in the one whose mix of taxes and services best matches their own preferences.

However, when applied to K–12 education in particular—the largest local program—large differences in spending per student could potentially perpetuate patterns of inequality, leaving the children of poor parents with less human capital (and lower future salaries) than their wealthier peers. Texas mitigates this issue to some degree with its so-called Robin Hood system, under which a portion of school property tax revenue is redistributed to poorer jurisdictions, though that system is itself controversial.[5]

A final issue is that an individual's property tax burden can rise dramatically when neighborhood property values spike, leading to a sudden unwelcome increase in tax liability for which the homeowner may be unprepared. People who cannot pay may be forced to sell their homes.

These surges can be dealt with by "circuit breakers" that phase in appreciation over several years, though phase ins inevitably reduce revenue available to local jurisdictions and may, depending on the circumstance, make it more difficult for those jurisdictions to provide the services residents expect.

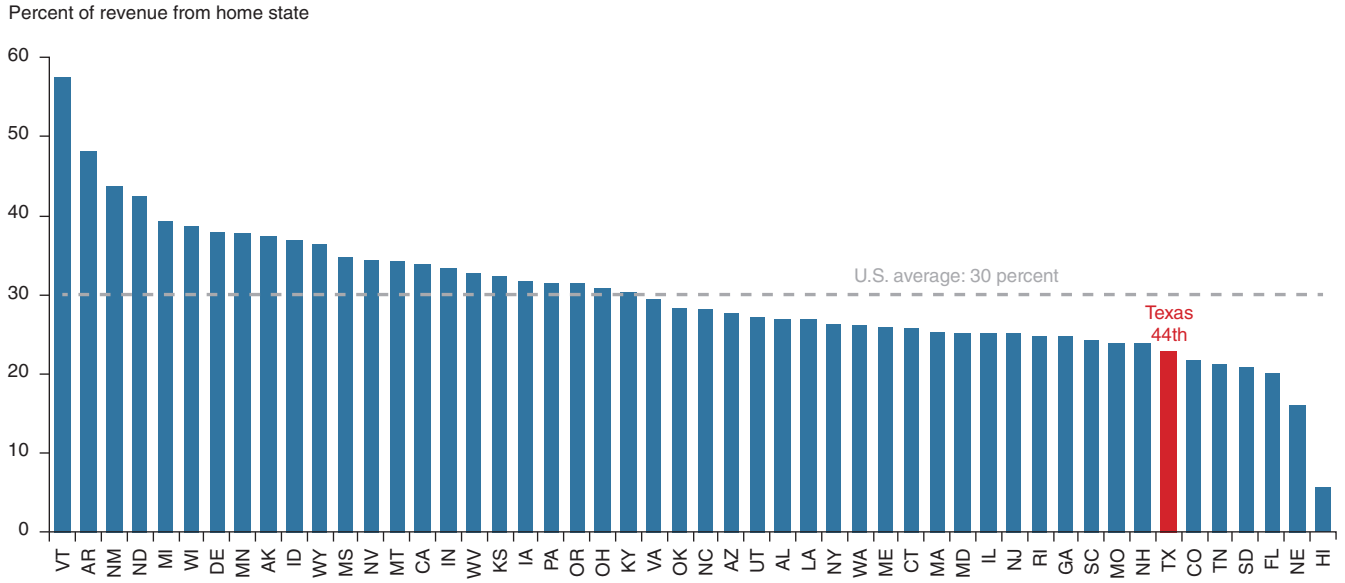
Texas also limits annual tax rate increases by allowing voters to hold a rollback election. While these rules are complicated and vary depending on the taxing authority, if the tax rate increase exceeds a certain percentage, property owners may elect to reduce the rate increase in a given year.

Imperfect Funding Method

The bottom line: Property taxes are an imperfect way to raise revenue. For this reason, some states emphasize sales and income taxes over property taxes. However, Texas' sales tax rate

CHART 5

State Transfers Provide Relatively Low Share of Local Revenue in Texas



NOTE: Texas localities received 22.9 percent of total revenue from the state in fiscal year 2015.
SOURCE: Census Bureau.

is already among the highest in the country and has been shown to disproportionately burden the poor, while an income tax is constitutionally prohibited in Texas and would risk discouraging work and investment were it somehow implemented.[6] Any taxing system comes with its own set of advantages and disadvantages.

Alternatively, property taxes could be cut without raising taxes elsewhere. However, significant property-tax-funded functions such as K–12 education, already well below the national average in terms of per capita funding, would fall further, potentially reducing the quality and quantity of those services.

One solution might be to pair local property tax cuts with increased state transfers, though those transfers would themselves have to be funded through service reductions or higher taxes at the state level. This doesn't automatically make efforts to rein in property tax growth a "bad" thing, but it does reinforce the need to carefully weigh the economic arguments, fully cognizant of both residential tax burdens and desired levels of government services.

It is eminently possible to address Texas' relatively high property tax burden, but doing so inevitably imposes sacrifices on some, while potentially affecting state and local tax progressivity and perhaps even future growth rates. It is also possible that the marketplace will address the issue through a housing contraction, but that would dramatically lower home valuations across the state. Were that to happen, today's higher property taxes caused by soaring home valuations might not seem like such a bad thing.

Saving is a senior research economist and advisor in the Research Department at the Federal Reserve Bank of Dallas.

Notes

[1] Based on the Census Bureau's American Community Survey 5-year estimate for 2016.

[2] Government-owned facilities are also generally exempt from property taxation.

[3] Texas fiscal years begin Sept. 1. Thus, fiscal 2015 began Sept. 1, 2014.

[4] See "Texas Housing Market Soars to New Heights, Pricing Out Many," by Laila Assanie, Federal Reserve Bank of Dallas *Southwest Economy*, First Quarter, 2017.

[5] For example, the Robin Hood system partially but not fully equalizes per-student funding across jurisdictions, leaving both donor and recipient districts unsatisfied with the outcome. Many also argue the system amounts to a de facto statewide property tax, though the state Supreme Court ended a lengthy legal battle last year by affirming its constitutionality. For a more thorough discussion of these and other economic issues, see "Improving School Finance in Texas," by Jason Saving, Fiona Sigalla and Lori L. Taylor, Federal Reserve Bank of Dallas *Southwest Economy*, no. 6, 2001.

[6] See "Texas Taxes: Who Bears the Burden," by Jason Saving, Federal Reserve Bank of Dallas *Southwest Economy*, Third Quarter, 2017.

A Conversation with Mine Yücel

Shale Renews Excitement in Energy Industry

Mine Yücel, a senior vice president and research advisor at the Federal Reserve Bank of Dallas, leads the Research Department's energy group. She joined the bank in 1989 and is a past president of the International Association for Energy Economics. She discusses the evolution of the energy sector, its role in Texas and her perspective as a female energy economist.

Q. What is energy economics and how does it differ from the study of other commodities?

Energy—whether it be oil, gas, coal or renewables—is an essential input for the economy. Energy prices affect all sectors of the economy, from businesses to households. And because the use of energy is so pervasive, energy supply and energy policy have been frequently deemed important for national security reasons. This was especially true in the 1970s when U.S. oil production started declining and oil prices soared due to geopolitical factors.

When looking at energy markets, oil really stands out. Oil is priced in international markets, but the market is not necessarily competitive. OPEC controls 40 percent of the global crude oil market and can influence oil prices. In the U.S., gasoline and diesel make up 67 percent of oil consumption, so a change in oil prices affects consumer spending directly through fuel and heating oil prices. Oil price changes also have historically affected gross domestic product (GDP) growth and inflation, and, therefore, have been an important consideration for monetary policy.

We have long had a domestic market for natural gas. But as U.S. natural gas production continues to rise, and U.S. liquefied natural gas exports increase, we will be more integrated with global natural gas markets and could feel the economic effects of changing natural gas prices.

Q. When you started working in energy economics in the 1980s, what were the big questions? What are they now?

I graduated in the early 1980s. Research focused on OPEC, its impact on oil markets and prices, and the effects of high oil prices on the macroeconomy.

As OPEC grew and started flexing its muscles, the price of oil shot up from $3.50 per barrel in 1973 to around $37 by 1980. There was much research on OPEC market structure: Was it a cartel, was it targeting market share or targeting revenue?

Oil prices started declining in 1981 and collapsed to near $14 in 1986. Then, there were questions about whether the impact of oil price changes was symmetric—that is, would falling oil prices benefit the economy, just as rising prices had hurt the economy? There were also questions about the health of oil-producing states such as Texas, Alaska and Louisiana whose economies were very dependent on the oil industry.

Interestingly, we are still researching these same questions. As the economy has evolved, questions about the impact of oil price shocks on the economy remain an ongoing concern, but the answers have changed somewhat. The source of the oil price shocks matters, and shocks have a smaller impact. Also, as the share of renewables such as solar and wind has increased, issues about how to integrate renewables into the electricity grid have come into focus.

Q. Oil price increases have seemed to always precede recessions. Is that still true?

Oil price shocks have preceded 10 of the 11 post-World War II recessions in the U.S. However, this is not a causal relationship. The recessions were not necessarily caused by oil price shocks. Rather, high oil prices most likely contributed to the weakness of an already fragile economy before the recessions.

Oil prices affect the economy through two channels: a price effect and an allocative effect. For example, when the price of oil goes up, we all feel the impact of higher gasoline prices and higher fuel prices and lower our spending accordingly. This is the negative price effect.

Because oil and goods and services related to oil have now become relatively more expensive, there is also a change in the use of resources that produce these goods and services—a reallocation of resources because of the relative price change. This reallocation effect is also negative.

These two effects are why the economy is affected negatively when oil prices rise. Of course, producers of oil are now better off because of the increase. This positive impact offsets some of the negative effects from the oil price rise.

Q. How has energy's impact on the Texas economy changed in your time?

I came to Texas in 1977. We were in the midst of an oil boom, and the state's economy was growing at double-digit rates. Texas went into a deep recession when oil prices started declining in 1982 and again when they collapsed in 1986.

The oil and gas industry lost roughly 150,000 jobs, about 2.2 percent of employment, from the peak of the boom in 1982 to early 1987. The second recession

"Horizontal drilling and hydraulic fracturing have been amazing technological developments that completely changed the oil and gas picture in the U.S."

coincided with the 1986 Tax Reform Act's more stringent treatment of investment income and the savings and loan crisis, which also buffeted the Texas economy.

After the bust, the Texas economy diversified, and low oil prices have much less of an impact on the Texas economy now. When oil and gas prices collapsed at the end of 2014, Texas didn't fall into recession unlike all other states with large oil sectors, such as Alaska, North Dakota, Oklahoma and Louisiana. During the most recent shale oil boom, increased oil production boosted the share of oil and gas in overall Texas GDP, but the share of employment has remained low, reaching a high of only 2.5 percent.

Q. What's the most exciting oil and gas industry change you have seen in your 30-plus-year career?

The most exciting development has been the shale revolution. U.S. crude oil imports topped 10 million barrels per day in 2004, almost twice what we produced. U.S. crude production had been declining since the peak in 1970, and there was much discussion about whether we were running out of oil. Horizontal drilling and hydraulic fracturing have been amazing technological developments that completely changed the oil and gas picture in the U.S. and the dynamics of the global oil market.

Now, the U.S. is producing nearly 11 million barrels per day, higher than our record in 1970. Since 2009, we have increased production by more than 5 million barrels per day. This is basically adding another Iraq into the global oil market.

Technology has helped with energy research as well. The availability of data and the ease of procuring energy data have been an immense benefit to research in energy. This is true for all research fields of course, not just energy. Improved econometric techniques are also very useful in parsing out the impacts of changes in energy markets and prices.

Q. How do you see energy markets in the future?

I think we will see increased use of renewables in the future. How close is that future, though? Renewables, such as wind and solar, are used in electricity generation but are still a small part of our energy mix. Currently, renewables account for 13 percent of U.S. energy production. There are a couple of factors hindering renewables in the short run. One is the problem of intermittency. For renewables to gain wider market share, we need better storage technology. Battery technology has been improving, but we're not there yet.

Another factor: Seventy-one percent of oil is used in transportation, according to the U.S. Energy Information Administration. Electric vehicles have been making inroads, but again, battery technology and infrastructure are limiting factors in the short run. However, France and the U.K. have said that they will ban gasoline and diesel cars by 2040, and India has also declared that all new cars after 2030 will be nonfossil fuel. Such policies may hasten the inroads that electric cars will make.

Q. Which one of your many accomplishments stands out?

My proudest accomplishment was becoming the president of the International Association for Energy Economics (IAEE) in 2011. The association was founded after the 1970s energy crisis. It is a worldwide organization that has affiliations and members in more than 100 countries. I've been going to IAEE meetings since 1986 and have probably met all the prominent energy economists in the world at the conferences. I learned a lot being a part of the IAEE and made lifelong friends from all over the world.

Q. You are a prominent female economist in a male-dominated field. What advice do you give?

Being a woman in the energy field may have initially been somewhat of a hindrance. The profession has slowly changed though. When I first started going to energy conferences in the mid-'80s, there were only a handful of women in the profession. We all knew each other quite well.

There are many more women now, and many young women are entering the profession because it is such an interesting area of study. But it is still a relatively smaller number than the men.

My advice to young economists would be to do your research and get published in peer-reviewed journals. That is what gets you the respect in the profession. Go to conferences to present your work; get to know people in your area. That is how your work gets noticed. Ask the interesting questions. And work on issues that have broad relevance for industry and academia.

Parental Borrowing for College Comes with Repayment Issues

By Wenhua Di, Carla Fletcher and Jeff Webster

ABSTRACT: As the cost of college continues to rise, parents are increasingly taking out federally backed loans to help make ends meet for their children. Parents, while often more adept at managing debt, assume some of the financial risks of their offspring who are seeking higher education.

College is an investment that generally yields benefits over a student's lifetime in the form of higher wages, more stable employment and better benefits. Typically, parents want to help their children with college costs, but they don't always have enough savings to do so.

Since the 1950s, federal government student loan programs have encouraged postsecondary education. More recently, federal assistance for parents wanting to help their children with college costs came in the form of the federal Parent Loan for Undergraduate Students (PLUS) program. It was created in 1980 and assists parents who are borrowing for their offspring's college expenses.

Parents have increasingly taken out PLUS loans, with the average amounts borrowed growing.[1] The parent loan default rate remains low, though signs of it increasing have appeared.[2]

Parents' repayment behavior differs from that of students, with parent borrowers presenting their own benefits and risks. Parent borrowers tend to have more experience dealing with debt and more realistic expectations for repayment than students. At the same time, parents say taking on loans for their children may affect their ability to save for retirement and undertake major purchases.

PLUS Program Growth

Most federal education loans are loans to students. Stafford loans make up the largest portion of the borrowing. As of second quarter 2018, there were 29.5 million subsidized Stafford loan recipients (receiving relatively favorable terms) and 28.3 million unsubsidized recipients, together representing $753 billion of the $1.4 trillion outstanding federal education loans.[3] The approximately 3.5 million parent PLUS borrowers (8.2 percent of all federal education loan borrowers) were responsible for $87.7 billion, or 6.2 percent of the outstanding loan debt.

Stafford loans (named after former Vermont Sen. Robert Stafford) are based on the level of financial need calculated using data supplied by students through the Free Application for Federal Student Aid.[4] Stafford loans, available to borrowers regardless of credit score, usually carry lower interest rates than private loans. They also offer various borrower protections such as hardship deferments, forbearance, income-driven repayment options and public service loan forgiveness.

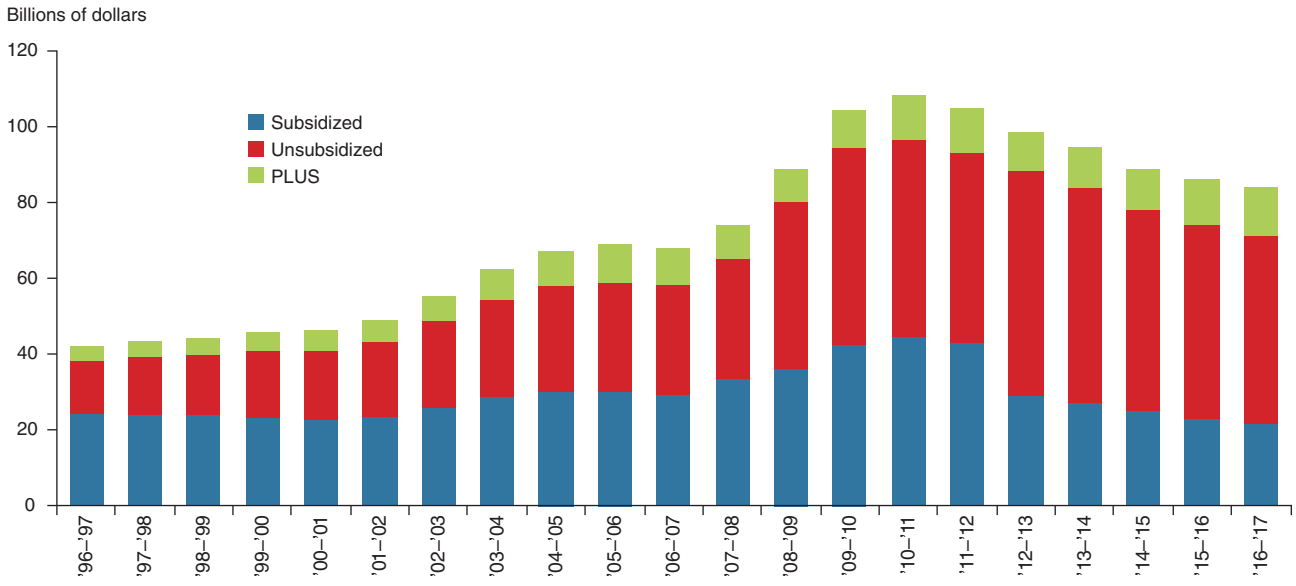
Stafford loans have annual and aggregate borrowing limits. With rising college prices and high financial need among students from middle- and lower-income families, there are often substantial gaps students must fill through savings, paid work and contributions from family and friends.

PLUS loans carry higher interest rates than Stafford loans and are intended for families who have exhausted student borrowing options.[5] PLUS borrowing limits were modified in 1992 to offer greater flexibility. Parents were subsequently allowed to borrow up to the difference between the total cost of attendance and the amount of other financial aid, regardless of expected family contribution, as long as the parental borrowers did not have an adverse credit history.[6] This modification typically provided parents with the ability to borrow much larger amounts.

Although PLUS borrowers are fully responsible for loan repayment, many proceed because they have altruistic motives.[7] College education typically

CHART 1

Parents' Share of Undergraduate Federal Loan Programs Increases



NOTE: Each time period refers to a school year.
SOURCE: College Board, Trends in Student Aid 2017.

leads to a host of financial and other lifetime benefits.[8] There could be some net gains for parents as well. Parents' net lifetime income may increase as a result of incurring PLUS debt—if a child completes a college degree, the subsequent higher income may offset the need for other future support from parents and allow contributions from children to parents in old age.

Greater Parental Borrowing

PLUS loans comprise an increasing proportion of federal aid to students and their families. About 8.6 percent of the $42.1 billion (in 2016 dollars) in undergraduate loans originated in the 1996–97 academic year were PLUS loans (*Chart 1*). The share rose to 15 percent of $84.2 billion in the 2016–17 academic year. The $15,878 average parent loan was $6,251 more than two decades earlier—much greater borrowing than the average amount of Stafford subsidized or unsubsidized loans.[9]

Like other federal education loans, PLUS loans are usually nondischargeable in bankruptcy. Borrowers may also have their wages, tax refund and Social Security benefits garnished if they default on the loans.

Deteriorating Loan Repayment

Parents can potentially access either a federal PLUS loan or a private loan. However, parents with lower credit scores can't easily obtain a private loan, which involves more rigorous underwriting. So, while PLUS loans are not need-based and were designed to support education for families of any income level, they tend to attract lower-income borrowers and those who can't qualify for private-lender funding.

This "adverse selection" of borrowers into the PLUS program became more apparent when conventional underwriting tightened following the Great Recession.[10]

The U.S. Department of Education has published default rates for PLUS loans for fiscal 2006 to 2010 (*Table 1*).[11] The overall default rate increased from 1.8 percent in fiscal 2006 to 5.1 percent in fiscal 2010. The rate more than doubled for loans involving students enrolled in proprietary, private nonprofit and public institutions during the period, with the rate at proprietary institutions being the highest.[12]

In response, the Department of Education tightened the parent PLUS credit check rules in October 2011. Loan denials increased 10 percentage points the following year.[13] The denial rate is also linked to a steep enrollment

TABLE 1

Parent PLUS Loan Defaults Increase Throughout Recession

Three-Year Cohort Default Rates	Fiscal year 2006	Fiscal year 2007	Fiscal year 2008	Fiscal year 2009	Fiscal year 2010
Parent PLUS overall (%)	1.8	2.2	2.6	3.4	5.1
Parent PLUS proprietary (%)	4.7	5.5	6.3	8.3	13.3
Parent PLUS private nonprofit (%)	1.2	1.6	2.0	2.5	3.4
Parent PLUS public (%)	1.2	1.6	1.9	2.2	3.1

NOTE: Rates are calculated based on borrowers entering repayment after in-school deferment. Proprietary institutions are generally for-profit private schools.
SOURCE: U.S. Department of Education, 2012.

TABLE 2 Loan Characteristics and Education Experience by Parent PLUS Loan Default Status*

Variables	Borrowers not in default	Borrowers in default
PLUS Loan Characteristics		
Avg. number of PLUS loans per borrower	2.0	1.5
Highest interest among PLUS borrowings (%)	7.4	7.2
PLUS loan beginning balance ($)	19,509	12,403
PLUS Loan Performance		
PLUS loan amount paid down ($)	8,080	109
Delinquency (%)	26.4	96.3
Deferment (%)	13.2	16.0
Forbearance (%)	31.8	56.5
Student Borrowing, Enrollment and Education Attainment		
Children's Stafford loan amount ($)	18,831	17,015
Second year funded by PLUS loan (%)	19.3	20.2
Third year funded by PLUS loan (%)	17.8	13.5
Fourth year funded by PLUS loan (%)	24.6	12.6
Fifth year funded by PLUS loan (%)	1.5	0.7
Two-year public (%)	3.7	5.0
Four-year public (%)	64.4	57.5
Four-year private (%)	22.4	20.1
Proprietary (%)	5.0	14.8
Minority-serving institution (%)	30.2	44.0
Graduated (%)	48.8	36.8
Withdrawn (%)	25.1	37.1

*Based on borrowers entering repayment in fiscal 2005–10.
NOTE: Loans from Trellis Co. portfolio, shown in nominal dollars.
SOURCES: Trellis Co.; authors' calculations.

decline in 2011 among historically black colleges and universities, which tend to be low-resourced schools with limited institutional grant funds to support their disproportionately large economically disadvantaged student populations.[14]

With the policy change, many parents who relied on the PLUS loans were shut out. Officials later loosened the standard to allow greater participation. Still, families with large unmet need using PLUS are the most likely to struggle with repayment.[15]

Loan Outcomes Examined

Studies of PLUS loans have been limited, largely because of the relatively small share of PLUS loans in the student loan market and the generally lower (albeit rising) default rate. Trends, patterns and the experiences of parental borrowing emerge in administrative data of PLUS borrowers assembled by the Trellis Co., a nonprofit student loan guarantor that has helped administer the Federal Family Education Loan Program in Texas since 1979.

The dataset covers 62,449 parent PLUS recipients who entered repayment between October 2004 and September 2010, with children attending Texas institutions.

Trellis' data track borrowers' repayment behavior from the beginning of repayment and continuing for the next seven years or until the loans were paid in full, consolidated and changed guarantor, or the borrower defaulted. About 8.6 percent of these PLUS borrowers defaulted during the seven-year period. Those who defaulted obtained fewer loans with smaller beginning balances, paid down less of the balance and had higher levels of delinquency, deferment and forbearance than those not in default (*Table 2*).

Parents who defaulted mostly supported students who took more time attending school.[16] Relative to borrowers not in default, the children of those in arrears were more likely to enroll in a two-year public college, a for-profit proprietary (private) school or a minority-serving institution and less likely to attend a four-year public or nonprofit private college and to have graduated.[17]

Multivariate statistical models—a means of examining the interplay between several variables and an outcome—were developed to examine how some of these factors explain the likelihood of a PLUS default.[18] Holding other factors constant, PLUS loans are more likely to default if the students also borrow large amounts, have dropped out of college without a degree or enroll in a four-year private, proprietary or minority-serving institution.

On the other hand, PLUS borrowers are less likely to default if they enter repayment with a higher beginning balance or fund children who have already completed relatively more schooling, are enrolled part time or have graduated from college. Parents' default probability is much more related to their children's college experience than to the PLUS loan's characteristics.

A students' college experience may be tied to family finances, academic aspirations and borrower risk preferences, all of which can influence repayment behavior.

Outperforming Stafford Loans

The Trellis data also include information on Stafford loans, allowing review of overlapping parent PLUS and student Stafford loan data from September 2006 to August 2009.

Compared with Stafford borrowers, PLUS borrowers on average took out fewer loans, had higher initial balances and paid a higher interest rate. PLUS borrowers' children were more likely

to attend four-year public or private institutions instead of a two-year public institution or proprietary college, had a higher graduation rate, were more likely to enroll full time and much less likely to drop out.

Since parents are generally older, financially more stable and more experienced with debt, it is not surprising that PLUS loans have better repayment outcomes than Stafford loans (*Chart 2*). For borrowers seven years into repayment in the Trellis portfolio, the default rate on Stafford loans was 28.3 percent, 18.1 percentage points higher than that of PLUS loans.

Despite a default rate increase around the recession, PLUS loans have been the only federal student loan program that generates profits for the government and, thus, helps offset other federal educational loan program costs. PLUS loans are forecast to generate a $20.6 billion profit for the federal government from 2018 to 2028.[19]

PLUS loans also outperform Stafford loans after controlling for other factors.[20] Student borrowers are more likely to default if they attend a two-year public institution, enroll part time or withdraw without a degree. Attending a nonprofit, private four-year institution tends to to increase the chance of default for parent borrowers but not for students.

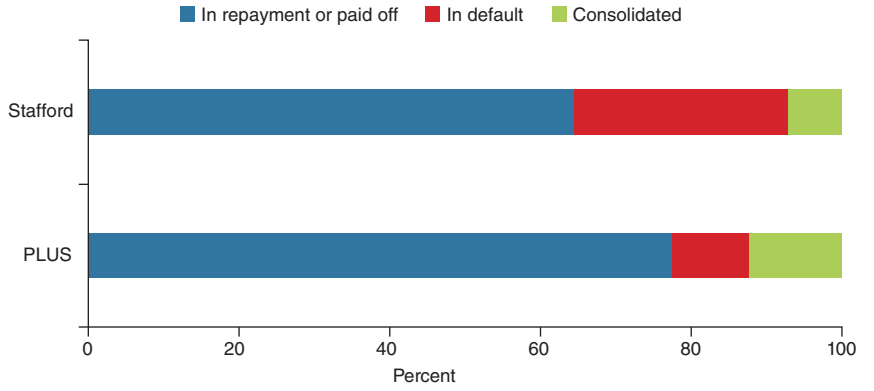
Parent, Student Interviews

To learn more about PLUS expectations and experiences, 49 parent borrowers and 36 students whose parents had borrowed on their behalf were interviewed. Parent borrowers tended to have more experience dealing with debt and had more realistic expectations for repayment than did students.

Overall, the majority of the parents and students expected the parents to repay the PLUS loans. The decision to pay for college through PLUS loans didn't always follow thoughtful discussions with students about explicit academic expectations and implications of ongoing financial obligations.

Parents also reported that PLUS loans affected their ability to save for retirement and make major purchases. The collegiate pathway to adulthood, when parental borrowing is involved, seems to come with parental sacrifice as well as a transfer of financial responsibility.

CHART 2 PLUS Loans Outperform Stafford Loans Seven Years After Repayment Begins



SOURCE: Authors' calculation based on Trellis data for fiscal 2007, 2008 and 2009.

Di is a senior economist in the Research Department at the Federal Reserve Bank of Dallas. Fletcher is a senior research analyst and Webster is the director of research at Trellis Co., a Round Rock, Texas, nonprofit corporation that seeks to help students retire education loans and improve access and outcomes involving education.

Notes

[1] Parents may also borrow from private lenders with terms, conditions and interest rates set by the lender based on the borrower's creditworthiness. Graduate students can obtain loans for themselves under a separate program, also called PLUS. That program is not the focus of this article.

[2] The PLUS loan default rate increased around the recession. Recent official data are unavailable.

[3] Federal Student Loan Portfolio, U.S. Department of Education, accessed July 20, 2018, https://studentaid.ed.gov/sa/about/data-center/student/portfolio.

[4] Subsidized and unsubsidized loans have the same interest rate fees. Students who demonstrate financial need and qualify for subsidized loans do not have the loan interest accrued while in school or during the grace period.

[5] As of July 1, 2017, the PLUS loan interest rate was 7.0 percent, and the loan fee at disbursement was 4.26 percent, while Stafford loan interest was 4.45 percent and the loan fee 1.07 percent.

[6] Parents need to pass the PLUS loan credit check. See, "Direct PLUS Loans and Adverse Credit," U.S. Department of Education, March 2015, https://studentaid.ed.gov/sa/sites/default/files/plus-adverse-credit.pdf.

[7] See "Borrowing Constraints, Parental Altruism and Welfare," by Jorge Soares, *Journal of Macroeconomics*, vol. 45, 2015, pp. 1–20.

[8] "America's Divided Recovery: College Haves and Have-Nots," by Anthony P. Carnevale, Tamara Jayasundera and Artem Gulish, Georgetown University Center on Education and the Workforce, June 2016.

[9] All calculations are in 2016 dollars. PLUS loans totaled $12.6 billion in 2016–17. Data are from "Trends in Student Aid 2017," College Board, accessed July 20, 2018, https://trends.collegeboard.org/student-aid.

[10] Some families prefer PLUS loans because of the repayment flexibility federal loans offer. PLUS borrowers can consolidate their loans and join the Income-Contingent Repayment Plan, which is less generous than most other income-driven repayment plans but caps payments at a share of earnings.

[11] A cohort default rate, the standard measure of federal education loan performance, is the percentage of borrowers who enter repayment during a particular federal fiscal year, Oct. 1 to Sept. 30, and default or fail to meet other specified conditions prior to the end of the second following fiscal year.

[12] Proprietary postsecondary institutions refer to those private, profit-seeking colleges that operate as businesses.

[13] "Cracking Down on PLUS Loans," by Libby A. Nelson, *Inside Higher Ed*, Oct. 12, 2012, www.insidehighered.com/news/2012/10/12/standards-tightening-federal-plus-loans?.

(Continued on back page)

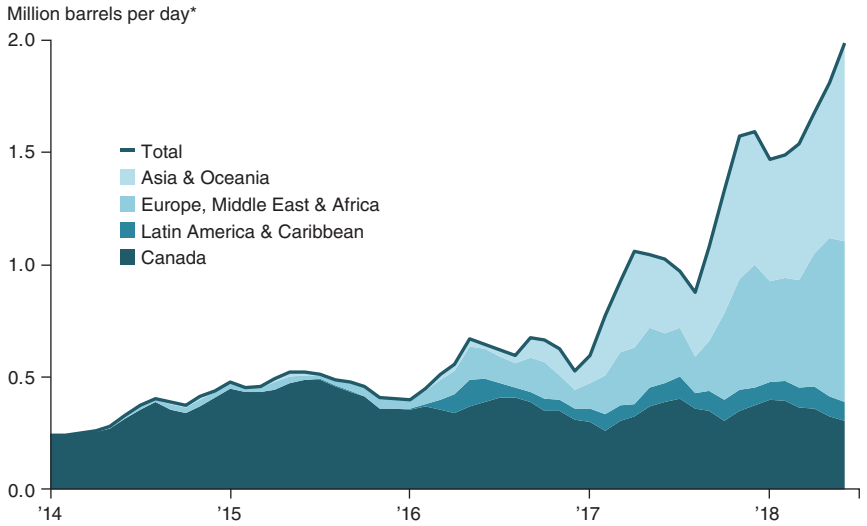
Shale Oil Propels U.S. Crude Export Increase

By Kunal Patel and Grant Strickler

Crude oil exports from the U.S. are rising, reaching 2.2 million barrels per day (mb/d) in June 2018, triple the 2016 average and the highest ever for the nation. More than 90 percent of crude exports this year have originated on the Gulf Coast, generating jobs, capital and income for ports in Houston and Corpus Christi.

Such exports were at a trickle before Congress lifted a federal crude oil export ban that had been in place since 1975. The change, which took effect in December 2015, allows U.S. producers to sell oil directly to the global market at a time when shale oil production is high and rising.

CHART 1 U.S. Crude Oil Exports Rising at Accelerating Rate



*Three-month moving average.
SOURCE: Energy Information Administration.

Shale Boom Impacts

U.S. crude oil production has grown steadily since 2008, reaching a record of more than 10 mb/d this year, with 12 mb/d expected by the end of 2019, according to the Energy Information Administration. Shale oil accounts for 99 percent of the production growth. Shale yields a light-sweet crude oil, requiring a simple refining configuration to produce gasoline and diesel.

As domestic crude production declined in the 1990s and 2000s, U.S. refiners made significant investments in their refining capabilities to process imported heavy-sour crude, primarily from Venezuela and nearby Mexico and Canada. Heavy-sour crude, which is generally cheaper than light sweet, provided greater profitability for refiners.

Building Infrastructure

With the shale boom, there was a mismatch between the crude oil produced and domestic refining capabilities, creating a pricing distortion for domestic production. This mismatch is one reason Congress removed the export ban; rising domestic production likely also made energy security less relevant.

When Congress ended the ban, the infrastructure needed to export significant volumes of crude oil was lacking. Midstream providers started investing in export-related infrastructure in the Houston and Corpus Christi regions in 2016. Exports from both ports increased, with the Port of Corpus Christi the first in the U.S. to partially load a very large crude carrier (VLCC), a type of vessel capable of transporting more than 2 million barrels of oil.

The Louisiana Offshore Oil Port, about 20 miles south of Louisiana's Port Fourchon, successfully fully loaded a VLCC last February and became the first U.S. port to do so. With improvements to export infrastructure and an increasing supply of light-sweet shale oil, U.S. exports are poised to continue expanding.

Before allowing exports, Congress permitted some small-scale exemptions—almost all (92 percent) destined for Canada. Now, 42 percent of U.S. oil exports go to Asia and Oceania; 34 percent to Europe, the Middle East and Africa; and 19 percent to Canada.

Constraining Factors

While the long-term outlook is bright for U.S. exports, infrastructure limits the near term. The Rapidan consulting group estimates current Gulf Coast export capacity at up to 3.0 mb/d, which could start constraining exports in as little as a year, assuming a reduction of transport bottlenecks in the oil-rich Permian Basin in West Texas and southeastern New Mexico.

Potential Chinese tariffs on U.S. crude exports could also be a limiting factor. However, assuming production growth continues and the construction of new export terminals is completed, other trading partners would likely emerge. The Intercontinental Exchange is looking to add a futures contract for crude delivered in Houston, making it easier for transport companies to purchase crude close to export infrastructure rather than having to source it from production areas in West Texas.

If Texas Were a Country ...

Design: Emily Rogers; Content: Christopher Slijk & Benjamin Meier

State conducts business on an international scale

18th largest world economy*

4th largest oil producer

19th largest global exporter

Texas is comparable to entire countries—and so are some of its local areas.

GDP

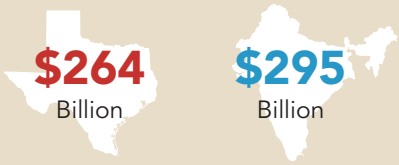
$1.7 Trillion — **Texas**

$1.8 Trillion — **Canada**

Dallas–Fort Worth **$511** Billion

Belgium **$510** Billion

Exports



$264 Billion — **Texas**

$295 Billion — **India**

Houston **$84** Billion

Norway **$89** Billion

Oil

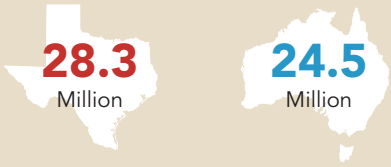
4.6 Million b/d — **Texas**

4.5 Million b/d — **Iraq**

Permian Basin **2.3** Million b/d

Mexico **1.9** Million b/d

Population



28.3 Million — **Texas**

24.5 Million — **Australia**

Houston **6.9** Million

Libya **6.4** Million

*Ranking based on purchasing-power-parity adjusted gross domestic product, a way of comparing economically differing nations.
NOTES: State data are as of 2017 except oil production, which is as of May 2018. Metro and regional data are as of 2017 for population, as of fourth quarter 2017 for oil production and as of 2016 for gross domestic product (GDP) and exports. The abbreviation b/d refers to barrels per day. Permian Basin calculation covers 55 counties in West Texas and encompasses the cities of Midland, Odessa and Lubbock.
SOURCES: GDP—Bureau of Economic Analysis and International Monetary Fund World Economic Outlook Database; exports—U.S. Department of Commerce International Trade Administration and International Monetary Fund; oil production—Texas Railroad Commission and International Energy Agency; population—Census Bureau and United Nations Department of Economic and Social Affairs.

Parental Borrowing for College Comes with Repayment Issues

(Continued from page 17)

[14] Before 2010, federal student loans were either made directly by the federal government or by private lenders but federally guaranteed. The guaranteed loan program implemented stricter credit checks on borrowers than the direct loan program. Officials subsequently made all new student loans direct loans, though underwriting became stricter. PLUS default rates are not factored into an institution's student loan default rate, which determines the institution's eligibility for federal aid. See, "The Wealth Gap PLUS Debt: How Federal Loans Exacerbate Inequality for Black Families," by Rachel Fishman, New America Foundation, May 2018, https://s3.amazonaws.com/newamericadotorg/documents/Wealth_Gap_Plus_Debt_FINAL.pdf.

[15] The U.S. Department of Education sets the minimum total debts with adverse conditions (i.e., accounts in collection or charge-offs) as exceeding $2,085 (inflation adjusted, 2015 dollars), instead of any amount. Thus, fewer borrowers are disqualified.

[16] Some students may take more than four years to complete a standard four-year program.

[17] The minority-serving institutions were defined according to the integrated postsecondary education data system data, which include historically black colleges and universities, predominantly black institutions and Hispanic-serving institutions. Some of minority-serving institutions are eligible for federal Title III funding under the Higher Education Act. In Trellis data, the largest historically black colleges and universities in Texas include Texas Southern University and Prairie View A&M University; the largest Hispanic-serving institutions include the University of Texas at San Antonio and the University of North Texas at Dallas.

[18] A logit model and a proportional hazard model are developed. The results are consistent across econometric specifications.

[19] Authors' calculation based on "Student Loan Programs—CBO's April 2018 Baseline," Congressional Budget Office, April 2018, www.cbo.gov/sites/default/files/recurringdata/51310-2018-04-studentloan.pdf.

[20] As shown in a logit regression of the likelihood to default on a loan and borrower characteristics.

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