

# Southwest Economy



## Water Scarcity a Potential Drain on the Texas Economy

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▶ *The “it’s always bigger in Texas” way of thinking faces a stern test when it comes to scarce water resources and how the state allocates them.*

Texas’ growth prospects depend in no small measure on ensuring durable and ample infrastructure—whether it be roads, bridges, electricity generation or water delivery. As Keith Phillips, Edward Rodrigue and Mine Yücel highlight in this issue of *Southwest Economy*, the “it’s always bigger in Texas” way of thinking faces a stern test when it comes to scarce water resources and how the state allocates them.

Here in the fast-growing but thirsty Southwest, the water problem is not just a result of the ongoing drought. Supplies and allocation methods have proven insufficient to keep up with demand. Although finding a way to increase resources would help, we also must better apportion what we have to more effectively meet our needs.

The “rule of capture” establishes ownership of natural resources that include groundwater in aquifers, plus oil and gas. The general rule is that the first person to capture a resource—in this case, drill and tap underground water—owns it fair and square. Without defined property rights, a shared resource is often overused—something economists call the “tragedy of the commons.” By comparison, the state owns and administers surface water, which is collected in the state’s man-made lakes for eventual use in many of our cities.

Establishing a mechanism for the exchange of groundwater—especially in farming—would introduce water markets that could give people the option to buy, sell or lease water rights and enable more efficient allocation, use and pricing. Property rights can establish ownership and markets can set prices to reflect potential users’ value for water.

It is encouraging that some regions are already using such market principles to manage their resources. Examples are the system governing the Edwards Aquifer in Central Texas and the water market in the Lower Rio Grande Valley.

We are justifiably proud of the opportunities that Texas affords to those with the vision and know-how to pursue them. That same kind of creative thinking will be necessary to help craft a market-based, comprehensive water solution that secures and allocates resources in the years to come.

A handwritten signature in black ink that reads "Richard W. Fisher". The signature is fluid and cursive, with a large initial 'R'.

*Richard W. Fisher  
President and CEO  
Federal Reserve Bank of Dallas*



# Water Scarcity a Potential Drain on the Texas Economy

By Keith Phillips, Edward Rodrigue and Mine Yücel

▶ As Texas' growing population has strained its limited water resources, the allocation of water has become increasingly important.

**T**exas has abundant natural resources, but water scarcity has the potential to impede the state's economic growth. Protracted drought in Texas has renewed awareness of water availability as one of the most pressing economic issues facing the state.

As water supplies shrink, demand is projected to rise, with Texas' population doubling to 52 million residents by 2047, according to the Texas State Data Center. Farming consumes the lion's share of the water supply. With the state's metropolitan areas expanding, however, urban demand for water has intensified.

Historically, users drew water freely from nearby streams or from groundwater aquifers—subterranean bodies of water replenished by rain seeping through the soil and rock. But as Texas' growing population has strained its limited water resources, the allocation of water has become increasingly important. Property rights

and markets can play a significant role in allocating water efficiently by establishing ownership and setting prices to reflect water's scarcity.

## Running Dry

In 2011, Texas suffered its worst single year of drought since records began in 1895, and the state's climatologist anticipates the region will remain drier than normal for another 15 years. Texas has a long history of regular and severe droughts.<sup>1</sup>

The stakes are particularly high for farmers, especially in the arid western half of the state, where low-margin, high-acreage crops such as alfalfa and cotton are harvested.

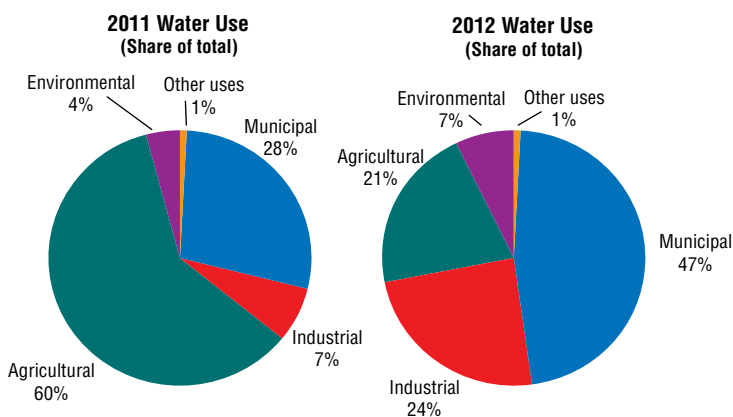
Along the Coastal Bend, where drought reduced water availability in 2012 and 2013, the Lower Colorado River Authority (LCRA) cut off most rice farmers' water to limit curtailment in Austin. The action reduced agriculture's share of water from the LCRA—one of 16 water authorities in the state—to 21 percent in 2012 from 60 percent the year before (*Chart 1*).

The farm sector uses the most water statewide, 61 percent, followed by municipalities at 27 percent (*Chart 2*). Manufacturing uses 6 percent, power generation 3 percent and livestock 2 percent, while oil and gas drilling accounts for about 1 percent.<sup>2</sup>

As Texas cities grow, water demand expands. Farmers, whose water rights are traditionally allocated based on historical use, can't benefit from selling their water to cities without developed markets. Municipalities, whose water prices often don't reflect scarcity and thus discourage conservation, are forced to ration supplies during dry spells.

Bolstering supply with new reservoirs is becoming more difficult. Dallas

**Chart 1** Lower Colorado River Authority Drought Curtailment Cuts Into Agricultural Use



SOURCE: Lower Colorado River Authority.

► *If current allocation methods remain unchanged, overall Texas water supplies could contract 3.3 percent by 2020 as demand rises 5.4 percent.*

needed three lakes to meet its water needs in 1970; now it draws from eight lakes up to 90 miles away, with plans to go more than 200 miles to the Texas–Louisiana border.

Texas water comes from aquifers (groundwater) and rivers, lakes and reservoirs (surface water). Panhandle farmers pumping the Ogallala Aquifer account for 60 percent of state groundwater use (*Chart 3*). Aquifers decline when pumping outpaces replenishment.<sup>3</sup>

The Ogallala typifies the state’s thirst for water. It has fallen several feet per year in some areas, while its average recharge rate is a half-inch per year.

If current allocation methods remain unchanged, overall Texas water supplies could contract 3.3 percent by 2020 as demand rises 5.4 percent.<sup>4</sup> The 2012 State Water Plan, derived from 16 regional water plans, suggests a mix of novel supply-and-demand strategies to meet urban needs.

Conservation, reuse and redistribution of existing supplies account for more than a third of proposed projects. Development of additional surface water supplies makes up another third, and new reservoirs account for about a fifth. The state plan suggests that demand for agricultural irrigation water will decrease from 10 million acre-feet

in 2010 to 8.4 million in 2060 because of more efficient irrigation systems, reduced groundwater supplies and the transfer of water rights from agricultural to municipal uses.

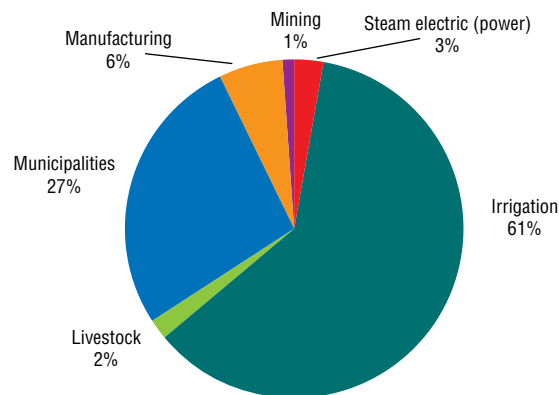
The plan also relies on water markets. How far market solutions can go toward distributing water depends on the location of supplies, the ability to monitor usage, and the legal and regulatory frameworks governing water allocation. Both surface and groundwater lack true market pricing, although the most severe challenges are in groundwater use because property rights do not exist.<sup>5</sup>

### Groundwater Allocation Challenges

Sixty percent of Texas’ water comes from groundwater aquifers, and farmers rely on groundwater for 80 percent of their irrigation use. Several problems plague Texas’ groundwater management, endangering local economies and wildlife.

Texas does not assign ownership rights to groundwater. A legal doctrine—the “rule of capture”—allows any landowner to drill a well and, in many parts of the state, pump almost unlimited amounts of water. Because water becomes private property only after a landowner draws it from the ground, there is a strong incentive to

**Chart 2** Most of Texas’ Water Used for Irrigation (2011 consumption shares)

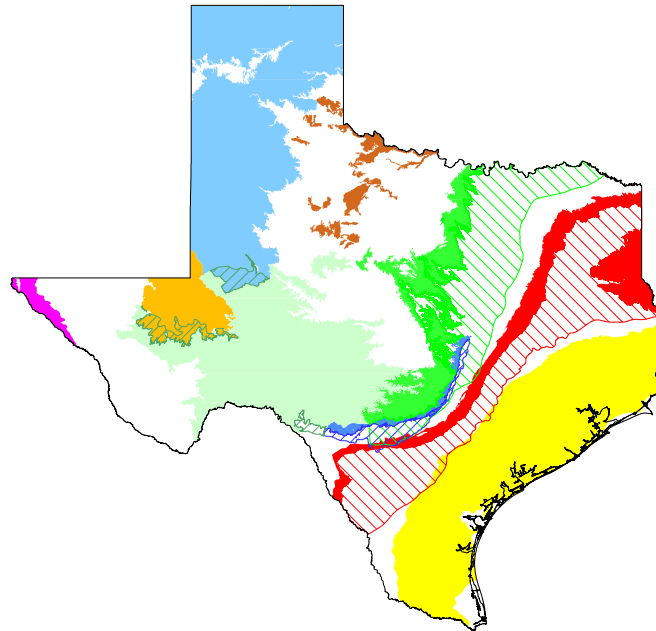


SOURCE: Texas Water Development Board.

Chart  
3

Texas' Major Aquifers Provide Groundwater Supplies

- Pecos Valley
- Seymour
- Gulf Coast
- Carrizo - Wilcox (outcrop)
- ▨ Carrizo - Wilcox (subcrop)
- Hueco - Mesilla Bolson
- Ogallala
- Edwards- Trinity Plateau (outcrop)
- ▨ Edwards- Trinity Plateau (subcrop)
- Edwards BFZ (outcrop)
- ▨ Edwards BFZ (subcrop)
- Trinity (outcrop)
- ▨ Trinity (subcrop)



NOTES: Outcrop refers to that portion of the aquifer in which water passes through a permeable layer of surface rock, allowing relatively quicker recharging. In the subcrop portion, water passes through an underground layer of rock, creating a slow recharge process. BFZ stands for Balcones Fault Zone, a region of the Edwards Aquifer.  
SOURCE: Texas Water Development Board.

be the first to pump. Economists call this the “tragedy of the commons.” Groundwater pumping from an aquifer has negative spillovers because one person’s actions leave less for everyone else. The system sends users exactly the wrong message: Pump faster as water becomes scarcer.

Groundwater conservation districts, the government bodies formed to address this issue, are made up of local users who decide how best to use the water in their county-sized jurisdictions. Because district borders follow county lines, several districts may overlay the same aquifer. Hence, the rule of capture extends the negative spillover from the individual to the district level.

One market-based solution, applied successfully in Australia and to surface water in the Lower Rio Grande Valley, is cap and trade. In this system, the state allocates—or caps—pumping rights and turns water into private property. Users are given well-defined deeds to water, in terms of the amount

of water they can pump. These can be traded, leading to a market for water, facilitating efficiency and conservation. Prices that arise from this system are closer to market prices than rate schedules set by agencies.

Texas House Bill 1763, passed in September 2005, recognized the “common pool resource” problem associated with competing groundwater districts. This legislation shifted decision-making toward larger entities that encompass entire aquifers, called Groundwater Management Areas (GMAs), which are overseen by the Texas Commission on Environmental Quality.<sup>6</sup>

With GMA oversight, an aquifer’s constituent districts agree on “desired future conditions,” a 50-year objective for groundwater levels. They outline how much each district will take, in essence assigning ownership to fixed quantities of water. GMAs could begin to facilitate markets by overseeing trade among districts. To measure groundwater allotments, however, wells need meters. Most groundwater conserva-

tion districts do not require farmers to install meters; most cities do not regulate “domestic” wells, which can pump up to 25,000 gallons a day. The High Plains Water District in Northwest Texas, whose area includes Lubbock, is an exception, requiring meters on all wells by 2016.<sup>7</sup>

The cap level on withdrawals is also critical. The cap can be set to sustain the aquifer, which means drawing only on the average annual recharge.

The Edwards Aquifer Authority in Central Texas, which serves San Antonio, oversees a cap-and-trade system. The current cap of 572,000 acre-feet is equal to the current permitted usage authorized for municipal, industrial and irrigation purposes. However, this amount does not include withdrawals from exempt wells, which can draw up to 25,000 gallons per day. During periods of drought, the authority issues mandatory curtailments rather than buy back the permits, and some users exploit the loophole by drilling exempt wells.<sup>8</sup>

Despite an array of challenges, groundwater often lends itself well to market trading. This is particularly true for aquifers similar to the Edwards that serve both agricultural and urban areas. To complete a local transaction, users rarely need to physically move the water; they can sell pumping rights to each other, with one user simply pumping less while the other pumps more.

When property rights to a resource are not allocated, it can be overused. Establishing groundwater rights would help end Texas' pumping free-for-all and create a more efficient distribution of aquifer resources. But as long as the rule of capture remains in place, property rights assigned by GMAs and aquifer authorities face frequent challenges. In recent rulings involving the Edwards Aquifer Authority, the Texas Supreme Court suggested that a formula taking into account land acreage above an aquifer as well as historical usage may be a better and legally defensible way to allocate water rights.<sup>9</sup>

### Surface Water Supply Issues

Forty percent of Texas water supply comes from surface water, found in rivers and reservoirs. Surface water is particularly important to cities, supplying 62 percent of their water.

Texas' surface water management institutions are more developed than their groundwater counterparts. The state owns surface water, holding it in trust for the public. Property ownership is defined: Residents and river authorities apply for the right to use the water or buy existing rights from others. Twenty-three state-chartered wholesalers (river authorities) own 70 percent of these rights (*Chart 4*).

River authorities manage reservoirs and sell water to cities and farmers. Their policies—rather than supply and demand—dictate prices. Typically, water is priced to reflect purification and transportation costs but not its opportunity costs (reflecting scarcity), leading to overuse and consumption rationing.

“Take or pay contracts,” requiring municipalities to pay for river authority water whether they use it or not, further

encourage water consumption even during periods of scarcity. The state also issues too many rights, causing existing rivers to be oversubscribed during droughts. Users need not buy water when they can obtain cheap new water rights from the state or exceed their current allotment.<sup>10</sup> Low prices and inflexible contracts both promote water use.

Texas has the legal and regulatory framework needed for efficient surface water use, but small changes in implementation could improve outcomes. When water is scarce, capping total diversion rights and monitoring them carefully would allow Texans to adapt through water markets. Water rights have traditionally been allocated by historical use and land access. The key is to provide users with certainty about the rules of water sales and well-defined rights that are not over-allocated to make trading simpler and more profitable. Greater potential profits would encourage participants to finance infrastructure, such as pipelines, needed to move water.

### Benefits of Water Markets

Water markets, which allow people to buy, sell or lease water rights, can allocate water to its most productive uses and help alleviate shortages. Prices are

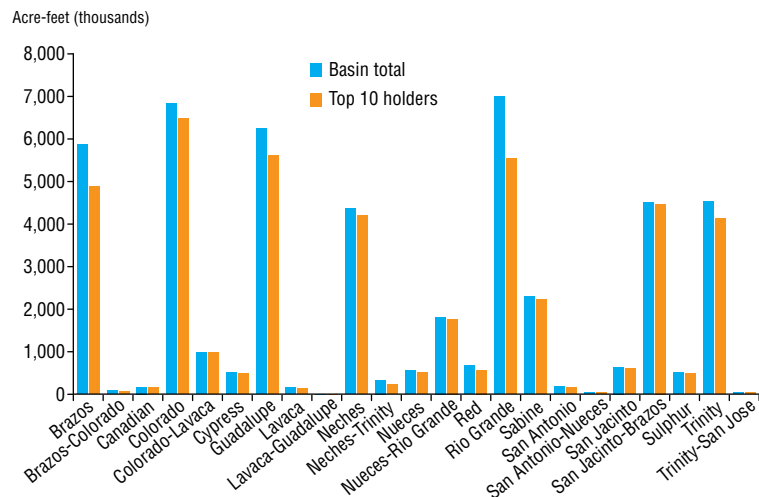
not set by an agency but are negotiated in the market process—rising in periods of relative scarcity and falling during times of relative abundance. This adjustment mechanism balances the quantities demanded and supplied, minimizing shortages.

Given that river authorities and municipalities will remain major players, how can surface water be priced so that it is allocated efficiently? In lieu of fully competitive markets, innovative contracts between big buyers and sellers can replicate market outcomes. The Edwards Aquifer Authority, before opening its cap-and-trade system, experimented with an irrigation-suspension program. Participating farmers left their land fallow for cash and cities received water.

To ensure every household has access to a base level of affordable water, households in municipal systems could receive a basic amount of water at a low price but pay more as their consumption increased, reflecting the marginal cost of the additional water. Some researchers have even suggested market mechanisms that allow households to sell some of their basic allocation if they choose to conserve.<sup>11</sup>

Because agriculture represents a small fraction of the state's economy but uses most of the water, cities and

**Chart 4** River Authorities Control Most State Surface Water



SOURCE: “A Powerful Thirst: Water Marketing in Texas,” by Mary Kelly, Environmental Defense, 2004.

industries would have the opportunity to buy water from the agricultural sector as their demand increased. This is already happening in areas such as the Lower Rio Grande Valley, home to Texas' most active water market, where more than 90 percent of sales by volume go from farmers to cities.<sup>12</sup> Fewer than 300 rice farmers served by the Lower Colorado River Authority hold the rights to a majority of the water; Austin-area homeowners have offered \$100 million for those rights.<sup>13</sup>

In the Lower Rio Grande Valley, water rights sell for nearly \$2,000 per acre-foot. Despite the region's rapidly growing population, a new water supply project hasn't been built in 40 years. Farmers turn a profit selling their water to other farmers and cities, and businesses can trust they will always have water, for a price.

The demand for water is sensitive to price. Estimates suggest that for every 1 percent increase in the price of water, farmers use 1 to 3 percent less. Cities' water needs are somewhat less sensitive. A 1 percent price rise reduces their demand by only 0.3 to 0.7 percent.<sup>14</sup>

One study found that municipal and industrial buyers across the American West would pay three to four times what farmers would pay for an additional acre-foot of water, on average.<sup>15</sup> Rice farmers, for example, receive Colorado River water for \$6 an acre-foot; Austin residents pay \$151 per acre-foot.<sup>16</sup> If prices were set through a market rather than by a water authority, cities and farmers would trade; farmers would have an incentive to sell more water and use less by planting fewer crops, substituting crops that consume less water or investing in more efficient irrigation systems.

The realization of water's value as a scarce commodity, like oil, will also promote conservation. People will try to make money selling unused water, or save money by purchasing less. Through market prices, people discover for which "needs" they're willing to pay. Some may find that high prices preclude miles of irrigated cotton or lush St. Augustine lawns.

## Water Markets' Promise

It is encouraging that some regions in the state are using market principles to manage water. Efforts include the cap-and-trade system governing the Edwards Aquifer and the water market in the Lower Rio Grande Valley. More widespread use of markets would ensure that Texans have enough water—and that it goes to its most productive uses. Many challenges to markets remain, including the rule of capture, which impedes groundwater markets, and "use it or lose it" laws, which hinder surface water markets.

*Phillips is a senior research economist and advisor at the San Antonio Branch, Rodrigue was a research intern in the Research Department and Yücel is senior vice president and director of research at the Federal Reserve Bank of Dallas.*

## Notes

<sup>1</sup> See "The Impact of the 2011 Drought and Beyond," Texas Comptroller of Public Accounts, February 2012, [www.window.state.tx.us/specialrpt/drought/pdf/96-1704-Drought.pdf](http://www.window.state.tx.us/specialrpt/drought/pdf/96-1704-Drought.pdf).

<sup>2</sup> See "A Deeper Dive: Gross Domestic Product (GDP) by State," The Texas Economy: Economic Outlook, Texas Comptroller of Public Accounts, 2010, [www.thetexasconomy.org/economic-outlook/economy/articles/article.php?name=DD-GDPbyState](http://www.thetexasconomy.org/economic-outlook/economy/articles/article.php?name=DD-GDPbyState), and Texas Water Development Board, Historic Water Use Estimates, August 2013, [www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp](http://www.twdb.texas.gov/waterplanning/waterusesurvey/estimates/index.asp).

<sup>3</sup> Aquifers suffer both local and regional declines. The Ogallala fell 9 percent, on average, from 1950 to 2005, according to the U.S. Geological Survey. But Texas experienced sharper drops, and local declines can be more acute. The aquifer serving parts of the Panhandle fell by half.

<sup>4</sup> Based on 2012 Texas State Water Plan, Texas Water Development Board, and authors' calculations.

<sup>5</sup> We refer to property rights as the ownership rights to a defined quantity or share of water, not the ownership rights to the land where the water resides.

<sup>6</sup> See "A Streetcar Named Desired Future Conditions: The New Groundwater Availability for Texas," Texas Water Development Board, prepared for The Changing Face Of Water Rights in Texas 2008, State Bar of Texas, May 8–9, 2008, [www.pg-tim.com/files/TX\\_Summary\\_HouseBill36\\_Desired\\_Future\\_Conditions.pdf](http://www.pg-tim.com/files/TX_Summary_HouseBill36_Desired_Future_Conditions.pdf).

<sup>7</sup> See "Ogallala Aquifer in Texas Panhandle Suffers Big Drop," by Kate Galbraith, *Texas Tribune*, May 22, 2013, <http://stateimpact.npr.org/texas/2013/05/22/ogallala-aquifer-in-texas-panhandle-suffers-big-drop>.

<sup>8</sup> See "A Powerful Thirst: Water Marketing in Texas," by Mary Kelly, Environmental Defense, 2004.

<sup>9</sup> See *Edwards Aquifer Authority v. Day* and *Edwards Aquifer Authority v. Bragg*.

<sup>10</sup> Some river authorities use this disparity to sell more water than they own.

<sup>11</sup> For example, see "Transferable Rate Entitlements: The Overlooked Opportunity in Municipal Water Pricing," by Robert A. Collinge, *Public Finance Review*, vol. 22, no. 1, 1994, pp. 46–64.

<sup>12</sup> A substantial number of water contracts take place between farmers. See "Water Marketing as a Reallocation Institution in Texas," by C. Chang and Ron Griffin, *Water Resources Research*, vol. 28, no. 3, 1992, pp. 879–90.

<sup>13</sup> See "Central Texas Coalition Urges Buyout of Rice Farmers," by Asher Price, *Austin American-Statesman*, March 3, 2013, [www.statesman.com/news/news/state-regional-govt-politics/central-texas-coalition-urges-buyout-of-rice-farmer/nWf6J](http://www.statesman.com/news/news/state-regional-govt-politics/central-texas-coalition-urges-buyout-of-rice-farmer/nWf6J).

<sup>14</sup> See "Reducing Institutional Barriers to Water Conservation," by Frank A. Ward and J. Phillip King, *Water Policy*, vol. 1, no. 4, 1998, pp. 411–20, [http://agecon.nmsu.edu/fward/natural%20resource%20news/wc\\_wpolicy\\_ward\\_king.pdf](http://agecon.nmsu.edu/fward/natural%20resource%20news/wc_wpolicy_ward_king.pdf).

<sup>15</sup> "Emerging Markets in Water: A Comparative Institutional Analysis of the Central Valley and Colorado–Big Thompson Projects," by Janis M. Carey and David L. Sunding, *Natural Resources Journal*, vol. 41, no. 2, 2001, pp. 283–328.

<sup>16</sup> See "Central Texas Water Conflict Heats Up Again," by Terrence Henry, *StateImpact Texas*, Dec. 13, 2012, <http://stateimpact.npr.org/texas/2012/12/13/central-texas-water-conflict-heats-up-again>.

*A Conversation with Agustín Escobar Latapí*

## You Can Go Home Again: Mexican Migrants Return in Record Numbers

*Agustín Escobar Latapí is a research professor at the Center for Research and Higher Learning in Social Anthropology in Guadalajara, Mexico, and is a member of Mexico's National Academy of Sciences. A specialist in Mexican social policy and migration, he discusses the southward return of migrants and its implications.*

**Q. You recently led a large group of researchers on a binational study of Mexico–U.S. migration. What's behind your finding of unprecedented return migration to Mexico from the United States?**

The U.S. tends to emphasize the total size of the Mexican immigrant population, which hasn't grown since 2007. The other side of the coin, of course, is what happens in Mexico. In a nutshell, the total size of the population moving to Mexico from the U.S. has grown remarkably. In the 2000 Mexican census, 230,000 Mexicans said that their country of residence had been the U.S. five years earlier. A decade later, 980,000 replied similarly. In addition to this fourfold increase, today's return migrants tend to stay in Mexico to a much larger extent than in previous periods.

The 2010 census also revealed that there were 739,000 U.S.-born individuals living in Mexico. Seven out of 10 in this group are under age 18. A significant portion were born to middle-class Mexican couples living along the border—holding U.S. visas and having the ability to pay for health care—who returned to Mexico with their newborn. But the rest are family members of return migrants living elsewhere in Mexico, not on the border. Most in this group have little experience in Mexico. Although their family helps with integration, they face many of the same issues with which international migrants elsewhere must deal. We consider them part of the larger phenomenon of return migration because their parents

were deported or they decided it was best to return to Mexico.

The 2008–10 economic downturn and slow recovery is the main reason for this large return flow to Mexico. Nevertheless, it is also clear to me that many of those returning would have remained open to a possible return to the U.S. had immigration policy not changed.

We tend to hear immigration policy hasn't changed, but it has. Widespread immigration enforcement is a new policy. Returns and removals have been at their highest levels since 2005, and many of these individuals face a mandatory prison sentence if they are caught again in the U.S. That, along with state and local enforcement, interagency cooperation regarding immigration, and a sluggish U.S. recovery in construction and other higher-paying, lower-skill industries has kept return migrants in Mexico.

A minor but positive trend is that the number of temporary work visas issued to Mexicans has increased. Workers prize these visas, which were not valued when crossing the border was low-risk and penalty-free.

**Q. Who are the return migrants and how well do they do once they are back in Mexico? Does it matter whether the return was forcible or voluntary?**

We have interviewed families who planned their return carefully, got all their papers in order, successfully enrolled their children in Mexican schools and signed up for Mexican free health

insurance and other social services. Mostly, these families delayed their return until they were sure they had jobs in Mexico.

But there are others. Many were deported and had no official Mexican identity papers. They needed the Mexican embassy in the U.S. to certify their children's birth certificates or school records. This is a lengthy process. Certifying U.S. school records in Mexico can be extremely complicated and expensive, and sometimes requires children and teenagers to pass Mexican proficiency tests that are neither widely available nor easily understood for someone coming from the U.S. education system.

And there are a large number of youth who were forcibly returned, some with no work experience and some after serving a jail sentence in the U.S. These individuals are at significant risk, and some carry out illegal activities in Mexico. Nevertheless, our study found that in Mexico, U.S.-born children of Mexicans is one of the groups with the highest high school enrollment rates. Meanwhile, the Mexican-born children of migrants who frequently cross the border are among those with the lowest enrollment rates. This illustrates the diversity of the return migrant group.

Two observations are worth additional study. First, the poverty rate in Mexico would be lower today if the return-migration population had not been so large, or if the potential migrant population had left Mexico. Second, farm employment in many of the areas from which migrants originated has expanded significantly in the last four or five years. But our fieldwork shows there is no simple relationship between returns and farm employment. For example, in Jalisco, many farm jobs traditionally performed by locals have already gone to migrants from poorer states in Mexico who have already settled in the agricultural export and tequila industries.

Call-center jobs are staffed to a large extent by U.S.-born youth whose families brought them back to Mexico. Jobs requiring good English are now often in the hands of people who actually do speak good English, which wasn't the case until recently.





▶ *“In the 2000 Mexican census, 230,000 Mexicans said that their country of residence had been the U.S. five years earlier. A decade later, 980,000 replied similarly.”*

**Q. What does the Mexican government do to help return migrants? Do children get back into school?**

There are contradictory claims and pressures on the Mexican government, and local government incentives often run counter to migrants’ interests. Mexican identity papers were relatively easy to come by in the past. However, pressure from the U.S., the war on organized crime and a growing, often-undocumented immigrant population in Mexico have prompted tighter requirements for most official identity documents. This complicates entry into schools or the formal job market.

Unfortunately, the plight of return migrants has not impacted Mexican policy in a consistent way. We interviewed officials of the free public health program, who confidently stated that U.S.-born children of return migrants are ineligible. And school officials often have the last say regarding who qualifies or what papers are required. Often, schools require original documents, which is a problem for someone who only got one or two copies before leaving the U.S. Mexico’s main cash transfer program for poor families is more open, and enrollment is centralized, but U.S.-born children still need official documents certified by the U.S. government or by the Mexican embassy in the U.S.

**Q. Are there data on attitudes toward return migrants among other Mexicans?**

There are no national surveys on Mexicans’ attitudes toward the return migrants, although some are under way. There was, however, a 2009–10 national

survey commissioned by [the magazine] *Este País* showing that general attitudes toward international immigrants are not positive. Professional immigrants of European stock were seen as enjoying an unfair advantage among employers. Conversely, in Southern Mexico, poor Central Americans are the target of the same feelings and attitudes poor Mexicans encounter in the U.S. They are seen as competing with poor Mexicans for jobs.

**Q. As migration has slowed from Mexico to the U.S., Central American migration appears to have picked up. Do some Central Americans stay in Mexico?**

Some are staying, although official immigration figures still show few have acquired Mexican residence. For most would-be “transmigrants,” staying in Mexico is a relatively poor choice, but one that they are increasingly opting for because of the risks of traveling further north. The Mexican labor market and pay levels are better than in most Central American countries, and many migrants can’t go home because violence in their countries is much worse than in Mexico. They have to perform informal jobs since they cannot get residence permits, which require they have a job and an address.

The larger picture shows that Central American transmigration or immigration to Mexico is part of a regional migration movement that is not Mexico’s sole responsibility. The entire Central–North American labor market is being reconfigured.

**Q. We have read accounts of more European and Asian migration to Mexico. How has migration to Mexico changed in recent years?**

There are many kinds of flows. For example, Mexicans who married Central Americans in the U.S. are returning to Mexico with their families, not usually to Central America. Official immigration

figures show small Asian and European numbers. There are no sources allowing us to distinguish, for example, European professionals arriving on work visas from students who secure Mexican scholarships, tourists who decide to stay or Asian company workers and their families.

**Q. What does your research suggest has been the impact of the violence in Mexico on migration to the U.S.?**

Our research shows that higher homicide rates correlate with falling emigration. This seems to be because traveling long distances in unsecure regions became much riskier. In these regions, families tend to receive higher remittances, possibly reflecting deteriorating incomes due to crime.

Along the border, higher violence correlates with elevated emigration levels, as one would expect.

Violence seems to be abating, although we cannot expect it to fall rapidly. Criminal mafias have secured footholds in legal businesses and local government. Crime rates are falling in many of the previous hot spots, often dramatically. But this sometimes means those groups moved elsewhere. Most of Mexico is still safe, however, and violence is lower than is often perceived.

**Q. If the Mexican president’s reform agenda is successful, how might that impact emigration?**

We are currently experiencing the end of the Mexican honeymoon with the return of the PRI [Institutional Revolutionary Party]. The government, which for the first time could get congress to pass major reforms, still hasn’t been able to pass and implement them as planned. The new government will have to prove its reforms make sense, provide more growth and reduce inequality. If it does, of course, Mexican emigration will find a natural, market-led course.



## NATIONAL DEFENSE: Texas Contractors May Feel New Sequester Cuts

**T**exas, the second-largest recipient state for Defense Department prime award contract dollars, may experience more than a hiccup if a second round of sequestration-tied federal budget cuts proceeds throughout fiscal 2014, which began Oct. 1, 2013. Companies in the state were awarded \$20.4 billion in fiscal 2013 and trailed only firms in Virginia, home of the Pentagon, with \$23.3 billion, department data show. Larger, multiyear projects were largely spared during the initial round of cuts.

Texas could lose almost \$6.5 billion in defense contractor revenue over 10 years, the third most behind California and Virginia, Pew Charitable Trusts estimated last year. Of the top 10 largest defense-related companies in the world as identified by the Stockholm International Peace Research Initiative, seven are represented in the Dallas–Fort Worth area. The companies make a variety of aviation, electronic and communications products, and most employ skilled workers.

Tarrant County, which includes Fort Worth, has an especially significant concentration of defense contractor-tied employment. Lockheed Martin, which has almost 15,000 workers and is the county’s third-largest employer, is ramping up production of its next-generation F-35 aircraft. The \$391 billion, multiyear program is one of the Pentagon’s most ambitious.

—Michael Weiss



## INCOME: Despite Gains, Texas Still Trails U.S. in Key Measures

**T**hree years after the recession ended, real (inflation adjusted) median household income improved for the first time in Texas and stopped declining in the U.S. Nevertheless, other economic benchmarks show Texas still trails the nation.

Texas’ real median household income grew 0.8 percent to \$50,740 in 2012, the first increase since 2008, according to the Census Bureau’s American Community Survey. Nationally, median income was essentially flat, up 0.1 percent to \$51,371. San Antonio recorded the largest increase in median household income among the 25 most-populous metropolitan areas in 2012, up 3.8 percent to \$51,486.

The rise helped the Texas poverty rate decline to 17.9 percent in 2012 from 18.5 percent in 2011, while the nationwide poverty rate remained unchanged at 15.9 percent. The Texas poverty rate fell for the first time since the recession, narrowing the gap with the national poverty rate.

Not all the news was as positive. Texas continues to lead the nation in the share of residents who lack health insurance. The proportion of uninsured Texans increased 0.9 percentage points to 24.6 percent in 2012, while the U.S. rate declined 0.3 percentage points to 15.4 percent. Texas, Nevada, New Mexico and Florida are the only states in which more than one-fifth of residents don’t have health insurance.

—Christina English



## BORDER: Staffing at Crossings Adds to GDP, Study Says

**C**ustoms and immigration agent staffing at the nation’s ports of entry has far-reaching economic impacts, according to a University of Southern California study supported by the Department of Homeland Security. The department, which didn’t endorse the findings, oversees Customs and Border Protection (CBP) operations.

Each officer added to existing staff at a port of entry is associated with an annual \$2 million increase in gross domestic product (GDP) and 33 additional jobs. Most of the economic benefits associated with the additional staffing would come from shorter queues in ground passenger travel, with only a small contribution—about \$120,000 in GDP and one job—from facilitating truck freight transportation.

The study finds that cuts in staffing levels similarly have significant implications for the flow of legitimate travel and commercial activity across U.S. borders. CBP agents temporarily avoided mandatory furloughs and the loss of overtime hours due to budget sequestration in fiscal 2013. Staffing was largely unaffected by the partial federal government shutdown in October, though paychecks were delayed. The department’s 2014 budget allows for a record 25,252 officers, adding 1,600 through appropriations and 1,877 through proposed user fee increases.

—Melissa LoPalo

# Energy, Trade in Southern New Mexico Lift State's Economic Performance

By Avilia Bueno and Roberto A. Coronado

**N**ew Mexico has struggled to keep pace with the nation's rebound from recession. As of August, the U.S. had recovered 78 percent of the 8.7 million jobs lost in the downturn. By comparison, New Mexico added back just 25 percent of the 51,700 jobs it lost.

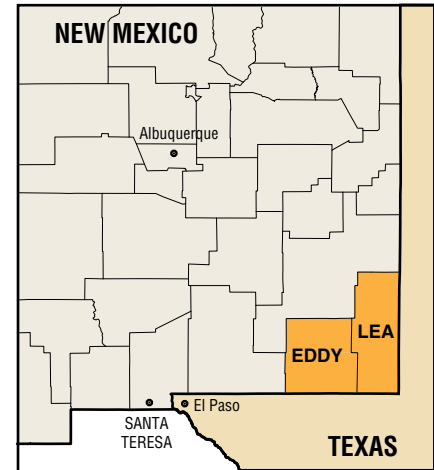
But the New Mexico story has several parts. Job growth in the southern portion of the state has been particularly brisk, the result of robust energy and trade sectors (*see chart*).<sup>1</sup>

Spurred by high energy prices and hydraulic fracturing in the Permian Basin's shale formation, southeast New Mexico's Eddy and Lea counties have stood out. Crude oil production in the state totaled about 84.4 million barrels in 2012, and Eddy and Lea took the lead, producing 44 million and 35.8 million barrels, respectively.<sup>2</sup> In addition to oil, production of commodities such as potash (a mineral used in fertilizer) has been rising and is likely to bring considerable investment to the region in coming years.

Employment grew 2.2 percent in Eddy and 3.2 percent in Lea from August 2012 to August 2013, significantly more than the 1.1 percent rate for New Mexico overall and the 1.6 percent figure for the nation. The August unemployment rate was a remarkably low 3.9 percent in Eddy and 3.8 percent in Lea, compared with 6.8 percent statewide.

New Mexico's 42 percent export growth rate led the nation from 2011 to 2012. Israel was its biggest destination market, on the strength of production from a Rio Rancho Intel semiconductor plant. Mexico was next, with 20 percent of the state's total exports. The biggest segment of state exports to Mexico is industrial inputs and components shipped to maquiladoras in the northern part of the country. Total exports to Mexico in 2012 were valued at around \$618 million, a small amount compared with other border states, such as Texas at \$94.8 billion and Arizona at \$6.3 billion.

Traditionally, New Mexico's manufacturing base has been centered



around Albuquerque, the state's largest metropolitan area. However, within the last 10 years, the Santa Teresa Port of Entry on the border has seen significant public and private infrastructure investment, which will aid its emergence as a major export platform to Mexico.

Southern New Mexico's economic fate is tied to oil and the global economy. As long as oil prices remain near current levels, drilling in the western Permian Basin will continue. Meanwhile, economic activity in Santa Teresa will be shaped mostly by Mexico, whose economy faces significant headwinds but improved prospects in 2014.<sup>3</sup>

While southern New Mexico may face challenges in the coming months, the region is likely to continue to shine as the rest of the state economy slowly mends.

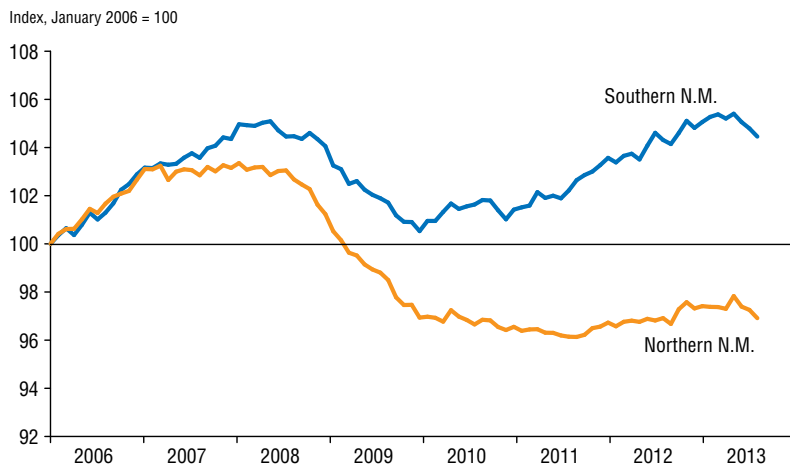
## Notes

<sup>1</sup> For more details, see "Southeast New Mexico Shines as State Economy Slowly Mends," by Avilia Bueno and Roberto A. Coronado, *Crossroads*, Issue 1, 2013.

<sup>2</sup> For more details on energy production in the Permian Basin, visit [www.dallasfed.org/research/econdata/permian.cfm](http://www.dallasfed.org/research/econdata/permian.cfm).

<sup>3</sup> For a more recent discussion of Mexico economic trends, see [www.dallasfed.org/research/update/mex/index.cfm](http://www.dallasfed.org/research/update/mex/index.cfm).

## Employment Shows Strength in Southern New Mexico



SOURCE: Bureau of Labor Statistics.

# Barbecue vs. Gumbo: Economic Traits Tie Neighboring Texas and Louisiana

By Jason Saving and Michael Weiss

**E**ven with a legacy of cultural differences as varied as their native cuisines, Texas and Louisiana still have much in common.

They are geographically contiguous, a roughly 240-mile border running between them, and they adjoin the Gulf of Mexico, from which some of the nation's busiest ports operate. They share a geology that begins in East Texas and extends through Louisiana, with vast deposits of fossil fuels and a regional topography that doesn't rise much above sea level. They also share a few historical traits, having been under the rule of many of the same entities, including Spain and the Confederacy.

Yet the states are perceived in radically different ways. Texas is often depicted as a fast-growing paragon of economic wherewithal, a hotbed of entrepreneurial initiative and opportunity. Louisiana is much less frequently described in such terms, though it's lauded for its unique culture and customs.

Economic and population statistics point up their differences. More than five Louisianas (52,271 square miles) could fit into one Texas (268,820 square miles). While Texas is the nation's second-most populous state (and growing), with 26.1 million residents as of 2012, Louisiana is 25th-most populous, with 4.6 million people, a base it has struggled to expand since Hurricane Katrina struck in 2005.

Texas' economic output, reflected in its real gross domestic product, has more than doubled since 1990; Louisiana's is just one-third larger over the period (*Chart 1*).

Texans' well-being has improved relatively more, with personal income rising 42 percent since 2000 versus 33 percent next door.

Income growth accelerated in Texas beginning in 2010, coinciding with expanding shale oil and gas exploration. Until 2010, personal income in the two states grew similarly—sometimes more in one than in the other, as in Texas during the 12 months immediately after Hurricane Katrina and in Louisiana during the year after that as rebuilding took hold.

In the last 30 years, as energy boomed, busted and boomed again, Texas diversified economically into the service sector and “knowledge” fields such as information technology; Louisiana largely stayed the course, albeit while overcoming the devastation of Katrina, one of the worst natural disasters to hit the U.S.<sup>1</sup> The shale energy revolution, providing new exploration and resource opportunities for both states, may offer Louisiana a new economic impetus for accelerated growth.

As is often the case, broad-brush overviews, while providing useful perspective, may overlook some subtleties.

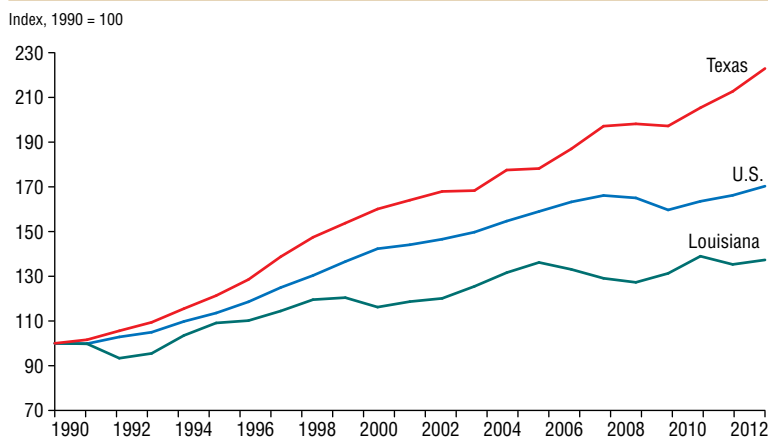
In reality, some of the same factors drive economic growth in Texas and Louisiana. While there are real differences between the two states—barbecue versus gumbo—a closer examination of those factors is particularly revealing.

## Assessing Business Climate

One place to start is the states' overall economic environment. All other things equal, economists have generally found that better business climates bring faster economic growth and, thus, more opportunities for workers and firms, though many other factors play a role. How do the two states stack up?

Data support the popular perception that Texas presents its residents with fewer economic constraints than the average state. The nonpartisan Fraser Institute's annual rankings, for example, place Texas second among the states for business-friendly climate. The measurement, derived from a

**Chart 1** Real Gross Domestic Product Growth



SOURCE: Bureau of Economic Analysis.

10-point scale measuring 10 characteristics, broadly covers size of government, tax policies and labor market regulations (*Chart 2*).

Texas scores well primarily because of government’s relatively small share of the economy and the relatively small per capita transfer payments disbursed for welfare and nutrition programs, bolstering the amount of resources remaining in the hands of individuals and businesses to consume or invest as they see fit.

Louisiana isn’t far behind, however. Its business climate ranks seventh, scoring above the national average in Fraser’s three general categories—government, taxes and labor relations. However, Louisiana’s scores over the sample period (2001–07) were much more volatile than Texas’, suggesting Louisiana firms faced a somewhat less certain business environment over that period.

Outside of Fraser’s measurement, legal idiosyncrasy can also play a role—though a difficult-to-quantify one—in an area’s business environment. Louisiana’s adherence in noncriminal matters to a form of the Napoleonic Code—not unlike another former French colony, Quebec—gives greater weight to custom and adherence to a broad civil code than does the com-

mon-law framework practiced in Texas and elsewhere in the U.S. The predominant framework relies more on legal precedent.<sup>2</sup> The difference can present a challenge to doing business in Louisiana without local counsel.

### The ‘Skill Premium’

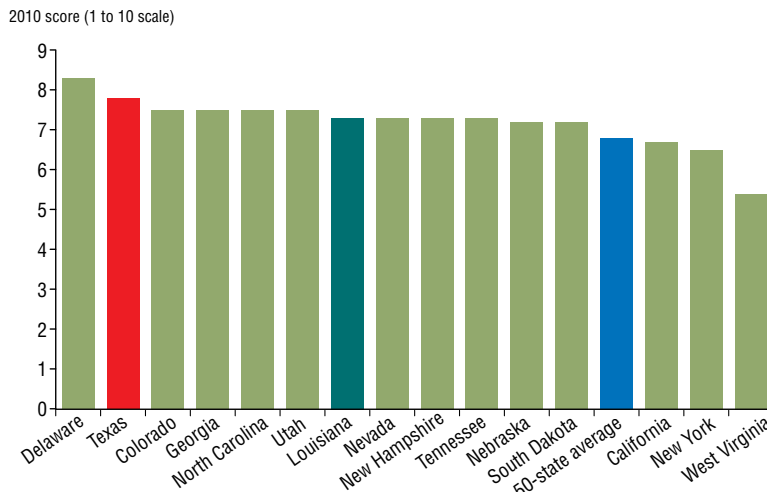
But putting one’s state on a better growth path over time is not simply about trimming government and making the system more transparent. In a global economy characterized by ever-increasing levels of competition, human capital has emerged as an ever-more-important determinant of growth.

The “skill premium” between highly and less-well educated workers has grown substantially, and there is every reason to believe it will continue to do so. This means the education system (particularly grades K-12), which is primarily state run and state funded, has a profound impact on longer-term growth by directly affecting students’ higher-education outcomes.

U.S. states spent on average \$10,580 per student on K-12 education in 2011 (the last year for which full data are available) (*Chart 3*). Texas spent 18 percent less than the national average over that period, placing it 43rd. Louisiana, on the other hand, spent 1 percent

► *In a global economy characterized by ever-increasing levels of competition, human capital has emerged as an ever-more-important determinant of growth.*

**Chart 2** | Texas, Louisiana Rate High in Business Climate Index



SOURCE: Fraser Institute.

more than the average, \$10,723, ranking it 23rd. (New York was the highest, \$19,067, and Utah the lowest, \$6,212.)

However, funding is not the only determinant of educational success, and broader measures suggest the states are on more equal footing than might be implied by the spending figures. Despite its above-average per-capita education spending, Louisiana ranks 48th in student performance, as measured by results for fourth-grade math competency in the nation's premier benchmark test, the National Assessment of Educational Progress (*Chart 4*). Texas placed 24th, with scores that almost mirror the national average. (Massachusetts was No. 1 and Mississippi No. 50.)

Infrastructure is another factor helping drive long-run economic growth. Texas, with its sprawling size, spends \$7.9 billion per year on its highways, the second-highest amount in the nation, but its per-capita spending level of \$319.41 puts it 8.5 percent below the national average. By contrast, Louisiana's \$2.1 billion yearly expenditure produces a per capita spending level of \$474.63, nearly 36 percent above the national average (*Chart 5*).

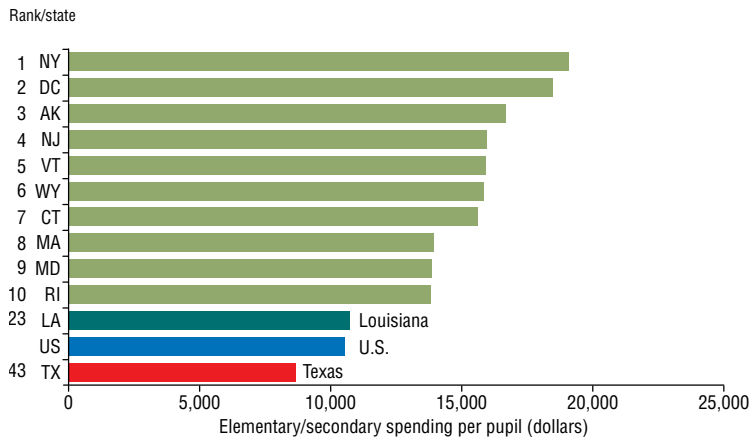
The difference may be partially attributable to Louisiana's costly and numerous elevated roads over marshes and swamplands, such as the 18-mile Atchafalaya Basin Bridge on Interstate 10 between Baton Rouge and Lafayette.

Again, total spending doesn't tell the whole story. The most recent Annual Highway Report finds that Texas roads and bridges were the 11th best in the nation, though its urban congestion was 4 percent above the national average and its overall fatality rate was 17 percent higher than the national norm. Louisiana's state highway system was ranked 35th, with an even higher fatality rate and a 71 percent greater likelihood that any given mile of interstate highway will be in poor condition.

### Ports of Plenty

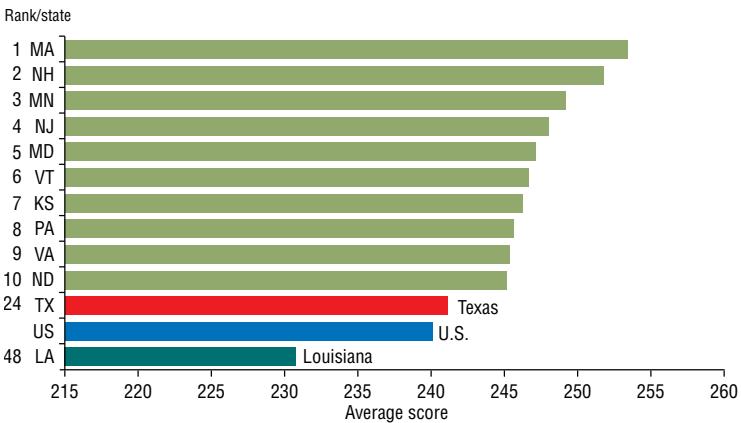
Texas and Louisiana have historically been open to waterborne trade. From the days when cotton was exported from New Orleans and Galveston, to

**Chart 3** Texas Trails Louisiana, Nation in Spending Per Pupil



NOTE: Based on rankings of the 50 states plus the District of Columbia.  
SOURCE: Census Bureau.

**Chart 4** Louisiana Trails Texas, Nation in 4th Grade Math Testing



NOTE: Based on rankings of the 50 states plus the District of Columbia.  
SOURCE: National Center for Educational Statistics, 2011.

more recent times, when petrochemicals and petroleum products have flowed from ports along the Gulf Coast, geographic happenstance ensured that waterborne trade would become a key component of both states' economic well-being. This is evident in an examination of port tonnages, with nine of the nation's 12 largest ports—including the two largest—found in the two states.

There are also important geographical differences that bear on the overall trade picture in the two states. Mexico's opening to trade and emergence as a player in the international economy have greatly expanded the

movement of goods in recent years, a trend that has disproportionately benefited its largest trading partner, Texas. Exporters have to some degree also chosen to locate in Texas due to its proximity to Mexico, causing Texas to surpass more-populous California as the nation's largest exporter. Louisiana has participated in this boom to a much lesser extent.

Reflecting these differences, more than one-third of Texas exports flow to Mexico, while Louisiana, which is one state away from the Mexican border, exports more goods to China (13.2 percent) than Mexico (10.7 percent) (*Chart 6*).

The relatively limited trade relationship with Mexico has also contributed to Louisiana exporting a more narrow composition of goods than Texas. For example, over 29 percent of Louisiana exports are petroleum products versus a smaller but still-large 13 percent for Texas. One-third of Louisiana exports are corn and soybean products, many arriving for loading from growing states upstream along the Mississippi River; Texas has comparatively little agricultural pass-through.

Still, both states make a disproportionately large contribution to total U.S. exports—17.1 percent of U.S. exports come through Texas even though only 8.1 percent of the U.S. population resides in the state, and 4.1 percent come through Louisiana even though only 1.5 percent of the population lives there.

### Investing in the Future

Texas and Louisiana are geographic neighbors that share many characteristics and face many common challenges. From their roots as southern states whose fortunes were closely tied to export markets, each has in its own way emerged as an important player on the global economic stage.

Perhaps the single-largest challenge ahead for both states lies in investing in human capital by improving and expanding education. As globalization and technological change skew U.S. labor demand toward high-skill

occupations, state education systems will need to rise to the challenge.

Especially in Louisiana—a state that receives relatively little domestic in-migration and also relatively few immigrants—policymakers will face substantial pressure to improve the K–12 education system or watch jobs leave to neighboring jurisdictions.

Such short-term pressure is somewhat less in Texas due to the large number of well-educated immigrants it receives from other states and nations and to the relatively high number of immigrants from points south who are willing and able to enter lower-skill occupations. But Texas will also need to improve the quality of its public

schools over the long run if it is to move up the value-added ladder.

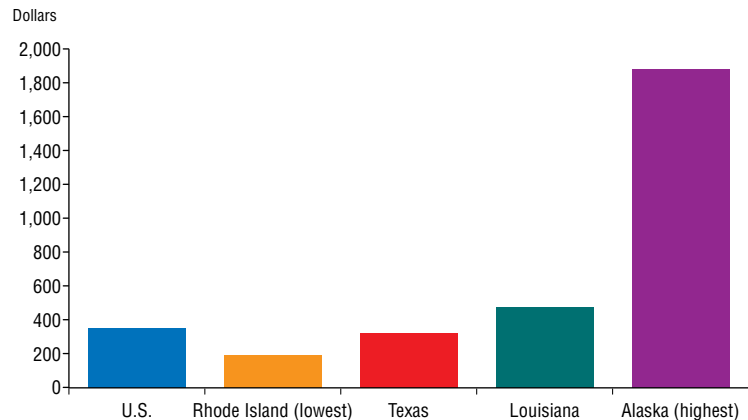
*Saving is a senior research economist and advisor and Weiss is a senior writer/editor in the Research Department of the Federal Reserve Bank of Dallas.*

### Notes

<sup>1</sup> See “The Economic Aftermath of Hurricane Katrina,” by Jacob Vigdor, *Journal of Economic Perspectives*, vol. 22, no. 4, 2008, pp. 135–54.

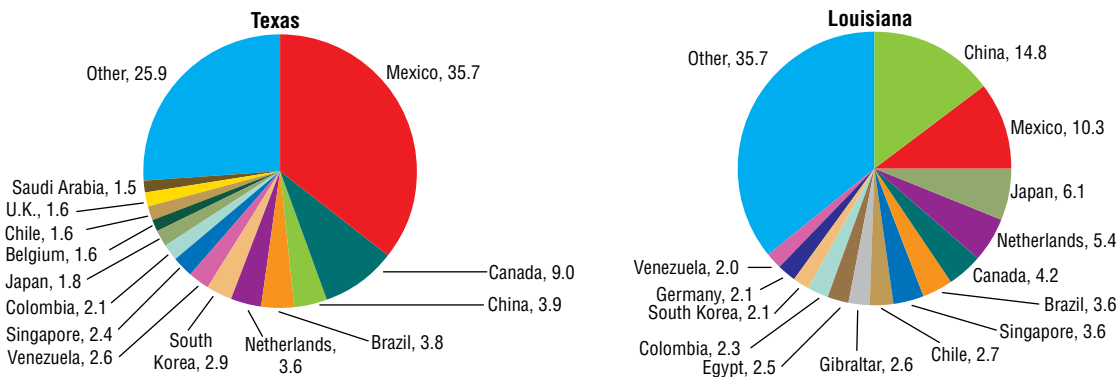
<sup>2</sup> See “The Civil Codes of Louisiana,” by A.N. Yiannopoulos, *Civil Law Commentaries*, Tulane University Law School, vol. 1, Winter 2008. Also, “Louisiana Begins to Slip Its Legal Ties to France,” by Lis Wiehl, *New York Times*, Oct. 13, 1989.

**Chart 5** Louisiana Tops Texas in Per Capita Highway Spending



SOURCES: Census Bureau; Federal Highway Administration.

**Chart 6** Top Export Destinations: Texas vs. Louisiana  
(Value of total exports, percent)



SOURCE: Census Bureau, 2013.

# Shale Revolution Feeds Petrochemical Profits as Production Adapts

By Jesse Thompson

▶ *The marriage of advanced techniques for horizontal drilling and hydraulic fracturing has helped reverse 30 years of declining domestic production of oil, natural gas and natural gas liquids.*

**B**ooming natural gas production from shale has undeniably benefited U.S. petrochemical production and profitability. New energy supplies from shale have been so abundant that prices for natural gas and coproduced natural gas liquids, or NGLs, have rarely been lower, helping reduce overall costs.

At the same time, oil and its by-products have rarely been higher. The price differential has driven a shift wherever possible from heavier raw-material inputs—oil by-products such as naphtha—to lighter inputs, including NGLs. Since 2011, the preference for NGLs (ethane, propane and butane) has placed sectors dependent on heavy-material inputs at a competitive disadvantage.

The ability to tap directly into shale, the “source rock” from which many hydrocarbons have slowly percolated for eons, has been revolutionary. The marriage of advanced techniques for horizontal drilling and hydraulic fracturing has helped reverse 30 years of declining domestic production of oil, natural gas and natural gas liquids. Texas has played a starring role in the transformation.

The Barnett Shale in North Central Texas, the Haynesville in East Texas and Northern Louisiana, the Permian Basin in West Texas (containing several shale formations) and the Eagle Ford in South Central Texas have been leading centers of activity. The Eagle Ford—which lies within 200 miles of the Gulf Coast—is particularly important to the petrochemical industry. Most U.S. petrochemical capacity resides on the Gulf Coast, and the Eagle Ford is especially rich in industry-favored NGLs.

For every thousand cubic feet (Mcf) of natural gas extracted in the Eagle Ford, six to nine gallons of NGLs

were produced in 2011.<sup>1</sup> That figure suggests that the Eagle Ford was likely responsible for as much as 27.7 million gallons per day of NGL production from January to August 2013—representing at least 20 percent of all NGLs produced in the U.S. The latest production rate compares with 2.9 million gallons per day in 2010.<sup>2</sup> The average amount of NGLs separated from the natural gas stream has likely increased since 2011 as low natural gas prices encouraged redeployment of drilling rigs to areas with higher concentrations of NGL and oil reserves (*Chart 1*).

Beyond a resurgence in the petrochemical industry, the production increase and lower NGL cost are responsible for a shift that has favored some products over others. Petrochemical producers seeking to exploit this competitive advantage have begun a wave of heavy construction that is expected to last the next several years, shifting trade balances and creating jobs.

## Fewer By-Products

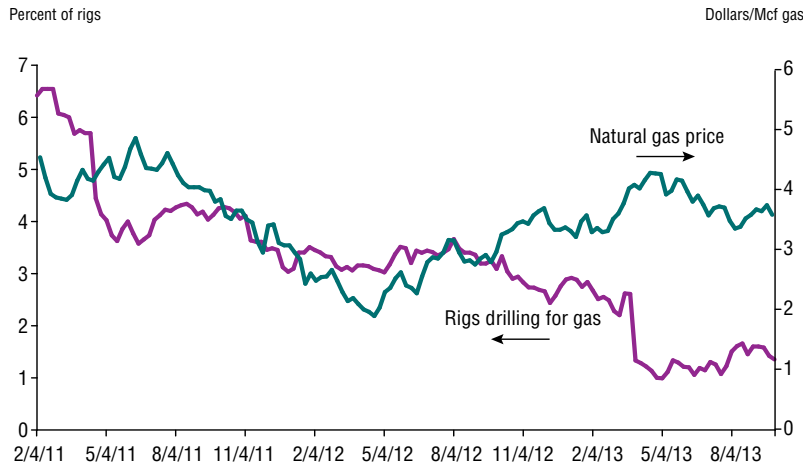
The primary building block of the global petrochemical industry is ethylene, produced in plants called crackers—factories that break up, or crack, whatever they’re fed into different substances. Ethylene, an intermediate chemical, is used to make other products as varied as plastic packaging, PVC (polyvinyl chloride) pipe for construction, and cell phones. Different inputs (feedstocks) can be sent to a cracker: lighter feedstocks such as ethane (the most common component of NGLs), or heavy feedstocks like naphtha (an oil by-product).

Ethane is a simple molecule and can only “crack” in a limited number of ways. Roughly 80 percent of ethane fed into a cracker is converted to ethylene, and most of the remainder is converted



**Chart 1**

**Eagle Ford Drilling Shifts from Natural Gas as Prices Fall**



SOURCES: Energy Information Agency; Baker Hughes.

into fuel gas, which is a mix of fuels that are gaseous at surface conditions and can include methane, hydrogen and carbon monoxide. Naphtha, however, is a soup of much more complex molecules and can, accordingly, crack in more ways. Only about 23 percent of the naphtha fed into a cracker is converted to ethylene. The majority of that naphtha is turned into a laundry list of intermediate chemical by-products (*Chart 2*).<sup>3</sup>

U.S. producers have reacted to the declining domestic price of NGLs—a result of booming shale production—

and the rising global price of oil-tied naphtha by dramatically shifting to light NGLs in their crackers. The swing from naphtha has been remarkable for an industry that had previously anticipated rising—not falling—natural gas prices in the coming decades. From 2001 to 2005, the share of U.S. cracker capacity that was fed NGLs declined from 75.4 percent to 67.9. It remained at relatively low levels through 2007. But by the first half of 2013, 90 percent of U.S. cracker capacity was fed NGLs.<sup>4</sup> This move has made the U.S. industry highly profitable

and globally competitive.<sup>5</sup> It also caused domestic shortages and record prices for the other products yielded from out-of-favor naphtha.

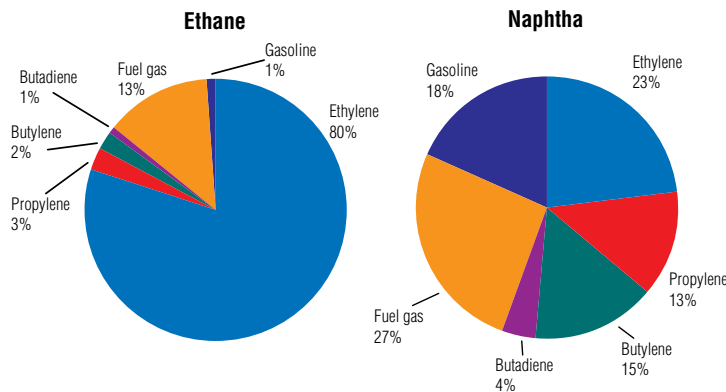
A wide assortment of products are affected by these domestic shortages—such as propylene (used in synthetic fibers for clothes, rigid packaging and plastic bottle caps), butadiene (used in car tires) and a group of chemicals known as BTX and often referred to as aromatics (used in Styrofoam cups, in solvents such as acetone and in gasoline formulations).<sup>6</sup>

Butadiene was in short supply event before the shale revolution. Inflation-adjusted U.S. butadiene prices have nearly doubled every five years over the past 15 years, averaging \$1,778 per ton in 2012, as global demand for rubber grew.<sup>7</sup> The price of propylene, meanwhile, averaged \$849 per ton from 2000 to 2010 and jumped to \$1,463 per ton from 2011 through the first half of 2013.<sup>8</sup> The price of benzene (the “B” in BTX) reached a high late last year, averaging \$1,426 per ton, a 109 percent increase from 2008 and a 97 percent rise from the 2000–10 average.<sup>9</sup>

Furthermore, the profits of manufacturers of many products derived from heavy by-products, such as packaging and plastic parts, have been squeezed by volatile materials costs and competition from substitutes made from shale-advantaged NGL-based ethylene.

**Chart 2**

**Feedstock Yields**



NOTE: BTX is included in gasoline totals.

SOURCE: *Petrochemicals in Nontechnical Language*, by Donald L. Burdick and William L. Leffler, Tulsa, Okla.: PennWell Publishing, 2010.

**Refinery Inputs Changing**

Refineries are affected as well. While they tend to keep the average characteristics of the oil they use within a narrow band—a mix of light, sweet oil and heavy, sour crude—supplies have shifted since 2008 as lighter, lower-cost shale oil came to market. Shale oil on average is 12.5 percent lower in aromatics content than the typical U.S. refinery mix had been when oil imports were greater.<sup>10</sup> A lighter mix can impact refinery yields, similar to how it affects cracker output. Taken together, refineries and crackers provide more than two-thirds of the nation’s BTX supply. With lighter feeds for crackers and with shale oil going to refineries, the domestic supply of aromatics has dropped by

► *Increased propane and butane exports would help bring regional and global prices into better balance.*

an estimated 20 percent.<sup>11</sup>

The story for refinery aromatics doesn't end there. Several demand factors contributed to lower production of aromatics, specifically benzene.

First, demand for higher-octane fuels has fallen in recent years, reducing the need for high-octane blending components, some of which contain benzene. Second, environmental concerns in the U.S. and abroad have reduced the amount of allowable aromatics, benzene in particular, in gasoline. Third, the requirement that refiners blend high-octane ethanol (typically made from corn) into gasoline reduces the use of benzene-rich blending components in gasoline.<sup>12</sup> Finally, gasoline consumption has declined since its peak in 2007, due in part to the Great Recession, a slow recovery and more-fuel efficient cars. Gasoline exports have bolstered U.S. gasoline production. Gasoline export production peaked in 2011 at 174.8 million barrels and was 149.7 million barrels in 2012. The annual average from 2000 to 2010 was 53.9 million barrels.

### Trade Shifting

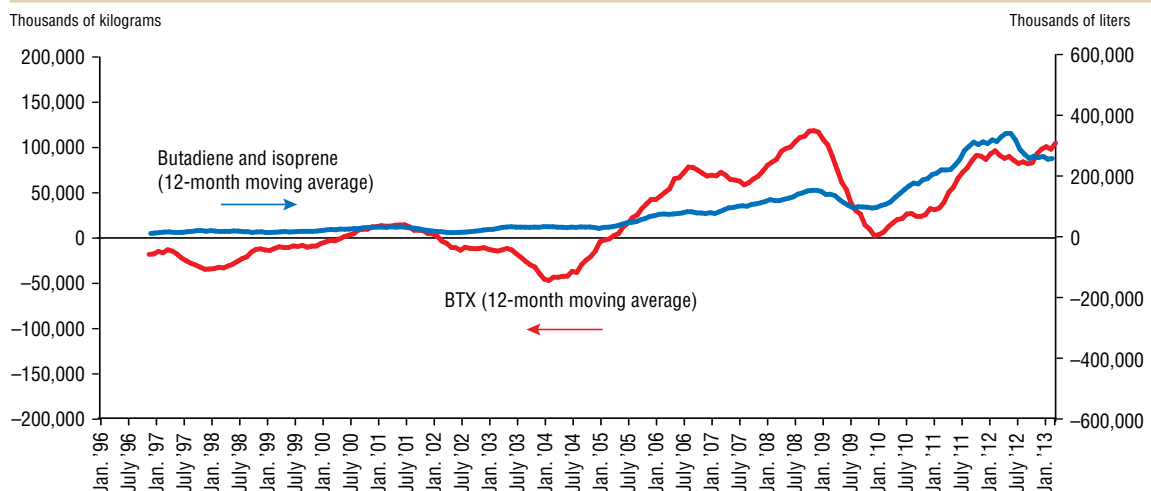
Meanwhile, imports of shale-disadvantaged chemicals into the U.S. have increased. Net imports of butadiene and isoprene have grown 167 percent since

2009, while net imports of BTXs over that same period increased 3,700 percent, albeit from a very low level (*Chart 3*).<sup>13</sup>

The Texas share of BTX imports into the U.S. was 43.3 percent in 2007 and 28.5 percent in 2012—15.1 percent for butadiene and 18.1 percent for isoprene. While these chemicals represent smaller markets than ethylene, they make up a vital part of the U.S. chemical industry. North American propylene, butadiene and benzene production combined was equal to 80 percent of the total tonnage of ethylene in 2007, when production peaked prior to the shale revolution.<sup>14</sup>

Potentially working against the overall shift are impending increases in export capacity for NGLs, particularly propane and butane, which are less expensive to ship than ethane and natural gas. A limited ability to export has driven down local NGL prices, prompting several firms to seek to significantly boost export capacity along the Texas Gulf Coast. Increased propane and butane exports would help bring regional and global prices into better balance. Producers would benefit, though the increased demand—and the higher prices it would bring—could make domestic products derived from propane and butane less competitive than they otherwise would have been.

**Chart 3** Net Chemical Imports Rise on Domestic Shortages



SOURCE: International Trade Commission.

## Planned Investments

The petrochemical industry's confidence in the low-price outlook for light NGLs underlies announcements of new U.S. plants and expansions that would increase capacity 33 percent by 2017 should they all be completed.<sup>15</sup> Faced with a longer-run prospect of high-priced imports and cheap, domestic NGLs, the economics of producing at least propylene—now in short supply—through a different process has become more attractive.

Rather than rely on propylene production as a by-product of crackers geared for ethylene, producers have announced eight construction projects dedicated to making propylene (Table 1).<sup>16</sup>

The announced capacity is expected to largely replace the output lost when naphtha became a less-profitable feed. With some construction already underway, many in the industry wonder if all the planned facilities will be built or completed on schedule. The permit process can take two years, and industry contacts are chafing at delays already encountered. Once projects start, the rule of thumb for major facilities has been four years of construction. However, there are indications that construction markets are tight—the supply of skilled trades personnel is a constant concern given the scale of demand.

Last year, construction workers with specialized skills building plants along the Gulf Coast earned as much as \$40 an hour. With wage pressures mounting, substantial cost increases loom. Thus, the wave of heavy petrochemical construction starts will likely approach more slowly than the announced time frames suggest.

## Long-Run Texas Benefits

While the U.S. shale revolution has provided cheap NGLs to feed petrochemical plants—making the plants the most profitable they've been in at least 10 years. Other domestic producers dependent on heavy by-products are less competitive.

Construction across the Texas Gulf Coast that includes plants specifically geared for propylene-based products

**Table 1**  
**Planned North American Projects**

Company	Propylene capacity (tons)*	Location	Projected startup
Enterprise Products	750,000	Texas	Q3 2015
C3 Petrochemicals	New plant	Alvin, Texas	Q3 2015
Dow Chemical	750,000	Freeport, Texas	2015
Williams Cos.	500,000	Alberta, Canada	Q1 2016
Formosa Plastics	600,000	Point Comfort, Texas	2016
Dow Chemical	New plant	n.a.	2018
Enterprise Products	New plant	Texas	n.a.
PetroLogistics	Expansion	Houston	n.a.

\* Capacity figures for some planned construction projects have not been disclosed.

SOURCES: ICIS; the companies.

will add needed new capacity, though the exact amount will depend on many factors, most notably regulatory requirements. Industries always face economic trade-offs, and producers have clearly deemed a petrochemical renaissance—driven by natural gas and NGLs from shale—to be well worth the cost of lost by-products. The Texas economy should benefit for years to come.

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## Notes

<sup>1</sup> Pricing is most frequently quoted in terms of 1 million British thermal units, MMBtu, a measure of energy content. Volumes are often given in terms of a thousand cubic feet of natural gas, Mcf. See "Flares in the Oilpatch: Understanding N.D. Infrastructure," by Trisha Curtis, Energy Policy Research Foundation Inc., Platts Rockies Fifth Annual Oil and Gas Conference, April 12, 2012.

<sup>2</sup> Production based on figures from the Energy Information Agency, Texas Railroad Commission and Energy Policy Research Foundation.

<sup>3</sup> See *Petrochemicals in Nontechnical Language*, by Donald L. Burdick and William L. Leffler, Tulsa, Okla.: PennWell Publishing, 2010.

<sup>4</sup> "U.S. Olefins First Half 2013: Ethylene Production Prospects Clouded by First-Half Turnarounds," by Dan Lippe, Petral Consulting, *Oil and Gas Journal*, Sept. 2, 2013.

<sup>5</sup> See "Booming Shale Gas Production Drives Texas Petrochemical Surge," by Jesse Thompson, Federal Reserve Bank of Dallas *Southwest Economy*, Fourth Quarter, 2012.

<sup>6</sup> BTX stands for benzene, toluene and xylene.

<sup>7</sup> Prices in Japan have been distorted by the nuclear disaster, and production in western Europe has been affected by the recession and U.S. shale boom,

complicating attempts to assign a specific portion of the price increase to constraints on U.S. supply.

<sup>8</sup> Data are from Nexant's U.S. propylene price index.

<sup>9</sup> Data are from Nexant's U.S. aromatics benzene index.

Bloomberg's price index (in cents per gallon) indicates a 105 percent increase in 2013 over the prior 10 years.

<sup>10</sup> BTXs belong to a family of substances called "aromatics," which are unsaturated naphthenes.

<sup>11</sup> See "Impact of Shale Plays on U.S. Aromatics Production and Pricing," Platts U.S., Jan. 10, 2013.

<sup>12</sup> By federal mandate, ethanol makes up 10 percent of gasoline content.

<sup>13</sup> Refineries are also large suppliers of BTXs. Thus, net imports of those products are also affected by their behavior.

<sup>14</sup> Data are from Nexant's North American production index.

<sup>15</sup> See note 5.

<sup>16</sup> See "Market Outlook: New PDH Units May Lead to U.S. Polypropylene Resurgence," by Michelle Klump, ICIS.com, April 5, 2013, [www.icis.com/Articles/2013/04/05/9656095/market-outlook-new-pdh-units-may-lead-to-us-polypropylene.html](http://www.icis.com/Articles/2013/04/05/9656095/market-outlook-new-pdh-units-may-lead-to-us-polypropylene.html).

## SNAPSHOT

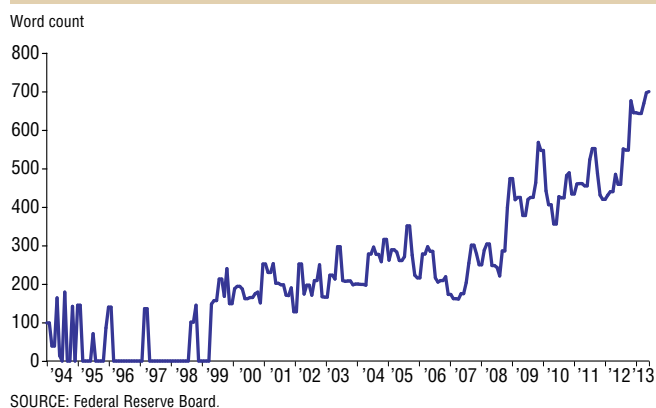
# The FOMC's Lengthening Statements

**T**wenty years ago, when the Federal Open Market Committee (FOMC) decided to alter the stance of monetary policy by raising or lowering interest rates, it did not announce that fact to the general public. Rather, financial market participants were left to divine what the FOMC had decided.

Today, when the FOMC decides to change the stance of monetary policy, it releases a detailed statement outlining the rationale for its decisions. The evolution of FOMC communications over the past two decades can be seen in the word count of the post-meeting statement.

The first one, issued on Feb. 4, 1994, was a mere 99 words (*see chart*). The statement issued after the April 30–May 1, 2013, meeting was 669 words and included—in addition to the committee's decision about the stance of monetary policy—information on the committee's assessment

FOMC Statement Word Counts Increase, 1994–2013



of economic conditions, the economic outlook and factors likely to prompt a change in the stance of policy.

—“A Short History of FOMC Communication,” by Mark Wynne, *Dallas Fed Economic Letter*, September 2013

## DALLAS FED

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