

# *The Southwest* ECONOMY

FEDERAL RESERVE BANK OF DALLAS

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## From Crude Oil To Computer Chips

### *How Technology Is Changing the Texas Economy*

*"I think there is a world market for  
maybe five computers."*

—Thomas Watson,  
chairman of IBM, 1943

*"I have traveled the length and breadth  
of this country and talked with the best  
people, and I can assure you that data  
processing is a fad that won't last out  
the year."*

—The editor in charge of  
business books for  
Prentice Hall, 1957

*"There is no reason anyone would want  
a computer in their home."*

—Ken Olson, president,  
chairman and founder of  
Digital Equipment Corp., 1977

Technological innovations are rapidly changing the way people live. Computers, fax machines, mobile phones and online computer services allow people to work faster and more efficiently, with ever-expanding access to information. With each new generation of machine, high-tech products become more pervasive household fixtures. No longer is it only the wealthy who can afford to own a VCR or cellular phone. New products are being developed every day to meet consumers' voracious appetites for faster, more efficient ways to conduct business and enhance leisure time.

Thanks to the acceptance and affordability of new technologies, certain high-tech industries have grown into a rapidly expanding segment of the economy. In Texas, employment at high-tech firms has grown twice as fast as the state's overall economy during the past 10 years.<sup>1</sup>

Although Texas' economic roots are grounded in agriculture and oil, the state has pioneered many technological innovations. Dallas' Texas Instruments (TI) was among the first companies to mass produce transistors, and a TI engineer, Jack Kilby, developed the integrated circuit. Another Dallas company—Electronic Data Systems Corp.

(EDS)—was among the first firms to offer data processing services. And Dell Computer Corp., headquartered in Austin, is the fifth largest maker of personal computers in the world and is one of the fastest growing U.S. corporations.

Despite recent lean years for the defense industry, Texas defense giants—including LTV, Bell Helicopter and Lockheed (formerly General Dynamics)—have been important catalysts for high-tech advancement. As such firms moved to Texas during the World War II buildup, they brought scientists and engineers. Other workers became skilled in electronics, telecommunications, and weapons and aerospace manufacturing. Now, even as employment in the defense industry wanes, the private sector is making use of defense-related technological advances.

#### **How Much High-Tech in Texas?**

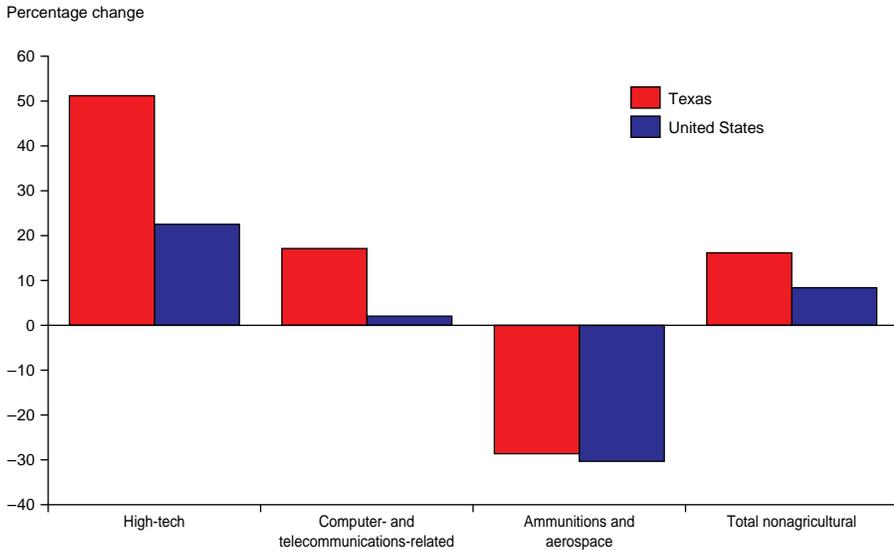
The Texas economy, once driven by resource-based industries such as farming, ranching and oil production, is evolving into a more knowledge-based economy. While the oil and gas extraction business is

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**Chart 1**  
Employment Growth, 1988–94



SOURCE: Bureau of Labor Statistics.

still very important to the state's economy, its share of total employment fell from its early 1980s peak of 5 percent to about 2 percent in 1994.<sup>2</sup> In contrast, the share of Texas employment in high-tech industries rose from about 2 percent in the mid-1970s to 3.4 percent in 1994.<sup>3</sup>

As Chart 1 shows, high-tech employment grew more than twice as fast in Texas than in the nation as a whole during 1988–94.<sup>4</sup> Texas' strongest performance relative to the nation's has come in computer- and telecommunications-related industries.<sup>5</sup> This category includes firms that make computers, computer chips and cellular phones and firms that provide programming or data processing services. Since 1988, employment in Texas computer- and telecommunications-related industries has grown more than eight times the national rate. Currently, the share of computer-related and telecommunications-related employment to total employment is 2.5 percent in Texas and 2.1 percent in the United States.

Chart 2 shows the 10 largest high-tech industries in Texas. Texas' employment in four of these 10 industries exceeds the national average. These industries (highlighted

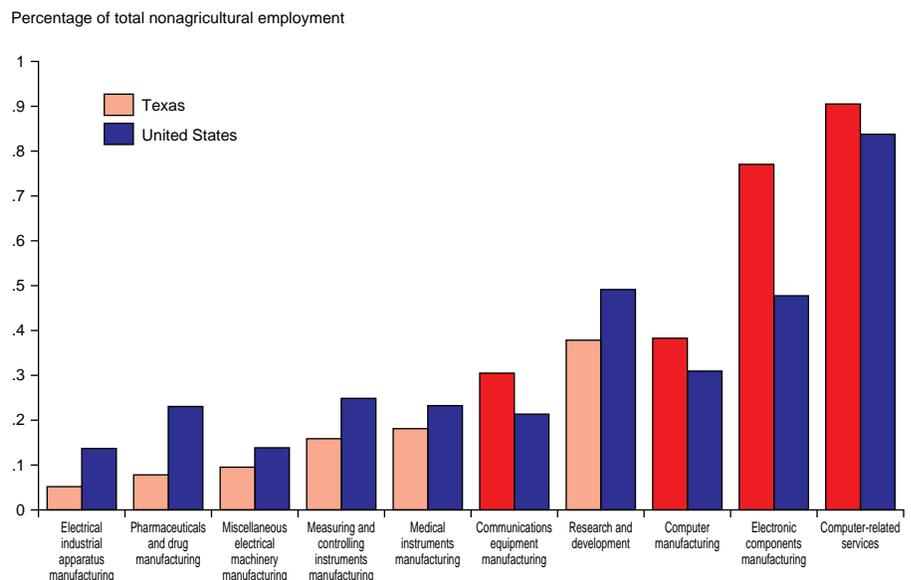
in bright red) are computer-related services, electronic components manufacturing, computer manufacturing and communications equipment manufacturing—all of which are computer- and telecommunications-related industries.

**Computer-related services.** As computer and communications technology has become more widely used,

the number of service firms has skyrocketed. Thus, it is not surprising that the largest high-tech industry in Texas is service-related. Employment in Texas' computer-related services industry has grown almost 50 percent since 1988, slightly faster than the national average. Included in this category are firms that provide computer programming, data processing, software design, systems design and information retrieval. Plano's EDS, for example, is the nation's largest provider of computer services to business and government.

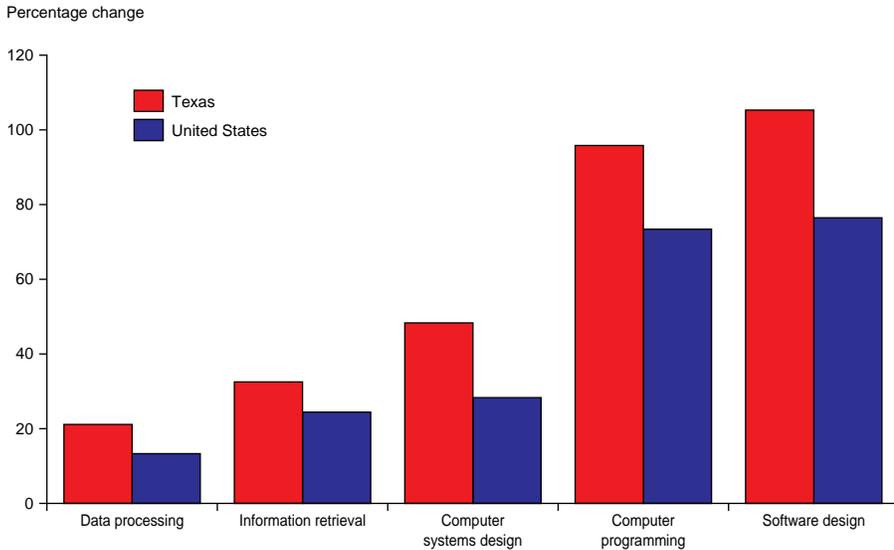
The computer-related services industry accounts for almost 1 percent of total Texas employment, which is roughly the same size as Texas' fabricated metals manufacturing industry. However, employment statistics may drastically underestimate the actual number of computer-related jobs in the Texas economy. Employment statistics count only firms that produce a service, such as programming. Programmers who work for a bank, for instance, are not counted. Because many firms employ their own programmers or systems specialists, total employ-

**Chart 2**  
High-Tech Employment in Texas  
(Shares of 1994 Total Nonagricultural Employment For Largest 10 High-Tech Industries in the State)



SOURCE: Bureau of Labor Statistics.

**Chart 3**  
Employment Growth in Computer-Related Services, 1988–94



SOURCE: Bureau of Labor Statistics.

ment in this sector is probably much higher than the numbers suggest.

The greatest job growth in Texas' computer-related services industry has been from firms that provide software design and computer programming (*Chart 3*). Since 1988, jobs in software production have grown by 105 percent in Texas, compared with 76 percent at the national level. Austin alone has more than 500 software companies. Computer programming employment in Texas has risen 96 percent since 1988, compared with 76 percent nationally.

**Electronic components manufacturing.** As *Chart 2* indicates, the second largest high-tech industry in Texas is electronic components manufacturing. This industry includes firms that produce computer chips and circuit boards, both hot commodities worldwide. Since 1988, circuit board manufacturing employment in Texas has expanded four times faster than in the nation.

Several large companies produce computer chips in Texas, including TI, Motorola, Advanced Micro Devices (AMD), Hitachi, Cyrix and National Semiconductor. Nationally, the computer chip industry has undergone a retrenchment in the last several years. However,

announced expansions by Hitachi, Motorola and TI and a worldwide shortage of computer chips suggest that this segment of Texas' high-tech industry has recovered and should see strong growth in the future.

**Computer manufacturing.** Texas is quickly becoming synonymous with computer production. The Lone Star State is home to Dell, Compaq, TI and AST. Employment at computer makers, while falling nationally, has risen strongly in Texas.<sup>6</sup> Since 1988, Texas employment at computer makers has risen 34 percent, and employment in the computer peripherals industry, which includes printers, has risen by 15 percent. Dell exemplifies this growth; Dell recently announced that it would build a third facility in Austin because its second facility will be at capacity when it comes online in November.

**Communications equipment manufacturing.** Communications equipment manufacturing includes firms that produce telephone, radio and television equipment. Texas job growth in this industry has not been as strong as in other high-tech sectors, mainly because new technology has made workers more productive. Nevertheless, employment growth

in this industry has been positive in Texas while declining at the national level. The Dallas/Fort Worth area is the heart of Texas' telecommunications industry, with firms such as Nortel, DSC, MCI and Nokia. Recently, Dallas/Fort Worth was chosen as the site for the headquarters of PCS PrimeCo, a joint venture of Bell Atlantic, Nynex, US West and AirTouch Communications.

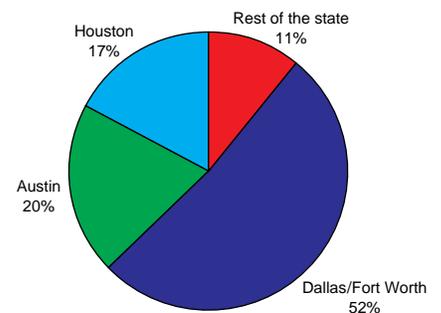
### Where Are the Jobs?

Like Dallas, with its communications nexus, other Texas cities have attracted concentrations of high-tech industries. Computer-related services and the production of electronic components, computers and communications equipment—major players in the Texas high-tech sector—are located mostly in major cities, as shown in *Chart 4*.<sup>7</sup>

Austin's computer manufacturing sector provides more than half of the state's jobs in that industry. The capital city also has a large concentration of computer chip makers, such as Motorola and AMD, and their suppliers, such as Applied Materials and Tokyo Electron America. As a result, one-fifth of the state's electronic component manufacturing is in Austin.

With 52 percent of the state's total, Dallas/Fort Worth has the lion's

**Chart 4**  
Where Texas' High-Tech Jobs Are



NOTE: Percentages are each city's share of Texas jobs in four leading high-tech industries—computer-related services, electronic components manufacturing, computer manufacturing and communications manufacturing. The share of total employment these four industries contribute to the Texas economy exceeds the national average.

SOURCES: Texas Employment Commission and Texas State Comptroller of Public Accounts.

*“In Texas, employment at high-tech firms has grown twice as fast as the state’s overall economy during the past 10 years.”*

share of high-tech jobs. Over half of the state’s computer-related services providers, such as programming and software design firms, are in D/FW. The area also houses most of the state’s communications equipment manufacturing firms, with almost 80 percent of Texas jobs in that sector. D/FW telecommunication firms, such as DSC, Siemens, Motorola and Ericsson, produce products ranging from switching devices used to transmit data and voices to cellular phones. Like Austin, Dallas/Fort Worth has a large concentration of computer chip manufacturers and is home to more than 50 percent of the state’s electronic equipment jobs.

Houston’s strongest high-tech industries are computer manufacturing and computer-related services. Home of Compaq Computer, Houston has 17 percent of the state’s high-tech jobs—rivaling Austin’s 20-percent share.

#### **Why Texas?**

Texas’ history in the defense and oil industries helps explain why the state has become a high-tech mecca. Texas Instruments, for example, built on its success in the oil business to become a large defense contractor and later one of the largest computer chip producers in the country.<sup>8</sup> But other factors have contributed to the state’s appeal to high-tech firms as well.

Texas’ low costs, high-tech research, large labor pool and prominence as a worldwide distribution hub have drawn firms to the state. Many of Texas’ high-tech exports go to Mexico. In 1994, for the first time since state export figures became available in 1987, Texas’ leading export industry was electronic components manufacturing, which contributed \$11.2 billion in state exports. The industrial machinery and computer manufacturing industry was a close second with \$11.1 billion in exports. Of the electronic components exports, \$5.8 billion went to Mexico, along

with \$2.4 billion of the industrial machinery and computer equipment. Several electronics firms, such as General Electric, Toshiba and Philips Consumer Electronics, are located in the El Paso/Juarez area and take advantage of the maquiladora program between the United States and Mexico.

In addition, Texas is an ideal location for firms exporting elsewhere. Several high-tech firms (such as Nokia, Zenith Electronics and GWS Perlos—a phone parts supplier) have located manufacturing plants or distribution centers at Alliance Airport in Fort Worth, partly because the airport’s central location and air, rail and highway access make it ideal for global distribution.

High-tech firms tend to cluster near one another to be close to suppliers and skilled workers. More than 20 suppliers followed Applied Materials to Austin after its move in 1988, for example. Texas’ labor force is younger and faster growing than the national average. And, while Texas’ level of educational attainment is about even with the national average, the skill distribution is widespread.<sup>9</sup> Despite its large percentage of high school dropouts, Texas also has a high percentage of skilled workers who help attract high-tech firms to the state.

High-tech companies have cited low costs as another factor drawing them to Texas. Although the real estate market has been improving in recent years, Texas apartment rents and construction costs are much lower than the national average. The average price of a Dallas home, for example, remains about 10 percent below the national average. Texas is also a low-tax state. Among the 50 states, Texas ranks 31st in per capita state and local tax revenues and 42nd in per capita expenditures.

Finally, Texas has industry consortiums and universities that provide high-tech research to benefit high-tech industries. For example, Austin is home to two of the nation’s

premiere research consortiums: Microelectronics and Computer Technology Corp. (MCC) and Sematech. These consortiums enable companies with common requirements for new technology to share the costs and risks of development. Also, the Technology Licensing Office at Texas A&M University and the IC<sup>2</sup> Institute at the University of Texas at Austin provide university research that benefits high-tech industries.

### Clouds on a Bright Future?

Although Texas' high-tech future looks bright, a few clouds on the horizon could impede employment growth. Environmental considerations, such as water purity, could deter companies from relocating to or expanding operations in Texas. Water is an important input in the computer chip manufacturing process, and companies in Austin are concerned about the water availability from the Edwards Aquifer.

A lack of office space in some prime high-tech office districts is another consideration. The office vacancy rate in Northwest Austin—the most popular area among high-tech companies—is about 3 percent. Even after completion of construction projects under way, space may not be available to meet demand. Although they are lower than the national average, Dallas' suburban office rents have risen rapidly in the past two years and are eating away at one of Texas' biggest draws.<sup>10</sup>

Signs also indicate that Texas' skilled labor market is tightening. Industry contacts in Austin report that they must look beyond Texas' borders to find skilled workers. In fact, the estimated unemployment rate for engineers and software developers is below 1 percent in Austin. Several high-tech companies that recently located outside of Texas cited the state's tightening labor pool as a major factor in their decision. So far, Austin appears to be the only Texas city straining at the seams, but labor market pressure

could occur in other Texas cities with a high concentration of high-tech industries.

Despite these obstacles, Texas should be a major benefactor in the quest for faster, more efficient ways to work and better leisure products. High employment growth should continue in high-tech industries concentrated in Texas—namely, computer-related services, electronic components manufacturing, computer manufacturing and communications equipment manufacturing—for several reasons. Industry consortiums, such as MCC and Sematech, and ongoing research at Texas universities yield synergies for high-tech businesses. The state's already strong base of high-tech companies and suppliers can entice other companies to relocate to Texas. And Texas' growing labor force and the ease of relocating workers from other areas of the country are valuable assets that should continue to attract high-tech relocations and expansions.

—D'Ann M. Petersen  
Michelle Thomas

### Notes

<sup>1</sup> In this article, we define high-tech to include the following three-digit Standard Industrial Code (SIC) categories: pharmaceuticals and drugs, computer manufacturing, electrical transmission and distribution equipment manufacturing, electrical industrial apparatus manufacturing, household audio and video equipment manufacturing, communications equipment manufacturing, electronic components manufacturing, miscellaneous electrical machinery manufacturing, measuring and controlling instruments manufacturing, photographic equipment and supplies manufacturing, computer-related services, and research and development. Our definition of high-tech industries is taken from the Texas Comptroller of Public Accounts. The comptroller's office bases its definition of high-tech on the following characteristics: (1) employing a higher percentage of technicians, engineers and scientists than most manufacturers and (2) having an above-average research and development component. Because of recent budget cuts and military personnel cuts, ammunitions

and aerospace industries are excluded from this analysis.

<sup>2</sup> The oil and gas extraction industry accounts for a larger share of state output than of total state employment. In 1982, oil and gas extraction accounted for roughly 18 percent of total state output, compared with about 7 percent in 1994.

<sup>3</sup> We use the Bureau of Labor Statistics ES202 employment data for the U.S. and Texas three- and four-digit SIC sectors. In the calculations of employment shares, we use U.S. and Texas total nonagricultural employment from the Bureau of Labor Statistics Establishment Survey. For the city employment data, we use ES202 employment data provided by the Texas Employment Commission (TEC) and the Texas Comptroller of Public Accounts.

<sup>4</sup> We use 1988 as our reference point because several four-digit SIC sectors in high-tech industries were not available before 1988.

<sup>5</sup> Computer- and telecommunications-related employment is a subset of high-tech employment and includes computer manufacturing, electrical transmissions and distribution equipment manufacturing, household audio and video equipment manufacturing, communications equipment manufacturing, electronic components manufacturing, miscellaneous electrical machinery manufacturing and computer-related services.

<sup>6</sup> Nationally, employment in computer manufacturing has fallen since 1988, but production has risen 136 percent. Over the past two decades, computer manufacturing has become much less labor-intensive because of new equipment technology. While output has risen sharply, new technology has enabled workers to become more productive.

<sup>7</sup> Due to confidentiality concerns, TEC will not release computer manufacturing employment for Houston and Fort Worth. We approximate this employment by using estimates for the number of jobs at computer manufacturers Compaq (Houston), Tandy Electronics (Fort Worth) and AST (Fort Worth).

<sup>8</sup> See "Industry: High Tech and Defense," *Forces of Change* (Austin: Texas Comptroller of Public Accounts), 1994.

<sup>9</sup> See Stephen P. A. Brown and Lea Anderson, "The Future of the Southwest Economy," *Southwest Economy*, November 1988.

<sup>10</sup> While downtown Dallas has one of the nation's highest office vacancy rates, the suburban rate has tightened. Most high-tech companies are located in the suburbs.