Texas Industrial Structure: How Much Does Texas Rely on Energy?

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Through the years, Texas has enjoyed the gains and weathered the hardships resulting from expansions and contractions in the energy industry. Currently, the state is benefiting from a production boom in oil and natural gas from unconventional sources, primarily oil and gas shale (Figure 1). This rapid expansion helped the Texas economy recover from the Great Recession of 2008–09 faster than the U.S. economy. The state is the largest single producer of both oil and gas in the country, with crude oil and natural gas production representing 30.5 percent and 28.6 percent of national output, respectively.

Not surprisingly, the boom in the energy industry has affected the structure and diversity of the Texas economy. The share of oil and gas extraction and the petrochemical industry in the state's gross product increased from 7.5 percent in 1997 to 11.3 percent in 2010 (Figure 2); adding the chemical industry increases the share from 10.9 percent to 14.5 percent during the same period.

Since the 1980s, Texas' economy has diversified away from the energy industry, reducing the economic instability caused by the variability of oil prices (Figure 3). The state stands as an example of how a diversified economy benefits both growth and stability. Now, new drilling technology is driving another boom in oil and gas production.

Why is Diversity Important?

It is generally accepted that increased diversification allows an economy to achieve greater levels of stability and performance[1] because a broader industry base protects the economy from a downturn in its major industry. A highly concentrated economy in which the vast majority of the output, earnings and employment originate from a few key industries is susceptible to shocks to those industries. A more diversified economy is less likely to be susceptible to vast swings, which generate greater instability.[2] In the same manner as an investment portfolio is diversified to protect against risk, an economy with a broad mix of industries is protected from the risk of economic fluctuations.[3]

Texas is an example of the economic costs of concentration and of the benefits of economic diversification. It went from being highly concentrated in the oil industry during the 1970s and 1980s to a more diversified economy in manufacturing and services today. During those decades, as energy prices increased, the Texas economy expanded at a rapid pace, accompanied by strong income and employment growth. Then, in 1986, oil prices collapsed, causing a statewide recession and a significant fall

Figure 1. Texas Oil and Natural Gas Production*
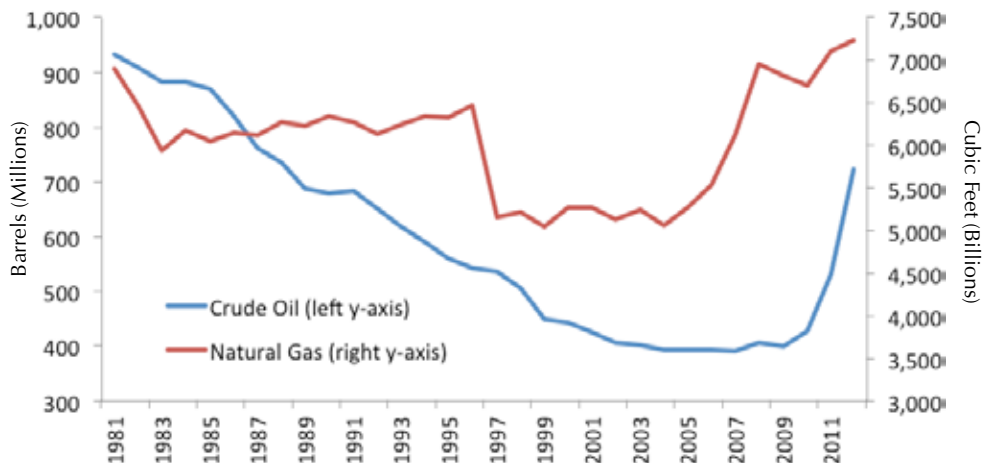
*Estimated by the Real Estate Center at Texas A&M University. Texas field production of crude oil and Texas natural gas marketed production.
Source: Energy Information Administration

[1] Siegel, P.B., Alwang, J., and Johnson, T.G. "Regional Economic Diversity and Diversification," Growth and Change, 26, 1995, pp.261–284.
[2] Sherwood-Call, Carolyn. "Assessing Regional Economic Stability: A Portfolio Approach," Federal Reserve Bank of San Francisco, Economic Review, Winter 1990, pp.17–26.
[3] Deitz, Richard and Garcia, Ramon. "Economic Diversity and New York State," Federal Reserve Bank of New York, The Regional Economy of Upstate New York, Winter 2002.

Figure 2. Oil and Gas Extraction, Petroleum Manufacturing*
Percent of Texas Gross State Product

*Estimated by the Real Estate Center at Texas A&M University.
Source: Bureau of Economic Analysis

Figure 3. Texas Oil Production and Employment*
Annual Percent Change
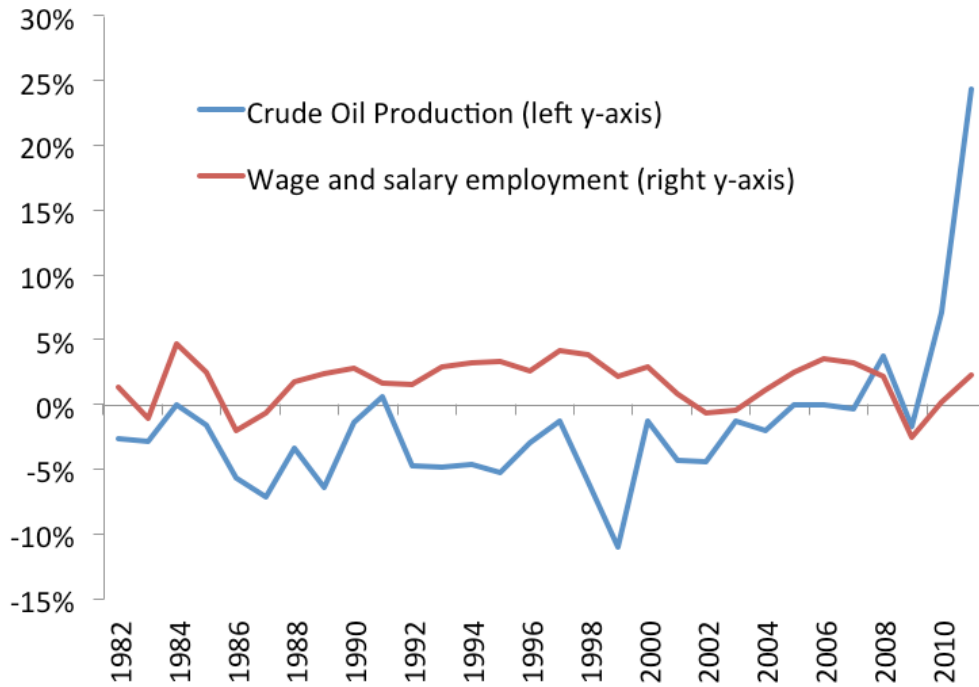
*Estimated by the Real Estate Center at Texas A&M University. Texas field production of crude oil and Texas natural gas
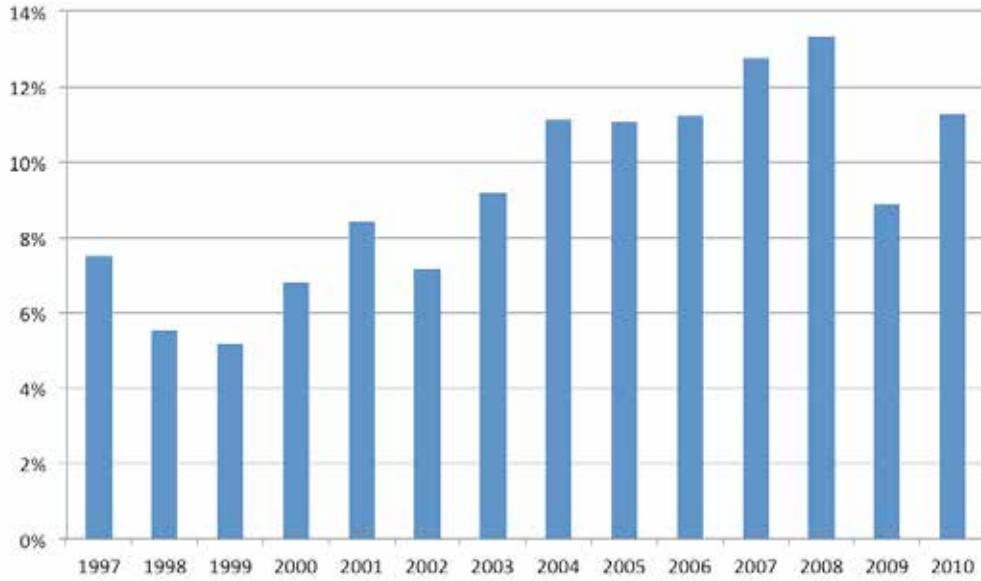 marketed production.
Source: Energy Information Administration

in employment.[4] The increased volatility in the Texas economy during the 1980s started the discussion focusing on a change from a specialized state economy to a more diversified one.[5] The shrinking of the energy sector and the growth of manufacturing and services allowed the economy to achieve a greater level of diversity.

How is Economic Diversity Measured?

Measuring economic diversity is not an easy task. A variety of measures are used to check the reliability and consistency of the results. Three different variables are used: output, earnings and employment. The following measures are estimated:

Location Quotient

$LQ_i = S_i^{Texas}/S_i^{US}$

where $i = 1, 2, \ldots N$ industries, S_i^{Texas} is the share of Texas i[th] industry, S_i^{US} is the corresponding share for the United States. Thus, the LQ_i compares Texas' share of economic activity with the corresponding national share. The United States is used as a benchmark of diversity, since it is a mix of all industries in all regions. An LQ greater than one represents specialization in a given industry and concentration by the region in that particular industry compared with its share of the national economy

Hachman Index

Hachman Index $= 1/ \Sigma[LQ_i \times S_i^{Texas}]$

where $i = 1, 2 \ldots N$ industries, S_i^{Texas} is the share of Texas i[th] industry. The Hachman Index measures how closely the Texas industry distribution compares with that of the United States. This measure is bounded between zero and one, where one means that Texas has the same industrial structure as the United States and is diversified, and zero represents a totally different industrial structure that is concentrated/specialized in a few industries.

National Average Index (NAI)

$NAI = \Sigma (S_i^{Texas} - S_i^{US})^2/S_i^{US}$

where $i = 1, 2, \ldots N$ industries, S_i^{Texas} is the share of Texas i[th] industry and S_i^{US} is the corresponding share for the United States. The NAI approaches zero as Texas' share of economic activity approaches the U.S. share for all industries, representing diversity. As the Texas economy differs from the U.S. share, the NAI becomes increasing larger, representing greater concentration/specialization.

Ogive Index

Ogive Index $= \Sigma (S_i^{Texas} - 1/N)^2/ 1/N$

where $i = 1, 2, \ldots N$ industries, S_i^{Texas} is the share of Texas i[th] industry. With N industries diversity implies that S_i^{Texas} is equal to $1/N$. If the Ogive Index equals zero, that

represents diversity. Higher values indicate more industry concentration/specialization. This value is sensitive to the number of industries utilized.

Entropy Index

Entropy Index $= \Sigma S_i^{Texas} ln(1/S_i^{Texas}) = - \Sigma S_i^{Texas} ln(S_i^{Texas})$

where $i = 1, 2, \ldots N$ industries, S_i^{Texas} is the share of Texas i[th] industry and ln is natural logarithm. A higher entropy index indicates greater diversification, while lower values indicate more concentration/specialization. A value of zero would occur if economic activity is concentrated/specialized in one industry.

Herfindahl Index

Herfindahl Index $= \Sigma S_i^{Texas}$

where $i = 1, 2, \ldots N$ industries, S_i^{Texas} is the share of Texas i[th] industry. The Herfindahl varies from zero, representing diversity, to one, representing concentration/specialization. Thus, a decline in the index means greater diversification and an increase indicates greater concentration/specialization.

Portfolio Theory

$\sigma_p^2 = \Sigma S_i^{Texas} \sigma_i^2 (X_i^{Texas}) + \Sigma\Sigma S_i^{Texas} S_j^{Texas} \sigma_{ij}^2 (X_i^{Texas}, X_j^{Texas})$

where $i = 1, 2, \ldots N$ industries, S_i^{Texas} and S_j^{Texas} is the share of Texas i[th] and j[th] industry, σ_i^2 is the variance of economic activity for the ith industry, σ_{ij}^2 is the covariance of the economic activity for the ith and j[th] industry. This measure assesses the sources of economic instability in the Texas economy by determining how recent changes in the industrial structure of the Texas economy have affected the stability of economic activity and how growth in different industries might affect future stability. A lower σ_p^2 indicates a more diversified economy with greater stability.

How Diversified is the Texas Economy?

The various diversity measures are estimated for 19 private manufacturing industries[6] from 1997 to 2011, with the exception of output for the manufacturing industry, which is only available disaggregated until 2010 (Tables 1–3). The estimated values during this period are relatively similar, with some tendency toward concentration in the major private state industries and manufacturing industries. The specialization trend has been accompanied by greater volatility, indicating that the major industries are relatively more unstable, with greater upswings and downturns, as in the case of the oil and gas industry. This was true during the Great Recession of 2008–09, during which output in the mining industry grew by 23.7 percent in 2009 and decreased by 10.4 percent the following year.

[4] Yücel, Mine K. and Brown, Stephen P.A. "The Effect of High Oil Prices on Today's Texas Economy," Federal Reserve Bank of Dallas, Southwest Economy, Issue 5, September/October 2004.
[6] Phillips, Keith R. and Gruben, William C. "Diversifying Texas: Recent History and Prospects," Federal Reserve Bank of Dallas, *Economic Review*, July 1989.
[6] When estimating the measures of diversification for employment and earnings, the number of manufacturing industries is 23. Some indexes are sensitive to the number of industries used.

Table 1. Diversity Estimates for Output

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	1997-2011
Location Quotient (LQ) > 1 Specialization in a given industry																
Private Industries																
Agriculture, forestry, fishing, and hunting	0.86	0.86	1.03	0.91	0.86	0.99	0.96	0.89	0.86	0.74	0.72	0.56	0.53	0.72	0.63	0.81
Mining	5.19	4.69	4.75	5.31	5.51	5.62	5.92	5.61	5.57	5.28	5.24	5.24	4.91	4.72	4.65	5.21
Utilities	1.23	1.25	1.30	1.38	1.47	1.35	1.36	1.31	1.32	1.36	1.28	1.28	1.18	1.13	1.09	1.29
Construction	1.04	1.08	1.10	1.08	1.13	1.15	1.17	1.10	1.11	1.07	1.08	1.14	1.29	1.27	1.26	1.14
Manufacturing	1.01	1.01	0.92	0.89	0.95	0.96	0.95	1.15	1.12	1.19	1.22	1.07	1.09	1.18	1.18	1.06
Wholesale trade	1.11	1.17	1.24	1.21	1.18	1.16	1.14	1.11	1.12	1.10	1.11	1.12	1.18	1.15	1.14	1.15
Retail trade	1.04	1.05	1.06	1.03	1.02	1.03	1.00	0.95	0.95	0.93	0.93	0.92	0.99	0.95	0.94	0.99
Transportation and warehousing	1.17	1.19	1.24	1.25	1.30	1.24	1.22	1.19	1.19	1.17	1.16	1.15	1.20	1.18	1.16	1.20
Information	1.06	1.07	1.01	1.07	1.03	1.01	0.99	0.94	0.92	0.93	0.90	0.82	0.86	0.79	0.76	0.94
Finance and insurance	0.77	0.78	0.80	0.77	0.74	0.78	0.80	0.75	0.72	0.68	0.70	0.78	0.81	0.82	0.81	0.77
Real estate and rental and leasing	0.80	0.82	0.84	0.83	0.77	0.78	0.75	0.71	0.70	0.69	0.67	0.68	0.70	0.70	0.71	0.74
Professional, scientific, and technical services	0.90	0.93	0.95	0.94	0.96	0.95	0.92	0.90	0.90	0.89	0.88	0.87	0.92	0.90	0.89	0.91
Management of companies and enterprises	0.23	0.22	0.22	0.22	0.25	0.28	0.28	0.33	0.39	0.40	0.46	0.47	0.51	0.51	0.50	0.35
Administrative and waste management services	1.07	1.08	1.08	1.06	1.05	1.05	1.02	1.01	1.01	1.01	1.03	1.02	1.08	1.03	1.02	1.04
Educational services	0.55	0.55	0.61	0.60	0.61	0.61	0.60	0.58	0.57	0.55	0.54	0.52	0.56	0.54	0.54	0.57
Health care and social assistance	0.89	0.89	0.89	0.88	0.87	0.89	0.88	0.86	0.83	0.81	0.79	0.76	0.83	0.82	0.80	0.85
Arts, entertainment, and recreation	0.67	0.66	0.67	0.64	0.64	0.67	0.67	0.64	0.64	0.64	0.60	0.59	0.66	0.63	0.60	0.64
Accommodation and food services	1.00	1.02	1.05	1.04	1.01	1.02	1.00	0.94	0.94	0.92	0.89	0.88	0.97	0.93	0.91	0.97
Other services, except government	0.97	1.00	1.05	1.03	0.97	0.96	0.95	0.91	0.92	0.89	0.89	0.92	0.99	0.96	0.95	0.96
Manufacturing																
Durable goods																
Wood product	0.69	0.78	0.78	0.73	0.69	0.73	0.70	0.63	0.60	0.62	0.62	0.64	0.77	0.63		0.69
Nonmetallic mineral product	1.06	1.13	1.26	1.22	1.21	1.34	1.17	1.18	1.28	1.20	1.15	1.19	1.17	1.07		1.19
Primary metal	0.54	0.56	0.54	0.59	0.70	0.63	0.61	0.76	0.64	0.71	0.68	0.76	0.88	0.78		0.67
Fabricated metal product	0.90	0.96	0.87	0.90	0.97	0.97	0.90	0.85	0.97	1.03	1.09	1.08	1.12	1.00		0.97
Machinery	0.83	0.77	0.82	0.91	0.90	0.87	0.90	1.19	1.24	1.36	1.43	1.35	1.35	1.39		1.10
Computer and electronic product	1.63	1.84	1.49	1.28	1.32	1.50	1.31	1.55	1.52	1.74	1.34	1.36	1.33	1.06		1.45
Electrical equipment, appliance, and component	0.49	0.50	0.55	0.53	0.51	0.56	0.53	0.51	0.55	0.59	0.52	0.54	0.60	0.54		0.54
Motor vehicle, body, trailer, and parts	0.22	0.23	0.32	0.29	0.47	0.54	0.53	0.41	0.43	0.60	0.60	0.60	0.63	0.58		0.46
Other transportation equipment	0.84	0.84	0.90	0.94	0.83	0.84	0.76	0.78	0.87	0.64	0.86	0.94	1.06	0.92		0.86
Furniture and related product	0.57	0.57	0.62	0.59	0.60	0.60	0.59	0.57	0.58	0.62	0.58	0.54	0.70	0.73		0.60
Miscellaneous	0.67	0.59	0.51	0.56	0.50	0.55	0.52	0.56	0.51	0.48	0.53	0.49	0.50	0.47		0.53
Nondurable goods																
Food and beverage and tobacco product	0.74	0.75	0.72	0.69	0.68	0.75	0.75	0.80	0.76	0.74	0.67	0.63	0.65	0.57		0.71
Textile mills and textile product mills	0.23	0.22	0.22	0.25	0.25	0.29	0.28	0.23	0.27	0.27	0.24	0.25	0.29	0.25		0.25
Apparel and leather and allied product	1.12	1.11	1.19	1.11	1.13	0.93	0.66	0.54	0.56	0.47	0.56	0.58	0.41	0.53		0.78
Paper	0.62	0.78	0.72	0.69	0.66	0.63	0.59	0.58	0.53	0.45	0.44	0.42	0.50	0.47		0.58
Printing and related support activities	0.74	0.74	0.79	0.77	0.81	0.72	0.75	0.67	0.67	0.65	0.62	0.59	0.64	0.62		0.70
Petroleum and coal products	3.35	2.86	3.45	2.57	3.66	3.28	2.62	3.71	2.38	2.50	3.42	2.00	2.47	3.06		2.95
Chemical	1.62	1.51	1.19	1.15	0.93	1.16	1.28	1.62	1.88	1.99	1.72	1.52	1.41	1.76		1.48
Plastics and rubber products	0.77	0.79	0.81	0.81	0.86	0.80	0.77	0.79	0.81	0.83	0.80	0.84	0.83	0.78		0.81
Hachman Index between 0 and 1, where = 1 diversified and = 0 specialized/concentrated																
Private Industries	0.82	0.88	0.89	0.82	0.79	0.80	0.75	0.75	0.73	0.72	0.72	0.68	0.78	0.78	0.77	0.78
Manufacturing	0.72	0.75	0.75	0.82	0.69	0.77	0.79	0.66	0.78	0.77	0.69	0.84	0.83	0.71		0.75
National Average Index (NAI) approaches 0 diversity and larger values represents greater concentration																
Private Industries	0.26	0.17	0.17	0.27	0.31	0.28	0.37	0.37	0.41	0.41	0.42	0.51	0.31	0.31	0.34	0.33
Manufacturing	0.38	0.34	0.33	0.22	0.45	0.30	0.27	0.51	0.29	0.30	0.44	0.20	0.21	0.40		0.33
Ogive Index if = 0 represents diversity and higher values indicate more concentration																
Private Industries	0.55	0.54	0.47	0.43	0.42	0.41	0.40	0.48	0.48	0.53	0.54	0.51	0.43	0.49	0.53	0.48
Manufacturing	1.11	1.07	0.73	0.72	0.74	0.73	0.89	1.40	1.28	1.42	1.59	1.18	1.19	1.78		1.13
Entropy Index higher values indicate greater diversification and lower values indicate more concentration																
Private Industries	2.66	2.66	2.68	2.69	2.69	2.70	2.70	2.68	2.68	2.67	2.67	2.67	2.70	2.68	2.67	2.68
Manufacturing	2.77	2.77	2.76	2.75	2.76	2.74	2.74	2.75	2.74	2.73	2.72	2.70	2.63	2.62		2.73
Herfindahl Index between 0 and 1, where 0 = diversity and 1 = concentration																
Private Industries	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Manufacturing	0.11	0.11	0.09	0.09	0.09	0.09	0.10	0.13	0.12	0.13	0.14	0.11	0.12	0.15		0.11

Portfolio Theory (σ2p) a lower value indicates diversification and stability

	1998–2001	2002–2005	2006–2011	1998–2011
Private Industries	2.42	6.82	8.16	6.71
Manufacturing	25.80	146.34	110.24	105.92

Estimated by the Real Estate Center at Texas A&M University
Source: Bureau of Economic Analysis

Table 2. Diversity Estimates for Employment

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	1997-2011
Location Quotient (LQ) > 1 Specialization in a given industry																
Private Nonfarm Employment																
Forestry, fishing, and related activities	0.99	1.03	1.04	1.04	0.87	0.92	0.90	0.90	0.89	0.85	0.84	0.81	0.80	0.80	0.78	0.90
Mining	3.97	3.94	4.04	4.02	3.92	3.94	4.00	4.02	4.01	4.00	3.97	3.98	3.86	3.80	3.81	3.95
Utilities	1.04	1.07	1.10	1.11	1.17	1.21	1.18	1.17	1.16	1.12	1.13	1.15	1.11	1.13	1.13	1.13
Construction	1.18	1.18	1.19	1.19	1.18	1.18	1.16	1.13	1.11	1.11	1.15	1.21	1.25	1.26	1.25	1.18
Manufacturing	0.85	0.85	0.85	0.85	0.86	0.85	0.85	0.85	0.86	0.87	0.88	0.87	0.88	0.87	0.87	0.86
Wholesale trade	1.11	1.12	1.12	1.12	1.12	1.11	1.11	1.11	1.11	1.11	1.11	1.11	1.10	1.10	1.11	1.11
Retail trade	1.01	1.01	1.01	1.01	1.02	1.03	1.01	1.01	1.00	1.00	0.99	0.98	0.98	0.98	0.97	1.00
Transportation and warehousing	1.12	1.13	1.13	1.14	1.14	1.13	1.13	1.15	1.15	1.16	1.15	1.13	1.12	1.13	1.12	1.14
Information	1.02	1.03	1.03	1.03	1.01	1.01	1.01	0.99	0.99	0.97	0.95	0.92	0.90	0.89	0.88	0.98
Finance and insurance	1.02	1.02	1.02	1.03	1.01	1.02	1.03	1.05	1.05	1.06	1.05	1.07	1.09	1.10	1.10	1.05
Real estate and rental and leasing	1.08	1.03	1.03	1.03	1.01	1.01	0.99	0.98	0.96	0.93	0.94	0.94	0.93	0.92	0.92	0.98
Professional, scientific, and technical services	0.96	0.97	0.97	0.97	0.96	0.96	0.96	0.97	0.97	0.97	0.96	0.96	0.95	0.95	0.94	0.96
Management of companies and enterprises	0.33	0.32	0.30	0.31	0.36	0.42	0.40	0.46	0.50	0.53	0.57	0.65	0.66	0.67	0.66	0.48
Administrative and waste management services	1.05	1.05	1.05	1.06	1.06	1.06	1.06	1.07	1.08	1.10	1.10	1.10	1.10	1.09	1.09	1.07
Educational services	0.66	0.65	0.68	0.69	0.68	0.69	0.68	0.67	0.67	0.66	0.66	0.64	0.65	0.65	0.65	0.67
Health care and social assistance	0.91	0.90	0.89	0.88	0.89	0.90	0.91	0.91	0.91	0.90	0.89	0.87	0.87	0.88	0.88	0.89
Arts, entertainment, and recreation	0.79	0.79	0.78	0.76	0.75	0.77	0.76	0.77	0.77	0.76	0.75	0.74	0.75	0.75	0.74	0.76
Accommodation and food services	0.98	0.99	1.00	1.00	1.01	1.01	1.01	1.01	1.01	1.00	1.00	0.99	1.00	1.00	1.00	1.00
Other services, except government	1.08	1.06	1.06	1.05	1.04	1.04	1.05	1.05	1.04	1.03	1.02	1.00	1.00	1.00	0.99	1.03
Manufacturing																
Durable goods																
Wood product	0.92	0.91	0.93	0.89	0.86	0.85	0.80	0.79	0.77	0.77	0.78	0.79	0.81	0.80	0.77	0.83
Nonmetallic mineral product	1.24	1.25	1.30	1.29	1.30	1.36	1.38	1.38	1.35	1.31	1.31	1.30	1.28	1.25	1.22	1.30
Primary metal	0.76	0.74	0.73	0.75	0.79	0.82	0.83	0.85	0.82	0.85	0.85	0.84	0.78	0.78	0.77	0.80
Fabricated metal product	1.17	1.17	1.16	1.15	1.17	1.19	1.15	1.15	1.18	1.22	1.24	1.27	1.26	1.24	1.26	1.20
Machinery	0.90	0.89	0.92	0.94	1.02	1.07	1.08	1.09	1.10	1.14	1.18	1.18	1.21	1.22	1.26	1.08
Computer and electronic product	1.45	1.52	1.51	1.51	1.42	1.38	1.36	1.36	1.35	1.29	1.29	1.27	1.22	1.21	1.24	1.36
Electrical equipment, appliance, and component	0.60	0.61	0.63	0.66	0.65	0.64	0.65	0.66	0.67	0.69	0.70	0.71	0.71	0.69	0.70	0.67
Motor vehicle, body, trailer, and parts	0.43	0.43	0.43	0.43	0.43	0.43	0.43	0.44	0.45	0.50	0.55	0.56	0.59	0.60	0.61	0.49
Other transportation equipment	1.20	1.21	1.21	1.19	1.15	1.16	1.36	1.34	1.33	1.30	1.24	1.20	1.18	1.20	1.18	1.23
Furniture and related product	0.76	0.78	0.79	0.82	0.83	0.84	0.86	0.87	0.87	0.90	0.88	0.87	0.89	0.90	0.87	0.85
Miscellaneous	0.89	0.89	0.87	0.85	0.85	0.84	0.85	0.87	0.84	0.81	0.79	0.75	0.75	0.74	0.75	0.82
Nondurable goods																
Food	0.99	0.97	0.97	0.98	0.96	0.98	0.97	0.97	0.98	0.95	0.91	0.88	0.87	0.88	0.85	0.94
Beverage and tobacco product	0.94	0.85	0.86	0.88	0.85	0.84	0.86	0.84	0.85	0.85	0.84	0.83	0.84	0.85	0.85	0.85
Textile mills and	0.13	0.14	0.15	0.16	0.17	0.19	0.22	0.23	0.24	0.25	0.27	0.30	0.31	0.33	0.37	0.23
Textile product mills	0.74	0.72	0.75	0.74	0.72	0.70	0.72	0.73	0.74	0.75	0.73	0.70	0.72	0.74	0.76	0.73
Apparel	1.12	1.08	1.07	1.01	1.01	0.96	0.80	0.69	0.63	0.58	0.54	0.50	0.56	0.55	0.59	0.78
Leather and allied product	1.36	1.42	1.43	1.43	1.51	1.60	1.66	1.67	1.79	1.80	1.86	1.79	1.84	1.94	1.85	1.66
Paper	0.76	0.76	0.75	0.75	0.73	0.74	0.73	0.72	0.70	0.66	0.65	0.63	0.62	0.63	0.63	0.70
Printing and related support activities	0.96	0.95	0.94	0.94	0.93	0.94	0.93	0.93	0.91	0.87	0.85	0.84	0.84	0.87	0.86	0.90
Petroleum and coal products	3.39	3.25	3.24	3.23	3.18	3.19	3.19	3.30	3.18	3.14	3.11	3.14	3.06	3.08	3.06	3.18
Chemical	1.47	1.45	1.44	1.42	1.40	1.37	1.36	1.35	1.32	1.29	1.28	1.28	1.26	1.26	1.26	1.35
Plastics and rubber products	0.91	0.90	0.92	0.93	0.93	0.91	0.90	0.90	0.90	0.89	0.88	0.87	0.87	0.84	0.81	0.89
Hachman Index between 0 and 1, where = 1 diversified and = 0 specialized/concentrated																
Private Nonfarm Industries	0.93	0.93	0.93	0.94	0.94	0.94	0.94	0.94	0.94	0.93	0.93	0.92	0.93	0.92	0.91	0.93
Manufacturing	0.88	0.88	0.88	0.89	0.89	0.89	0.89	0.89	0.90	0.90	0.90	0.90	0.91	0.91	0.91	0.89
National Average Index (NAI) approaches 0 diversity and larger values represents greater concentration																
Private Industries	0.07	0.07	0.07	0.07	0.07	0.06	0.07	0.06	0.07	0.07	0.07	0.09	0.08	0.09	0.09	0.07
Manufacturing	0.14	0.14	0.13	0.13	0.12	0.12	0.12	0.12	0.12	0.11	0.11	0.11	0.10	0.10	0.10	0.12
Ogive Index if = 0 represents diversity and higher values indicate more concentration																
Private Nonfarm Industries	0.50	0.50	0.49	0.48	0.48	0.47	0.47	0.46	0.45	0.45	0.44	0.42	0.42	0.42	0.41	0.46
Manufacturing	0.61	0.65	0.62	0.66	0.65	0.66	0.61	0.58	0.59	0.62	0.64	0.66	0.70	0.70	0.74	0.64
Entropy Index higher values indicate greater diversification and lower values indicate more concentration																
Private Nonfarm Industries	2.68	2.68	2.68	2.68	2.68	2.69	2.68	2.69	2.69	2.69	2.70	2.71	2.70	2.71	2.71	2.69
Manufacturing	2.81	2.80	2.81	2.80	2.79	2.81	2.81	2.81	2.79	2.79	2.78	2.76	2.76	2.76	2.75	2.79
Herfindahl Index between 0 and 1, where 0 = diversity and 1 = concentration																
Private Nonfarm Industries	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.07	0.07	0.07	0.07	0.08
Manufacturing	0.07	0.07	0.07	0.08	0.08	0.07	0.07	0.07	0.07	0.07	0.08	0.08	0.08	0.08	0.08	0.07

Portfolio Theory (σ2p) a lower value indicates diversification and stability

	1998–2001	2002–2005	2006–2011	1998–2014
Private Industries	1.09	0.96	2.73	1.84
Manufacturing	2.75	6.27	7.94	6.45

Estimated by the Real Estate Center at Texas A&M University
Source: Bureau of Economic Analysis

Table 3. Diversity Estimates for Earnings

	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	1997-2011
Location Quotient (LQ) > 1 Specialization in a given industry																
Private Nonfarm Employment																
Forestry, fishing, and related activities	0.87	0.91	0.91	0.88	0.73	0.74	0.73	0.74	0.76	0.72	0.70	0.65	0.66	0.65	0.62	0.75
Mining	4.68	4.77	4.96	4.95	4.99	5.21	5.53	5.80	5.92	5.74	5.58	5.54	5.23	5.13	5.09	5.27
Utilities	1.07	1.13	1.23	1.40	1.44	1.37	1.32	1.33	1.27	1.40	1.40	1.46	1.24	1.31	1.26	1.31
Construction	1.12	1.11	1.08	1.04	1.06	1.07	1.10	1.05	1.04	1.01	1.09	1.13	1.25	1.28	1.26	1.11
Manufacturing	0.89	0.91	0.88	0.89	0.92	0.92	0.91	0.93	0.96	1.00	0.99	0.93	0.93	0.93	0.93	0.93
Wholesale trade	1.13	1.19	1.25	1.23	1.19	1.17	1.16	1.14	1.14	1.13	1.14	1.15	1.17	1.17	1.18	1.17
Retail trade	1.02	1.03	1.03	1.00	0.99	1.02	1.00	0.97	0.96	0.94	0.94	0.91	0.96	0.95	0.95	0.98
Transportation and warehousing	1.28	1.26	1.28	1.32	1.44	1.30	1.30	1.30	1.28	1.29	1.30	1.27	1.32	1.37	1.38	1.31
Information	0.98	0.98	0.95	0.95	0.94	0.96	0.93	0.90	0.86	0.85	0.85	0.74	0.76	0.71	0.70	0.87
Finance and insurance	0.81	0.83	0.83	0.85	0.83	0.85	0.85	0.83	0.83	0.79	0.80	0.78	0.84	0.82	0.81	0.82
Real estate and rental and leasing	1.47	1.29	1.39	1.39	1.16	1.14	1.12	1.13	1.07	1.05	1.05	1.11	1.15	1.13	1.14	1.19
Professional, scientific, and technical services	0.91	0.92	0.93	0.93	0.95	0.95	0.94	0.93	0.93	0.92	0.91	0.87	0.90	0.91	0.90	0.92
Management of companies and enterprises	0.21	0.15	0.15	0.16	0.25	0.25	0.26	0.28	0.33	0.38	0.46	0.43	0.50	0.48	0.49	0.32
Administrative and waste management services	1.06	1.06	1.05	1.04	1.03	1.04	1.02	1.02	1.01	1.02	1.06	1.03	1.07	1.05	1.05	1.04
Educational services	0.56	0.55	0.60	0.59	0.60	0.61	0.60	0.60	0.59	0.57	0.56	0.54	0.56	0.56	0.54	0.58
Health care and social assistance	0.92	0.89	0.88	0.88	0.87	0.90	0.89	0.89	0.85	0.83	0.83	0.79	0.83	0.83	0.82	0.86
Arts, entertainment, and recreation	0.68	0.65	0.64	0.62	0.60	0.65	0.65	0.65	0.64	0.65	0.63	0.60	0.65	0.64	0.63	0.64
Accommodation and food services	0.96	0.97	0.98	0.98	0.96	0.97	0.96	0.94	0.92	0.91	0.89	0.87	0.93	0.92	0.90	0.94
Other services, except government	1.00	1.00	1.04	1.03	0.97	0.97	0.97	0.95	0.95	0.92	0.93	0.95	1.01	1.00	0.99	0.98
Manufacturing																
Durable goods																
Wood product	0.84	0.87	0.89	0.81	0.76	0.74	0.70	0.67	0.65	0.63	0.65	0.67	0.74	0.70	0.68	0.73
Nonmetallic mineral product	1.15	1.12	1.19	1.17	1.09	1.29	1.23	1.20	1.17	1.12	1.12	1.16	1.12	1.05	1.02	1.15
Primary metal	0.64	0.60	0.61	0.62	0.65	0.69	0.69	0.69	0.66	0.66	0.70	0.73	0.63	0.63	0.61	0.65
Fabricated metal product	1.08	1.06	1.04	1.06	1.06	1.07	1.05	1.01	1.04	1.07	1.12	1.20	1.22	1.16	1.18	1.10
Machinery	0.86	0.84	0.86	0.93	1.00	1.12	1.09	1.05	1.06	1.08	1.17	1.18	1.29	1.29	1.31	1.07
Computer and electronic product	1.51	1.62	1.58	1.49	1.45	1.40	1.37	1.34	1.33	1.27	1.22	1.22	1.21	1.14	1.17	1.35
Electrical equipment, appliance, and component	0.55	0.57	0.57	0.60	0.55	0.56	0.57	0.56	0.56	0.54	0.55	0.62	0.62	0.62	0.62	0.58
Motor vehicle, body, trailer, and parts	0.31	0.31	0.31	0.31	0.32	0.32	0.33	0.33	0.34	0.38	0.38	0.39	0.47	0.48	0.47	0.36
Other transportation equipment	1.08	1.08	1.08	1.09	1.03	1.09	1.28	1.20	1.17	1.09	1.06	1.05	1.09	1.11	1.06	1.10
Furniture and related product	0.63	0.63	0.67	0.68	0.68	0.69	0.72	0.68	0.67	0.67	0.65	0.68	0.76	0.76	0.72	0.69
Miscellaneous	0.74	0.71	0.69	0.67	0.65	0.67	0.71	0.66	0.62	0.58	0.55	0.61	0.57	0.57	0.56	0.64
Nondurable goods																
Food	0.89	0.87	0.88	0.87	0.84	0.87	0.88	0.86	0.84	0.78	0.73	0.73	0.75	0.72	0.69	0.81
Beverage and tobacco product	0.90	0.85	0.84	0.78	0.73	0.75	0.80	0.70	0.68	0.67	0.68	0.73	0.78	0.75	0.74	0.76
Textile mills and	0.12	0.12	0.13	0.14	0.14	0.15	0.18	0.18	0.18	0.18	0.20	0.23	0.23	0.24	0.26	0.18
Textile product mills	0.56	0.54	0.58	0.57	0.53	0.52	0.52	0.49	0.48	0.48	0.47	0.47	0.51	0.50	0.49	0.51
Apparel	1.01	0.97	0.93	0.89	0.80	0.79	0.64	0.49	0.41	0.35	0.31	0.29	0.32	0.32	0.34	0.59
Leather and allied product	1.15	1.14	1.22	1.24	1.04	1.16	1.26	1.08	1.12	1.13	1.17	1.18	1.34	1.39	1.31	1.19
Paper	0.66	0.64	0.68	0.66	0.63	0.64	0.64	0.61	0.57	0.53	0.57	0.52	0.56	0.52	0.51	0.60
Printing and related support activities	0.81	0.81	0.81	0.80	0.79	0.79	0.80	0.77	0.73	0.67	0.67	0.68	0.72	0.72	0.70	0.75
Petroleum and coal products	3.82	3.79	3.82	4.23	3.99	3.63	3.85	4.11	4.04	3.96	3.96	3.32	3.23	3.49	3.48	3.78
Chemical	1.63	1.61	1.57	1.47	1.45	1.43	1.47	1.50	1.45	1.43	1.44	1.26	1.23	1.23	1.23	1.43
Plastics and rubber products	0.79	0.76	0.79	0.79	0.80	0.79	0.80	0.77	0.75	0.72	0.72	0.74	0.76	0.72	0.70	0.76
Hachman Index between 0 and 1, where = 1 diversified and = 0 specialized/concentrated																
Private Nonfarm Industries	0.96	0.96	0.96	0.95	0.95	0.96	0.91	0.87	0.84	0.83	0.86	0.78	0.91	0.90	0.88	0.90
Manufacturing	0.78	0.77	0.79	0.78	0.77	0.80	0.78	0.75	0.74	0.72	0.74	0.79	0.83	0.79	0.78	0.77
National Average Index (NAI) approaches 0 diversity and larger values represents greater concentration																
Private Industries	0.16	0.16	0.16	0.18	0.18	0.18	0.22	0.28	0.32	0.34	0.30	0.42	0.25	0.26	0.28	0.24
Manufacturing	0.28	0.30	0.27	0.29	0.31	0.25	0.29	0.33	0.34	0.38	0.36	0.27	0.21	0.27	0.28	0.30
Ogive Index if = 0 represents diversity and higher values indicate more concentration																
Private Nonfarm Industries	0.57	0.56	0.52	0.50	0.50	0.49	0.48	0.47	0.48	0.49	0.48	0.49	0.46	0.46	0.46	0.50
Manufacturing	1.09	1.18	1.22	1.28	1.17	1.03	0.94	1.01	1.04	1.07	1.07	1.02	1.04	1.04	1.09	1.09
Entropy Index higher values indicate greater diversification and lower values indicate more concentration																
Private Nonfarm Industries	2.65	2.65	2.66	2.67	2.67	2.68	2.68	2.68	2.68	2.68	2.68	2.67	2.69	2.69	2.69	2.67
Manufacturing	2.66	2.64	2.64	2.62	2.63	2.66	2.67	2.65	2.63	2.61	2.61	2.62	2.62	2.61	2.59	2.63
Herfindahl Index between 0 and 1, where 0 = diversity and 1 = concentration																
Private Nonfarm Industries	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Manufacturing	0.09	0.10	0.10	0.10	0.10	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09	0.09

Portfolio Theory (σ2p) a lower value indicates diversification and stability

	1998–2001	2002–2005	2006–2011	1998–2011
Private Industries	4.44	4.43	10.44	8.77
Manufacturing	10.98	9.25	27.25	19.04

Estimated by the Real Estate Center at Texas A&M University
Source: Bureau of Economic Analysis

Based on output, nonfarm employment and nonfarm earnings, the Texas economy is concentrated in the following private industries: mining (includes oil and gas extraction), utilities, construction, manufacturing, wholesale trade, transportation and warehousing, and administrative and waste management services (Tables 1–3). The manufacturing industry is specialized in the following industries: nonmetallic mineral products, machinery, computer and electronic products, petroleum and coal products, and chemicals.

Some industries are specialized only in their output or employment or earnings. This is true for the manufacturing industry, which in employment does not show a high level of concentration of jobs compared with the nation. In contrast, the retail sector shows a greater level of specialization in employment versus the nation. This is true for the earnings generated by the real estate and rental and leasing industry, which shows a greater level of concentration than the United States. Observing the manufacturing industry by employment and earnings concentration, other transportation equipment and leather and allied products stand out.

In general, the results show that the structure of the Texas economy has not changed a great deal with the recent oil and gas boom. While structural changes in any economy take time and happen over long periods, there is some initial evidence that the Texas economy has been affected by the energy sector's recent expansion.

How Does the Texas Economy Compare with Other States?

To compare the structure of Texas' economy with that of other states, the NAI was estimated for the 50 states and the District of Columbia. This measures the disparity between the nation's and the states' industry distribution using the nation's industrial structure as the point of reference for diversity. By private firm output, Texas

ranks 38th; by nonfarm employment, 31st, exhibiting an overall higher level of concentration than half of the states (Table 4). Interestingly, when calculating the NAI for the manufacturing industry, it ranked 8th by output and 3rd by employment, demonstrating an overall higher level of diversification than 42 states (Table 5). This indicates that the composition of Texas' manufacturing industry is now

Table 4. Texas Private Industries Diversity Rankings by Output and Nonfarm Employment

Output			Nonfarm Employment		
Ranking	State	Index	Ranking	State	Index
1	Illinois	8.8	1	Illinois	23.4
2	Utah	10.9	2	Missouri	24.7
3	Pennsylvania	11.8	3	Georgia	27.4
4	Georgia	12.6	4	Utah	32.3
5	California	12.9	5	Minnesota	33.8
6	Arizona	15.3	6	Washington	34.4
7	Missouri	16.5	7	California	37.5
8	New Hampshire	16.5	8	Pennsylvania	41.3
9	Minnesota	16.9	9	Oregon	41.9
10	New Jersey	19.7	10	Ohio	43.9
11	Michigan	22.1	11	Nebraska	45.5
12	Ohio	22.2	12	North Carolina	50.5
13	Virginia	23.2	13	Arizona	50.8
14	Alabama	24.2	14	New Jersey	51.0
15	Maine	25.4	15	Michigan	51.1
16	Kansas	27.3	16	New Hampshire	51.5
17	Washington	28.9	17	Kansas	52.3
18	Tennessee	29.4	18	Tennessee	54.1
19	Vermont	30.2	19	Virginia	58.3
20	Massachusetts	30.8	20	Connecticut	67.3
21	Wisconsin	31.1	21	Kentucky	67.8
22	Colorado	32.8	22	Alabama	72.8
23	Maryland	33.8	23	Idaho	73.9
24	Florida	34.3	24	Iowa	74.6
25	South Carolina	34.9	25	Colorado	76.9
26	Rhode Island	36.1	26	South Dakota	79.6
27	North Carolina	37.9	27	Maryland	80.9
28	Kentucky	41.1	28	Rhode Island	84.8
29	Oregon	42.3	29	Florida	84.9
30	Mississippi	44.0	30	South Carolina	97.3
31	Connecticut	46.6	**31**	**Texas**	**100.0**
32	Arkansas	54.8	32	New York	100.1
33	New York	57.9	33	Vermont	103.1
34	Indiana	71.0	34	Delaware	105.8
35	Idaho	78.2	35	Wisconsin	106.3
36	Iowa	83.4	36	Massachusetts	106.7
37	Montana	87.4	37	Mississippi	116.0
38	**Texas**	**100.0**	38	Indiana	121.9
39	Nebraska	109.5	39	Arkansas	124.2
40	Hawaii	125.6	40	Maine	127.2
41	Oklahoma	137.3	41	North Dakota	143.2
42	New Mexico	140.0	42	Louisiana	159.5
43	West Virginia	174.9	43	Montana	163.7
44	North Dakota	184.8	44	New Mexico	170.6
45	South Dakota	213.1	45	Hawaii	214.3
46	Louisiana	230.4	46	Oklahoma	331.5
47	Nevada	241.2	47	West Virginia	396.0
48	Delaware	315.2	48	Nevada	588.3
49	District of Columbia	390.6	49	Alaska	687.7
50	Alaska	1192.8	50	District of Columbia	1115.1
51	Wyoming	1512.7	51	Wyoming	1661.7

Estimated by the Real Estate Center at Texas A&M University. Average from 1997–2011.
Source: Bureau of Economic Analysis

more varied and much closer to the national composition. In contrast, the private industry structure of the state's economy is much more concentrated and less similar to the national composition compared with other states.

The Takeaway

Texas has benefited in recent years from a rapid expansion in the production of oil and natural gas from unconven-

tional sources, primarily oil and gas shale. This increase in the importance of the petroleum and natural gas industry in the state's economy has had some initial effects on the structure and variability of the Texas economy, showing a tendency toward greater specialization and greater variance. Overall, the structure of the Texas economy remained relatively similar from 1997 to 2011. Diversification of an economy produces higher stability and greater

**Table 5. Texas Manufacturing Industries Diversity Rankings
by Output and Nonfarm Employment**

Output			Nonfarm Employment		
Ranking	State	Index	Ranking	State	Index
1	Tennessee	58.6	1	Pennsylvania	66.9
2	Pennsylvania	68.1	2	Missouri	93.1
3	Maryland	73.0	**3**	**Texas**	**100.0**
4	Missouri	75.6	4	Tennessee	115.1
5	Minnesota	77.3	5	Virginia	122.1
6	Illinois	77.5	6	Illinois	136.4
7	New York	90.2	7	Florida	137.2
8	**Texas**	**100.0**	8	Maryland	158.2
9	Florida	102.9	9	New York	159.0
10	Colorado	104.5	10	Minnesota	175.5
11	Ohio	108.8	11	Wisconsin	203.8
12	California	125.9	12	Utah	206.2
13	Oklahoma	132.2	13	Oklahoma	211.4
14	Wisconsin	145.0	14	Ohio	241.7
15	Virginia	161.3	15	Vermont	242.0
16	Nebraska	161.5	16	Iowa	245.9
17	Iowa	161.7	17	California	246.9
18	Indiana	164.6	18	Alabama	253.4
19	Arkansas	176.4	19	Colorado	263.9
20	Alabama	177.6	20	Kentucky	266.5
21	North Carolina	178.5	21	South Dakota	272.0
22	Massachusetts	179.6	22	Massachusetts	283.7
23	Vermont	181.0	23	Connecticut	295.5
24	Utah	181.4	24	Arkansas	350.2
25	Kentucky	181.4	25	New Hampshire	368.6
26	Delaware	182.6	26	New Jersey	369.8
27	Mississippi	191.2	27	Kansas	378.5
28	New Jersey	197.1	28	Arizona	387.8
29	New Hampshire	205.9	29	New Mexico	401.8
30	Connecticut	221.2	30	Indiana	406.4
31	South Carolina	306.4	31	Delaware	414.9
32	West Virginia	336.0	32	Mississippi	428.2
33	Georgia	337.8	33	North Dakota	435.0
34	South Dakota	350.1	34	Washington	483.2
35	Rhode Island	360.8	35	Oregon	483.4
36	Kansas	382.0	36	Nevada	484.4
37	District of Columbia	404.6	37	Nebraska	515.9
38	North Dakota	409.8	38	Rhode Island	556.8
39	Arizona	442.9	39	Idaho	609.5
40	Idaho	476.9	40	North Carolina	653.0
41	Hawaii	583.3	41	Louisiana	675.3
42	Michigan	600.9	42	Georgia	676.7
43	Nevada	601.0	43	West Virginia	718.4
44	Maine	605.8	44	South Carolina	855.8
45	Oregon	642.8	45	Wyoming	981.2
46	Wyoming	733.2	46	Michigan	988.3
47	Louisiana	822.2	47	Hawaii	1123.8
48	Washington	902.6	48	Maine	1149.5
49	Montana	903.9	49	Montana	1155.3
50	New Mexico	916.7	50	District of Columbia	1727.2
51	Alaska	1084.5	51	Alaska	2733.1

Estimated by the Real Estate Center at Texas A&M University. Average from 1997–2011.
Source: Bureau of Economic Analysis

performance. Economies with a broad mix of industries experience less volatility than those concentrated in a small number of dominant industries. Texas is an example of the economic costs of industry concentration and the benefits of industry diversification. Texas must continue to pursue industrial diversification while also taking advantage of its growing energy industry.

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