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Houston Business

A Perspective on the Houston Economy

Tracking Industrial Diversification in Houston: Three Approaches

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The 1980s were a period of remarkable change for Houston. In 1982, the city's oil boom came to an abrupt end, only to be followed by a serious recession that led to the loss of 212,000 local jobs. Houston then staged a turnaround in early 1987, and by May 1990 the city had restored all the jobs lost to the oil downturn. An additional 45,000 jobs moved the city to record levels of employment by mid-1991, but by then the recovery from the oil bust was over. Houston entered a period of slow to stagnant growth that has continued into 1994.

This article examines structural change in the Houston economy since 1981 in the context of industrial diversification and reduced local dependence on the oil industry. The wrenching losses in oil production, services and machinery in the 1980s, and an economic recovery that occurred without apparent help from these upstream energy industries, sharply altered Houston's industrial base. Houston from 1981 to 1991 provides an excellent study of industrial change against a backdrop of decline and renewal.

STRUCTURAL CHANGE AND DIVERSITY

This article uses three approaches to describe structural change and industrial diversification in Houston. First, we ask if Houston is less dependent on the energy industries, simply counting local energy jobs and asking if the percentage of oil-related jobs changed from 1981 to 1991. Second, we ask if Houston is now more like the national economy. Has the city moved toward the economic

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mainstream? Finally, we think of each Houston industry as analogous to a stock and the city's collection of oil, pipeline, construction and other industries as a stock portfolio. We ask if Houston's portfolio of local industries is now less risky than in 1981.

We use two standards to gauge progress in Houston. First, we examine change in Houston's industrial structure over the years, particularly since the end of the oil boom in 1981. Second, we compare Houston's industry mix to that of Dallas, a city widely recognized as a diversified regional financial and distribution center.

Stability is a logical result of diversity for a regional economy, and many economic studies (although they are not unanimous) find more stability in diversified regions of the United States and the United Kingdom. Diversity and regional growth, at least in theory, are inversely related. A region should accept a less diverse (and presumably less stable) industry mix only in exchange for higher industry growth. In reality, industrial diversity in a particular region is largely an artifact of the past, and efforts to adjust the local economic base to current conditions are slow and incomplete. One result is that observed regional growth rates and regional diversity typically show little or no relationship.

Houston's relationship with the oil exploration industry is a good example of how this link between growth and industrial volatility can change. Local ties to this highly unstable industry were happy as long as upstream oil provided strong growth. Only in recent years, as the industry has shrunk or grown slowly, has Houston sought diversity elsewhere. Houston's inability to adjust its industrial portfolio quickly has left the local economy saddled with volatility from oil markets that is not compensated for by industry growth.

DATA SOURCES

The data employed in this article and all tables and figures, are taken from U.S. Bureau of the Census, *County Business Patterns*. These data describe private-sector employment in Harris and Dallas counties. We conduct the analysis at a two-digit level of industry detail, except for selected industries that we combine because of lack of disclosure or changes in industry definition. Data are available each year from 1970 through 1991, and we handle some disclosure problems by interpolation or by turning to other data sources.

Limiting the area of analysis to Harris and Dallas counties provides a consistent and detailed set of data that extends over a 21-year period. These counties incorporate the central city and major beltways of both Houston and Dallas, but they miss recent suburban business development in both cities. For Houston, omitted growth includes that in Fort Bend County, Brazoria County and Texas City in Galveston County; for Dallas, omitted growth includes that in Denton County and Plano in Collin County. Growth of suburban bedroom communities is largely irrelevant for this analysis, but suburban industrial growth could affect our results. For this to be true, however, suburban growth would have to represent a major departure from the industry mix in the central county. A close look at suburban growth trends in Houston and Dallas failed to show such a break with the rest of the local industrial base. We assume Harris County and Dallas County are generally interchangeable with Houston and Dallas, respectively.

The last year of data available from *County Business Patterns* is 1991. This is adequate, however, as 1991 marks the year that saw economic recovery in Houston come to an end. Since mid-1991 the local economy has been in a holding pattern with little or no economic expansion. No diversification or structural change has been apparent since 1991.

ENERGY IN THE ECONOMIC BASE

Regional analysts often divide local employment between basic and nonbasic industries. A city's basic industries sell goods and services to other towns and cities throughout the United States or the world. As a group, these goods and services constitute the city's export base. Nonbasic industries sell goods and services only within the city and include grocery stores, dry cleaners and gasoline stations. Basic industries are important because they provide income to pay for imports from other cities and to support local nonbasic industries.

Actual data on exports from Houston to other towns and cities do not exist, and the definition and calculation of the export base relies on rules of thumb. These rules, for example, often simply assign all mining and manufacturing to the export base. They identify service-sector exports by seeking unusual concentra-

tions of service industries and assign "surplus" employment—employment thought to be too large to satisfy only local needs—to the export sector. Location quotients to identify this local surplus (LQ_i) can be calculated as follows:

$$LQ_i = \frac{\text{percent share of local employment in industry } i}{\text{percent share of U.S. employment in industry } i}$$

If $LQ_i > 1$, Houston produces a greater than typical share of this service and both satisfies its own needs as well as exports some services. After local needs are met, the share of service employment engaged in export activity is

$$\text{share of industry } i \text{ exported} = (LQ_i - 1) / LQ_i.$$

Thus, for example, if $LQ_i = 1.5$, we assign one-third of this sector's employment to the export base.

Table 1 shows location quotients for Houston and the share of employment in each sector that our rules attribute to export production. The 100-percent figures for Houston mining and manufacturing are the result of assumption. The zero figures mean there are no exports from these sectors, and the region meets its needs through some combination of local output and imports. Those sectors with a location quotient greater than 1 meet all local needs and they also export.

Figure 1 shows our estimates of Houston's export base employment from 1970 through 1991. The figure also shows the base employment that we attribute to upstream and downstream energy. Upstream oil in Houston is defined

Table 1
Definition of Harris County's Economic Base by Industry in 1991

Industry	LQ_i	Percent Basic
Mining	5.06	100
Manufacturing	.61	100
Heavy construction	4.79	79.6
Transportation, communication, public utilities		
Water transportation	3.51	71.5
Pipelines, excluding natural gas	8.52	88.3
Transportation services	1.58	36.7
Electric, gas, sanitary services	1.81	44.7
Wholesale trade	1.21	17.1
Retail trade	.85	0
Finance, insurance and real estate		
Holding and investment offices	1.24	19.2
Services		
Business services	1.70	41.1
Miscellaneous repair services	2.36	57.6
Legal services	1.30	22.8
Administrative and auxiliary	1.27	21.2

Figure 1
Energy in Houston's Export Base, 1970–91

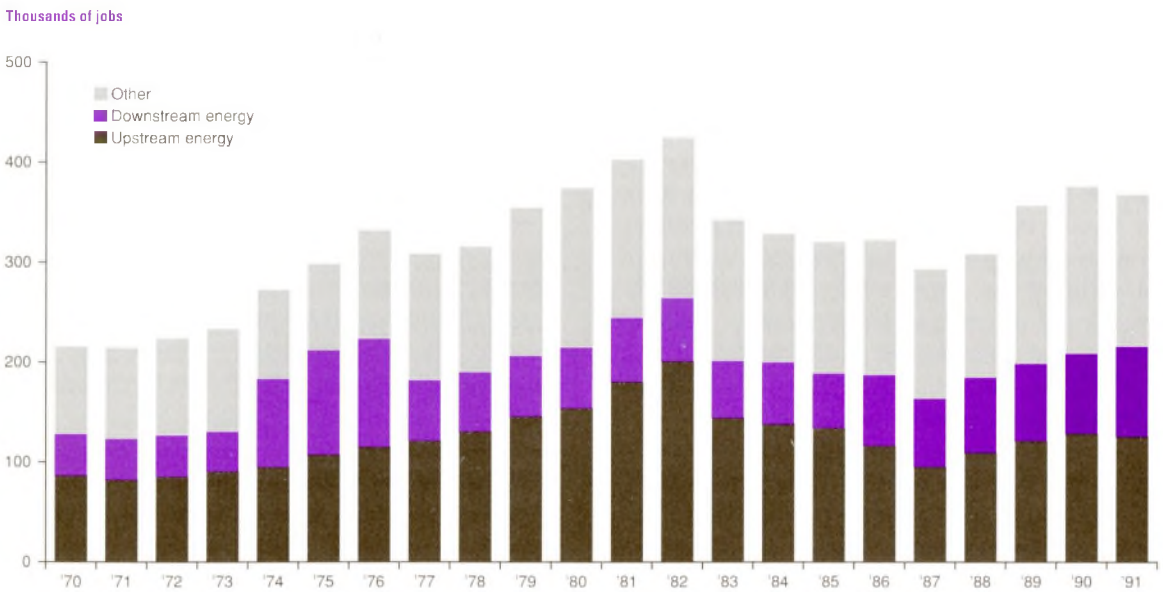
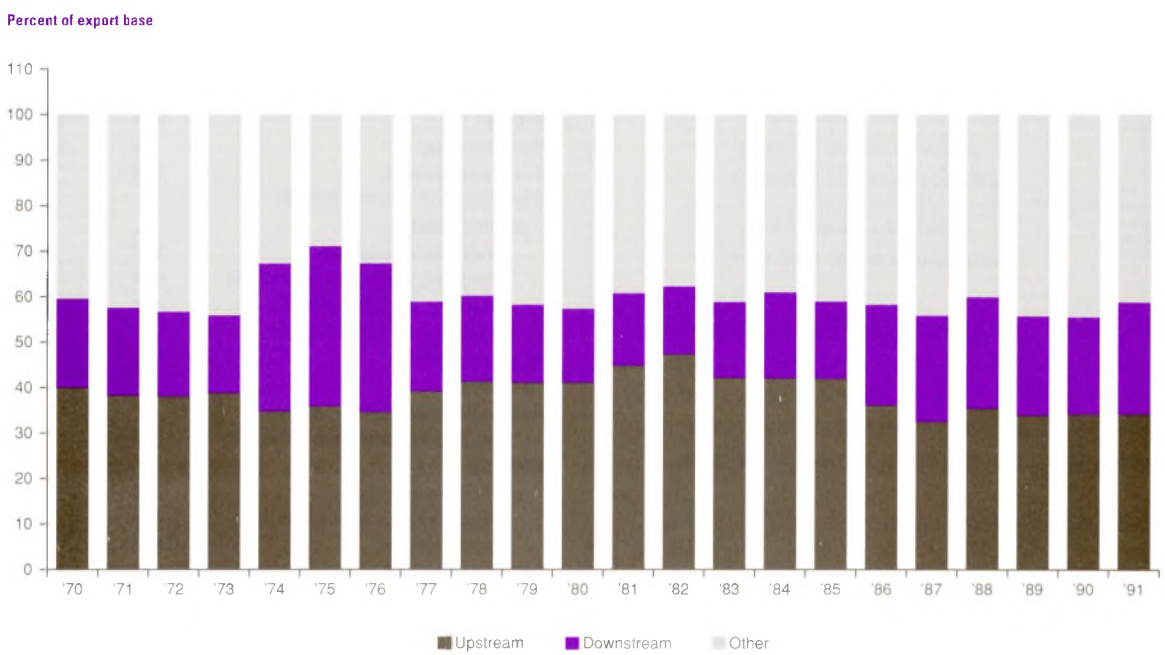


Figure 2
Energy in Houston's Export Base, 1970–91



as oil and gas mining, primary and fabricated metals, electrical and other machinery, and instruments. Downstream oil is chemicals, refining, plastics, pipelines and heavy construction. Heavy construction for the chemical and refining industries, specifically for maintenance and expansion of Gulf Coast plants, plays an especially large role from 1974 to 1976, and then again from 1987 to 1991.

Upstream oil, following the collapse of drilling activity that began in 1981, stabilized by 1985. Although upstream losses continued through 1987, the net job loss between 1985 and 1991 was only 8,800 jobs. Meanwhile, downstream sectors added 35,800 jobs to the export base, and two-thirds of the jobs were in heavy construction. Some of the heavy construction growth was a transfer of jobs out of refining, as many companies turned increasingly to contractors for routine maintenance and turnaround work. Refining lost 2,800 jobs between 1985 and 1991, while chemicals and plastics added 6,700.

If we use the share of energy employment in the export base as a measure of dependence on oil and natural gas markets, the overall share has been surprisingly stable (*Figure 2*). Energy accounted for 62 percent of the base by the end of the oil boom in 1982, and it fell to 56 percent by 1987. But by 1991, energy had risen back to 59 percent of the base. Low energy prices turned out to have unexpected benefits, as refining and chemical industries prospered as the price of their inputs—energy feedstocks—fell sharply. Upstream employment fell from 47 percent to 34 percent of export-related employment between 1982 and 1991; meanwhile, downstream employment rose from 15 percent to 25 percent of the export base, led by a boom in chemical construction.

Construction of new petrochemical facilities resulted from rising global demand for chemicals, limited production capacity after many years of high energy feedstock prices and high profits as the cost of oil and natural gas feedstocks fell sharply after 1981. Heavy construction jobs in Houston (excluding road and highway construction) jumped from 21,000 jobs in 1985 to 46,000 jobs by 1990. Heavy construction also assumes a large role in both of our other measures of diversification in Houston. Heavy construction plays a unique local role in refining and petrochemicals, keeping Houston from conforming to the U.S. industrial structure. It also is as volatile and risky to the local economy as the oil and gas mining industry it replaced.

MORE LIKE THE UNITED STATES?

Has Houston become more like the U.S. economy in recent years? The following index measures how the economy of a local area such as Houston differs from the U.S. economy:

$$I = \sum_{i=1}^{n} \frac{(s_i - s_i^*)^2}{s_i^*},$$

where s_i is the local share of employment in industry i, s_i^* is the U.S. share of employment in industry i and n is the number of industries.

The United States represents the standard for a highly diversified place in this index, as it represents an average of the industrial strengths and weaknesses of its less diversified regions. A diversified city or region is one with industrial structure similar to the nation, and thus with a low index value. The more the structure differs from the United States, the less diversified the place and the more the index rises. Industries that contribute large values to the index stand out because of their unusually large or small local share of total employment. As a group these industries provide insight into the special role played by each local area within the national economy.

Figure 3 shows index values for Houston and Dallas from 1970 to 1991. The bulge in the Houston index from 1974 to 1977 is the heavy construction boom that followed the 1973 oil embargo; the smaller bulge from 1988 to 1991 is also substantially due to heavy construction. The Houston index has been between 30 and 40 since 1980, and since 1987, points to Houston becoming less like the United States. The Dallas index is smaller, indicates Dallas is more like the United States and more diversified, and has values that remain in a range from 20 to 25.

The industries that most distinguish Houston from the United States, and which together

Figure 3
More Like the United States?
Index Values for Houston and Dallas

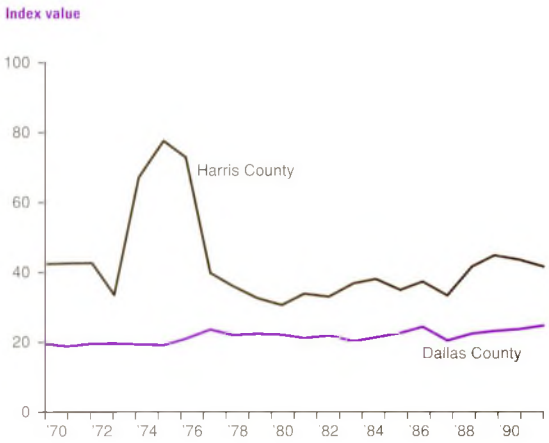
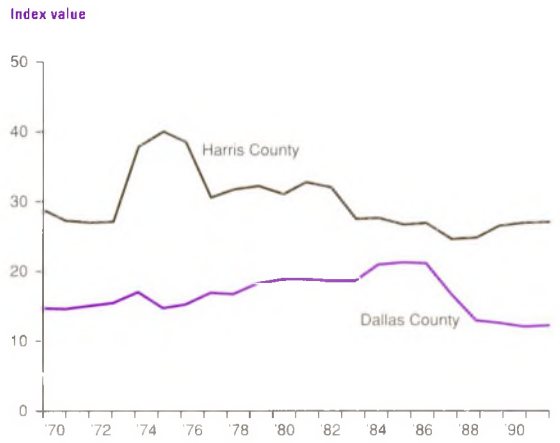


Table 2
Contribution to Industrial Instability in Houston

Industry	Beta	Employment share (Percent)	Variance	Covariance
Heavy construction	2.72	2.9	53.64	1.15
Electrical and other machinery	2.52	3.7	9.52	2.17
General contractors	2.34	1.9	18.36	2.00
Fabricated metal	1.77	1.8	5.15	1.68
Social and miscellaneous services	1.62	4.5	7.84	1.26
Business services	1.32	7.7	3.22	1.07
Oil and gas mining	1.32	4.6	7.46	.97
Eating and drinking places	1.31	5.8	4.53	1.05
Special trade contractors	1.19	3.9	3.00	1.08
Banking	1.05	1.8	4.33	.97
Wholesale trade	1.03	8.8	1.48	.90
General merchandise retail	.87	2.2	.54	.81
Chemicals	.86	1.7	2.33	.82
Miscellaneous retail	.75	2.0	.89	.73
Trucking and warehousing	.71	1.6	2.18	.67
Administrative and auxiliary	.58	4.2	9.42	.17
Auto dealers and service stations	.42	2.0	1.27	.39
Food stores	.35	2.9	1.69	.29
Health services	.31	6.2	.68	.26

Figure 4
Portfolio Variance: Houston and Dallas Compared



account for more than half the index in 1991, are oil and gas mining and heavy construction. Surprisingly, oil and gas mining is a *growing* contributor in recent years, even as the industry has shrunk locally. Because the industry declined faster in the nation than in Houston, the index assigns local oil and gas mining a growing weight in recent years. Other large contributors in 1991 were business services, transportation equipment, water transportation, pipelines and refining. Except for business services, these industries (like heavy construction) are tied to downstream production or the movement of chemicals and refined products. Air transportation and business services are the two largest contributors to the Dallas index.

PORTFOLIO VARIANCE

A third way to think about industrial diversification uses a financial analogy and considers the set of industries in a region as a portfolio of community investments. Returns to the community from these investments take the form of jobs and income. Variance is the usual measure of risk associated with a portfolio, and we define portfolio variance (PV) as

$$PV = \sum_{i=1}^{n} w_i^2 VAR_i^2 + \sum_{i=1}^{n} \sum_{\substack{j=1 \\ j \neq i}}^{n} w_i w_j COV_{ij},$$

where VAR_i is the variance of employment industry i, COV_{ij} is the covariance of employment in industry i and industry j and w_i is the share of industry i in total employment.

Thus, portfolio variance is comprised of the variances of industry-by-industry employment, plus all the covariances among these industries. We use shares of total employment as weights. For Houston and Dallas, we use employment growth rates to compute variance and covariances.

Covariances are important because they can make an industry attractive to a community—make it less risky—despite a high variance. An industry that is uncorrelated or negatively correlated with the existing portfolio can make a bigger contribution to reducing average portfolio variance than an industry with a smaller variance. In Houston, for example, air transportation and electric, gas and sanitary services have a large variance; however, a negative covariance makes them attractive as a strong contributor to local stability.

Following the financial analogy, we can calculate an important measure of the contribution of each industry to portfolio variance called *beta*. The formula not presented here is the ratio of the industry variance and covariances to the portfolio variance. If beta is greater than 1, the industry is less stable than the overall portfolio; if it is equal to 1, its variance is typical of the portfolio; and if it is less than 1, the industry contributes to portfolio stability. Table 2 shows a list of industries in Houston ranked from the largest to smallest beta value—that is, from the most risky to least risky. The list includes only those industries that account for 1.5 percent or more of total employment during the 1981–91 period. Variances and covariances are also shown.

Heavy construction is at the top of this list. Although direct downstream employment in refineries and chemical plants is relatively stable, related heavy construction adds strongly to portfolio variance in Houston. Other construction jobs tied to putting up buildings, such as general contractors and special trade contractors, are also represented among industries with a large beta value. Upstream volatility is reflected in large beta values for several industries: oil and gas mining, fabricated metals and machinery. Industries with a beta value less than 1 include such basic services as retail, health and auto dealers and gasoline stations.

Figure 4 shows overall portfolio variance for both Houston and Dallas from 1970 to 1991. The overall picture again shows Houston as less diversified than Dallas, in the sense that Houston's portfolio variance is much larger. There is no

trend toward the portfolio variance becoming more stable in Houston in recent years. Among industries with the largest betas in Dallas are building construction—building material, lumber, general and special trade contractors—and machinery. Oil and gas mining and heavy construction (mostly road and infrastructure construction in Dallas, not petrochemicals) have beta values less than 1.

HOUSTON AND ECONOMIC DIVERSITY—SOME CONCLUSIONS

If diversity is desirable or necessary for the Houston economy, our results are disappointing. The role of the oil industry is reduced in Houston but probably by much less than is popularly believed. Construction of downstream petrochemical plants led to the return of oil-related jobs in the late 1980s, and a volatile heavy construction industry replaced variable oil services and machinery. The share of energy employment in Houston's export base rose to 59 percent by 1991, only 3 percent less than in 1981. Houston's economy has made no recent progress in becoming more like the national economy, and its industrial portfolio is now no more diversified than it was in 1986 and is as risky as ever.

If these results are disappointing, they should not be surprising. The 1987–91 period of economic recovery marked Houston's best opportunity to diversify its economy. As was discussed in the May 1991 and April 1992 issues of *Houston Business*, the city's recovery stemmed from traditional and distinctive Houston institutions and was not a remaking of the city along the lines of some national model.

Growth after 1987 came partly from stabilization of the upstream oil industry and the consolidation of many headquarters operations into Houston. These new oil headquarters developed extensive backward linkages into the city's legal, financial, accounting, consulting, engineering and other white-collar professions. Probably the most important growth came from a global boom in the construction of petrochemical facilities. The Texas Gulf Coast shared in this expansion, with $8 billion in announced construction. Houston also provided the rest of the world much of the engineering and construction expertise for this petrochemical boom, through such local companies as M.W. Kellogg, CRSS, Brown & Root and Fluor Daniel. Significant local growth resulted from the 1984 decision to build the space station, adding a huge new project to the Johnson Space Center's ongoing space shuttle operations. And the Texas Medical Center provided thousands of new jobs, both through direct employment and through $1.4 billion in new construction between 1986 and 1991.

In summary, growth from 1987 to 1991 came from oil upstream, oil downstream, the Texas Medical Center and the Johnson Space Center—the same four growth centers that have defined the Houston economy for decades. However disappointing this may be for those who sought an alternative and more diversified economic model for Houston, this search for new local industry may underestimate the basic strength of Houston's traditional economic base. Houston is an engineering city: upstream and downstream oil, heavy construction and the Johnson Space Center. Even the Medical Center's role in biology is analogous to that of engineering relative to the physical sciences. Powerful economies of agglomeration and localization bind these industries to Houston. Ironically, as Houston's focus in recent years has shifted to diversity, the work of academics such as Paul Krugman and Michael E. Porter has spotlighted the development of special industrial niches, much like Houston's four growth centers, as the keys to growth in a global market.

A lack of diversification does not imply a failure to innovate. Even if Houston remained within its traditional industrial framework, it sought new paths to profit and regional growth. New or growing areas in Houston such as applied software, environmental controls and cogeneration continue to fit the historical mold of engineering for energy, machinery and construction industries. As an engineering center, Houston's businesses face new and practical problems every day; the city builds new business on solutions to these problems. Furthermore, Houston—far more than other Texas cities—takes these solutions and markets them around the world. Houston could not have recovered from the oil bust without innovative new products and new markets for local business.

NOTE: Jun Ishii, an economics student at Rice University, contributed to this article.

Results of the Houston Beige Book survey, conducted in early June, continue to be consistent with slow growth in the city. The good news is a continued rebound in commodity chemical markets and a return of oil prices to $20 per barrel. Both point to better times ahead for Houston, with a possible revival of chemical construction and stronger drilling directed toward oil in overseas markets.

RETAIL AND AUTOMOBILE SALES

Area retailers report that May was a slow month by area retailers, with conditions only slightly improved in early June. Storewide plans are being met, and inventories are clearing out, but Houston retailing remains highly competitive and price-sensitive. Auto sales in April and May match those for the same period in 1993, as do the sales results for the first five months of the year.

ENERGY PRICES AND ACTIVITY

Oil prices on the futures market fell as low as $14.05 on March 28, but by mid-June they had moved back over $20 per barrel. Higher oil prices are a response to several factors: civil war in Yemen, turmoil in Nigeria, fear of military action in Korea, and broader signs of economic recovery throughout the industrialized world. Local analysts remain divided over the ability of stronger global economic expansion to hold oil prices at recent higher levels.

Natural gas prices slipped under $2 per thousand cubic feet in mid-May, largely on the basis of no seasonal demand for heating or cooling. Industrial and local distribution companies took advantage of low prices to refill storage facilities depleted during the cold winter. Hot weather and rising electric generation in the eastern United States pushed prices back over $2 by mid-June.

Drilling activity has not staged a strong seasonal upturn; the rig count has stayed mostly between 700 and 750 since April. Natural gas drilling continues to drive the number of working rigs, and drilling activity remains at levels well ahead of last year. Drilling activity in the Gulf of Mexico remains strong, but an oversupply of rigs and other equipment has pushed down utilization rates and depressed day rates. Drilling outside the United States and Canada remains slow.

CHEMICALS AND REFINING

The regional chemical industry continues the strong rebound that began early in 1994. The styrene chain, especially polystyrene, is leading the recovery with strong demand and large price increases. The European market for petrochemicals has tightened significantly in recent weeks, helping Gulf Coast producers. The Asian market is not as tight and has resisted some recent price increases. On the whole, however, respondents report good volume, good prices and good profits.

Product demand is strong for refiners and is rising seasonally with the summer driving season. Strong demand, however, has translated only into moderate price increases for gasoline, while the price of crude oil has pushed sharply higher. One result is the disappearance of the strong margins enjoyed by the industry over the winter and a return to the pattern of weak profits seen over the past two summers.

REAL ESTATE

Office space remains the weakest real estate market in Houston, and downtown is still the weakest part of the office market. The industrial market continues to improve, with the first quarter of 1994 marking the third consecutive quarter of strong results. High quality bulk warehouse space is in short supply at present.

Apartment rents and occupancy are flat, but they remain at high levels. About 4,500 new apartment units may be built this year, and new units continue to lease well. Existing home sales in Houston continue at rates 10 percent ahead of last year, despite higher interest rates. Starter homes, and other homes in lower price ranges, are selling best.

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