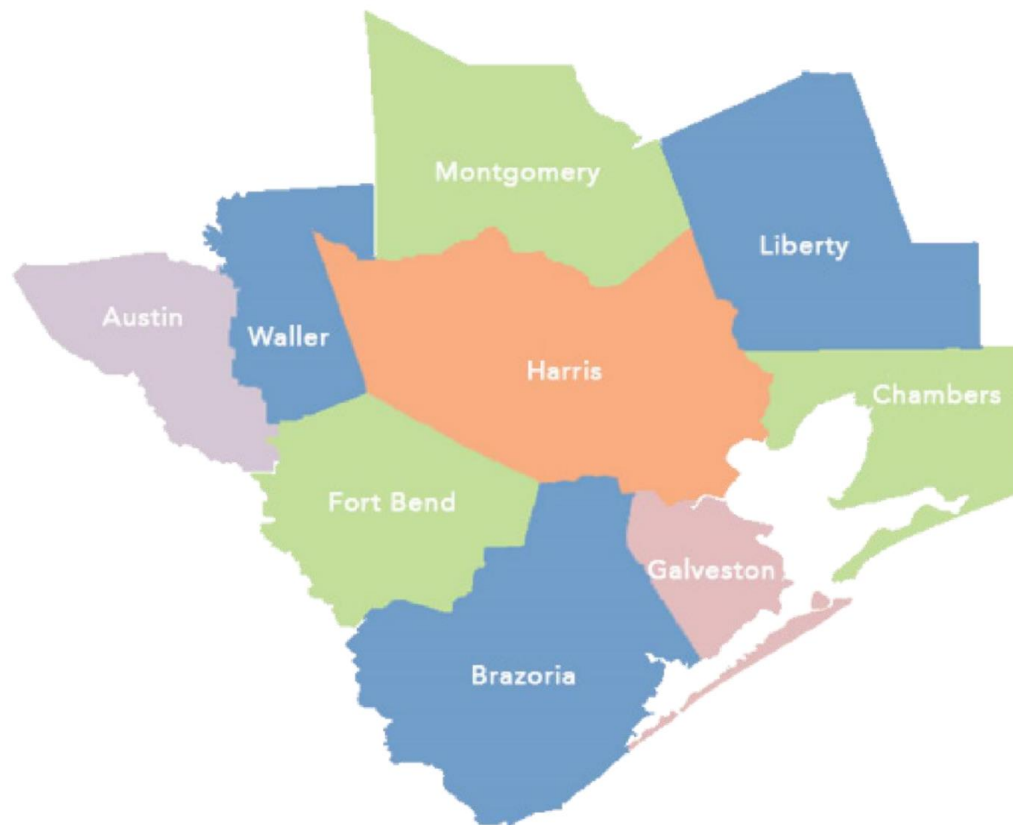


Jobs Matter:

An Economic Analysis of The Houston-The Woodlands-Sugar Land, Texas MSA

Urban and Regional Economic Development

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Introduction

The importance of employment to an individual can hardly be overstated. Beyond a source of revenue that enables sustenance and shelter, many Americans invest a significant amount of their time, energy, and sense of self into their work. On a larger scale, examining work is integral to exploring aids and deterrents to urban development. In analyzing the development of Houston, an expanding metropolitan area of approximately 6.9 million people, we find that not only do people matter, but that jobs matter very much to people. This report will begin by providing a broad perspective of Houston's economy through infrastructure, output, and innovation. From there we will explore recent fluctuations in employment and unemployment. We will then delve deeper into the underlying industry trends, specifically regarding employment and wages, to present a thorough overview of the successes and unmet challenges of Houston's economic landscape.

Economic Standing and Infrastructure

The saying "Everything is bigger in Texas," certainly holds true for Houston's economy. The Houston MSA boasts many top national and global titles in recent years:

- 1st in US waterborne tonnage
- 1st in US imports
- 1st in US exports
- One of the largest petrochemical complexes in the world in Port Houston
- The largest medical complex in the world at the Texas Medical Center

The Houston MSA benefits from Port Houston, with 25 coastal miles of public facilities and private industrial companies connected through a 52-mile channel and a series of bays to the Gulf of Mexico. This world-class port is also connected to three Class I railroads and 5,500 road lane miles in Houston. In this deeply interconnected region, companies contract each other's resources and services. Indeed, as the Port Region Alliance states, "one company's waste is another's feedstock" (Port Region Alliance).

Channel-related businesses generate over one million Texas jobs and \$4.5B in local taxes. Growth is only accelerating through modernizing investments. For instance, recent installations of ship-to-shore cranes from South Korea are twice as fast than existing cranes in Port Houston's Barbour's Cut Terminal, which will result in increased loading and shipping capacity in the channel (Houston Economy at a Glance).

Houston's Export-Oriented Economy

The Houston MSA exported \$95.8B in goods in 2017- the highest of any MSA in the nation - and was ahead of New York (\$93.7B), Los Angeles (\$63.8B), Seattle (\$59B) and Chicago (\$46B). In total, Houston exports account for 6.2% of all US exports. However, because the Texas Triangle is so productive, Houston ranked just 20th nationally in the share of MSA to total state exports (TSA Export).

Top Houston MSA Exports in 2017	Amount
Chemical Manufacturing	\$ 26,630,760,925
Petroleum and Coal Products Manufacturing	\$ 26,534,278,465
Oil and Gas Extraction	\$ 17,934,118,254
Machinery Manufacturing	\$ 5,895,911,368
Computer and Electronic Product Manufacturing	\$ 5,751,196,546

Table 1: US International Trade Administration, 2017

The top Houston exports in 2017 were in advanced industries such as energy, manufacturing and electronics, as shown in Table 1. In fact, the Houston MSA ranked first in advanced industrial output in 2015 at \$160B (Brookings Advanced Industries).

Houston's GDP grew by an average of \$15B annually since 2010. However, this trend reversed in 2015 when the Houston MSA decreased by approximately \$16B in Real GDP following a downturn in the oil sector. Having since recovered from the economic downturn, the Houston macroeconomy is now leveling out. In 2017, as Real GDP in the US increased by 2.1% across the board, the Houston MSA was the only large population MSA (over 2M residents) to remain flat at \$436,369B (BEA GDP). While this may be alarming as a one-year snapshot, it is an improvement over the previous years and suggests the region is recovering.

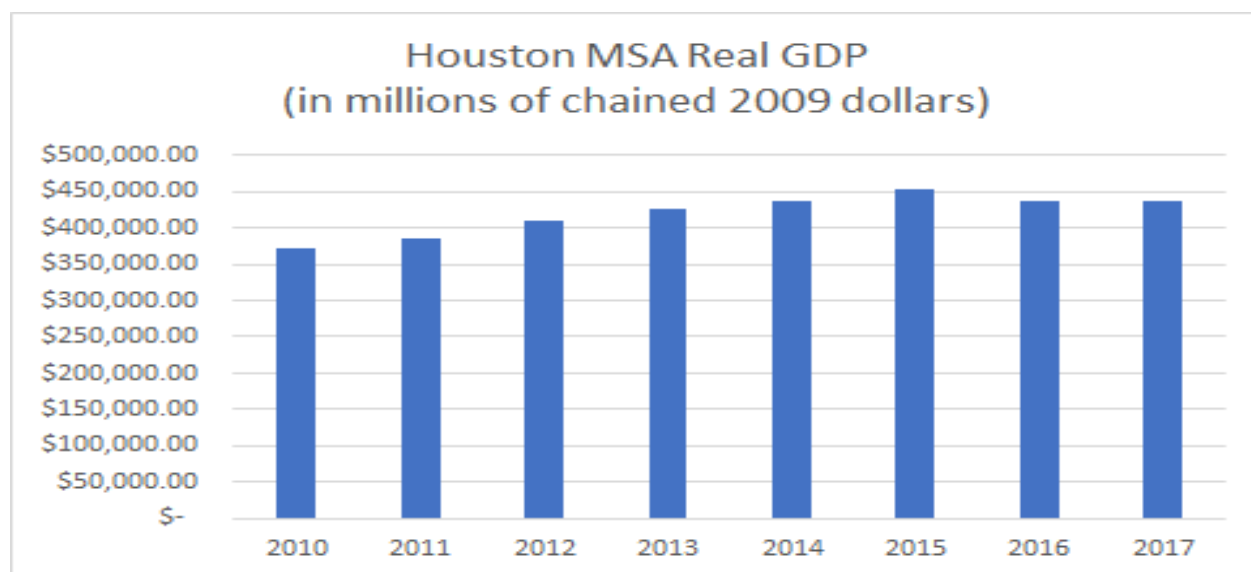


Figure 1: US Department of Commerce, Bureau of Economic Analysis, 2017

The Impact of Oil in Houston:

As we saw in the 2015 economic downturn in Houston, oil and, increasingly, the broader energy sector, plays an outsize role in the Houston economy. While Houston first became an oil city due to bountiful oil fields, oil production is a distant relic of Houston's past, with the Houston MSA accounting for only 0.8% of the oil production in the State of Texas in 2016. Rather, the region is now the technical and innovation hub of the global energy industry, with Houston home to the headquarters of numerous energy companies including ConocoPhillips, Marathon Oil, and Occidental Petroleum.

The oil industry has a highly integrated supply chain involving upstream (resource extraction and equipment), midstream (transportation and pipeline construction) and downstream (refining and petrochemical) sectors. Employing over 175,000 workers directly in the aforementioned sectors, the energy sector is a dominant force in Houston. In addition to these workers, there are thousands more employees that support these sectors through interconnected industries and the relatively long supply chains associated with the energy sector (Forbes – Houston Oil Sector).

Concentration of Oil-Related Occupations in Houston in 2017

Occupation	Concentration Ratio	Number of Workers	Metro Rank by No. of Worker
Petroleum Engineer	16.65	10,950	#1
Geoscientist	8.81	5,170	#1
Geological and Petro Tech	8.29	2,520	#1
Chemical Engineer	7.5	5,170	#1
Health/Safety Engineer	2.87	1,540	#1
Cartographer	1.91	460	#2
Mech. Draftsman	1.75	2,090	#2
Chemist	1.41	2,450	#3
Buyer/Purchasing Agent	1.34	11,360	#3
Logistician	1.34	4,380	#4
Mechanical Engineer	1.26	7,530	#4
Cost Estimator	1.22	5,280	#3

Note: Concentration ratio is the share of a local occupation in total employment divided by the occupation's share in the nation.

Source: Bureau of Labor Statistics, *Occupational Statistics*

Table 2: BLS Occupational Statistics via Forbes - Houston Oil Sector

Houston is likely to remain the energy industry leader for years to come given not only strong fixed infrastructure with a vast refinery and transit network, but also a high concentration of skilled labor in the Houston MSA. Many of the positions supporting the oil industry, like petroleum engineers, are highly specialized positions held by few individuals. Although the job counts for these positions are low, their concentration and integral nature to the oil industry suggest these jobs are unlikely to leave Houston anytime soon.

Patents

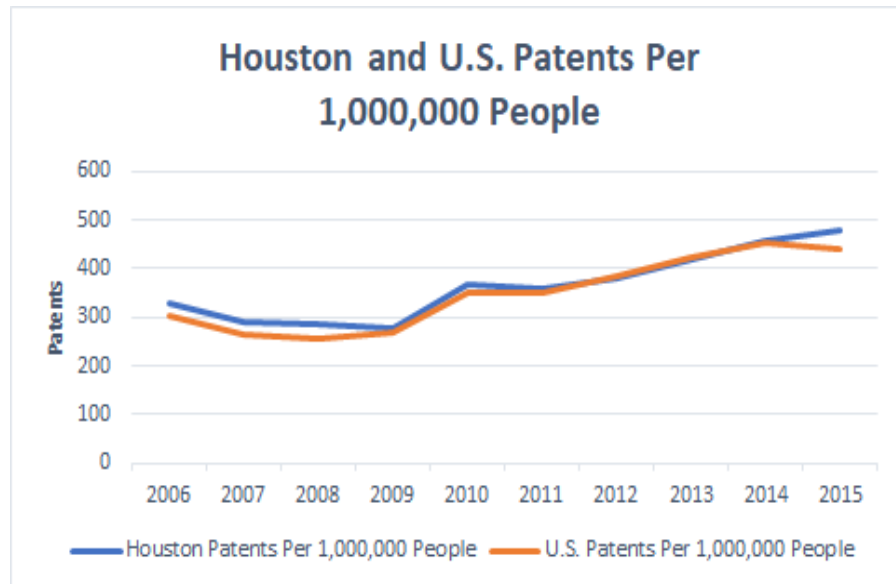


Figure 2: United State Patent and Trademark Office, 2006-2015

While infrastructure, GDP, and exports provide a general sense of a metropolitan area's economic health, the best proxy for innovation is likely patents. In 2015, the Houston MSA was home to 3,186 patent licenses, and boasted a higher number of patents per capita compared to the national average. For the last ten years, Houston has followed a similar trajectory to the United States in nominal patent growth (Figure 2). Patents per year fell locally and nationally during the Great

Recession, rebounding in 2009, and have increased steadily since.

The concentration of the energy sector is mirrored in the high concentration of energy patents in Houston. In 2015, 8 out of the 10 companies with the most patents were related to the energy sector through patents in oil, plastics, and drilling. Only the University of Texas and Hewlett-Packard Development Company broke the top 10 list with patents predominantly in medicine and technology respectively (USPTO). As can be seen from Figure 3, the number of patents for wells/deep boring almost doubled from 324 to 622 for Houston from 2006-2015. Given existing strength in oil infrastructure, concentration of workers, and continued research and development evident by the high share of energy-related patents, Houston is poised to be the leader of the energy sector for years to come.

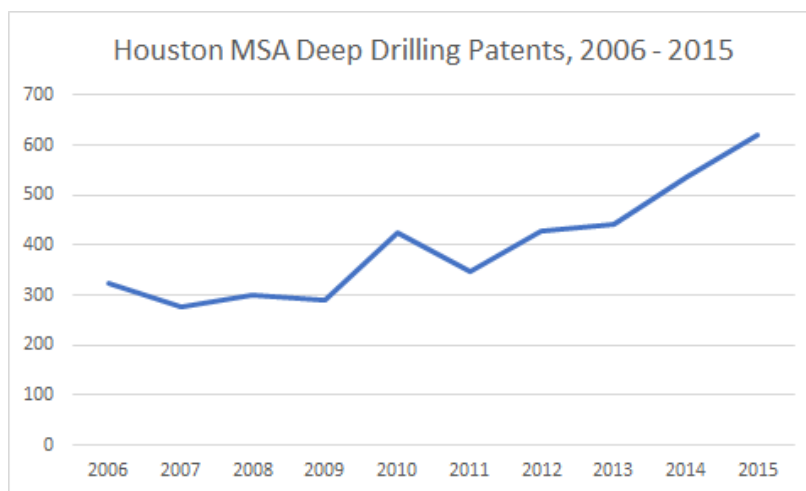


Figure 3: USPTO, 2006 - 2015

However, it is critical to note that the Houston economy is continuing to diversify and that critical research and development are being conducted in other sectors including medical innovations at the Texas Medical Center and new technologies at HP.

Top 10 Houston Corporation by Number of Patents

Houston Corporation	2015 Patents
Baker Hughes	359
Halliburton	209
Schlumberger Technology	181
HP	139
DOW Global Technologies	100
ExxonMobil Chemical Patents	89
Shell Oil	79
University of Texas	44
Smith International	44
Weatherford/Lamb Inc	10

Table 3: USPTO, 2015

The patent data suggest that innovation looks different in Houston compared to most MSAs. Houston has a relatively high per-capita GDP like other relatively high-patent MSAs like San Jose, Austin, and New York. However, for most U.S. cities, patents are driven by STEM-education, either by STEM-educated workers or renowned research institutes in science, technology, and engineering (Brookings – Patents). As of 2013, Houston ranked 23rd in number of STEM-graduate programs and 81st for employees with a bachelor's degree in STEM—only 11.1% of the labor force (Brookings – Patents). It seems that Houston modernizes on its own terms, managing to rely on a strong energy cluster to thrive and ultimately set the MSA apart.

Forces in the Houston Economy: Domestic Subsidies and International Trade

Domestic Subsidies

Today, states across the nation are actively competing to recruit domestic corporate relocations through local and state benefits packages. The state of Texas has offered \$7.9B in subsidies to companies since 1988, encouraged by Governor Rick Perry's Texas Enterprise Fund and the company TexasOne. Texas targets California companies, in particular, and it is the third largest importer of companies from the Golden State (Subsidy Tracker - Good Jobs First).

Location data is limited, but the City of Houston has offered over \$82M in company subsidies since 2004. Compared with the City of Austin's 83 subsidies totaling over \$310M and Dallas' 451 subsidies totaling over \$700M, Houston's packages seem small. This city-level analysis feeds into the narrative that American jurisdictions are competing with each other for jobs—recall that Austin is the most frequented Houstonian relocation MSA and Dallas is the biggest source of new Houston residents.

However, the economic gain from these subsidies and corresponding relocations may be limited, as a recent study using the National Establishment Time Series (NETS) found that job relocations accounted for 28,375 net Texan jobs gained, or just 0.03% job growth from 2003-09 (Good Jobs First – Shell Game). Compare this with the over 600,000 jobs created in the Houston region over the last 6 years.

International Trade & Risks

As the nation's largest exporting MSA, Houston is significantly integrated into the global economy with over \$46B exports to the Americas and over \$25B to both Europe and Asia. Houston also imports over \$20B in goods from each of these regions and has smaller but still significant trade deals with countries in the Middle East and Africa (Global Houston).

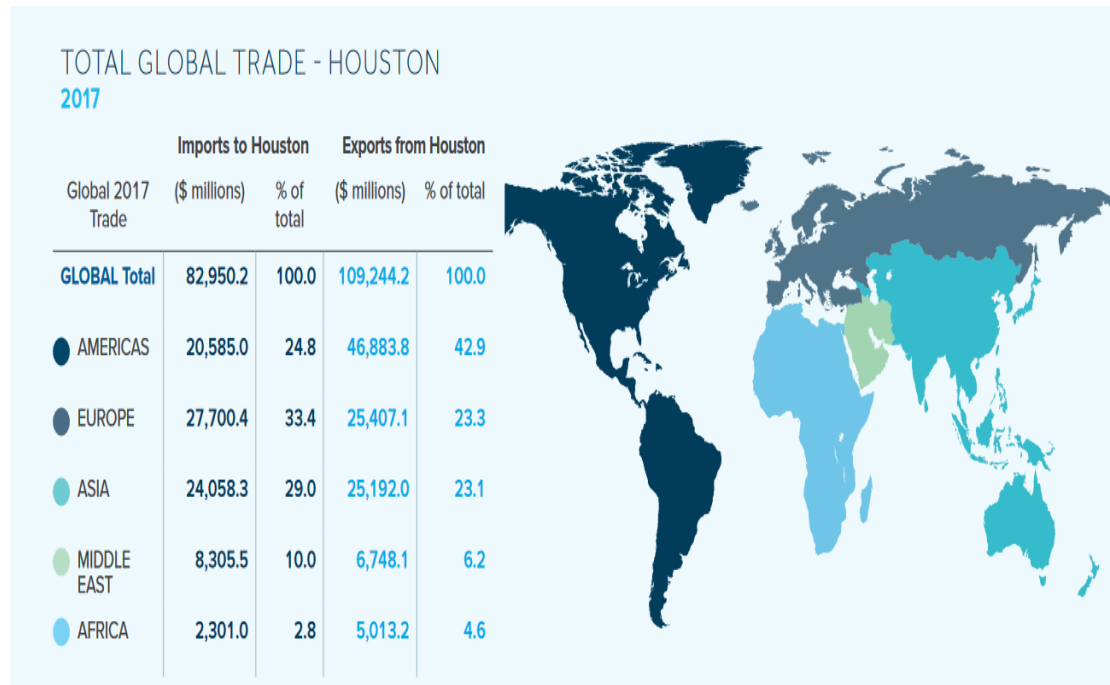


Figure 4: Global Houston, Greater Houston Partnership, 2018

This comes with significant benefits as well as risks, outlined by the Greater Houston Partnership's report, Global Houston. Several global risks to the stability and growth of Houston's economy include:

- A global trade war and changing multi-lateral trade agreements under the Trump Administration
- Changes in patterns of migration flow
- Geopolitical conflict in regions of key import/export partners

Local industries, organizations and governments must keep these risks in mind when making investments into the Greater Houston economy. However, it is clear today that Houston has benefitted immensely from integrating itself into the world economy—and as the world economy grows, so too will Houston (Global Houston).

Employment Growth Despite Economic Downturns

The Houston MSA is characterized by rapid population growth, and employment growth largely mirrors the increasing population. According to the Bureau of Economic Analysis, as of 2016 the Houston MSA labor force consisted of 4,065,842 people.

Houston Employment in Millions, 2010 - 2016

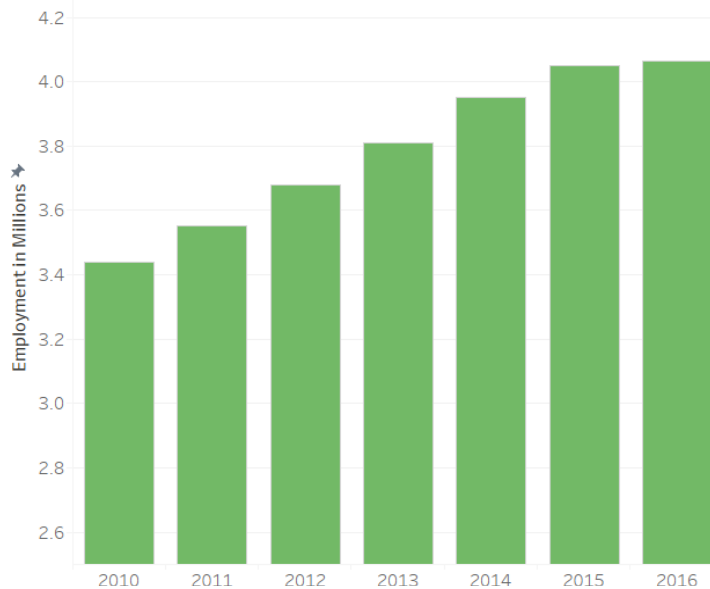


Figure 6: BEA-REIS

Houston Employment % Change, 2010 - 2016

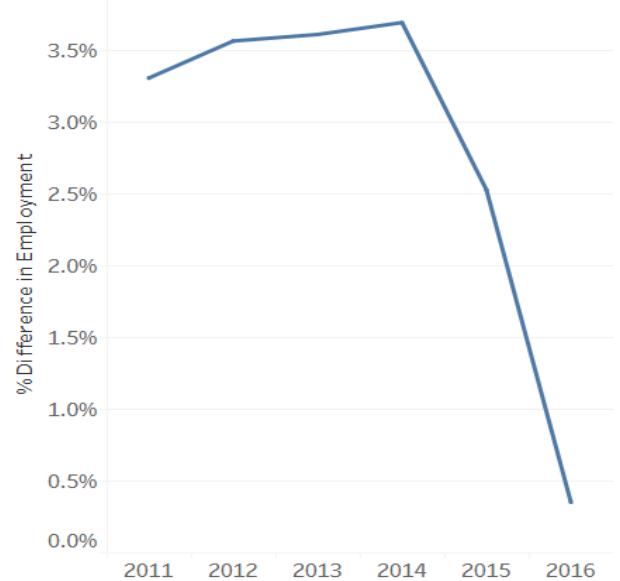


Figure 5: BEA-REIS

To provide context for Figure 5, in 2010, much like the rest of the United States the Houston MSA was still reeling from the Great Recession. While Houston's workforce has gained over 600,000 jobs, growing steadily since 2010, the considerable drop in oil prices exacted a toll on Houston's employment growth in 2015 and 2016. Figure 6 shows Houston's employment growth rate, which hovered above 3% through 2014 before eventually plummeting to 0.35% in 2016 following the bust in oil and gas prices. It is noteworthy that although growth has slowed, employment in the Houston MSA is continuing to increase. In fact, recent reports from the Bureau of Labor Statistics show that Houston's employment has increased throughout 2017, surpassing employment growth for the United States again in late 2017 (BEA-REIS 2017).

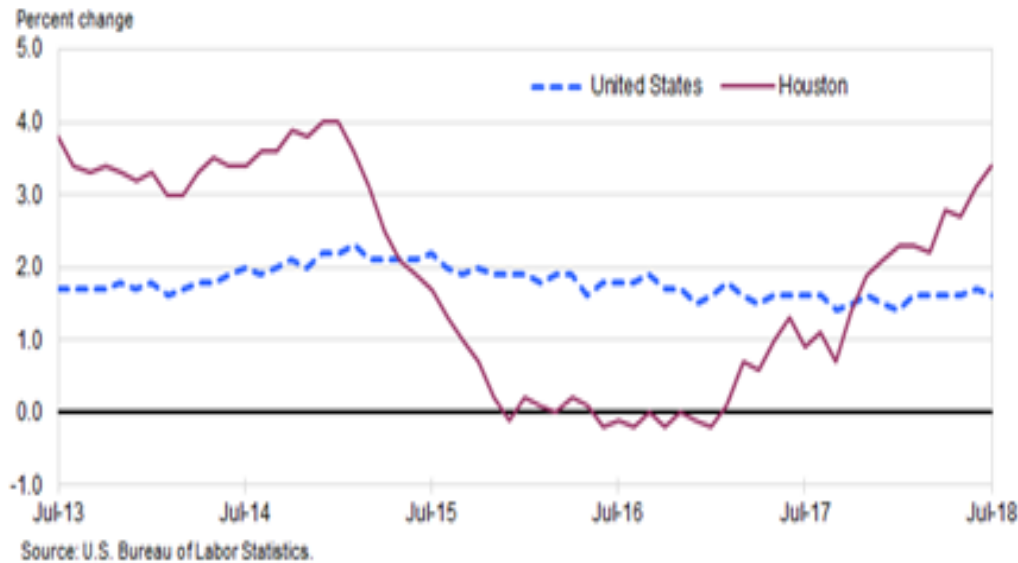


Figure 7: BLS Houston Area Employment

While, any economy dominated by one sector will naturally see cyclical variations (Figure 7) it appears that Houston has managed to diversify employment industries enough to provide some insulation against the boom and bust cycle. The loss of 74,000 oil-related jobs between 2014 and 2016 in Houston-The Woodlands-Sugarland was mitigated largely by the continuous growth in the United States (Forbes - “How Houston Survived”). Buoyed by companies with national scope such as United Airlines, AIG, Sysco, and Waste Management, the economy of the Houston MSA was further sustained by the remaining boom years’ local momentum. Lastly, the Houston MSA’s petrochemical construction industry, because of its reliance on oil as a production input, was able to flourish with dropping oil prices and further keep employment growth afloat (Forbes). While it is unlikely that Houston’s economy will ever be completely immune to the inherent fluctuations of its prominent energy industry, enhanced sector diversification has proved pivotal in ensuring continuous growth.

Unemployment

The Houston MSA’s unemployment rate follows an inverse trajectory to employment growth. Figure 8 illustrates that during the Great Recession unemployment peaked at 8.3% and left 245,000 people in the Houston MSA labor force out of work. Following the recession, the unemployment rate dropping steadily to 4.6%. The oil downturn (’15-’16) generated a spike in the unemployment rate to 5.3% in 2016 until the economy began to recover the next year. As of August 2018, the Houston MSA unemployment rate had fallen to 4.3%, just slightly above the national average of 3.9%, with approximately 165,000 unemployed Houstonians in the labor force.

While there is an obvious relationship between employment growth and unemployment trends, there are additional complicating factors to consider in analyzing the Houston MSA's aggregate unemployment. Despite enjoying relative economic prosperity compared to the United States, the Houston MSA has a below-average labor force participation rate compared to other large metropolitan areas (Table 4). As of 2018, only 66% of Houstonians over the age of 16 are either working or actively looking for work. It's possible that two significant economic downturns in the past ten years have discouraged workers and driven them to leave the labor force. It is highly likely that tumultuous economic conditions of the last decade have affected labor force participation, but another possible explanation may lie in Houston's demographic profile.

Houston Unemployment Rate, 2010 - 2018

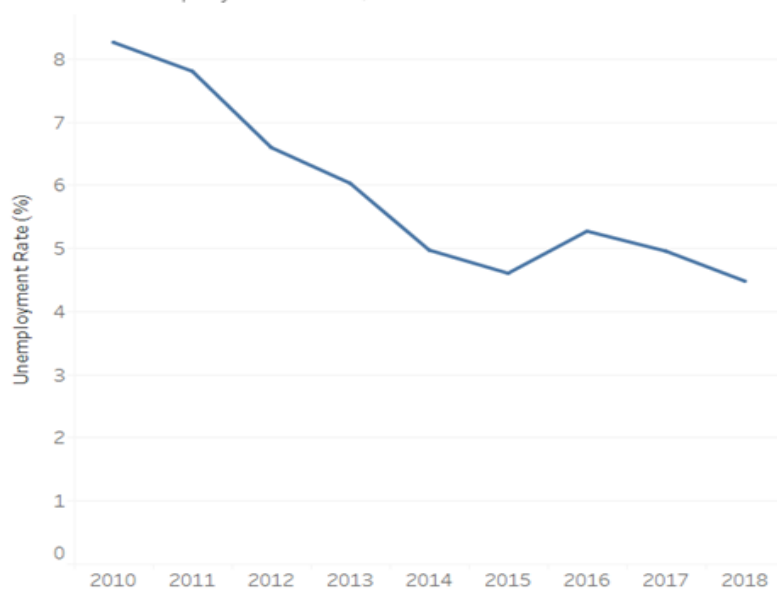


Figure 8: BLS - QCEW Unemployment Rate, 2010 - 2018

MAJOR METRO LABOR FORCE PARTICIPATION RATE*

Metro	Rate	Metro	Rate
Minneapolis	72.0	San Diego	66.3
Washington	71.8	Houston	66.0
Denver	71.2	Los Angeles	64.8
Boston	69.0	New York	64.6
Dallas-Fort Worth	68.4	Philadelphia	64.2
Seattle	68.4	Phoenix	62.8
San Francisco	67.6	Detroit	62.3
Atlanta	67.4	Riverside	60.2
Baltimore	66.9	Large Metro Avg.*	66.7
Chicago	66.6	U.S. Average	63.2

* excludes retirement destinations Miami and Tampa

Source: U.S. Census Bureau, 2017 American Community Survey

Table 4: Greater Houston Partnership Economy at a Glance

native Texans. Alternatively, it's possible that Houston's economic prosperity has not only made having children more affordable but has also broadened possibility for the luxury of single-income families.

Another demographic consideration that could explain Houston's relatively low labor force participation is educational attainment. Educated workers are more likely to participate in the workforce than their lesser educated counterparts. The CBO estimates the difference in U.S. labor force participation for men ages 25-54 without a college education is 9% lower than college

According to the Congressional Budget Office, there are numerous demographic characteristics that will decrease one's likelihood of participating in the labor force. For example, parents are less likely to engage in work if they are raising children, which may be impacting labor force participation rates for the Houston MSA (Congressional Budget Office). Houston benefits from high birth rates and a relatively young population compared to the United States; as such, some parents may be opting out of employment for child rearing. This may be due to Houston's relatively high incidence of immigrants, who are more likely to raise families than

graduates as of 2017. As seen in Figure 9, the labor force participation rate for men without a high school diploma is even lower, averaging below 80% in the United States for 2017 (Congressional Budget Office).

While about one in three Houstonians have at least a bachelor's degree (similar to national levels), Houstonians are more likely to have a high school diploma or less (about 50%) compared to the United States average of 40% (American Community Survey, 2012-2016). Though the relative devaluation of education in Houston is largely due to the prominence of industrial employment in energy, manufacturing, and construction, members of this less-educated cohort in Houston's labor force were most likely to be affected by the recent oil downturn, possibly to the point of leaving the labor force.

US Labor Force Participation of Men Ages 25-54, by Education

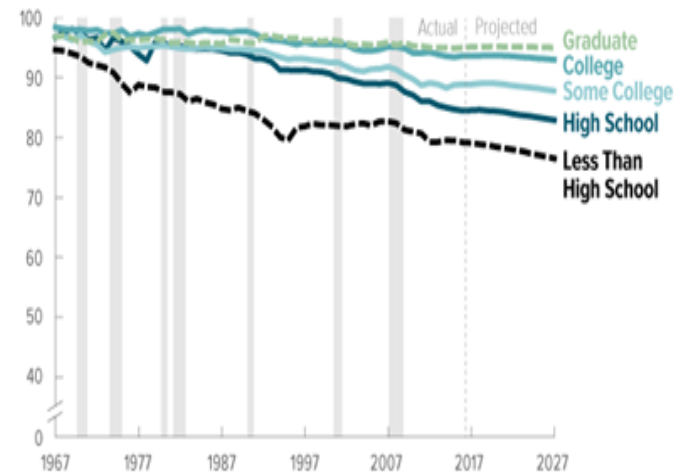


Figure 9: Congressional Budget Office, February 2018

Employment by Sector and Job Growth Across Diverse Industries

Of the 4,065,842 employed workers in the Houston MSA in 2016, 76% were wage and salaried workers and 24% were proprietors, which closely mirrors the national proportions (BEA). The ranking of employment by industry is shown in Table 5. Private industry dominates with 3.77 million Houstonians working in the private sector in 2016, with 610,000 of those jobs created since 2010.

Industry	Jobs in 2016
Health care and social assistance	377,159
Retail trade	376,697
Construction	311,369
Accommodation and food services	303,615
Other services (except government and government enterprises)	255,628
Manufacturing	241,777
Finance and insurance	203,095
Real estate and rental and leasing	184,911
Mining, quarrying, and oil and gas extraction	132,381
Educational services	77,136

Table 5: BEA GDP & Personal Income 2016

Top private employment sectors in 2016 were health care and social assistance, retail trade, construction, and accommodation and food services. This is the same ordering for top national employment sectors, except for construction in third place, which is held nationally by professional, scientific and technical services (BEA). This makes sense, given the significant infrastructure investments being made in the region and the relatively higher population growth in Houston.

2010-2016	National Growth		Industry Mix		Region Shift		Region v. Industry	Total Jobs
Total Employment	Percent	Net	Percent	Net	Percent	Net	Percent	Net
	11.92	409,938	0.6	20,659	5.75	197,500	5.15	628,097

Table 6: Calculations by the Texas Regional Economic Analysis Project (TX-REAP)

For a deeper analysis of local industry employment growth compared to overall national and industry trends from 2010-2016, we use the shift-share analysis in Table 6. This aggregate shift-share tells us that growth in the Houston MSA is 6.35% (region plus industry mix) greater than the 11.92% growth projected by the overall national growth rate. Furthermore, Houston's industries are growing at an average rate of 5.15% faster than those industries nationally.

Using this 2010-2016 shift-share analysis on an industry-by-industry level, we find that many industries in Houston "led" national growth. In some industries, such as management, local government, farm employment and finance, this means Houston gained jobs faster than those industries nationally (REA Shift-Share). For military and federal civilian professions, net jobs were lost, but at a slower rate than the national trend. The next sections on job gains and losses will explore these industry changes in more depth.

Specific Houston Job Gains

Much of the recent job growth in Houston correlates directly to the rapid population growth that has added almost one million residents to the Houston MSA -- people need places to live and work. The biggest job-creating professions were accommodation and food services (76,126), health care and social assistance (68,600), construction (56,048) and retail trade (53,677). Professions which lagged national industry trends include manufacturing and entertainment and recreational

professions, which added 10,044 and 8,401 jobs respectively, at a rate approximately 1% slower than those national industries (REA Shift-Share).

The fastest-growing employment sector in Houston, Management of Companies and Services, has grown from 27,000 employees in 2010 to 49,000 employees in 2016. Unlike other large job creators, management sector growth is not directly correlated to Houston's growing population, but rather to fundamental shifts in the Houston economy.

Jobs Matter – An Economic Analysis of the Houston, Texas MSA

For instance, Mitsubishi Heavy Industries moved their corporate headquarters with 1200 jobs from New York to Houston in 2016 to be closer to their customers. Additionally, Mitsubishi was able to improve bottom line performance due to lower taxes and operating costs resulting from cheaper real estate and operating costs (MHI).

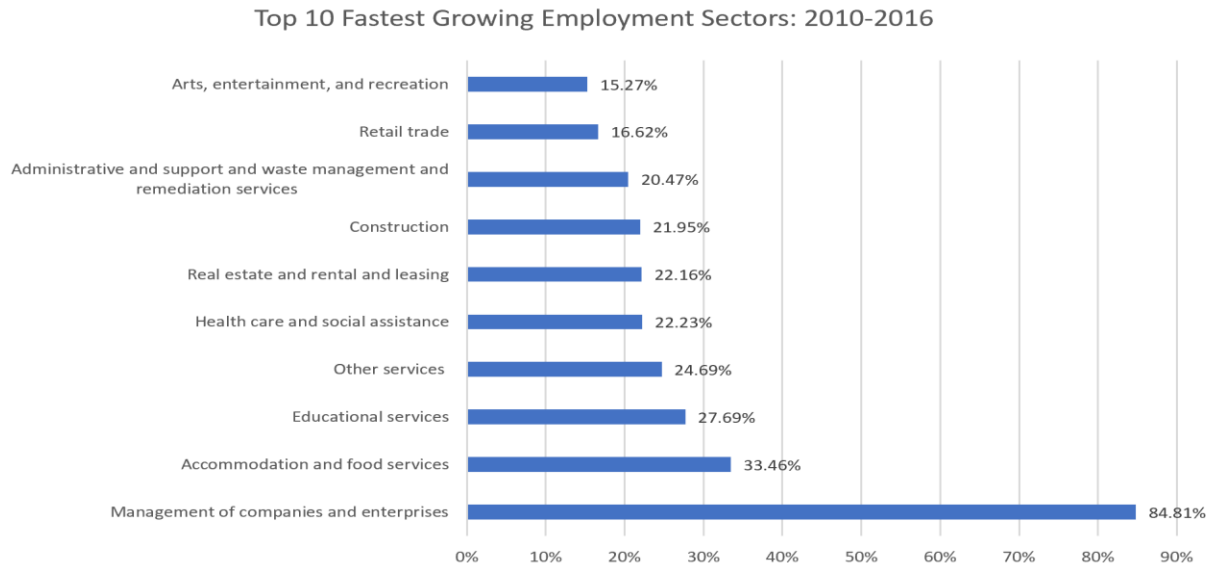


Figure 10: BEA-CA25N 2010-2016

The Greater Houston Partnership (GHP), a private consortium of over 2100 Houston companies, drives economic development by aggressively advocating for pro-business regulations, supporting the formation of new companies, and encouraging existing companies to relocate to Houston. GHP has achieved strong success, with 244 companies opening new offices in Houston in 2015 alone. With the synergy of 21 Fortune 500 companies already headquartered in Houston, a pro-business climate, and a deliberate drive to recruit, support, and incubate new businesses, more companies are likely to move to or open in the Houston market over the coming years (GHP). While energy will likely dominate the Houston economy for years to come, increased diversification of the labor market will allow Houston to better weather cyclical fluctuations

Houston Job Loss

While Houston has seen job growth in 22 of 24 NAICS categories since 2010, Houston lost jobs in the Federal Civilian and Military sectors. As previously mentioned, though, these losses mirror similar losses in these sectors across the nation. Moreover, in numeric terms the loss of military jobs is insignificant with only 191 of 15,244 military jobs lost during this time. The decrease coincides with national Department of Defense trends with an 8.8% decrease in troop counts nationwide over the same time period.

Federal Civilian jobs declined by 2,051 from a high of 30,568 jobs in 2010 – a 6.71% decline, which is slightly higher than the national decline of 5.66%. While there were no drastic changes in the Federal Civilian sector for the Houston MSA, there was a large drop in 2011 and federal jobs have

been marginally increasing every year since. The federal budgetary landscape in 2011 helps to explain these cuts, in 2011 many federal workers nationwide were being offered buyouts and early retirement packages to meet automatic cuts imposed by failed budget negotiations (OPM).

Wages and Quality of Jobs

While we see that the number of jobs in Houston is growing, we now want to analyze whether these are good jobs; that is, if they pay a living wage. According to the MIT living wage calculator, a single working adult in Houston needs to earn \$11.25 to have a living wage of \$23,390 annually. On average, the two largest contributions to living wage requirements are housing (\$8,250) and transportation (\$4,250). While monthly housing costs are relatively low at \$687, transportation costs in the Houston MSA are especially high due to relative lack of reliable public transportation outside of downtown Houston and need for a personal car for commuting. While in other cities, those workers scraping by on minimum wage can rely on a robust public transit network, in Houston, having access to a car is often integral to having access to a job (MIT Living Wage).

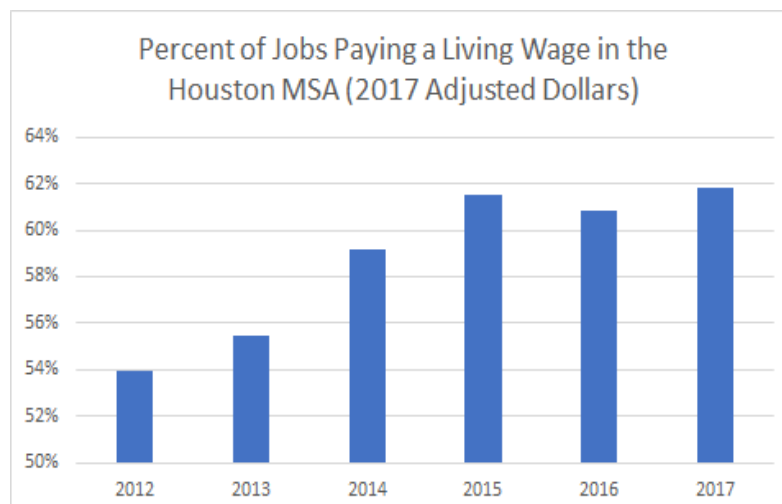


Figure 11: Quarterly Workforce Indicators

As we see in Figure 11, the share of living wage jobs in Houston has increased year over year since 2012 except for the oil downturn in 2016. As the region continues to grow, so does the demand for labor, thus driving wage rates higher. However, while more workers are earning a living wage suitable for an individual, this doesn't take into account family structure in Houston, where a relatively larger share of the population resides in a multi-person household -- 3.35 vs. 2.58 people per household nationally (ACS).

As mentioned previously, though jobs are growing, such growth is predominantly in the lower paid service sectors. While there are some high-paying technical jobs growing rapidly, the relative size of these sectors is small and the educational barriers needed to attain these high paying jobs are significant. Accordingly, even while demand for developers and engineers is high in Houston, this has little impact on the average worker.

2010 Wage	2018 Wage	Rate of Growth	Number of workers (2018)	Sector
\$17,888	\$19,916	11.34%	254,953	Food Service
\$49,816	\$53,612	7.62%	192,086	Administrative and support services
\$48,568	\$51,480	6.00%	156,757	Health care services
\$54,340	\$59,644	9.76%	108,536	Specialty trade contractors
\$79,404	\$87,256	9.89%	97,186	Merchant wholesalers, durable goods
\$61,828	\$67,132	8.58%	84,612	Hospitals
\$24,232	\$25,792	6.44%	66,648	Food and beverage stores
\$23,816	\$26,572	11.57%	59,700	General merchandise stores
\$89,648	\$100,724	12.35%	51,098	Construction of buildings
\$84,708	\$91,208	7.67%	50,996	Heavy and civil engineering

Table 7: BLS QCEW Waages and Waage Growth for 10 Larargest Employment Sectors in Houston

The table above features the top ten employment sectors in Houston; each 2018 industry wage highlighted has an average wage less than \$60,740, the living wage necessary for a family of four (MIT). Although we see a significant share of jobs paying a living wage for an individual, when considering the quality of Houston’s jobs, it seems many may offer incomes barely sufficient to provide for a family.

Conclusion

The economy of Houston is both growing and evolving. While economic growth is often celebrated, positive top-level numbers bely a more nuanced reality on the ground. Yes, there are more jobs in Houston today than there were 10 years ago. However, evaluating the quality of said jobs and more importantly the quality of life these jobs provide tells a far more complex story. With much of Houston’s job growth rooted in low-skilled jobs, relatively low-paying jobs, it is critical that Houston focus not just on top-level job growth but also on equitable job growth. Already, the increasing diversification of the Houston economy is promising, with more industries outside the oil sector lending stability during cyclical downturns and providing new employment and training opportunities for Houston. Houston has much to celebrate in their job market. However, there is still much to be improved upon to make the Houston economy even stronger. Much can be done today to encourage greater labor force participation and invest in training and opportunities to get more Houstonians into better jobs.

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