**Cities data set analysis**

The idea behind our analysis was to observe the growth of tech-related industries versus manufacturing industries in different cities in the US between the years 2007 – 2016. We picked some of the well-established economic giants such as New York city on the east coast, San Francisco on the west coast, Houston in south & Chicago in mid-west. Along with that we were curious to observe trend in some upcoming cities such as Austin in Texas which is traditionally oil driven economy (manufacturing sector) which currently in lime light because of new tech storm in the city. Similarly, Detroit which is traditionally a manufacturing hub and we were curious to see what kind of balance between manufacturing and tech in recent year exists in it. And finally, Boston, an innovation hub, we wanted to see how manufacturing sector is doing compared to Tech.

* The data source for the project is US Gov. Census data:
  + Population of the Cities
  + Payroll, yearly for metro area for the respective cities
  + Establishments (count years) for manufacturing sector and tech sector for the metro are
  + Employment (count years) for manufacturing sector and tech sector for the metro are
* Factors consideration for manufacturing sectors and tech sectors:
  + Data for Manufacturing & Mining, quarrying and oil & gas extractions were grouped together and considered under “manufacturing sector “ for the trend observations
  + Data for Information, and Professional, scientific and technical services were grouped together and considered under “Tech sector “ for the trend observations

**Cities**

* **Austin**

Austin has become one of the most highlighted up and coming cities, as it is attracting a significant amount of start-ups. Interestingly, Austin’s population has been increasing steadily during our dataset timeframe.

Austin's manufacturing sector employment decreased more than 20% between 2007 and 2010, and although it has increased since, in 2016 is still around 15% lower than 2007. Given the population growth, we can conclude that the unemployment rate increased or/and the population found jobs in other sectors. Meanwhile, Austin's manufacturing sector establishments number showed a expansion, with the most growth showed since 2011.Austin's manufacturing sector total payroll decreased significantly, before growing at the fastest rate from all of our manufacturing metrics from 2010 to 2013. Hence, we can conclude conclude that Austin employees’ wages increased significantly.

Austin's tech-related sector employment never contracted; and since 2011, it has increased significantly, leading the sector to have 60% more employment than in 2007. At the same time, tech-related sector’s total payroll increased like in no other analyze city, as it more than double between 2007 and 2016; however, this was partly due to the strong increase in employment in the area.

Comparing both industries, we can see that the behave completely different. Manufacturing’s metrics growth was outpaced by the growth enjoyed by the population, while the tech-related sector metrics enjoyed stronger growth than population, with payroll enjoying the strongest growth (meaning that wages have increased significantly).

* **Boston**

Boston is well-known for being one of the most important technologies hubs on the east coast, which is complemented with its well-renowned universities, but not for its manufacturing sector. In our sample Boston’s manufacturing employment steadily fell down, although payroll (and wages) has increased since 2010. The strong decline in establishments and employment, which has a strong correlation in the manufacturing sector, led us to conclude that Boston’s manufacturing is in decline and should not be expected to increase in the near future.

Boston’s tech-related sector suffered due to the financial crisis but has recovered moderately since 2011. Between 2007 and 2011, tech-related employment decreased by around 5%, however, it has recovered since then and in 2016 recorded a 10% increase in compare to the level of 2007. Interestingly, the number of establishments never recovered, which could mean that more employees are working in each establishment due to the bankruptcy of some companies or the merging of establishments. Meanwhile, total payroll has increased since 2009; nonetheless, it recorded a steeper increase since 2011 (when the employment started to increase again).

* **Chicago**

Chicago is one of the most significant metropolitan areas in the USA (top 3 in GDP size), which contrast with the other Midwest city that we analyze (Detroit). The first thing that we noticed is that Chicago is the second city with the lowest population growth between 2007 and 2016. Meanwhile, the manufacturing sector's employment decline immensely (17.5%) until 2010 and since then it has remained fairly stable. However, manufacturing’s payroll increased moderately since 2009, leading the payroll to be almost the same in 2016 from our starting (2007).

The tech-related sector also suffered until 2011; however, it has shown an increase of more than 10% of employment since then, while payroll has increased by around 25%.  It worth noting that both sectors recorded approximately the same increase in nominal wages during the same period.

* **Detroit**

After enjoying years of tremendous growth, Detroit, the center of the USA’s auto industry, has been negatively affected by changes in the global supply, which led us to analyze how much has been the impact on the local economy.

From all the cities analyzed, Detroit is the only one that experienced a decrease in population, with a 14% decline between 2007 and 2016. Interestingly, employment has recovered completely in the same time period, which led us to conclude that the unemployment rate in manufacturing should be lower than in 2007. During the same 10 years, the total payroll increased by 10%, which shows that employees are earning slightly better than before (the increase is less than 1% compounded).

During the same time period, the tech-related employment did not recover completely, as happened with the rest of the cities. But the total payroll increased more than in manufacturing, meaning that tech-related wages have improved way more than manufacturing in Detroit.

* **Houston:**

Houston has been one of the biggest cities in south and considered to be oil driven economy and as any other metropolitan city, the population has been growing steadily in Houston. Along with being an oil giant, Houston is known as space city, and expected to be doing good in both manufacturing sector and Tech sector.

From our observation, it can be seen that, 2008 recession has hit Houston too and the sudden drop in businesses and jobs in both manufacturing sector and Tech sector can be seen. Right after 2010, the city has been doing equally better in both mechanical and in tech industry and growing.

In the recent years, since year 2015, the pay & establishments in both mechanical sector and the tech sector has been on sharp decline. The reason for this sudden drop in the scope of this project but it assumed that probably lot of businesses have been moving from Houston to upcoming cities such as Austin.

* **New York:**

In New York City, the population has steadily increased over the decade as expected but on the flip side the number of establishments in manufacturing sector has experience the great hit right after year 2008 and plummeted sharply between the year 2008 and 2011 and more so number of jobs. In the manufacturing sector, number of jobs decreased by 20% over the period of 2008 – 2010, after the year 2010 there was some stability observed but manufacturing jobs kept on decreasing. The overall salary scale was maintained right after sudden drop in 2008, but overall manufacturing jobs in New York is observed to be in steady decline.

On the other hand, Tech sector in New York has been doing quite well, the numbers of new companies have been opening at the steady pace and so as employment. Above all, the pay scale in Tech jobs has grown leaps and bounces. Since year 2010 the salary growth in Tech sector has grown by 35%.

* **San Francisco:**

San Francisco has been a Tech hub and cradle of the most computer related companies. The most attractive thing about San Francisco is observed to the pay scale in the Tech companies. The pay scale in Tech has grown by more than 80% between the year 2007-2015, That certainly makes it an accretive place to be I that city for someone working in Tech. However, between the year 2015 – 2016 the growth has not been more than 5%. The tech companies and the tech jobs have also been growing constantly.

In manufacturing sector, right after recession on 2008, market had been going down and establishments, job and salary was going down steadily, but right after year 2015it is observed that the manufacturing sector has been revived, and jobs have been increasing and so as the pay. This increment is assumed to be the by-product of the robotics & hardware advancement in the Silicon Valley. As the tech companies growing in robotics, they probably need more and more hardware and the manufacturing industries have been doing better in recent time.