Boston Economic Analysis: 2000-2018

Koko Xu

Department of Economics, New York University

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Prof. Ahmed Elkhouly

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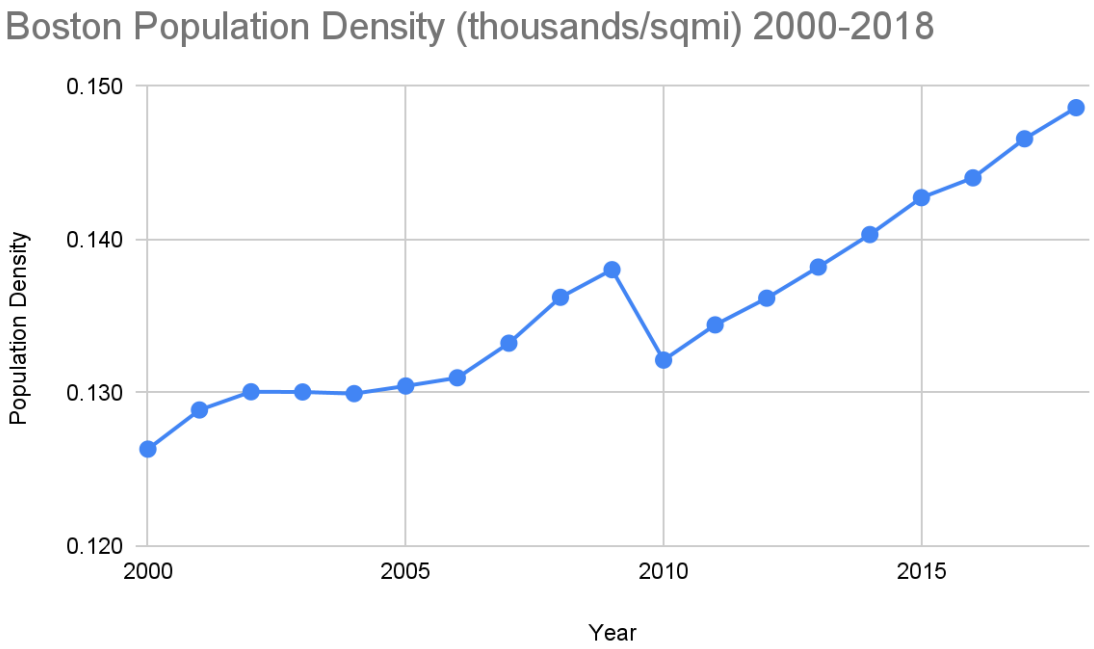
1. Population Density

Year	Population (thousands)	Population Density
2018	694.583	0.149
2017	685.094	0.147
2016	673.184	0.144
2015	667.137	0.143
2014	655.884	0.140
2013	645.966	0.138
2012	636.479	0.136
2011	628.335	0.134
2010	617.594	0.132
2009	645.169	0.138
2008	636.748	0.136
2007	622.748	0.133
2006	612.192	0.131
2005	609.690	0.130
2004	607.367	0.130
2003	607.871	0.130
2002	607.931	0.130
2001	602.380	0.129
2000	590.433	0.126
Land (sqmi)	4674	



A: Population Density is measured by dividing the total number of individuals in a geographic region by the total land area of said geographic region. It is most commonly measured in thousands of people per square mile.

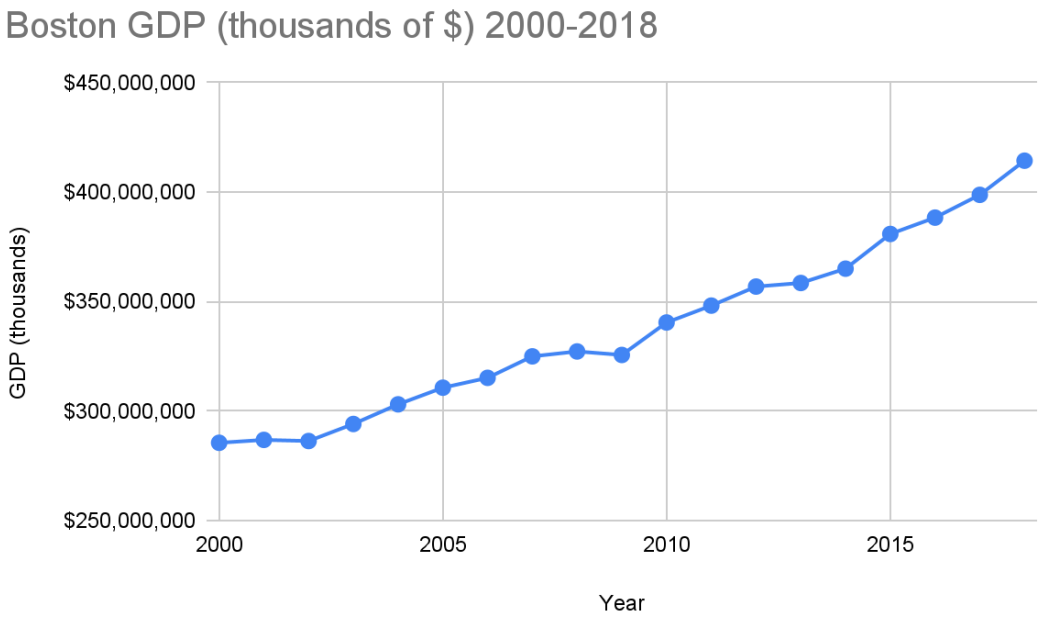
B: Boston's population density increased from 2000-2002, stayed approaximately constant between 2002-2005, increased between 2005-2009, decreased drastically between 2009-2010, and increased steadily from 2010-2018.

C: Since Boston's population density is calculated by dividing Boston's population by Boston's land area, and we know that Boston's land area has stayed constant between 2000 and 2018 at 4674 square miles, we can conclude that Boston's population density is perfectly correlated with Boston's total population. Since Boston population growth should theoretically be in line with US population growth during the same period, the minor increase between 2000 and 2006 in Boston population is not a meaningful increase if we adjust it to overall growth rate.

With that in mind, Boston's lack of population increase between 2000 and 2006 can be attributed to rising average house prices, since Boston's average house price increased steadily during the same period. Similarly, we can see that Boston's average house prices decreased between 2006 and 2009, which corresponded to increase in population density during the period. If housing is cheaper in Boston, more people will live in Boston, and vice versa by law of supply and demand. The dramatic decrease in 2009 can be the aftermath of the 2008 financial crisis, which caused overall economic collapse and employment in Boston to drop from 95.15% to 92.50%. As less people are employed in the city, they cannot afford to live in the city without income, so they move out of Boston. Similarly, as Boston employment climbed back steadily from 2010 to 2018, we saw steady increase in Boston's population density as people returned to the city for work.

2. Gross Domestic Product

Year	GDP (thousands)
2018	$414,346,347
2017	$398,750,645
2016	$388,346,340
2015	$380,880,796
2014	$365,032,742
2013	$358,488,456
2012	$356,854,846
2011	$348,153,680
2010	$340,446,586
2009	$325,615,980
2008	$327,216,743
2007	$324,976,499
2006	$315,164,204
2005	$310,664,832
2004	$303,059,668
2003	$294,087,036
2002	$286,303,896
2001	$286,818,266
2000	$285,492,552



A: Gross Domestic Product is a measurement of the value of all goods and services produced. It is calculated by the formula GDP = private consumption + gross private investment + government investment + government spending + (exports – imports). GDP measures the productivity of a geographic area over a specific time period.

B: Boston's GDP has increased overall between 2000 and 2018. It has seen minor year-over-year declines in 2002 and 2009.

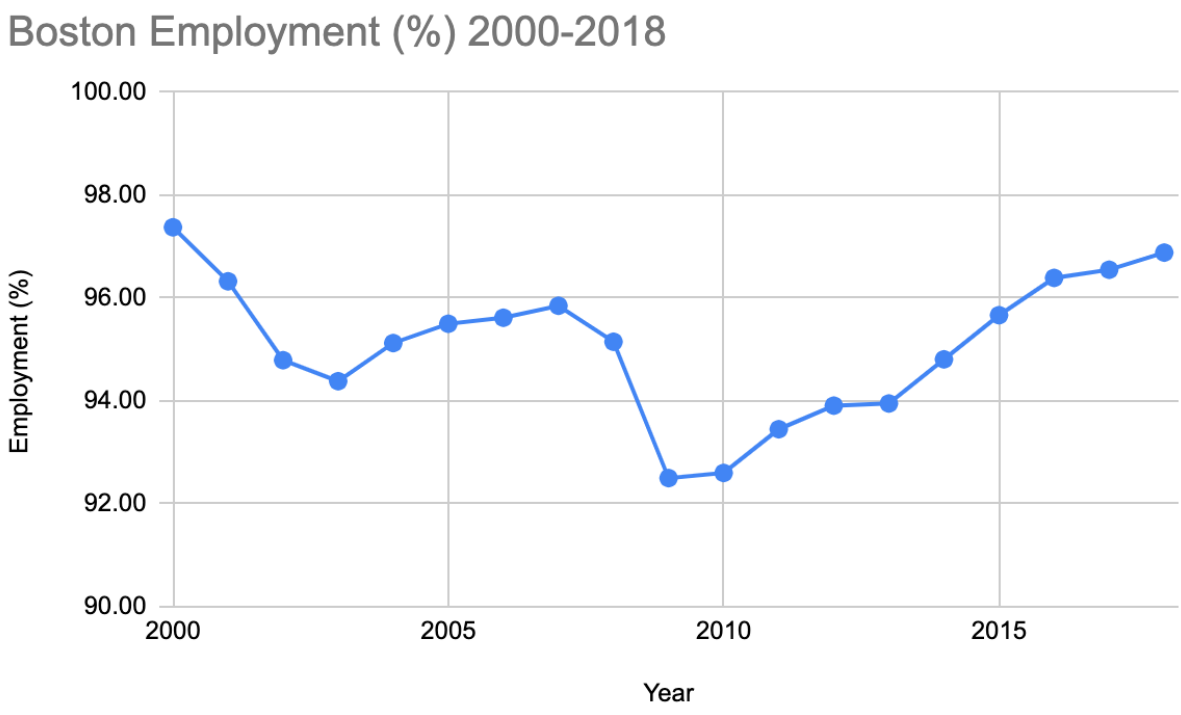
C: Boston has consistently ranked top ten in GDP. Its GDP from 2000 to 2018 has grown steadily for the most part with a few minor drawbacks. As technology continues to advance and population continues to increase, the US economy will grow, and in turn the Boston economy, and thus GDP. That's why there is overall increase in Boston GDP over the period.

There are a few GDP drawbacks to note during 2000-2018, one during 2001 and one during 2009. As we've established before, technology and population are major drivers of GDP. In 2001, the dot-com bubble has just bursted and the market has entered a recession from overconfidence of internet companies. This caused an overall decrease in capital invested in technology-enabled firms, which slowed technological advancements as well as production from internet-based firms. This decrease put a dent in Boston's GDP because Boston is one of the most innovative cities in the US and housed many internet-based firms. A decrease in their production led to a decrease in Boston's GDP.

In 2009, the US economy has just suffered the 2008 subprime mortgage crisis. This caused many people to lose their housing and employment, reflected in the decrease in Boston employment in 2009. Since we've established that population is a major driver of GDP, a decrease in Boston population from people unable to afford city housing caused a decrease in Boston GDP.

3. Employment

Year	Employment (%)
2000	97.38
2001	96.33
2002	94.79
2003	94.38
2004	95.13
2005	95.50
2006	95.62
2007	95.85
2008	95.15
2009	92.50
2010	92.60
2011	93.45
2012	93.91
2013	93.95
2014	94.81
2015	95.67
2016	96.39
2017	96.55
2018	96.88



A: Employment rate is the percentage of a population that is over the age of 16 and employed at a paid job, either by an employer or self-employed, or has stopped looking for work.

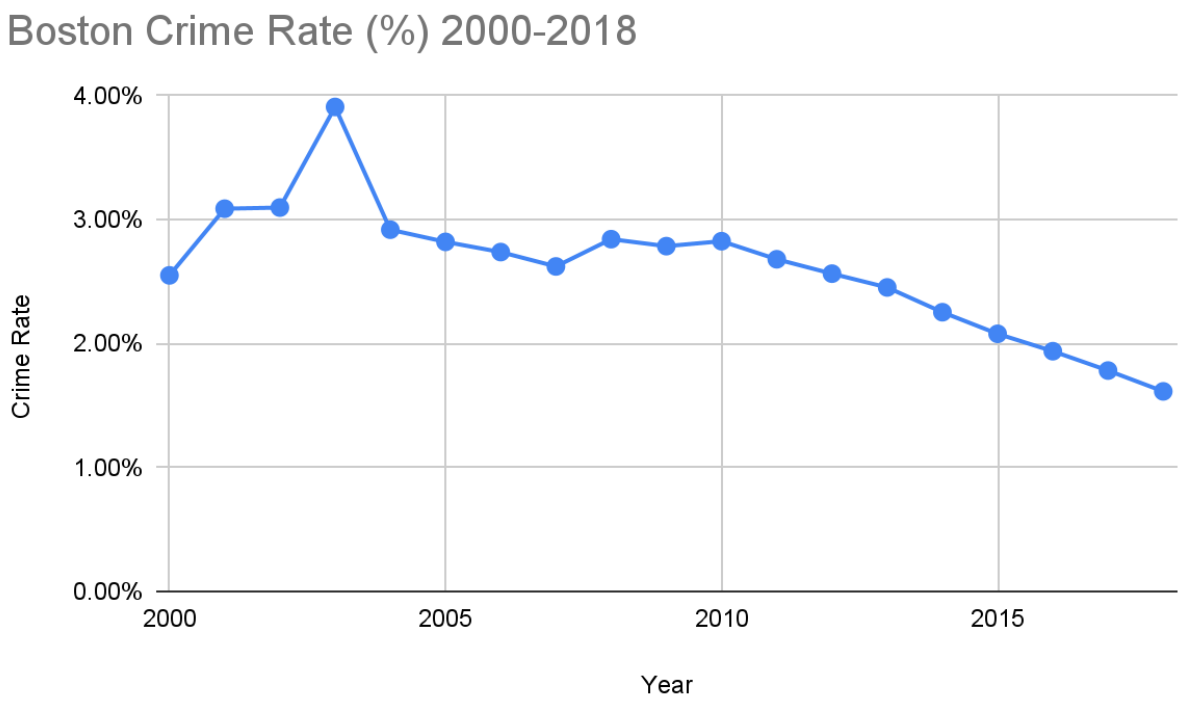
B: Boston's employment rate decreased each year between 2000 and 2003, increased between each year 2003 and 2007, decreased each year between 2007 and 2009, and increased each year between 209 and 2018.

C: Since employment rate is directly correlated with unemployment rate, and unemployment rate is directly related to economic recessions, we can take a look at recent economic recessions to understand Boston's employment rate.

Boston's decrease in employment rate from 2000 to 2003 can be attributed to the aftermath of the dot-com bubble burst that started in 2001. As Boston's internet-based companies suffer the bubble burst, they lay off more employees. From 2003 to 2007 the economy saw recovery from the recession, and so did employment rate. The second recession came in 2007 when the housing market crashed, which was reflected in the employment rate's drastic decrease from 2007 to 2009. When the economy went into the 2008 recession, firms suffered losses and must layoff employees. After the crash, the economy slowly bounced back from post 2009, which resulted in a steady growth of employment rates in Boston as firms were able to hire more employees.

4. Crime Rate

Year	Crime Rate (%)
2018	1.61%
2017	1.78%
2016	1.94%
2015	2.08%
2014	2.25%
2013	2.45%
2012	2.56%
2011	2.68%
2010	2.83%
2009	2.79%
2008	2.84%
2007	2.62%
2006	2.74%
2005	2.82%
2004	2.92%
2003	3.91%
2002	3.10%
2001	3.09%
2000	2.55%



A: Crime rate reflects the number of crimes committed over a given period of time. In this case, it is calculated by dividing the number of crimes committed per 100,000 population by 100,000 and multiplied by 100 to get the percentage crime rate of the Boston Metropolitan Area.

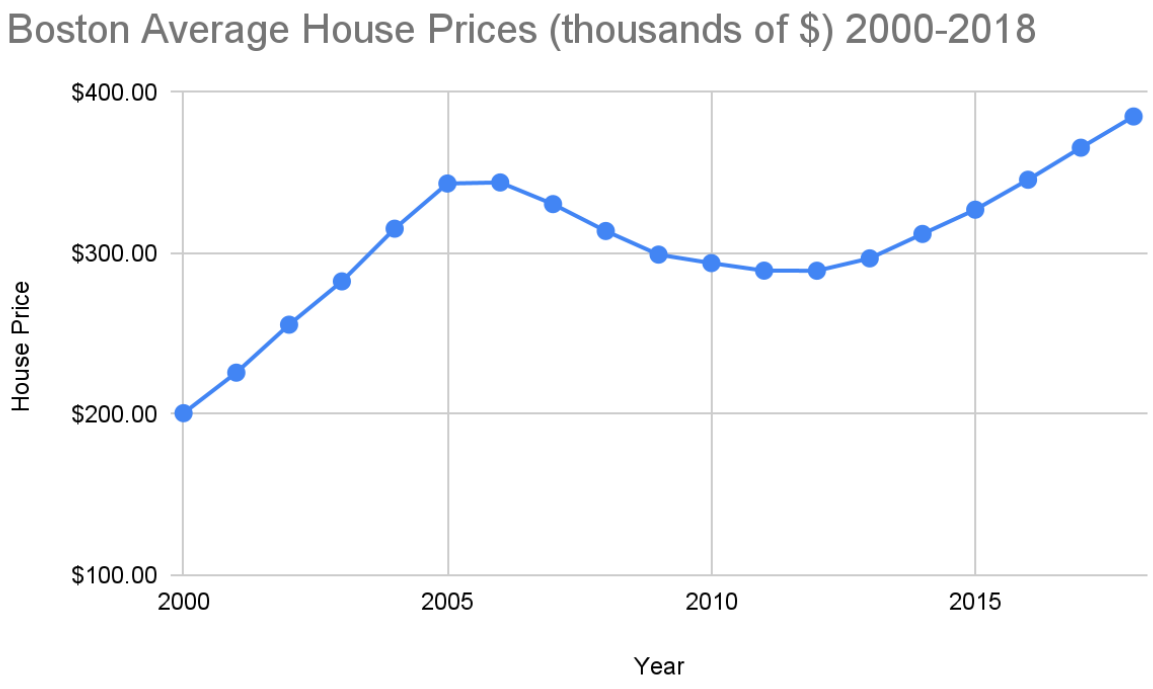
B: Boston's crime rate increased from 2000 to 2003, and steadily decreased from 2003 to 2018 with a minor fluctuation from 2007 to 2010.

C: Some factors that affect crime rate include unemployment rate, access to guns, and population density. Due to lack of historic gun ownership data, I'll be analyzing Boston crime rate mostly from unemployment rate and population density. Generally, crime rates are higher when unemployment rate and population density are high. This can be explained by the Crime Triangle, which states that the three drivers of crimes are the desire of a criminal to commit a crime, target of the criminal's desire, and the opportunity for the crime to be committed. When unemployment is high, criminals have more of a desire to commit a crime for economic gains. When population density is high, criminals have more opportunities to commit crimes.

With this in mind, we can see that while crime rate increased from 2000 to 2003, so did unemployment and population density. Similarly, when unemployment dropped and population density increased from 2003 to 2007, crime rate decreased. During the crime rate fluctuation in 2007 to 2010, the unemployment and population density in Boston fluctuated drastically as well as a result of the financial crisis. After the period, unemployment steadily decreased and population density steadily increased, and we see that crime rate decreased from 2010 to 2018.

5. Average House Prices

Year	House Price (thousands)
2000	$200.65
2001	$225.84
2002	$255.63
2003	$282.54
2004	$315.28
2005	$343.35
2006	$344.01
2007	$330.56
2008	$313.84
2009	$299.18
2010	$293.90
2011	$289.22
2012	$289.16
2013	$296.84
2014	$312.01
2015	$327.09
2016	$345.69
2017	$365.59
2018	$385.00



A: Average house price is the average cost of a house in a geographic region over a time period. It is calculated by taking the average of all real estate transactions in the said geographic region over the said time period.

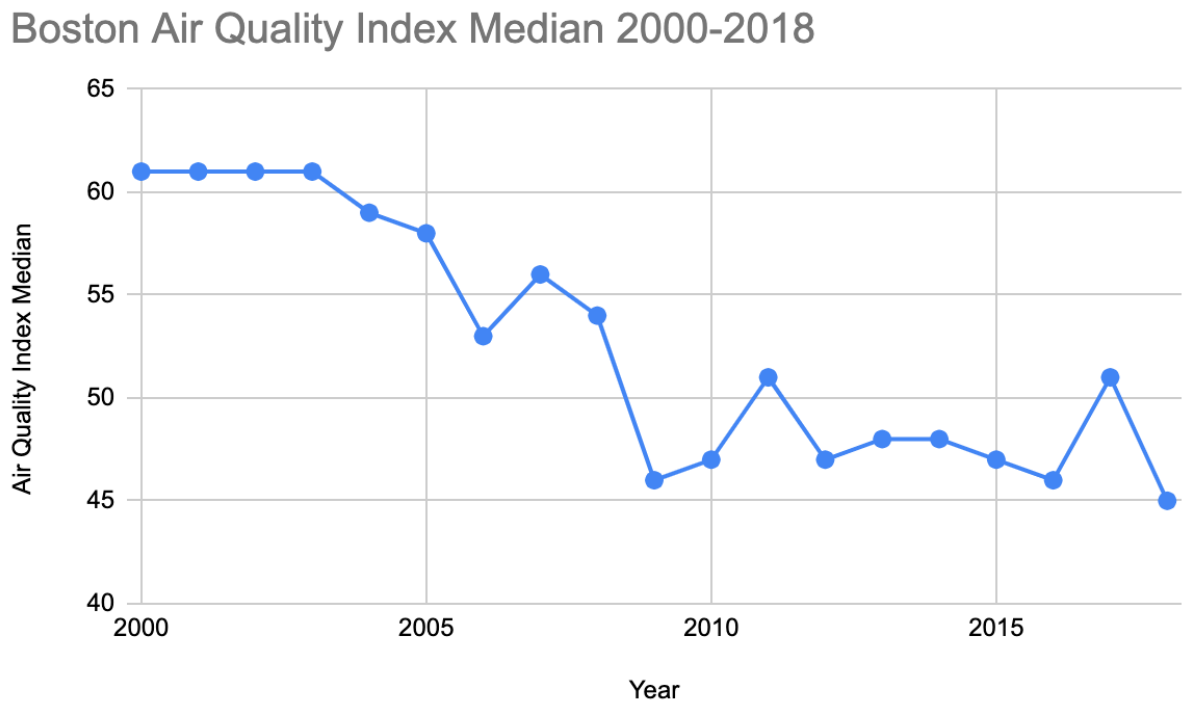
B: Boston's average house price increased between 2000 and 2006, decreased between 2006 and 2012, and increased between 2012 and 2018.

C: The real estate market in the 2000s and early 2010s is all about the 2008 financial crisis. Back in the early 2000s, investors were receiving more interest from mortgage-backed securities than US treasury bonds, which incentivized investors to buy these securities. In order to keep up with the demand for mortgage-backed securities, lenders lowered their standards for mortgages, sometimes not even verifying the borrower's income. This created a lot of subprime mortgage-backed securities, which were very risky. But credit agencies were giving these mortgages AAA ratings because they are new types of mortgages and historically mortgages are very safe investments. Now that it's easier to get a mortgage, we see that average house prices rose from 2000 to 2006 as more people look to buy houses.

But these subprime mortgages were lent to people who cannot afford mortgages in traditional markets. So as more people fail to keep up with mortgage payments, banks are forced to take their houses as collateral. The banks then had to put the houses on sale in the market, but the market price was already overpriced, so no one was willing to buy them. This sudden increase in supply and decrease in demand drove house prices down, which led to people who were paying mortgages making overpriced payments. As a solution, they stopped paying and gave the houses up, which fueled the cycle again. This can be reflected in the average house price drop from 2006 to 2012. After 2012, the Boston housing market returned to normalcy and saw healthy growth in line with inflation and general economic growth.

6. Air Quality Index

Year	Air Quality Index Median
2000	61
2001	61
2002	61
2003	61
2004	59
2005	58
2006	53
2007	56
2008	54
2009	46
2010	47
2011	51
2012	47
2013	48
2014	48
2015	47
2016	46
2017	51
2018	45



A: Air Quality Index is a measurement of air pollution in a given geographic region at a time. AQI is a value from 0 to 500, with higher values indicating higher air pollution. Usually, an AQI below 100 means good quality air.

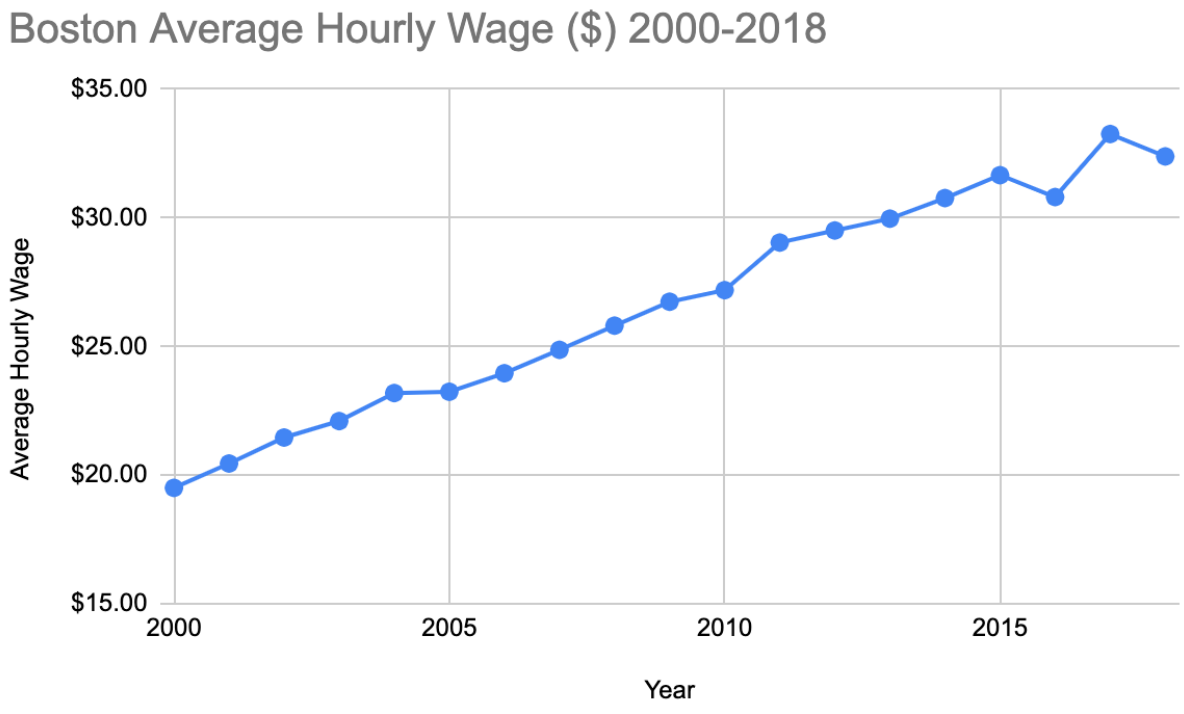
B: Boston's Air Quality Index stayed constant between 2000 and 2003, decreased between 2003 and 2006, increased from 2006-2007, decreased from 2007-2009, increased from 2009-2011, decreased from 2011-2012, increased from 2012-2013, stayed constant from 2013-2014, decreased from 2014-1016, increased from 2016-2017, and decreased from 2017-2018.

C: The AQI reflects pollution, and Boston's pollution is most highly affected by fossil fuel consumption, which comes from factories and transportation. In terms of transportation, when the population grows fossil fuel emissions from transportation in the city grow. In terms of factories, when the number of firms increases so will fossil fuel emissions from firms. With this in mind, we can see that from 2000 to 2009, population grew and number of firms spiked drastically, and thus AQI decreased. From 2010 to 2018 AQI stayed relatively steady with two spikes: one from 2010 to 2012, and one from 2016 to 2018.

In 2010, a study released by the Manomet Center for Conservation Sciences revealed that wood-burning power plants, a new practice popularized from 2008 to 2010, emitted more greenhouse gases than coal and traditional fossil fuels. The study led to the Massachusetts Initiative to Limit Carbon Dioxide Emissions and resulted in Massachusetts' largest solar-powered plant going into work in November of 2010, which improved AQI in 2011. In 2017, President Trump repealed President Obama's Clean Power Plan from 2015, along with other deregulatory efforts from the administration, AQI in Boston spiked. In 2018, EPA introduced the Affordable Clean Energy rule, which drove AQI down again.

7. Average Hourly Wage

Year	Average Hourly Wage
2000	$19.50
2001	$20.45
2002	$21.46
2003	$22.10
2004	$23.19
2005	$23.24
2006	$23.96
2007	$24.87
2008	$25.81
2009	$26.74
2010	$27.19
2011	$29.04
2012	$29.51
2013	$29.97
2014	$30.77
2015	$31.66
2016	$30.81
2017	$33.26
2018	$32.39



A: Average hourly wage is the average wage paid to workers per hour in a given geographic region. It is calculated by dividing the average annual wage of a geographic region by the average number of hours worked for the year (typically 40/week).

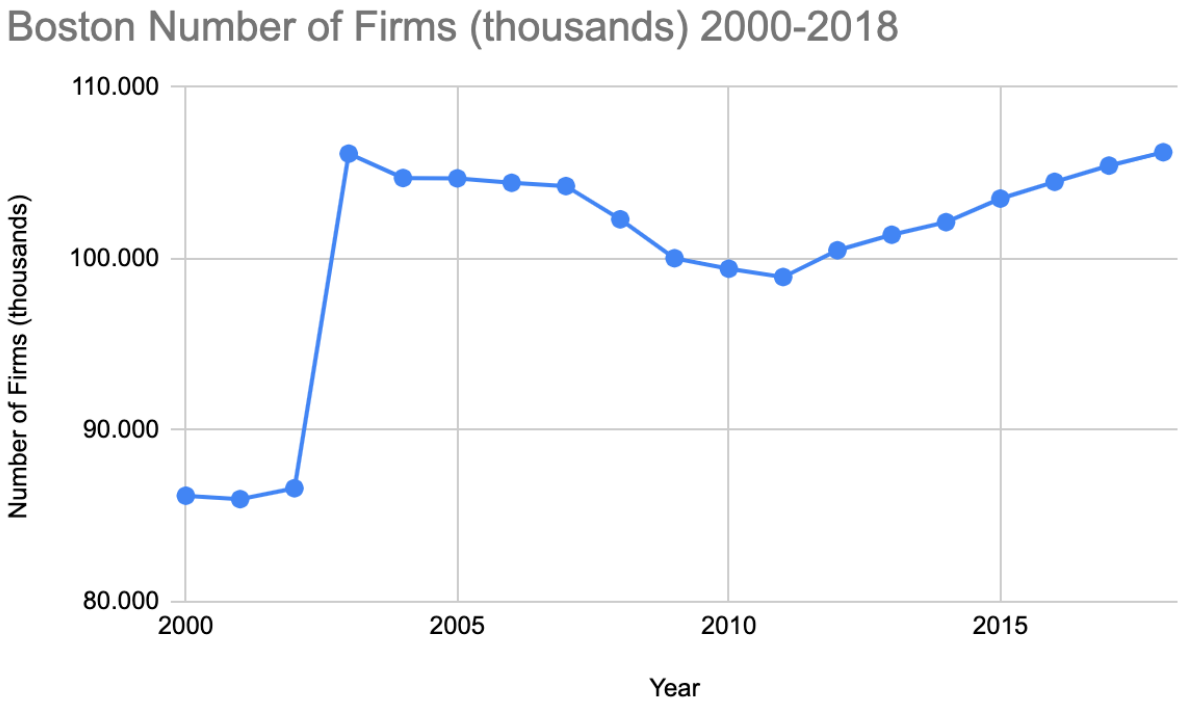
B: Boston's average hourly wage increased steadily from 2000 to 2015, saw a slight decrease from 2015-2016, increased from 2016-2017, and again saw a slight decrease from 2017-2018.

C: Boston's average hourly wage is mostly a factor of GDP. Even with unemployment fluctuations and economic recessions, the law of supply and demand will keep the average hourly wage at a relatively constant growth rate that's in line with inflation. This is because during recessions there are fewer firms, and each firm hires fewer workers. There are also fewer workers who can afford to live in the city, this decrease in demand and supply for workers cancel out and results in a steadily increasing average hourly wage.

As we can see, Boston's GDP grew at a steady rate from 2000 to 2018, and so did Boston's average hourly wage. As long as firms are becoming more productive, wages for workers will increase. The average hourly wage also needs to keep up with inflation, which is about 2-3% compounded annually. We can see that Boston's average hourly wage grew at comparative rates (~3.25%). The slightly higher growth than inflation reflects an overall economic expansion in Boston in the 18 years.

8. Number of Firms

Year	Number of Firms (thousands)
2000	86.180
2001	85.981
2002	86.616
2003	106.128
2004	104.708
2005	104.688
2006	104.428
2007	104.238
2008	102.300
2009	100.030
2010	99.418
2011	98.935
2012	100.494
2013	101.399
2014	102.133
2015	103.508
2016	104.485
2017	105.432
2018	106.212



A: Number of firms is the total number of businesses across all industries in a given geographic region. In this case, it is the total number of businesses in the Boston Metropolitan Statistical Area.

B: The number of firms in Boston decreased slightly from 2000 to 2001, increased dramatically from 2001 to 2003, steadily decreased from 2003 to 2011, and steadily increased from 2011 to 2018.

C: The number of firms in Boston experienced a huge increase from 2002 to 2003, and decreased in the years following 2003 until 2011, at which point it increased steadily until 2018. In 2002 the Commonwealth of Massachusetts passed a series of laws that incentivized construction and infrastructure development. One such act allowed for “abatement of up to 75 percent of the real estate tax obligations and up to 100 percent of the outstanding interest and penalties” if an agreement was to be achieved between the city and developers. Another act authorized the reconstruction of the Red Line subway in Boston. One act even allowed for leasing of the previous Boston Municipal Incinerator in South Bay for up to 99 years. The property was over 123,000 square feet. These government incentives drove an influx of construction firms to Boston in 2002, and in the following years as competition drove the number of firms down from the initial influx and construction projects start to be completed, the number of firms decreased. After 2011, the number of firms increased steadily across all industries as the overall economy of Boston grew at a healthy rate.

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