Your Gross Property Tax Estimation: What Will You Pay?

Week 5

Sharad Sawhney, Unnaty Gandhi, Mihir Gandhi, Ruchi Parab, Chunbing Yang
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What is Gross Property Tax?

"Property tax is a real estate ad-valorem tax, calculated by a local government, which is paid by the owner of the property. The tax is usually based on the value of the owned property, including land" - Investopedia

Do you think an event like **World War** would shift the scales of the trends of gross tax across various property types in Boston or a handful **elite families** of Boston would be responsible for elevating the median gross tax of Boston? The article describes such inconspicuous factors which are responsible for the changing trends of the median gross tax for the mentioned period. Also, by the end of the article, estimating the value of gross tax for a commercial or residential property would be possible. We have constructed a dashboard on RShiny which will aid us in visualizing these various effects.

Keywords of variables used in the analysis:

YR_BUILT – Year in which the property was assessed

ZIPCODE – Neighborhoods of Boston

LU – Types of property

AV_LAND – Total assessed value of land

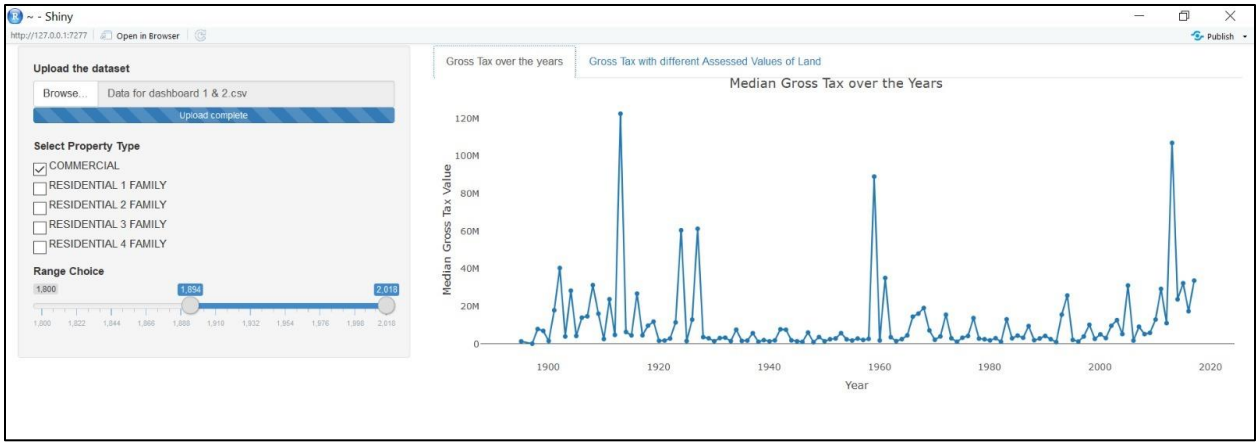
GROSS_TAX – Tax bill amount based on total assessed value multiplied by the tax rate

AV_TOTAL – Total assessed value of property

STRUCTURE_CLASS – Structure classification of commercial building

Assessing the Trends – "Gross Tax over the Years"

Let us start off by looking through the trends of gross tax with respect to the various property types in Boston. The types of properties considered are: Commercial, Residential 1-Family, Residential 2-Family, Residential 3-Family and Residential 4-Family. The period considered for analyzing the trends ranges from 1860 to 2018. Let us look at a visualization to get a deeper picture of the analysis.



Looking at the plot, we observe that, a time series graph shows the trend of median gross tax over the period for any given property type. A user can choose any of the property type to visualize the trends over time. Moreover, to get an in-depth analysis, a slider to the left of the plot would allow the user to choose a specific period for analysis. Let us now see the factors which affect the trend for each property type.

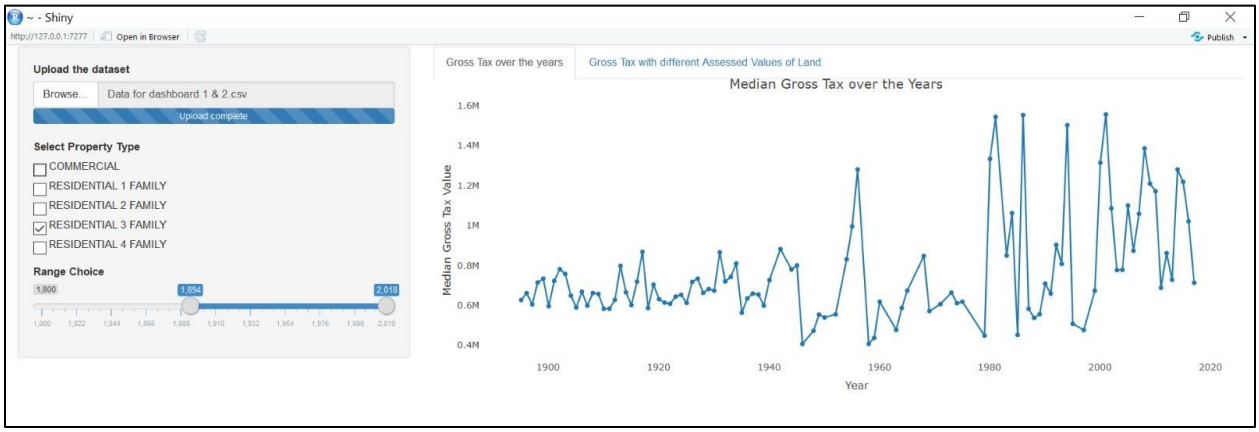
"The rise of Biotechnological advances in the Cambridge area in 1960s led to a steep rise in the commercial space market in Boston."

For Commercial Properties:

Since Boston was highly active in cross country trading, we can see considerable rise in the amount of median gross tax value from 1900 to 1930. Areas like Quincy Market, Boston Common and Tremont Street were some of the densely populated places in Boston where traders set shop and carried out their businesses on a large scale. A steep increase is seen during the period from 1960 to1962, as the war restrictions were no longer applicable, and many commercial spaces were constructed during this period. Also, many of the current property management firms were established considering the boom in the property market. Moreover, during this time, a boom was observed in the field of biotechnology in the Cambridge area, which led to a steep increase in the office spaces. Post 1962, there has been a constant rise in the median gross tax due to the **rise of commercialization** in Boston. As mentioned in the article by Jay Nuss Realty Group, LLC., Boston was amongst the "Top 10 Commercial Markets to Watch During 2013". This was due to the steep increase of job availability and technological advancements owing to **innovation** in the myriad industries.

"Effects of World War were one of highest contributors to the change of property trends in Boston ranging from lifting the property war restrictions to providing homes to the war veterans."

Residential 1-Family and 2-Family:



Both land types show a steep increase during the period from 1865 to 1870 due to the transformation of the historical buildings to residential buildings. The elite families of Boston converted most of the historical structures into their place of residency by shelling out large sums of money which in turn led to an increase in gross tax. For 1-family residential properties, the median gross tax levied after 1870 was constant. Factoring in the employment scenario in Boston after the year 2000, there was a huge gap in demand and supply of housing vis a vis buyers. This gap was due to the dual labor market (45% of managerial and profession occupation and 44% of lower wage and retail occupations) which created housing challenges for the city. Thus, new projects were established at a high rate which led to a steep increase in the median gross tax after 2007.

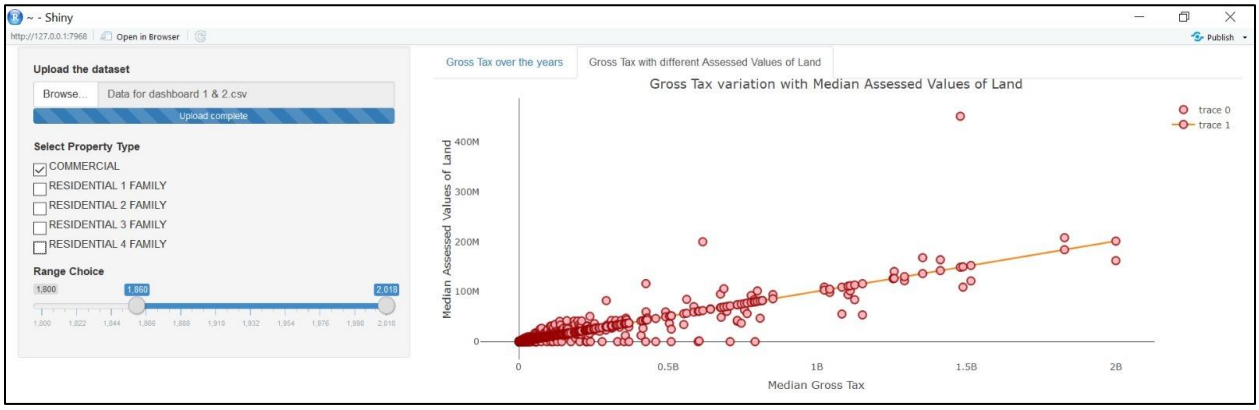
Residential 3-Family and 4-Family

Similar trends, as observed in Residential 1 – Family and 2 – Family properties from the period 1865 – 1870, can be seen in these land types due to the conversion of historical buildings to residential buildings. Major changes can be observed post 1940s, i.e. the post-World War period. Many reasons contributed to the rise of 3 and 4 – family residential properties across Boston. One of the major factors which led to the rise was “Rent Control”. “Rent Control” refers to a situation imposed by the governing bodies where, the landlords were not allowed to charge a tenant more than a preset amount. Due to this, many of the war veterans were able to find themselves with housing which in turn led to a higher demand of residential properties across Boston. Suburbs were filled with such housing options for veterans which led to an overall increase in the median gross tax during that period. Rise of industries and employment continued to be a driving force in increasing the value of median gross tax for residential properties in the 21st century.

Comparing the plots for residential properties, we can observe that, with the increase in the number of families living in a property, the median gross tax increases. This effect is due to the increase in the number of homes which lead to higher value of assessed land and finally resulting in a higher value of gross tax.

Estimating Your Gross Tax

Once we observe the trends of gross tax across various properties, we now look at the estimated value of gross tax for every property type. The estimates are computed with the help of a linear model which gives the line of best fit for every property type. A concentration of points near the line of best fit suggest that the two parameters are highly collinear which in turn means that, the model created is highly accurate. Let us now look at a sample plot which shows the distribution of median gross tax with respect to the median value of assessed land for the commercial property type.



Here, users can select the type of property they wish to assess the gross tax. The options available to the users are: Commercial, Residential 1-Family, Residential 2-Family, Residential 3-Family and Residential 4-Family. The legend on the right shows “trace 0” which are the original plots of the data set and “trace 1” shows the line of best fit created by the linear model. The line of best fit shows the estimated value of either of the axes based on their intercept. Thus, a user can estimate the value of gross tax when the assessed value of the land is known.

33%

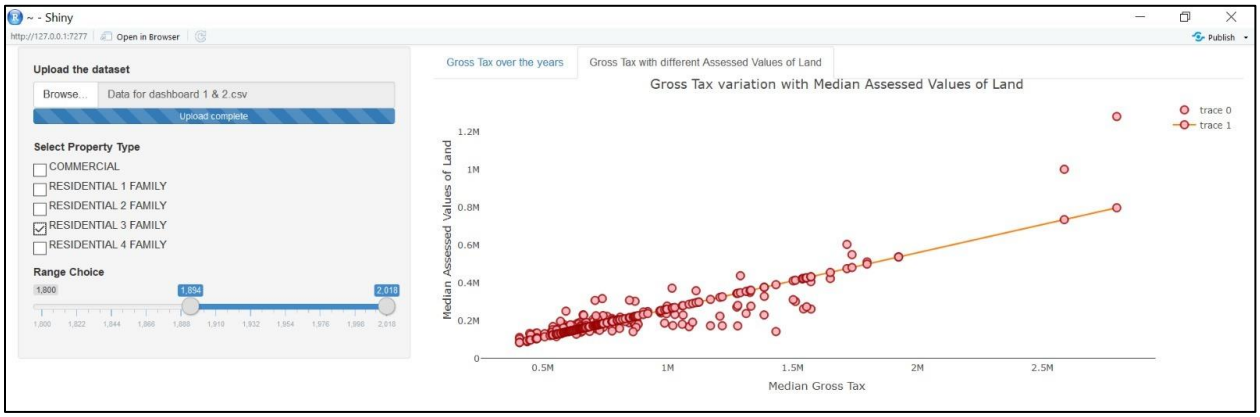
Higher tax attracted by commercial properties due to high income and expenses as compared to residential properties.

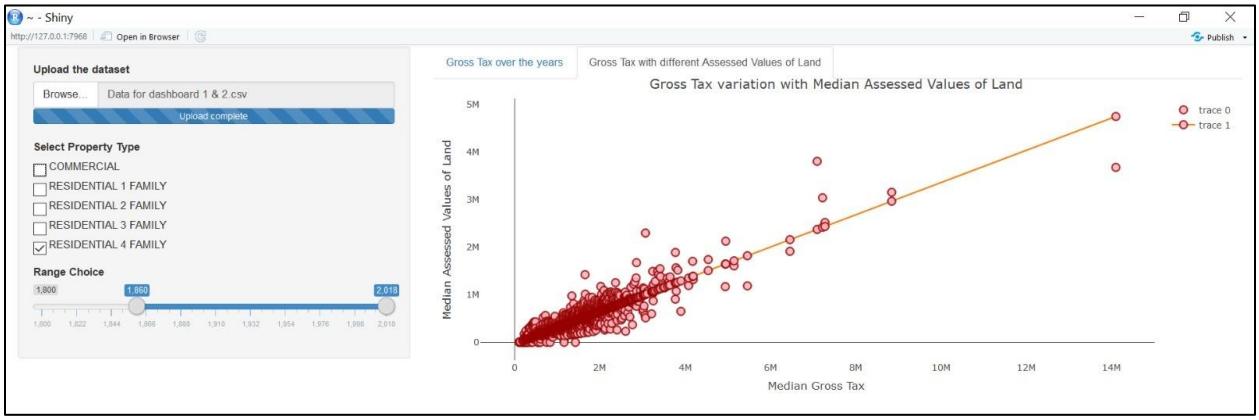
Commercial Properties:

Commercial properties generally attract a heavier gross tax due to the high value of income and expenses. Income includes factors like rents and sales. Expense include factors like management, legal and advertising fees, payroll, utilities etc. This tax difference can be seen by comparing the commercial properties with the Residential 4-family properties. For a given median value of assessed land of approximately 3 million dollars, commercial properties attract a higher gross tax of approximately 33% than the Residential 4-family.

"Residential properties made of steel structure attract approximately 27% higher gross tax than the properties made from reinforced concrete."

Residential Properties:





From the dashboard images, we can infer that, the residential properties with 4 families attract a 7% higher tax than the residential properties which have 1 to 3 families. This rise of gross tax is due to the higher management costs in the property as well as an overall increase in the utilities of each house. Also, since the 4-family or more houses occupy a larger land area, it leads to an overall increase in the gross tax of the property. There is no change of gross tax observed when the property types are residential 1-family, 2-family and 3-family.

Summary

Thus, from the analysis, we concluded that, factors such as World War contributed immensely to the rise of median gross tax for properties in Boston. Lifting the war restrictions on the properties after World War II and providing homes to the war veterans were some of the hidden factors which contributed to the trend. One of the most interesting factors which led to the sudden rise of median gross tax during early 1900s was the conversion of historical monuments to residential properties. Due to the policies imposed by the new President, most of the manufacturing plants are setting their roots back in America. This would give a boost to industries and

employment opportunities and since Boston is a commercial hub, it will attract a lot of opportunities. This phenomenon would in turn drive the property rates up leading to a higher gross tax value.

Also, predicting the value of gross tax based on the value of assessed land is feasible as the accuracy of the model created is quite high. The high accuracy can be seen from the close concentration of the points near the line of best fit. Thus, by checking the value of assessed land value on the line of best fit, we can estimate the value of gross tax present on the corresponding axis. Such models can be used by home buyers to estimate the value of a property beforehand. Thus, this method can help prevent the inflated prices and frauds by the real estate management companies.

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