

# IS 607 Final Project, An Evaluation of New York State Property Taxes

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## New York Property Taxes vs Inflation and Income, 2011 vs 2004

### MOTIVATION

Two counties in New York State, Westchester and Nassau County, are known for having some of the highest property taxes in the country. A few years ago I was evaluating NY neighborhoods within reasonable commuting distance of Manhattan as potential places to live. I considered various parts of Westchester County before deciding against Westchester due to the high property taxes. At the time I was curious as to how much these rates had increased over the last few decades and conducted some basic online research on historical property tax rates in Westchester County. What I found was that the property tax rates had increased faster than inflation, and much of this was due to the increase in the school tax rate. My motivation for this project is that I'm interested in conducting a more in depth analysis of property tax data for New York State counties and see how it compares to Westchester County.

### PROJECT SCOPE

This project analyzes property tax rate changes in New York State counties and how these rates compare to the inflation rate (as measured by the CPI - Consumer Price Index) and income level (as measured by AGI - Adjusted Gross Income) changes between 2004 and 2011. This purpose of this comparison is to evaluate how much the property tax burden has changed relative to inflation and income for New York State counties. While it would be interesting to look at data before 2004, in order to limit the scope of this project will focus just on the 2004 to 2012 period.

### PROJECT WORKFLOW

This project will follow a data science workflow, with the following Steps

1. Acquire the data
2. Clean and transform the data, including exploratory analysis and graphics to describe the data
3. Analyze and present the data including statistical analysis and graphics to support conclusions. The analysis includes the 'map' feature of R to present results in a map of New York State Counties. This feature was not covered in class

### STEP 1: DATA SOURCES

The Real Property Tax Rates Levy Data and Municipality (2004-2012)

URL: <https://data.ny.gov/Government-Finance/Real-Property-Tax-Rates-Levy-Data-By-Municipality-/iq85-sdzs>

file type: csv

Source: New York State Department of Taxation and Finance

Total Income Liability by Place of Residence

URL: <https://data.ny.gov/Government-Finance/Total-Income-And-Tax-Liability-By-Place-Of-Residen/nacg-rg66>

file type: csv

Source: New York State Department of Taxation and Finance

CPI data URL: <http://www.multpl.com/inflation/table>

file type: web page and converted to a csv

Source: U.S. Bureau of Labor Statistics

New York State County Population:

URL: <http://labor.ny.gov/stats/nys/statewide-population-data.shtm>

file type: MS Excel file converted to a csv

Source: 2010 Census

## Import Data into R

```
options(stringsAsFactors = FALSE)
#prevent data frame columns from being automatically converted to factors

propertytax<-
  read.csv("C:/temp/Real_Property_Tax_Rates_Levy_Data_By_Municipality__Beginning_2004.csv")

income<-
  read.csv("C:/temp/Total_Income_And_Tax_Liability_By_Place_Of_Residence__Beginning_Tax_Year_1999.csv")

inflation<-
  read.csv("C:/temp/Inflation_rates.csv") #web data converted to csv

censusPop<-
  read.csv("C:/temp/NYCountyPopulation.csv") #original Excel file edited and converted to csv
```

## STEP 2: part 1: Clean the data

Adjust column names, adjust data formatting such as removing \$ signs and changing data to numeric form.

## DATA ISSUES

There were several data issues encountered in the data files, that were handled in one of three ways:

- editing the csv file before import (note: the files included with this report are the edited files)
- the data is edited via R coding
- some of the observations in the data were corrupted in some way, in this case various simplifying assumptions were made to move ahead with this analysis for the purpose of this project. A comprehensive study on this subject would need involve inquiries to the data source to obtain corrected data.

Specific Issues Encountered:

The County of St. Lawrence appears differently in each data source. To resolve this issue either the original csv was edited or the following R code modifies the data frame, so that St Lawrence always appears as St Lawrence and not St. Lawrence.

The Income data had a “Total, New York City” which needed to be changed to “New York City”. It also had “Manhattan” instead of “New York” County which needed to be changed to make it consistent with the other data sources used in this analysis.

New York City data for 2004 doesn’t exist in the file. To resolve this the 2005 data was manually copied to create a 2004 to create a proxy 2004 record.

The property tax data had ‘New York City’, but did not have records for each borough. However, the property tax is the same for all five boroughs of NYC so the NYC records were copied for 2004 and 2011 to create individual borough records in the csv file.

The census data has New York City Boroughs but doesn’t have a subtotal for NYC so a sum of the population of the five boroughs of New York City was added to the csv file

## Step 2: Part 2, transform the data and use exploratory analysis and graphics to describe the data

This section will provide initial transformation and calculations to set up the data frames that will be used in the analysis. Transformations involved the use of dcast from the rshape2 package, join\_all from the plyr package, and base R functions such as aggregate.

- 1-Calculate the change in inflation rate between 2004 and 2011
- 2-Create a data frame with the the percent change (between 2004 and 2011) for the school and non-school components of the property tax
- 3-Create a histogram and density function using ggplot2 to get an overview of how tax rate increases distribute for NYC counties. These charts will provide an initial overview of how property taxes rates have changed between 2004 and 2011.
- 4-Set up a dataframe with the rate of change in Adjusted Gross Income between 2004 and 2011

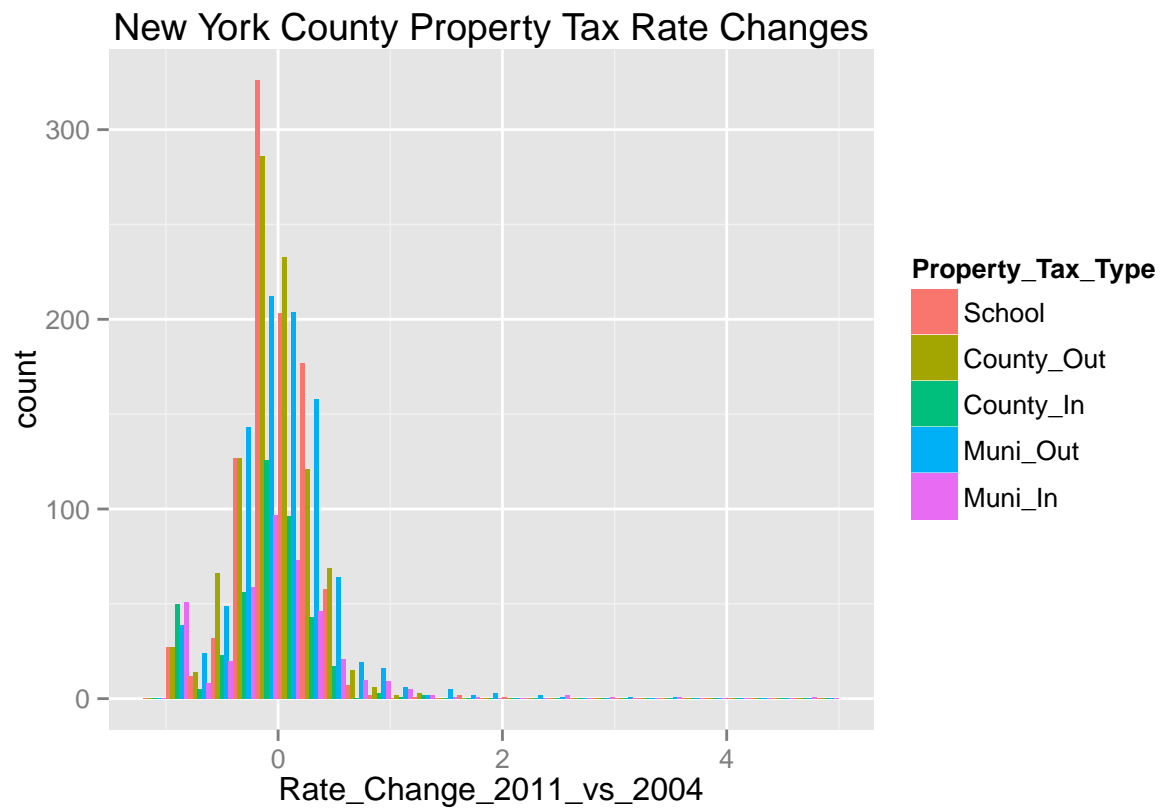
```
## [1] "The inflation rate change between 2004 and 2011 is:"
```

```
## [1] 0.1892
```

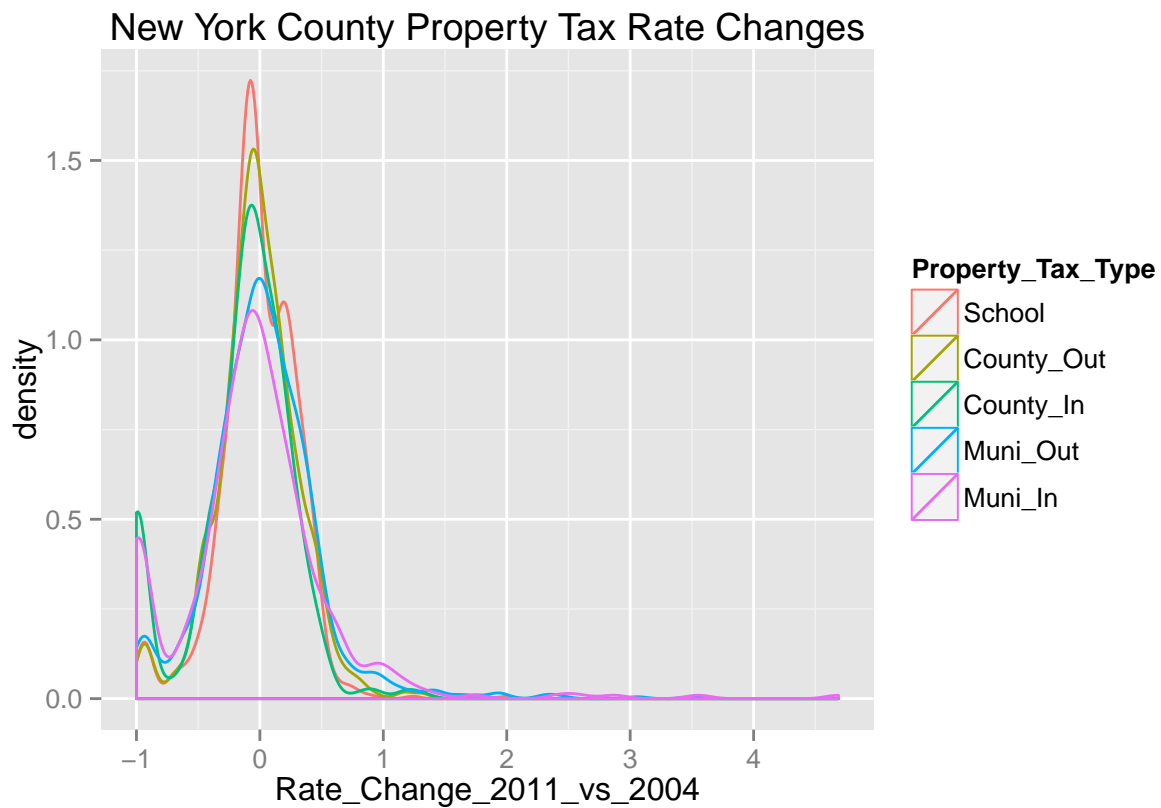
```
## [1] "The new transformed data frame structure for property tax is:"
```

	Municipality	County	School	County_Out	County_In	Muni_Out	Muni_In
## 1	Adams	Jefferson	0.20196	-0.05349	-0.05349	0.039171	0.16116
## 2	Addison	Steuben	0.18796	0.20558	-0.06335	-0.003974	-0.13598
## 3	Afton	Chenango	0.17621	-0.05974	-0.05974	-0.008180	-0.03797
## 4	Alabama	Genesee	-0.06232	-0.01976	NaN	0.000000	NaN
## 5	Albany	Albany	-0.05245	0.05502	NaN	-0.123901	NaN
## 6	Albion	Orleans	-0.07945	0.11603	0.13549	0.066975	0.14440

```
## [1] "Histogram of Property Tax Rate Changes between 2004 and 2011"
```



```
## [1] "Density function of Property Tax Rate Changes between 2004 and 2011"
```



## Initial Observations

Initial exploratory statistics and graphics indicate that there are many counties in NY State where property taxes rates have stayed flat or have been reduced, but there are also many counties where property tax rates have increased significantly.

```
## [1] "The new transformed data frame structure for income is:"
```

```
##      County    AGI AGIAverage
## 1     Bronx 0.2584    0.01837
## 2     Kings 0.4157    0.20142
## 3    New York 0.3103    0.25617
## 4    Queens 0.2712    0.09233
## 5    Richmond 0.1694    0.08495
## 6 New York City 0.3114    0.14578
```

### STEP 3: Analyze and present the data including statistical analysis and graphics to support conclusions. The analysis includes the ‘map’ feature of R to present results in a map of New York State Counties. This feature was not covered in class

Data Issues Encountered during Step 3:

During the analysis phase a significant data issue was discovered that was not correctable. The tax rate data which is supposed to be significantly less than \$1000 was well over \$500 for several counties. The problem appeared with Nassau, Suffolk, and Westchester, and at least one Municipality in Albany. However, since the issue appears to persist throughout the years the assumption made for the purpose of this project is that the year over year changes are equivalent to the year over year rate changes and that this data can still be used for computing rate change. It was also assumed for the purpose of this project that the levy data was correct even where the rate data was obviously incorrect.

```
## [1] "The following result shows some of the issues, specifically with the impossibly high school tax
```

```
##      County SchoolRate
## 1      Albany    121.11
## 2    Allegany     21.47
## 3      Bronx     76.49
## 4     Broome     77.28
## 5  Cattaraugus    46.91
## 6      Cayuga    22.31
## 7   Chautauqua    22.44
## 8     Chemung   163.29
## 9    Chenango    26.56
## 10   Clinton    16.64
## 11   Columbia    15.25
## 12   Cortland    20.21
## 13   Delaware    66.43
## 14   Dutchess    26.58
## 15      Erie     37.44
## 16     Essex     12.56
## 17   Franklin    53.07
## 18     Fulton    20.48
## 19    Genesee     23.02
## 20     Greene     17.84
## 21   Hamilton    10.74
## 22   Herkimer    39.54
## 23   Jefferson    14.09
## 24     Kings     76.49
## 25     Lewis     31.84
## 26  Livingston    20.60
## 27     Madison    20.19
## 28     Monroe    23.94
## 29  Montgomery    45.29
## 30     Nassau   4159.17
## 31    New York     76.49
## 32 New York City     76.49
## 33     Niagara    22.80
## 34     Oneida     53.96
## 35   Onondaga    107.06
```

## 36	Ontario	20.00
## 37	Orange	63.11
## 38	Orleans	22.89
## 39	Oswego	47.34
## 40	Otsego	22.94
## 41	Putnam	23.24
## 42	Queens	76.49
## 43	Rensselaer	57.64
## 44	Richmond	76.49
## 45	Rockland	79.02
## 46	Saratoga	22.81
## 47	Schenectady	82.25
## 48	Schoharie	69.62
## 49	Schuyler	19.09
## 50	Seneca	23.79
## 51	St Lawrence	40.86
## 52	Steuben	82.27
## 53	Suffolk	955.71
## 54	Sullivan	60.11
## 55	Tioga	103.67
## 56	Tompkins	18.79
## 57	Ulster	117.70
## 58	Warren	111.44
## 59	Washington	85.38
## 60	Wayne	22.08
## 61	Westchester	505.23
## 62	Wyoming	19.74
## 63	Yates	14.36

## Property Tax Rate Analysis

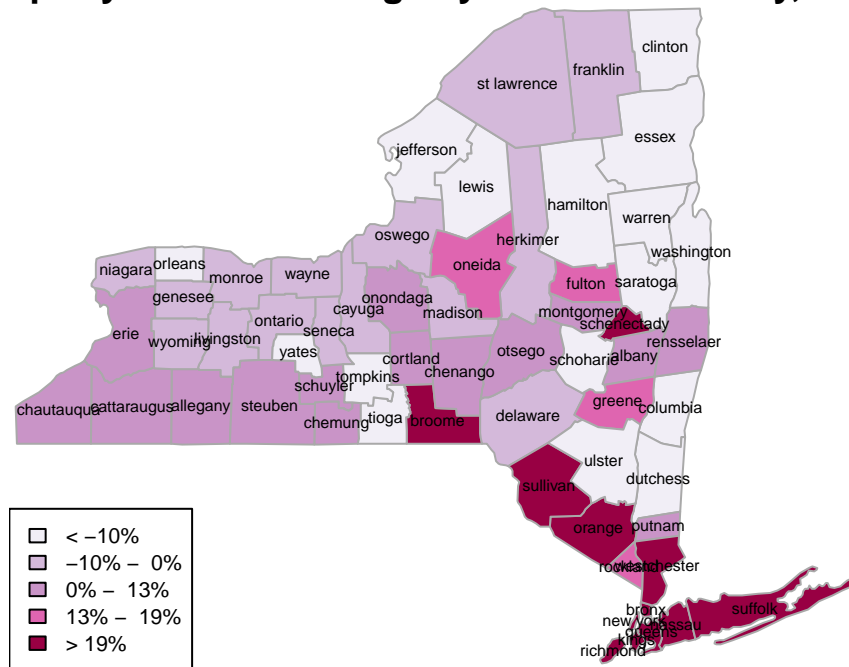
This section analyzes the property tax rate change by county and will:

1-Provide a color coded map of these changes, using the R map function

2-Provide data on counties where school property tax rates increased faster than inflation between 2004 and 2011

3-Display the percent of the New York State population that lives in these counties

## School Property Tax Rate change by New York County, 2011 vs 2004



## [1] "NY State counties where school property tax has increased faster then inflation:"

County	School_Rate_11vs04	School_Rate_11	AGI_11vs04	Population
Nassau	1.3048	4159.17	0.13357	1339532
Westchester	0.4051	505.23	0.14412	949113
Orange	0.3301	63.11	0.18424	372813
Sullivan	0.2355	60.11	0.07585	77547
Schoharie	0.2133	69.62	-0.01842	32749
Broome	0.2041	77.28	0.15841	200600
Bronx	0.2006	76.49	0.25835	1385108
Kings	0.2006	76.49	0.41572	2504700
New York	0.2006	76.49	0.31028	1585873
Queens	0.2006	76.49	0.27122	2230722
Richmond	0.2006	76.49	0.16939	468730
Suffolk	0.1952	955.71	0.20919	1493350

Inflation_11vs04
0.1892
0.1892
0.1892
0.1892
0.1892
0.1892
0.1892
0.1892
0.1892
0.1892



```
## 42          0.1892
## 44          0.1892
## 53          0.1892
```

```
## [1] "Percent of NY State population living in a county where the school tax has increased faster than
```

```
## [1] 0.4588
```

The map shows that the property tax rate increases have varied considerably across counties, while some counties have increased property taxes in excess of the rate of inflation (18.9%), many other counties appear to have reduced their tax rates between 2004 and 2011. New York State appears to look very different depending on the county. With respect to the counties that have increased property taxes appear in the table above and as expected include New York City (Bronx,Kings,New York,Queens,and Richmond), Westchester, Nassau and Suffolk. The population in these counties makes up 45.9% of the population of New York State, thus nearly half of the population of New York State lives in counties where the property tax rate increase exceeded inflation between 2004 and 2011.

## Property Tax Rates changes vs. income changes between 2004 and 2011

This section will provide tables that show:

- 1-The counties where the school tax rate has increased faster than average income between 2004 and 2011
- 2-The percent of the NY State population living in a county where the school tax has increased faster than income.

```
## [1] "Counties where the school tax rate has increased faster than income (average AGI):"
```

##	County	School_Rate_Change	AvgAGI_Change
## 61	New York City	0.2006	0.145784
## 30	Oneida	0.1595	0.135690
## 47	Suffolk	0.1952	0.134247
## 3	Broome	0.2041	0.114477
## 62	Queens	0.2006	0.092325
## 63	Richmond	0.2006	0.084948
## 28	Nassau	1.3048	0.084853
## 37	Putnam	0.1304	0.084715
## 33	Orange	0.3301	0.084558
## 42	Schoharie	0.2133	0.078665
## 55	Westchester	0.4051	0.077890
## 17	Fulton	0.1328	0.075661
## 39	Rockland	0.1692	0.025726
## 58	Bronx	0.2006	0.018366
## 48	Sullivan	0.2355	0.005771

```
## [1] "Number of counties where the school tax rate has increased faster than income (average AGI):"
```

```
## [1] 15
```

```
## [1] "Percent of NY State population living in a county where the school tax has increased faster than
```

```
## [1] 0.6325
```

There are 15 counties including the 5 counties/boroughs of New York City where the school tax rate has increased faster than average income. The population of these counties comprises 63.2% of the population of New York State, thus a majority of the population of New York State lives in a county where the school property tax rate has outpaced income increase rates.

## Property Tax Levy and Income Analysis

The property tax rate does not take into account changes in property values which will result in higher property taxes even if the property tax rate has not increased. To analyze this aspect of property taxes this section will evaluate property tax levies which are a function of the property tax rates and the property values, and thus implicitly account for changes in house prices.

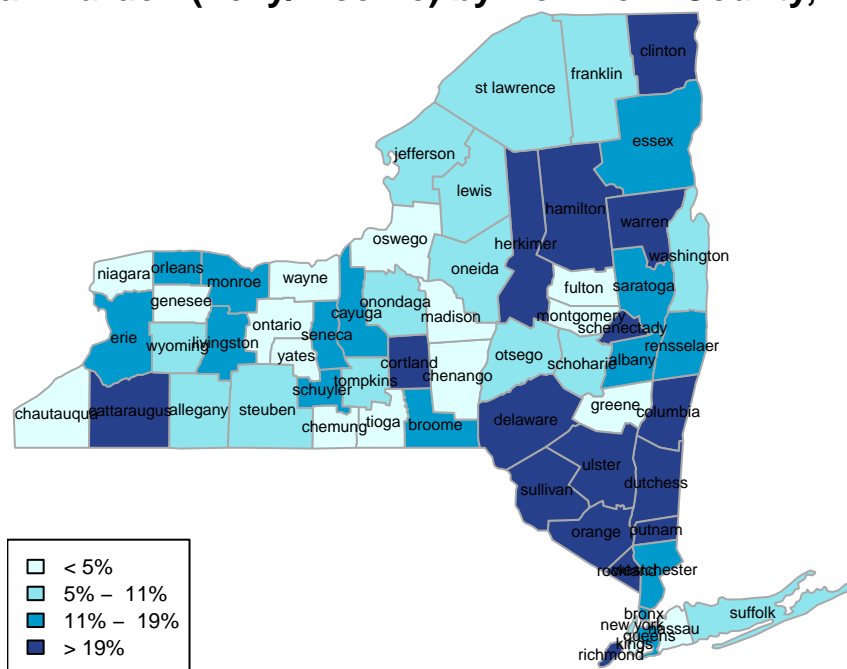
This section will explore the property tax burden, defined here as the property taxes paid as a proportion of income and how this proportion has changed between 2004 and 2011. The results of this analysis will be displayed in a color coded map of New York County. This map will display the change in the property tax burden between 2004 and 2011.

```
## [1] "The structure of the combined data frame created for tax levies, income, and population:"
```

##	County	TotLevy.2004	SchoolLevy.2004	TotLevy.2011	SchoolLevy.2011
## 1	Albany	740637088	334861818	967275956	444236303
## 2	Allegany	117852880	31178752	151037078	35711777
## 3	Bronx	12720048530	7020465552	18323689139	12137662831
## 4	Broome	362328133	161978160	488655391	212925579
## 5	Cattaraugus	140194782	47461875	193860500	62286153
## 6	Cayuga	131673034	54413281	168942221	72546370
##	AGI.Total.2004	Returns.2004	AGI.Total.2011	Returns.2011	Census.2010
## 1	6599561	135201	7677295	140676	304204
## 2	558910	17560	663809	18197	48946
## 3	14007490	476420	17626369	588674	1385108
## 4	3129669	84798	3625446	88141	200600
## 5	1080106	33217	1188768	33328	80317
## 6	1179773	33248	1345517	33148	80026

```
## [1] "Map of property tax rate increases by New York County between 2004 and 2011"
```

## Property Tax Burden (Levy/Income) by New York County, 2011 vs 2004



The map shows that the property tax burden (total property tax levy/total income) has increased in all New York State counties between 2004 and 2011. Since the school portion of the property tax rate has fallen in some of these counties it would appear that this would be related to increased property values or possibly increases in other property tax rates which this project didn't explicitly explore. Interestingly the tax burden in the five New York City counties, Nassau, Suffolk, and Westchester does not appear to have increased as much as other areas, which appeared to fare better when comparing property tax rates to average income. There are various factors that might affect this ratio including changes in property values, but a complete understanding would require further analysis that is beyond the scope of this project.

## FINAL CONCLUSIONS

This analysis explored property tax changes across New York State counties between 2004 and 2011. Through statistics and graphics including charts and maps, this analysis found that property tax rate increases have varied considerably across counties, while some counties have increased property taxes in excess of the rate of inflation (18.9%), many other counties appear to have reduced their tax rates between 2004 and 2011. New York State appears to look very different depending on the county; however, due to population concentrations in certain counties, nearly half of the population of New York State (45.9%), lives in counties where the school portion of the property tax rate increased at a rate that exceeded inflation between 2004 and 2011. Furthermore, 63.2% of the population of New York State lives in a county where the school property tax rate has outpaced the rate of increase in incomes.

The property tax rate does not take into account increases in property values which will result in higher rates even if the property tax rate has not changed. To analyze this aspect of property taxes this project analyzed property tax levies which are a function of the property tax rates and property values, and thus implicitly account for changes in house prices. More specifically the analysis explored the property tax burden (property taxes paid as a proportion of income) and how this has changed between 2004 and 2011. The map showed a

different pattern than the rate analysis had shown, and the tax burden in New York City, Nassau, Suffolk, and Westchester counties does not appear to have increased as much as other areas. There are various factors that might affect this ratio including changes in property values, but a complete understanding would require further analysis that is beyond the scope of this project.