

**Title: Updated Results on Property Assessment Accuracy, Uniformity and Equity in Philadelphia.**

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**Part I**

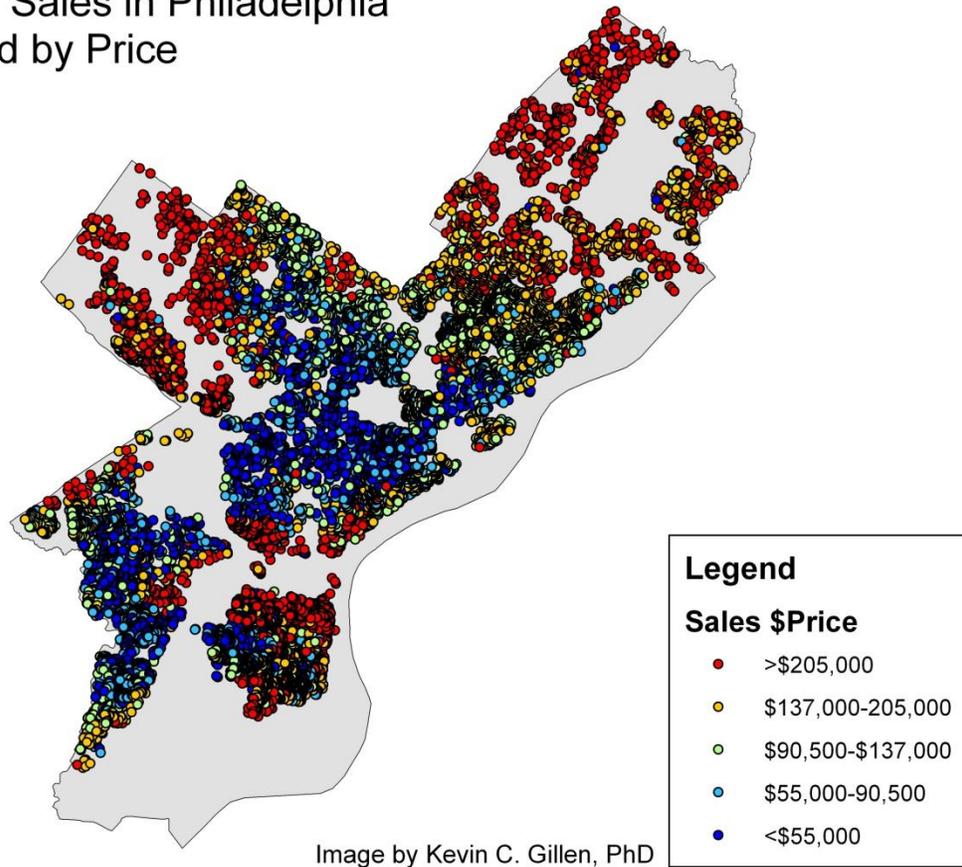
**Objective: *To update the property tax analysis originally performed for the Philadelphia Tax Reform Commission in 2003.***

**Procedure:** The analysis essentially involves comparing house values to their assessed values, and then computing some diagnostic statistics. Since it's difficult to obtain precise and objective values for all single-family homes in Philadelphia, we use actual sales prices.

**Data:** All 2007 home sales were extracted from my proprietary database. Properties with any tax exemptions were dropped, as well as outliers with prices  $\leq \$10,000$  or  $\geq \$2m$ . Only single-family homes were retained; condos and apartment properties were dropped. This database includes only arms-length transactions between private individuals, so prices are likely to reflect true market values since buyers and sellers in these transactions are likely to be seeking a price that maximizes their own self-interest. There were 16,890 transactions in the dataset used in this analysis.

The following figure shows a map of these home sales in 2007, color-coded by their transaction price:

## 2007 Home Sales in Philadelphia Color-Coded by Price



The map uses a temperature color ramp, with cool colors denoting relatively low-priced home sales and warm colors denoting relatively high-priced home sales. Unsurprisingly, the lowest-priced dwellings are located in the low-income neighborhoods of North and West Philadelphia, while the higher-priced dwellings are located in the more affluent neighborhoods of Center City, Northwest Philadelphia and Upper Northeast Philadelphia.

**Variable Definitions:** For each transaction, the following variables were computed:

**Assessment Ratio (AR):** The Assessment Ratio of a property is the ratio of each individual property's assessed value (AV) to its market value (MV)<sup>1</sup>. MV is proxied by the recorded sales price of each property.

<sup>1</sup> Note: The nomenclature used in this document is different than the one used by Philadelphia's assessing authority, the BRT. In BRT terminology, "Market Value" is the BRT's estimation of what a property is worth, and "Assessed Value" is "Market Value" times the fractional assessment formula of 0.32. Instead, we use "Assessed Value" to mean the estimated appraisal value set by the assessor, and "Market Value" to mean the actual value the property would transact for under arms-length market conditions.

$$AR_i = \frac{AV_i}{MV_i}$$

Where:

AV = Assessed Value (determined by the BRT)

MV = Market Value (the arms-length Sales Price)

$i=1,2,\dots,N$

$N=\#$  of properties=16,890

**Coefficient of Dispersion (COD):** The COD measures the accuracy of a dwelling's assessment by computing the absolute percentage by which the assessed value deviates from its market value:

$$COD_i = \frac{|AR_i - AR_0|}{AR_0}$$

Where:  $AR_i$  = Assessment Ratio of  $i$ th property

$AR_0$  = Target Assessment Ratio in the taxing jurisdiction

(And  $|$  denotes the absolute value operator.)

In a world of perfect accuracy, every property would be assessed exactly at its market value. If this were true, each property would have an AR of "1" and a COD of "0". Hence, we use a value of "1" for  $AR_0$ , and then compute the COD for 16,890 home sales. The mean COD is then computed as the average COD across all properties.

The International Association of Assessing Officers states that the Target COD for residential properties in "older, heterogeneous areas" such as Philadelphia should be 15% or less.

**Price-Related Differential (PRD):** The PRD measures the neutrality, or equity, of property assessments. It is the ratio of the average AR (across all properties) to a weighted average AR (across all properties), where the weights are determined by the total dollar amount of assessments and market value:

$$PRD = \frac{\frac{1}{N} \sum_{i=1}^N AR_i}{\left( \frac{\sum_{i=1}^N AV_i}{\sum_{i=1}^N MV_i} \right)}$$

If assessments are neutral and equitable, a PRD should be as close to 1 as possible. The IAAO recommends these guidelines:

- $PRD < 0.98$  assessments are “progressive”; i.e. favoring low-valued homes
- $0.98 \leq PRD \leq 1.03$  assessments are neutral
- $PRD > 1.03$  assessments are “regressive” ; i.e. favoring high-valued homes

Taken together, the COD and PRD are what statisticians refer to as “sufficient statistics” because they completely characterize the degree of assessment accuracy and equity in a particular housing market. The COD measures accuracy, while the PRD measures equity. They are analogous to kicking a field goal. The COD tells you if you missed the field goal and by how much (accuracy), but doesn’t tell you if you missed wide right or wide left. Conversely, the PRD tells you if missed wide right (regressivity) or wide left (progressivity), but doesn’t tell you by how much you missed. But, taken together, they both tell you how accurate and fair assessments are.

### **Citywide Results:**

- In 2003, we computed an average COD of 34.4%, more than double the recommended target. Moreover, only 51.4% of all homes analyzed had a COD of 15% or less.
- With the 2007 data, we computed an average COD of 64.2%. Additionally, only 3% of all homes analyzed had a COD of 15% or less.
- **Clearly, assessment accuracy in Philadelphia has gotten dramatically worse since the original analysis done by the Tax Reform Commission five years ago.**
- In 2003, we computed a PRD of 1.19, which clearly exceeded the threshold value of 1.03, indicating that assessments were regressive.
- With the 2007 data, we computed a PRD of 1.2, indicating that assessments remain regressive, with owners of lower-priced homes paying a greater percent of their dwelling’s value in property taxes.
- **Clearly, assessment inequity has remained regressive since the original analysis done the TRC five years ago.**
- **In summary, assessment accuracy has worsened dramatically during the last five years. While assessment regressivity has not worsened, it still remains significant.**

We now perform this same analysis by neighborhood. For this we need to redefine our diagnostic statistics as follows:

$$AR_j = \frac{\sum_{i=1}^j AV_i}{\sum_{i=1}^j MV_i}$$

Where:

AV = Assessed Value<sup>2</sup> (determined by the BRT)

MV = Market Value (the arms-length Sales Price)

i=1,2,...,j

j=# of properties in the neighborhood=16,890

The neighborhood assessment ratio is defined as the ratio of total assessed value of a neighborhood’s housing stock to the total market value of that neighborhood’s housing stock. This ratio is not as susceptible to a few outliers like the citywide ratio is (the effect of outliers is more pronounced on smaller datasets, like neighborhoods).

With this definition of AR, we then define a neighborhood’s PRD as follows:

$$PRD_j = \frac{AR_j}{\left( \frac{\sum_{i=1}^N AV_i}{\sum_{i=1}^N MV_i} \right)}$$

This is simply the ratio of the neighborhood’s AR to the citywide AR. It describes the degree to which a neighborhood is relatively over- or under-assessed, compared to the citywide average. Values greater than one indicate that a neighborhood is assessed at a higher fraction of its value than the citywide average, while values less than one indicate that a neighborhood is assessed at a lower fraction of its value than the citywide average.

### Neighborhood Results:

The following map color-codes each neighborhood by its degree of relative over- or under-assessment. The city wide average AR is 31.67, which indicates that Philadelphia—as a whole—is under-assessed. However, the high value of the COD indicates that there is also great variation in ARs across neighborhoods. So, I color-coded neighborhoods based upon what its AR was relative to the citywide average of 31.67. Values greater than that indicate a relatively over-assessed neighborhood, and are color-coded red. Values less than that a relatively under-assessed neighborhood, and are color-coded blue. Lastly, because there was wide inter-neighborhood variation in ARs, each neighborhood is labeled with the value of its AR.

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<sup>2</sup> This is what the BRT terms “Market Value” in its property tax roll.



## 2007 COD by Neighborhood

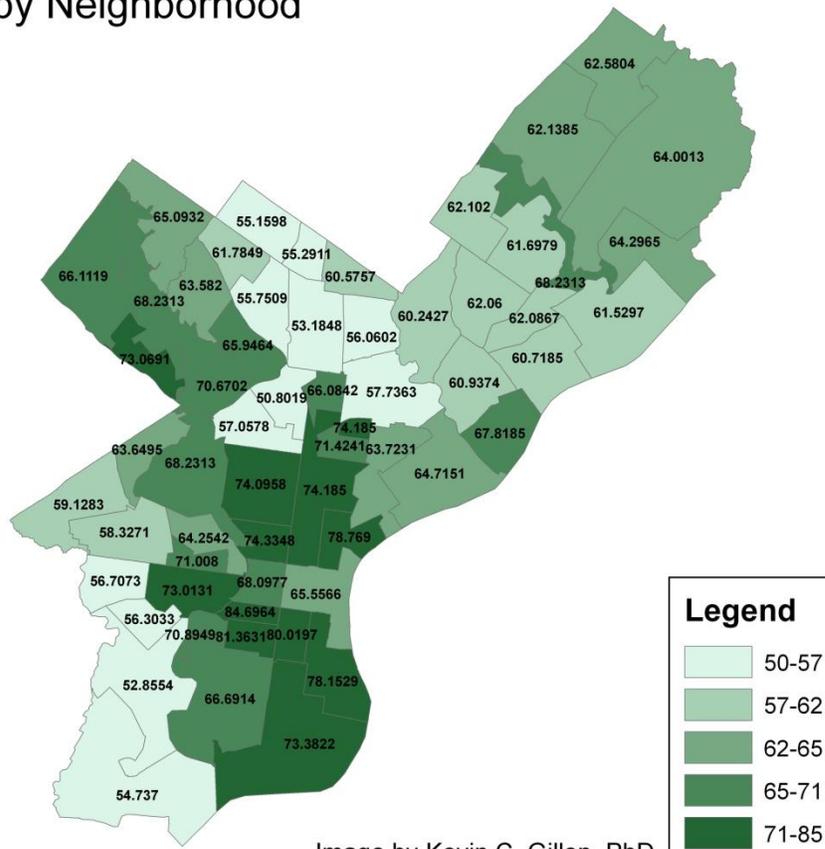


Image by Kevin C. Gillen, PhD

As the map indicates, assessment error is acutely high across the city. The IAAO recommends a COD of 15% or less for older, heterogeneous urban markets like Philadelphia. However, as the map indicates, the minimum COD in Philadelphia is 50%! From there, assessment accuracy only gets worse, with the maximum value being 85%. Not a single neighborhood in Philadelphia meets IAAO guidelines for assessment accuracy. Essentially, the map states assessment errors in Philadelphia neighborhoods range from “really erroneous” to “incredibly erroneous”.

The next map color-codes each neighborhood by the value of its PRD. Following the IAAO guidelines, neighborhoods with a PRD greater than 1.03 are color-coded red, while neighborhoods with a PRD less than 0.98 are color-coded blue. Each neighborhood is also labeled with the value of its PRD<sup>3</sup>.

<sup>3</sup> For visual clarity, the PRD values displayed on the map are scaled up by multiplying them times 100. So, for example, a value greater than 103 is deemed as relatively over-assessed.

## 2007 PRD by Neighborhood

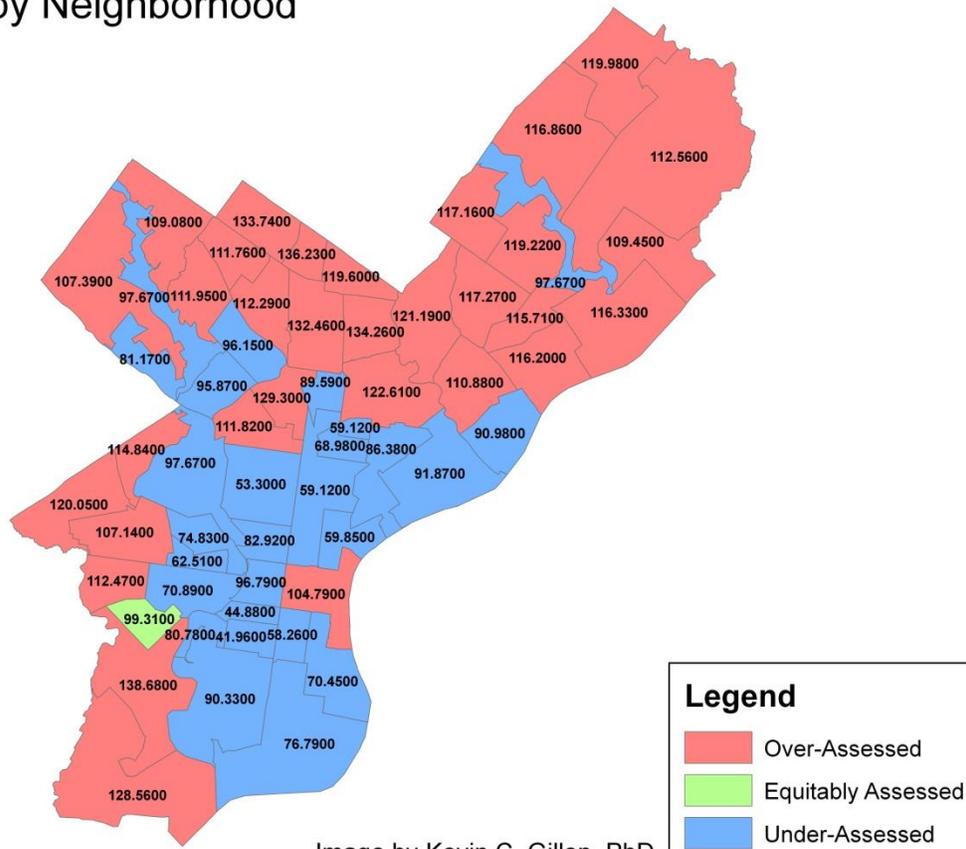


Image by Kevin C. Gillen, PhD

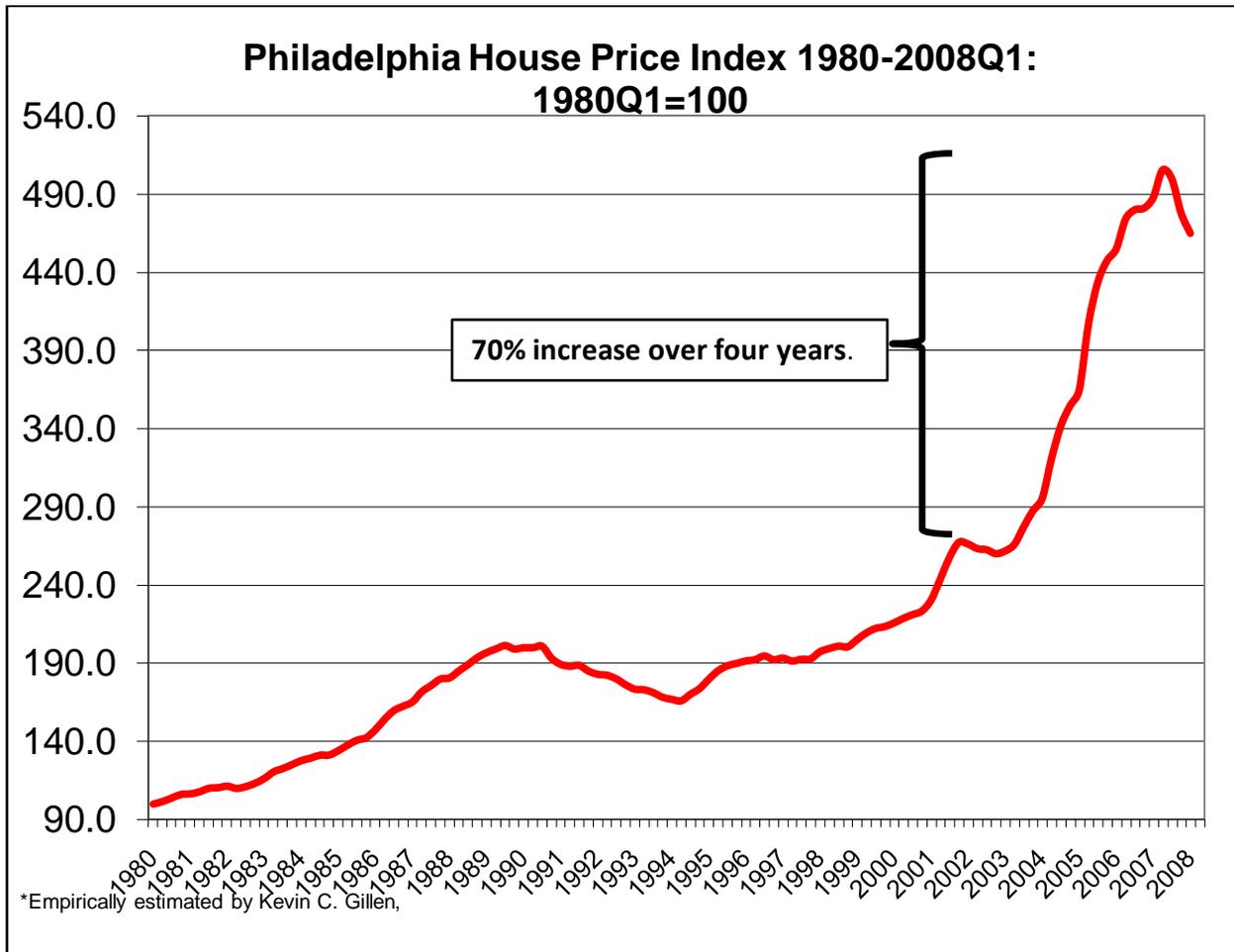
This map is essentially identical to the AR map because it basically shows the same thing: how a neighborhood is assessed relative to the citywide average. But, what it also shows is that only **one** neighborhood (Kingsessing) meets the IAAO’s professional guidelines of assessment accuracy and equity! In other words, the degree of relative over- and under-assessment is very large, even for specific neighborhoods and not just the city.

As support of this last statement, consider the range of ARs across neighborhoods. At the lowest end, Point Breeze is the most under-assessed neighborhood, with an AR of 13 and a PRD of 42, respectively. At the highest end is Southwest Philadelphia, with an AR of 44 and a PRD of 139.

A table reporting the AR and PRD of each neighborhood is located in the appendix of this report.

**Results in Context:** While these results may seem dramatic, they should be understood in context. In particular, it is helpful to examine what has happened in Philadelphia’s housing market since the results of the Tax Reform Commission were first published in late 2003.

The following chart shows the average path of citywide house prices over the past four years. It was computed via a regression which regresses individual house prices on factors affecting their value (e.g. size, age, physical condition, location), plus a vector of variables denoting what year and quarter each dwelling transacted in. This allows us to derive a house price index for the path of typical Philadelphia homes.



At the end of 2003, the index had a value of 286. By the end of 2007, the index had attained a value of 488. That is an increase of 70% over four years. In addition, this increase is greater than anything Philadelphia had ever experienced since 1980, and probably in living memory as well.

With such rapid increases in house values, it is more challenging for assessments to accurately keep up. As prices have grown faster than assessments, the difference between assessed values and market values has also grown. The result is that COD, which measures this gap, has also grown as well.

While this dramatic—and rapid—increase in house prices may explain the growing gap between assessments and property values, it does not entirely excuse it. The recent boom occurred over several years, not just one. Since properties are re-assessed every year, they should have at least partially kept up with these price increases. Indeed, four-fifths of all Philadelphia homes have been assigned new assessments during this period, which is the largest number of property revaluations in recent memory.

Although PRD has essentially remained unchanged during this time period, this probably has to do with the geographic variation in assessment error. As the maps indicate, relative over- and under-assessment is not clearly correlated with neighborhood housing values. There are both rich and poor neighborhoods that are both over- and under-assessed. Moreover, there is significant variation in how much house prices increased in different neighborhoods. While the 70% increase in house prices is the city's average, some neighborhoods grew in value by more than this, while others grew in value by less than this. The result is that these factors essentially cancelled each other out, so the net effect on overall regressivity is zero. So, while Philadelphia assessments may remain regressive, the degree of regressivity has not worsened over the past four years.

#### **Summary:**

- By the standard industry metrics of assessment accuracy, property assessments in Philadelphia have grown significantly more inaccurate since the results of the TRC were first published four years ago.
- However, this is primarily due to rapidly appreciating house prices rather than worsening assessments.
- But, because properties are re-assessed every year, and the boom in house prices occurred over several years, rising house prices may explain the growth in disparity, but do not excuse it.
- Although the regressivity of assessments has not worsened, assessments in general remain regressive, with owners of relatively lower-valued homes paying a higher percentage of their home's value in property taxes.
- **In summary, we are, on average, all significantly under-assessed, but wealthier households are more under-assessed than poorer households.**

## Part II

**Objective:** *To re-compute Philadelphia's Coefficient of Dispersion using a definition consistent with the Clifton v. Allegheny County decision.*

**Data:** The analysis presented here uses the exact same data as the analysis in the original report.

**Variable Definitions:** For each transaction, the following variables were computed:

**Assessment Ratio (AR):** The Assessment Ratio of a property is the ratio of each individual property's assessed value (AV) to its market value (MV)<sup>4</sup>. MV is proxied by the recorded sales price of each property.

$$AR_i = \frac{AV_i}{MV_i}$$

Where:

AV = Assessed Value (determined by the BRT)

MV = Market Value (the arms-length Sales Price)

i=1,2,...,N

N=# of properties=16,890

**Coefficient of Dispersion (COD):** The COD measures the accuracy of a dwelling's assessment by computing the absolute percentage by which the assessed value deviates from its market value:

$$COD_i = \frac{|AR_i - AR_0|}{AR_0}$$

Where: AR<sub>i</sub> = Assessment Ratio of ith property

AR<sub>0</sub> = Median Assessment Ratio in the taxing jurisdiction

(And | denotes the absolute value operator.)

The AR was computed for each property transaction in the sample. Across all 16,890 properties, the median AR was 34.4615%, and the mean AR was 37.9179%. The median value of 34.4615% was used as the value for AR<sub>0</sub> in the computation of each property's COD. The mean COD is then computed as the average COD across all properties.

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<sup>4</sup> Note: The nomenclature used in this document is different than the one used by Philadelphia's assessing authority, the BRT. In BRT terminology, "Market Value" is the BRT's estimation of what a property is worth, and "Assessed Value" is "Market Value" times the fractional assessment formula of 0.32. Instead, we use "Assessed Value" to mean the estimated appraisal value set by the assessor, and "Market Value" to mean the actual value the property would transact for under arms-length market conditions.

### **Citywide Results:**

- In 2003, we computed an average COD of 34.4%, more than double the recommended target. Moreover, only 51.4% of all homes analyzed had a COD of 15% or less.
- With the 2007 data, we computed an average COD of 40.7%. Additionally, only ~35% of all homes analyzed had a COD of 15% or less.
- **Clearly, assessment accuracy in Philadelphia has gotten worse since the original analysis done by the Tax Reform Commission five years ago.**

### **Neighborhood Results:**

We now perform this same analysis by neighborhood. This was done by simply computing the mean COD across all properties in a given neighborhood. Gray neighborhoods indicate neighborhoods in compliance with IAAO guidelines (COD $\leq$ 15%), and green neighborhoods indicating non-compliance (COD $>$ 15%). Darker shades of green indicate higher average CODs. Neighborhoods are labeled with the value of their average COD.



commercial property is characterized by many transactions in which the recorded price does not reflect a true market value. In particular, transactions which are blanket sales<sup>5</sup>, are done for tax purposes, or involve public sector entities<sup>6</sup> are common. Of the 9,138 commercial transactions which occurred in 2006 and 2007, only 7,391 qualified as occurring under arms-length conditions. Their breakdown by type of property is as follows:

<b>Cat_Code</b>	<b>Category</b>	<b># Transactions</b>
2	Hotels and Apartments	3,813
3	Retail	1,410
4	Commercial	759
5	Industrial	302
6	Vacant Land	1,107
	<b>Total</b>	<b>7,391</b>

*Source: BRT Property File*

The COD and PRD were then computed for each category of property type, for all properties across the city.

**Citywide Results:**

Table Two compares the average COD for 2006-2007, to the average COD computed in 2003 by the Tax Reform Commission:

<b>Category</b>	<b>Target*</b>	<b>2003</b>	<b>2006-2007</b>
Hotels and Apartments	<=15%	32.2%	47.8%
Retail	<=15%	48.6%	69.6%
Commercial	<=15%	46.7%	80.6%
Industrial	<=15%	58.9%	64.6%
Vacant Land	<=20%	77.4%	159.8%

*\*Source: International Association of Assessing Officers*

- Average assessment error has gotten significantly worse since the TRC last analyzed the issue. Average CODs have grown significantly in all categories of property since 2003.

<sup>5</sup> A blanket sale is one in which several properties are transacted for a single “blanket” price.

<sup>6</sup> e.g. the Redevelopment Authority

- No category of real estate in Philadelphia meets IAAO guidelines for accuracy.

Table Three gives a similar analysis for the PRD:

<b>Category</b>	<b>Target*</b>	<b>2003</b>	<b>2006-2007</b>
Hotels and Apartments	.98-1.03	1.12	1.08
Retail	.98-1.03	1.22	1.37
Commercial	.98-1.03	1.15	0.89
Industrial	.98-1.03	1.21	1.08
Vacant Land	.98-1.03	1.46	0.97

*\*Source: International Association of Assessing Officers*

The results for assessment equity are more mixed than for assessment accuracy:

- Since 2003, assessment equity has improved for every category of property except retail.
- However, despite these improvements, no category of property meets IAAO guidelines for assessment equity (although, vacant land comes very close).
- Hotels, Apartments, Retail and Industrial properties are assessed *regressively*: higher-valued properties pay a *smaller* percentage of their value in property taxes.
- Commercial properties and vacant land are assessed *progressively*: higher-valued properties pay a *higher* percentage of their value in property taxes.

In summary, the results indicate that assessment accuracy in Philadelphia has worsened since 2003. While assessment equity has exhibited some relative improvement, all categories of real estate still fail to meet IAAO guidelines for either accuracy or equity.

### **Citywide STEB and COD Ratios:**

Every year, the Commonwealth’s State Tax Equalization Board (STEB) determines the ratio of assessed values to market values for each county in Pennsylvania. Used for tax assessment purposes, these ratios are known as STEB ratios or Common Level Ratios. Dividing a particular property’s assessed value by its STEB ratio gives the property’s implied market value. Hence, the STEB ratio (aka Common Level Ratio) for a county is simply the ratio of its total assessed value to its total market value:

$$STEB = \frac{\sum_{i=1}^N AV_i}{\sum_{i=1}^N MV_i}$$

I compute this using the same data that was utilized in my analysis of both single-family residences (16,890 arms-length transactions in 2007) and commercial properties (7,391 arms-length transactions in 2006-2007). The numerator is simply the sum of assessed values<sup>7</sup> across all 24,281 properties, while the denominator is simply the sum of transaction prices across all 24,281 properties:

$$\begin{aligned} STEB &= \$2,381,794,256 / \$5,596,722,437 \\ &= 42.56\% \end{aligned}$$

The calculated STEB ratio is 42.56%, which implies that Philadelphia's stock of real estate is assessed at approximately 43% of its actual market value. Note that this contrasts with the 2006 reported STEB of 29.7%. If you believe this ratio should actually be the ratio of *assessments*, (and not assessed value), simply multiply the numerator by 0.32 to obtain \$762,174,162, and dividing by the denominator yields a STEB of 13.62%.

We now compute the COD across all properties. To do this, it's first necessary to identify the median assessment ratio (AR) across all properties. After computing each property's assessment ratio, the median was computed to be 34.25%. Each property's COD was then computed as the absolute percent deviation of its AR from this median value. The average COD across all 24,281 properties was then computed to be 50.1%. Note that this is less than the average CODs when it is computed separately for each category of property. However, it still exceeds the IAAO-recommended guideline of 15% by several multiples, and exceeds the value of 39.5% reported by the STEB.

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<sup>7</sup> Note: This number is from BRT, but BRT refers to this number as the "Market Value".

## Appendix: Assessment Statistics by Neighborhood

<b>Neighborhood</b>	<b>Assmt Ratio</b>	<b>PRD</b>
Allegheny West	35.4	111.8
Bella Vista/Southwark	18.4	58.3
Bridesburg	28.8	91.0
Bustleton	37.0	116.9
Cedarbrook/Stenton	42.4	133.7
Center City/East	33.2	104.8
Center City/West	30.7	96.8
Chestnut Hill	34.5	109.1
East Falls	30.4	95.9
East Germantown	35.6	112.3
East Mount Airy	35.4	111.8
Eastwick	40.7	128.6
Fairhill	21.8	69.0
Fairmount/Spring Garden	26.3	82.9
Fox Chase/Burholme	37.1	117.2
Frankford	35.1	110.9
Germantown	30.5	96.2
Grays Ferry	25.6	80.8
Holmesburg	36.8	116.3
Hunting Park	28.4	89.6
Juniata Park/Feltonville	38.8	122.6
Kensington	27.4	86.4
Kingsessing	31.5	99.3
Lawncrest	38.4	121.2
Logan/Ogontz/Fern Rock	42.0	132.5
Manayunk	25.7	81.2
Mantua	23.7	74.8
Mayfair	36.6	115.7
North Philadelphia/East	18.7	59.1
North Philadelphia/West	16.9	53.3
Northeast Philadelphia	35.6	112.6
Northern Liberties/Fishtown	19.0	59.9
Oak Lane/East Oak Lane	37.9	119.6
Olney	42.5	134.3
Overbrook	38.0	120.1
Oxford Circle/Castor	37.1	117.3
Parkland	30.9	97.7
Point Breeze	13.3	42.0
Port Richmond	29.1	91.9

Powelton Village/West Powelt	19.8	62.5
Queen Village/Pennsport	22.3	70.5
Rhawnhurst	37.8	119.2
Roxborough	34.0	107.4
Schuylkill/SW Center City	14.2	44.9
Somerton	38.0	120.0
South Philadelphia/East	24.3	76.8
South Philadelphia/West	28.6	90.3
Southwest Philadelphia	43.9	138.7
Tacony/Wissinoming	36.8	116.2
Tioga/Nicetown	40.9	129.3
Torresdale	34.7	109.5
University City	22.5	70.9
West Mount Airy	35.5	112.0
West Oak Lane	43.1	136.2
West Philadelphia/Cobbs Cree	35.6	112.5
West Philadelphia/Parkside	33.9	107.1
Wynnefield	36.4	114.8