

Predictable Mass Appraisal and the Real Property Income and Expense Portal

Robert Ross

Chief Data Officer, Cook County Assessor's Office

1/29/2020

Three numbers

$$\textit{Tax bill} = \frac{\textit{Levy}}{\textit{Base}} * \textit{Your value}$$

PTAXSIM mostly addresses this ratio

- **Levy:** The amount of property tax revenues the government will try to collect
- **Base:** The total market value available to the government for property taxation.
- **Your value:** Your market value, minus exemptions where applicable.

The Levy

Scenario 1: simulate tax increase alone

- The workbook comes with a pre-calculated scenario showing the impact of a \$94 million increase in the City of Chicago's property tax levy.
- User can use the 'simulating scenarios' sheet to input the desired property value and class.
- Select scenario 1.
- Again, noting small differences in actual calculation vs. tax bills due to truncation and rounding errors.



Panel 1 - User Input

In addition to calculating actual tax bills, this worksheet can calculate tax bills under constructed hypothetical scenarios.

Scenario	Scenario Description
Scenario 1 - Increase in City taxes	From 2018 to 2019, the City of Chicago increased the amount of money it was raising from property taxes by \$83 million, or 6.52%. Suppose instead that it had increased its levy by substantially more - what would have been the impact on taxpayers? In this scenario, alt 2019 adds an additional \$94 million to the actual \$83 million increase in property taxes in 2019.
Property Class	
300 Class Commercial Apartments > 7 units	
Tax Year**	Property Value
actual 2019	<u>\$1,000,000</u>
alt 2019	<u>\$1,000,000</u>

Poll #1

- Holding the tax base constant, what would have been the impact of increasing the City's levy by \$94 million on 3-00 class property's tax bills?
 - \$0-\$100 / \$1 million in market value
 - \$100 - \$500 / \$1 million in market value
 - \$500 - \$1,000 / \$1 million in market value
 - \$1,000 - \$1,500 / \$1 million in market value
 - >\$1,500 / \$1 million in market value

Panel 2 - TAXING DISTRICT BREAKDOWN - TAXES

	Municipal Budgets (millions)		Total Municipal Assessed Value (billions)		Calculated Effective Millage Rate (% of property value)		Your Tax Bill for Each Jurisdiction	
	actual 2019	alt 2019	actual 2019	alt 2019	actual 2019	alt 2019	actual 2019	alt 2019
INFRASTRUCTURE AND RECREATION TAXES								
Metro Water Reclamation Dist. of Chicago	\$637	\$637	\$56	\$56	1.1326	1.1326	\$1,133	\$1,133
Parks-Museum/Aquarium Bond	\$0	\$0	\$30	\$30	-	-	\$0	\$0
Chicago Park District	\$286	\$286	\$30	\$30	0.9498	0.9498	\$950	\$950
Subtotal							\$2,082	\$2,082
SCHOOL TAXES								
Board of Education Chicago	\$3,178	\$3,178	\$30	\$30	10.5538	10.5538	\$10,554	\$10,554
Chicago Community College District	\$130	\$130	\$30	\$30	0.4336	0.4336	\$434	\$434
Subtotal							\$10,987	\$10,987
CITY TAXES								
Chicago School Bldg & Imp Fund	\$148	\$148	\$30	\$30	0.4922	0.4922	\$492	\$492
Chicago Library Fund	\$106	\$106	\$30	\$30	0.3527	0.3527	\$353	\$353
City of Chicago	\$1,407	\$1,445	\$30	\$30	4.6720	4.7973	\$4,672	\$4,797
Subtotal							\$5,517	\$5,642
COUNTY TAXES								
Cook County Forest Preserve District	\$98	\$98	\$57	\$57	0.1719	0.1719	\$172	\$172
County of Cook, Public Safety, & Health Facilities	\$758	\$758	\$57	\$57	1.3235	1.3235	\$1,324	\$1,324
Subtotal							\$1,495	\$1,495
Totals before exemptions#	\$6,749	\$6,787			20.0820	20.2073	\$20,082	\$20,207

\$125 per \$1 mln in market value. For 5-00 class, its \$313 per \$1 mln

The Base

IL Dept. of Revenue Ratio Studies

Assessment Ratios 2018

Geographic Area		Adjusted Median	Median	Coefficient of Dispersion (COD)	Number of Sales	Quartiles 1st	Quartiles 3rd	Ratio Range	Price-related Differential (PRD)	95% Confidence Interval	Coefficient of Concentration (COC)
Cook County											
(All Districts and Townships are listed by Property Groups.)											
Total County	1	5.60	5.31	141.41	241	2.46	11.23	87.43	2.89	4.30 - 5.86	10.79
	2	8.67	8.19	22.55	24,942	6.99	9.53	26.90	1.04	8.16 - 8.21	33.96
	3	6.70	6.07	54.62	224	4.52	8.62	36.14	1.43	5.60 - 6.54	17.41
	4	-	8.97	0.00	1	-	-	0.00	1.00	- - -	100.00
	5-A	22.72	20.66	50.71	254	14.44	29.57	100.83	1.84	19.00 - 22.47	14.96
	5-B	21.40	20.73	50.71	77	14.56	27.42	88.67	1.54	18.42 - 23.26	20.78
Township/Districts											
Triad Assmt. District 1	1	-	5.85	166.62	137	2.46	14.02	87.06	4.77	5.07 - 7.16	13.87
	2	-	7.78	24.35	11,216	6.59	9.06	24.05	1.07	7.74 - 7.82	34.48
	3	-	5.89	61.61	172	4.16	8.79	36.14	1.49	5.40 - 6.37	19.19
	4	-	8.97	0.00	1	-	-	0.00	1.00	- - -	100.00
	5-A	-	19.11	53.68	131	14.06	28.60	100.83	2.08	17.54 - 21.31	17.56
	5-B	-	10.71	117.93	18	4.48	22.87	88.67	2.53	- - -	16.67
Triad Assmt. District 2	1	-	3.14	60.59	48	1.74	4.92	14.11	1.27	2.36 - 3.69	12.50
	2	-	8.23	18.34	7,282	7.06	9.44	23.42	0.97	8.18 - 8.27	36.42
	3	-	6.04	28.26	22	4.66	6.87	12.01	1.17	4.81 - 6.69	22.73
	5-A	-	22.81	39.94	55	14.92	29.23	58.86	1.52	17.56 - 24.73	18.18
	5-B	-	20.19	39.61	40	16.73	25.78	62.82	1.13	18.10 - 24.23	25.00
Triad Assmt. District 3	1	-	6.98	85.61	56	3.84	12.55	58.43	1.30	5.14 - 10.42	5.36
	2	-	8.89	22.21	6,444	7.66	10.42	26.66	1.05	8.84 - 8.95	35.07
	3	-	7.43	32.16	30	5.60	9.30	13.92	1.19	5.85 - 8.62	20.00
	5-A	-	23.70	48.31	68	16.26	33.07	89.97	1.73	18.50 - 27.90	16.18
	5-B	-	27.65	39.05	19	17.14	38.64	49.49	1.29	- - -	10.53

5-B - Industrial Property; 5-A - All other Class 5 property

** Insufficient data available. Analysis made only for property groups containing 25 or more transfers.

*** No adjustments necessary because there was no significant reassessment in 2015.

Simulated growth rates by class

Major Class	2018 ratio
Vacant Land	5.85%
Residential	7.78%
Commercial Apartments	5.89%
Non-Profit	8.97%
Commercial and Industrial	18.04%

***Based on figures from a forthcoming property tax incidence study from the Urban Land Institute Chicago District Council**

Parameter Table 1

In the table below, the user can input growth rates in EAV by property class to simulate tax bases for the City of Chicago. Figures on the worksheet 'Scenario Data' are driven by this table.

Class	Class Description	Actual growth rate in gross EAV 18-19	Simulated growth rate in gross EAV 18-19
1	Vacant Land	0.43%	83.00%
2	Residential	-0.15%	36.00%
3	Commercial Apartments	10.19%	84.00%
4	Non-Profit	0.72%	121.00%
5	Commercial and Industrial	4.58%	44.00%
6	Industrial Incentive	10.20%	10.20%
7	Commercial Incentive	7.11%	7.11%
8	Commercial/Industrial Incentive	244.30%	244.30%
9	Commercial Apartment Incentive	24.85%	24.85%



The Cook County Assessor's Property Tax Rate Simulator

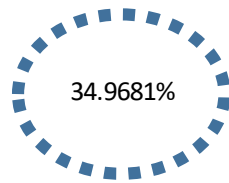
Simulating Scenarios
V 1.0

Panel 1 - User Input

In addition to calculating actual tax bills, this worksheet can calculate tax bills under constructed hypothetical scenarios.

Total City Base Simulations

	2019 EAV	Variance from actual 2019 figures
City of Chicago Tax Base on Agency Rate Report	\$ 87,816,177,317	0.0000%
<i>Actual 2019 Increment in City of Chicago</i>	\$ 16,987,853,372	
Net City of Chicago Tax Base 2019 based on calculations in this workbook	\$ 87,984,499,223	0.1917%
Simulated City of Chicago Tax Base Using Parameters in Parameter Table 1	\$ 118,523,825,330	34.9681%



34% larger base

Scenario	Scenario Description
Scenario 2 - Increase in the Tax Base	From 2018 to 2019, assessed values of commercial properties grew by about 20%, while the total value of residential properties grew by about 14%. On the worksheet 'Growth Simulation,' the user can input their own growth figures for EAV. The default is the baseline.
Property Class	
300 Class Commercial Apartments > 7 units	
Tax Year**	Property Value
actual 2019	\$1,000,000
alt 2019	\$1,000,000

Poll #2

- Holding the tax base constant, what would have been the impact of increasing the City's tax base by 30% on 3-00 class property's tax bills?
 - \$0-\$100 / \$1 million in market value
 - \$100 - \$500 / \$1 million in market value
 - \$500 - \$1,000 / \$1 million in market value
 - \$1,000 - \$1,500 / \$1 million in market value
 - >\$1,500 / \$1 million in market value

Panel 2 - TAXING DISTRICT BREAKDOWN - TAXES

	Municipal Budgets (millions)		Total Municipal Assessed Value (billions)		Calculated Effective Millage Rate (% of property value)		Your Tax Bill for Each Jurisdiction	
	actual 2019	alt 2019	actual 2019	alt 2019	actual 2019	alt 2019	actual 2019	alt 2019
	INFRASTRUCTURE AND RECREATION TAXES							
Metro Water Reclamation Dist. of Chicago	\$637	\$637	\$56	\$56	1.1326	1.1326	\$1,133	\$1,133
Parks-Museum/Aquarium Bond	\$0	\$0	\$30	\$41	-	-	\$0	\$0
Chicago Park District	\$286	\$286	\$30	\$41	0.9498	0.7025	\$950	\$703
<i>Subtotal</i>							\$2,082	\$1,835
SCHOOL TAXES								
Board of Education Chicago	\$3,178	\$3,178	\$30	\$41	10.5538	7.8058	\$10,554	\$7,806
Chicago Community College District	\$130	\$130	\$30	\$41	0.4336	0.3205	\$434	\$320
<i>Subtotal</i>							\$10,987	\$8,126
CITY TAXES								
Chicago School Bldg & Imp Fund	\$148	\$148	\$30	\$41	0.4922	0.3640	\$492	\$364
Chicago Library Fund	\$106	\$106	\$30	\$41	0.3527	0.2608	\$353	\$261
City of Chicago	\$1,407	\$1,407	\$30	\$41	4.6720	3.4555	\$4,672	\$3,456
<i>Subtotal</i>							\$5,517	\$4,080
COUNTY TAXES								
Cook County Forest Preserve District	\$98	\$98	\$57	\$65	0.1719	0.1513	\$172	\$151
County of Cook, Public Safety, & Health Facilities	\$758	\$758	\$57	\$65	1.3235	1.1650	\$1,324	\$1,165
<i>Subtotal</i>							\$1,495	\$1,316
Totals before exemptions#	\$6,749	\$6,749			20.0820	15.3581	\$20,082	\$15,358

-\$4.7K per \$1 mln in market value. For 5-00 class, its \$11.8K per \$1 mln

$$\textit{Tax bill} = \frac{\textit{Levy}}{\textit{Base}} * \textit{Your value}$$

✓

? ? ? ?

✓

An average 84% increase in commercial apartment values \neq your apartment's value will increase 84%.

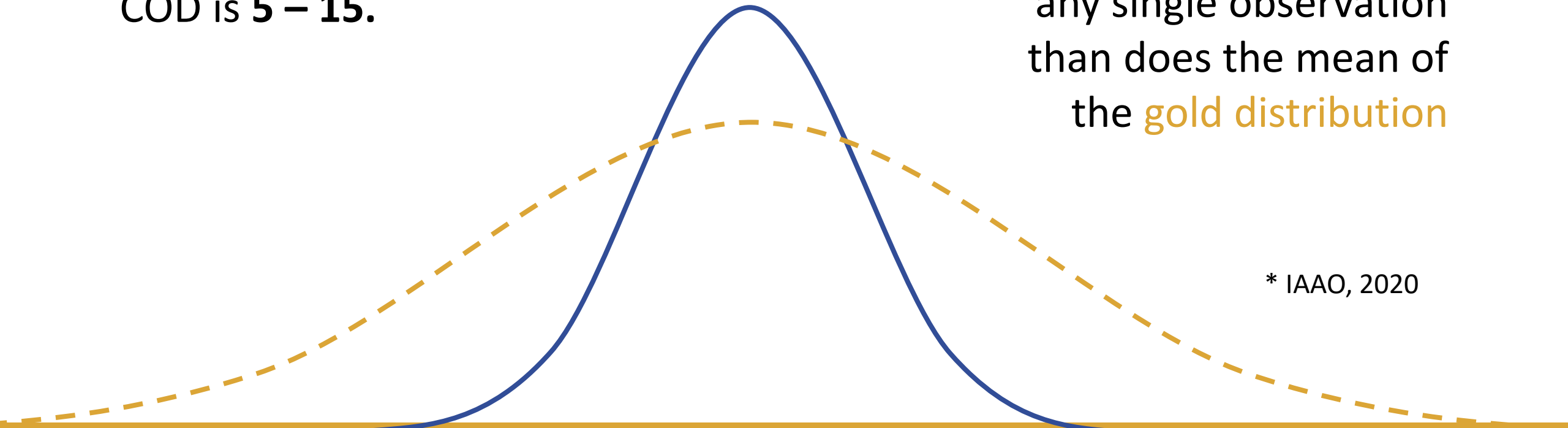
High dispersion in 2018 commercial assessments

Two distributions.
Same mean.

Range for
COD is **5 – 15**.

apartments are at...
~50*

The mean of the **blue distribution** provides more information about any single observation than does the mean of the **gold distribution**



* IAAO, 2020

**RPIE will reduce dispersion of
estimated values and increase
predictability**

Poll #3

- How likely are you to file an RPIE or encourage others to file an RPIE before March of 2021?
 - I will certainly not.
 - Very unlikely
 - 50/50
 - Fairly likely
 - Certainly
 - Not sure/don't know/not applicable

Automated Valuation

- The data science department has built an open-source automated valuation model for commercial apartments.
- [Source code](#) is available to the public.
- Output and supporting data is available to the public.
- Robust technical documentation is available to the public.
- Automated valuation increases speed and predictability in assessments.
- Automated Valuation Model output is then reviewed intensively by Valuations Department's commercial team.

Current RPIE coverage

- The RPIE response rate is really low.
- 100% response rate is not required for a high level of precision.
- Timing is important: RPIE filings in the next few months will be far more important to initial assessments than filings in the summer/fall.

City	Total PINs	Filed RPIE
Hyde Park	2263	1.2%
Jefferson	2081	0.6%
Lake	1491	0.9%
Lake View	2048	2.7%
North Chicago	500	1.8%
Rogers Park	774	1.4%
South Chicago	431	1.2%
West Chicago	2256	1.9%

Current AVM performance

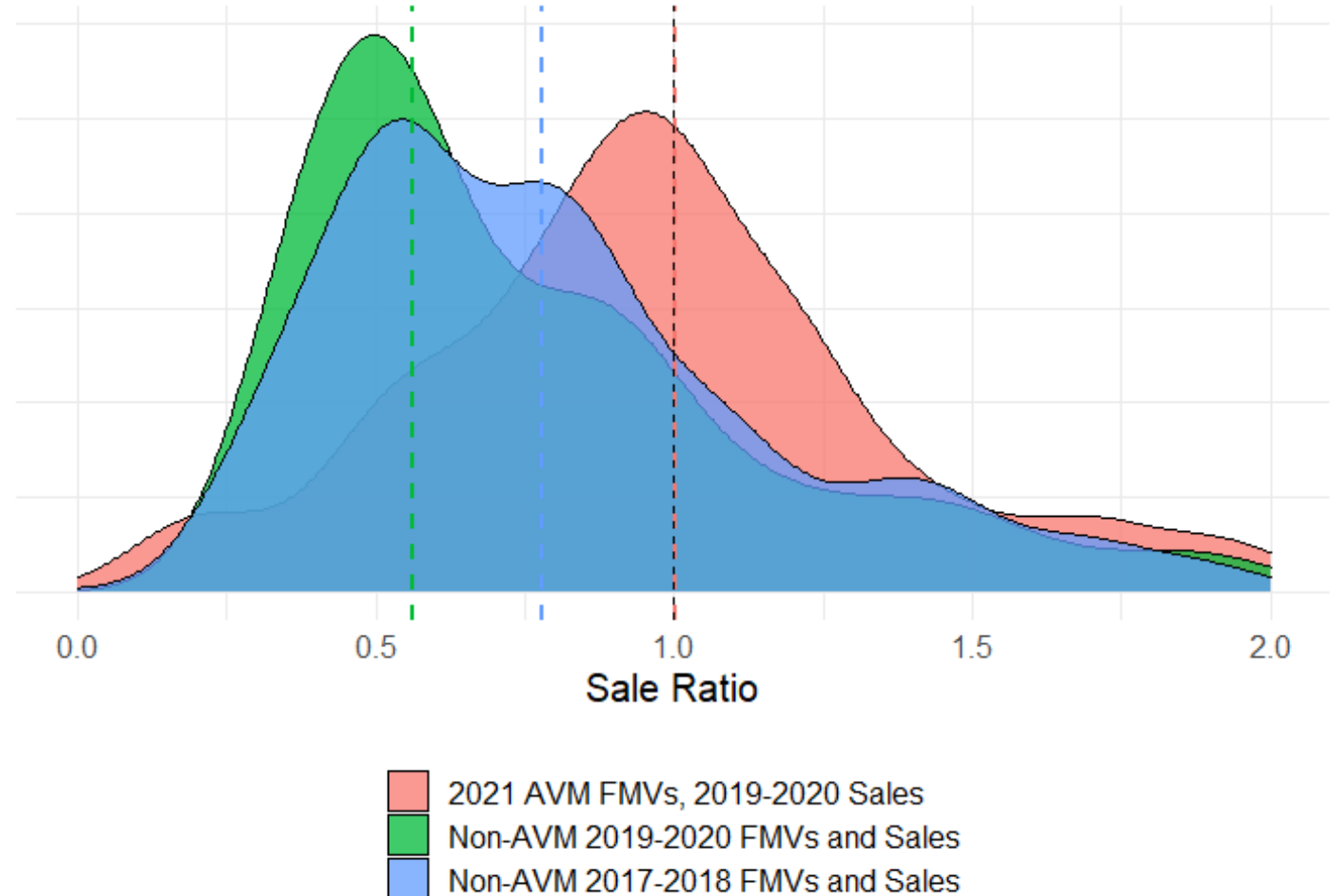
	N Sales	Total FCV (Blns)	Median year-over-year change in FCV	Median Ratio	COD	PRD
AVM						
2021	139	\$30	73%	1.00	38.60	1.33
Non-AVM						
2020	144	\$4	65%	0.79	42.92	1.32
2019	30	\$7	94%	0.50	19.77	1.08
2018	373	\$22	19%	0.77	52.56	1.53

*This performance is based off a 1% RPIE filing rate.

Current AVM performance

- Sales ratios help characterize the overall quality of assessments for a specific group and period of time.
 - Ratio = Sale Price / Fair Market Value
 - 1 → accurate
 - < 1 → under-valued
 - >1 → over-valued
- AVM achieves a median ratio of exactly one.
- AVM still produces a high dispersion.

Distribution of Sales Ratios
by PINs



Gross Potential Income Calculation

- Assemble all rented units for all RPIE filings.
- Add:
 - Unit physical attributes.
 - Building attributes.
 - Location attributes.
 - Time of lease.
 - Property grade and other strata.
- Use regression analysis to predict individual unit rents.
- Aggregate to the building & PIN level.

RPIE data drives GPI estimation

RPIE rented
units

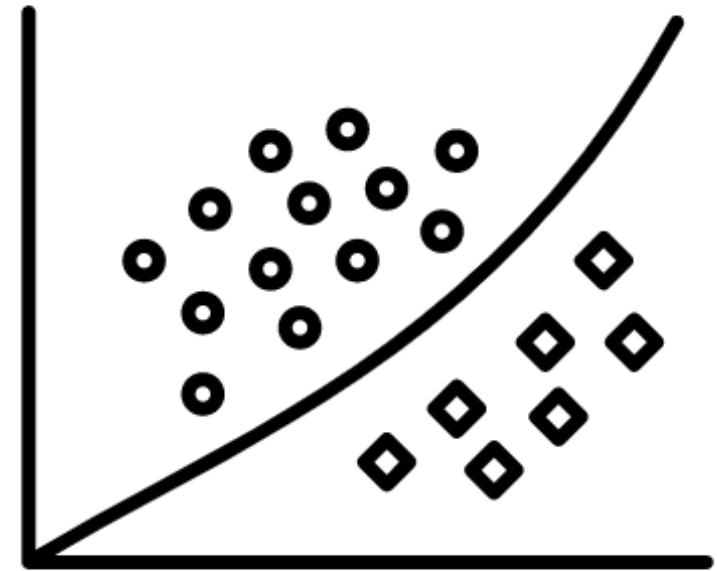
- Lease date, monthly rent
- Unit, building, and neighborhood characteristics

RPIE vacant
units

- Unit, building, and neighborhood characteristics

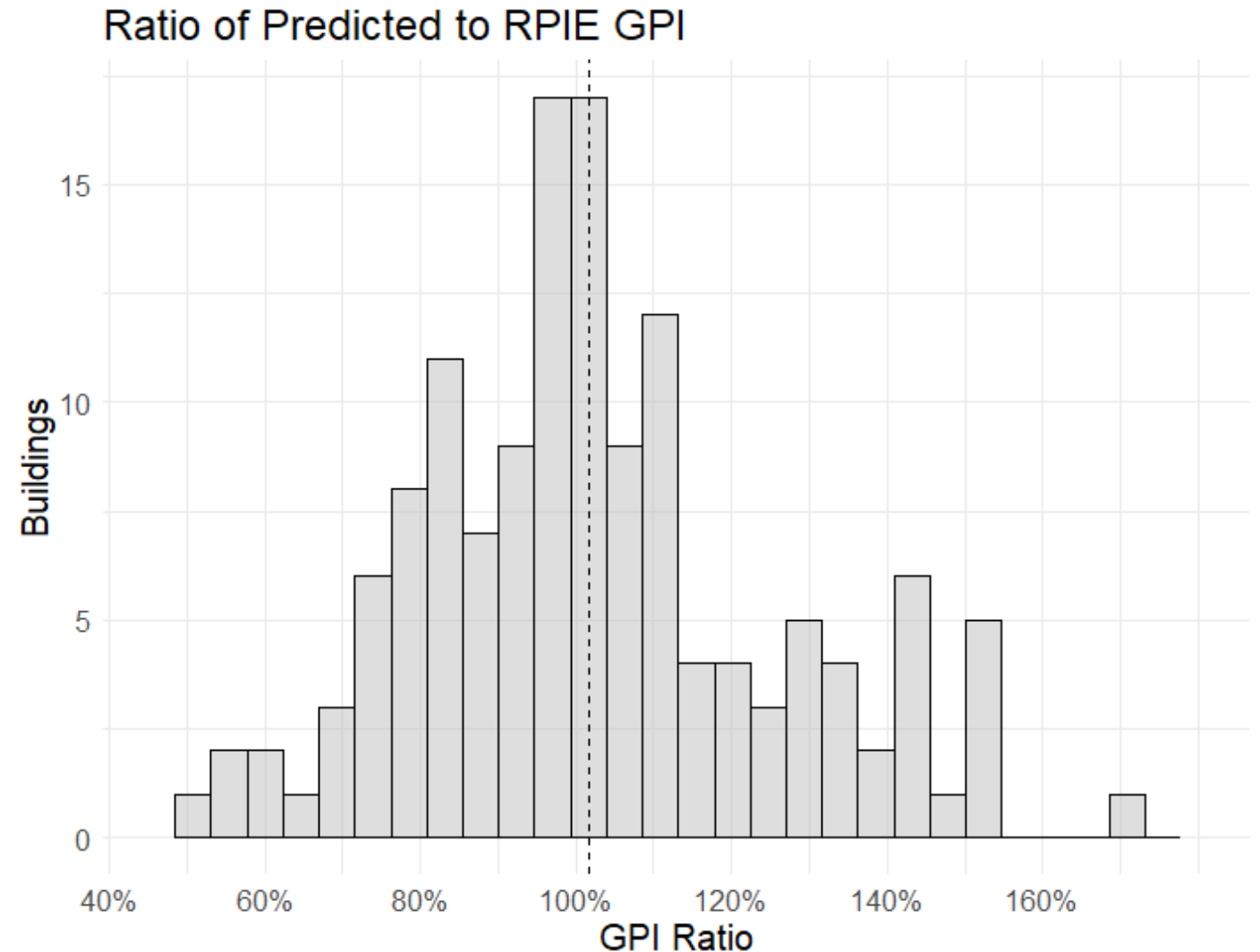
Units w/o
RPIE

- Unit, building, and neighborhood characteristics



Dispersion of GPI estimates

- Graph shows percentage difference between AVM predicted GPI, and reported GPI via RPIE.
- $R^2 = 65\%$
- Dispersion is fairly high.
- Dispersion of GPI estimates drives dispersion in overall predictions.
- More RPIE \rightarrow less dispersion.



Chicago rents fell 12% in 2020. For renters, it ‘restores your faith in humanity.’ For landlords, ‘it’s a huge hit.’

By HANNAH HERRERA GREENSPAN

CHICAGO TRIBUNE | JAN 11, 2021 AT 11:48 AM

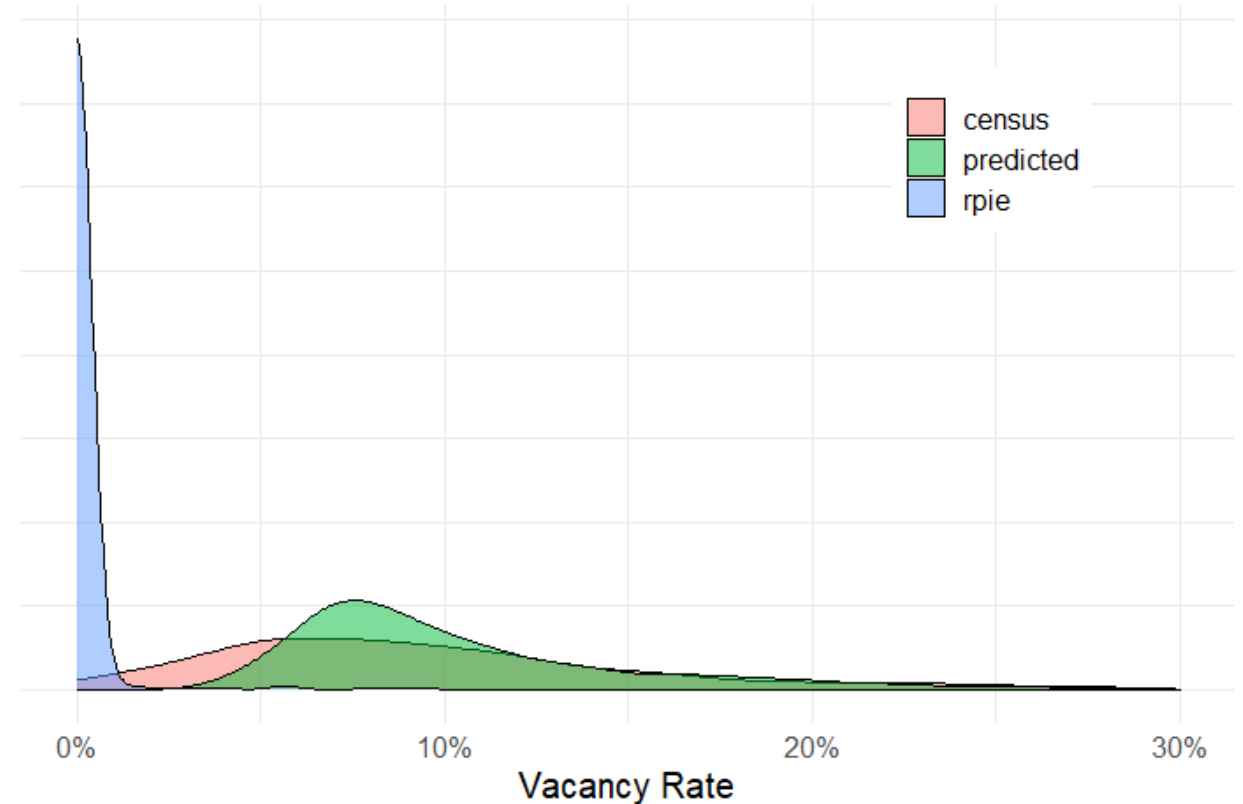


- There are about 320,000 residential rental apartments in Chicago.
 - ~16,000 properties.
- ~ 1% completed RPIE filings last year
- Low RPIE response rates make it very difficult to build a statistical model that can account for recent changes in rental amounts.
 - Especially true if changes in rental values are isolated to specific sub-markets and/or regions.

Vacancy

- RPIE asks 'how many months over the past year was this unit vacant.'
- This is used to power a statistical model to estimate vacancy rates.
- Nearly all RPIE filings report a very low vacancy.
- Model estimates an average vacancy rate ~ 7%.
- Again, high dispersion.

Distribution of Vacancy Rates
across Census Tracts



The script chose to use **ACS** vacancy rates to construct GPI for this report.

Income and Expenses

SCHEDULE E Supplemental Income and Loss
(Form 1040) (From rental real estate, royalties, partnerships, S corporations, estates, trusts, REMICs, etc.)
 Department of the Treasury
 OMB No. 1545-0045
 2016 Attachment Sequence No. 13

Name(s) shown on return: [REDACTED]

Part I Income or Loss From Rental Real Estate and Royalties Note. If you are in the business of renting real estate, report the income or loss from Form 4835 on page 2, line 40 of Schedule C or C-EZ (see instructions). If you are an individual, report farm rental income or loss from Form 4835 on page 2, line 40 of Schedule C or C-EZ (see instructions). If you are an individual, report farm rental income or loss from Form 4835 on page 2, line 40 of Schedule C or C-EZ (see instructions).

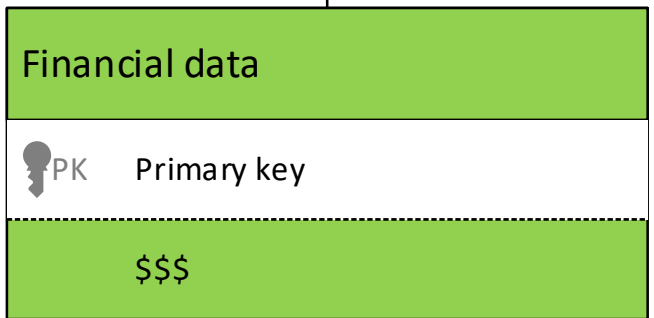
A. Did you make any payments in 2016 that would require you to file Form(s) 1099? (see instructions) Yes No
 B. If "Yes," did you or will you file required Form(s) 1099? Yes No

1b	Type of Property (from list below)	2 For each rental real estate property listed above, report the number of fair rental and personal use days.	Fair Rental Days	Personal Use Days	QJV
A	only if you meet the requirements to file as a qualified joint venture. See instructions.	A			
B		B			
C		C			

Personal use days. Check the QJV box.
Type of Property:
 1 Single Family Residence
 2 Multi-Family Residence
 3 Vacation/Short-Term Rental
 4 Commercial
 5 Land
 6 Royalties
 7 Self-Rental
 8 Other (describe)

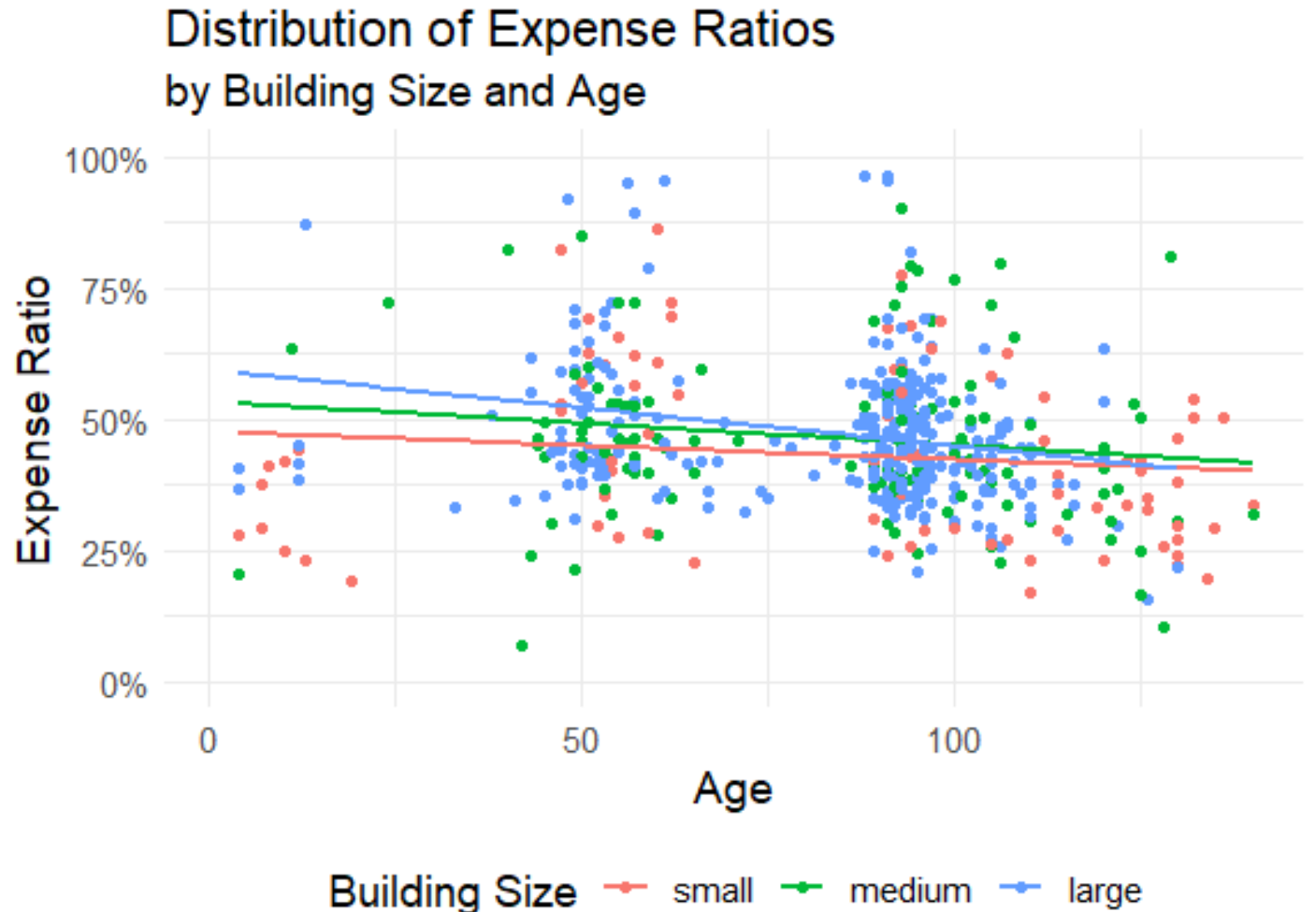
Income:	Properties:	A	B	C
3 Rents received				
4 Royalties received				
Expenses:				
5 Advertising				
6 Auto and travel (see instructions)				
7 Cleaning and maintenance				
8 Commissions				
9 Insurance				
10 Legal and other professional fees				
11 Management fees				
12 Mortgage interest paid to banks, etc. (see instructions)				
13 Other interest				
14 Repairs				
15 Supplies				
16 Taxes				
17 Utilities				
18 Depreciation expense or depletion				
19 Other (list)				
20 Total expenses. Add lines 5 through 19		22		
23a Total of all amounts reported on line 3 for all rental properties			23a	
Total of all amounts reported on line 4 for all royalty properties			23b	
Total of all amounts reported on line 12 for all properties			23c	
Total of all amounts reported on line 18 for all properties			23d	
Total of all amounts reported on line 20 for all properties			23e	
24 Income. Add positive amounts shown on line 21. Do not include any losses here.			24	
25 Losses. Add royalty losses from line 21 and rental real estate losses from line 22. Enter total losses here.			25	
26 Total rental real estate and royalty income or (loss). Combine lines 24 and 25. Enter the result here.			26	

For Paperwork Reduction Act Notices, see the separate instructions. Cat. No. 11344L. Schedule E



Expense ratios

- Plot to the right shows actual reported expenses ratios.
- Age and building size impact expense ratio.
- Without sufficient RPIE filings, we lack the ability to run a statistical model on these outcomes.
- Resort to non-statistical approaches, like taking medians within categories.

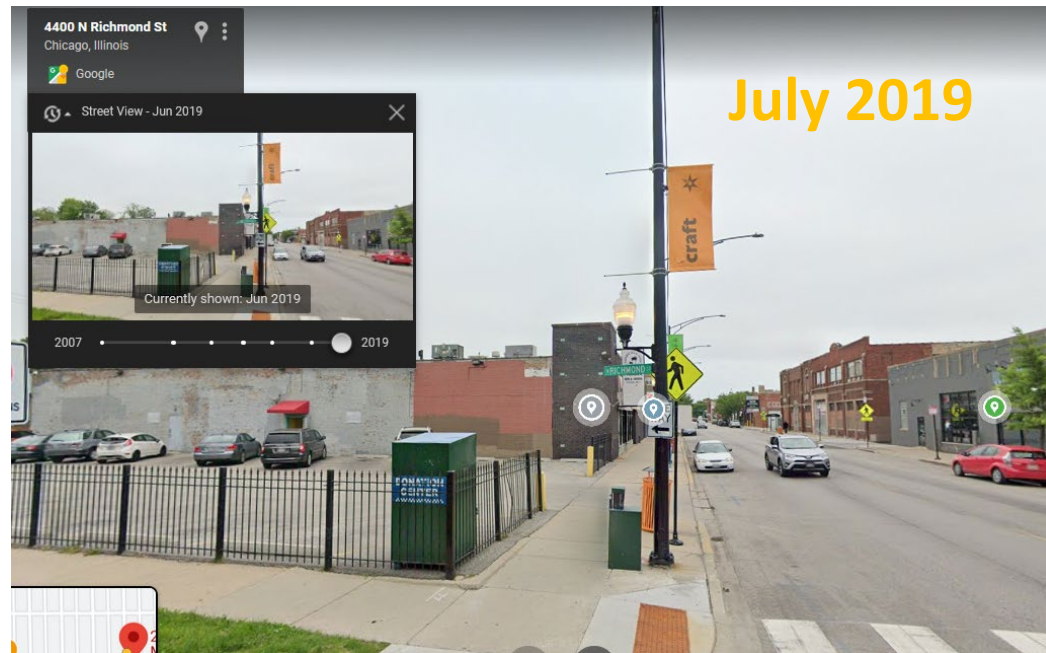


Y axis limited at 1 | 528 total, 512 unique expense ratios constructed using RPIE filings

Free rent, concessions, & affordable housing

- RPIE asks for
 - Total amount of free rent by unit
 - Affordable housing status by unit
 - Total concessions for commercial units
- This allows us to adjust assessments as appropriate by individual property, or by group...
- If we have a sufficient number of RPIE filings to identify these properties and/or groups.

Changes to characteristics



RPIE allows basic characteristics issues to be quickly addressed

Pre-RPIE

- Property assessed as though a building existed on it.
- Mailed AV = \$240K
- Appeal
- Certified AV ~ \$30K

RPIE

- Property assessed as it actually stood on 1/1/2021.
- No appeal necessary...
- ...if RPIE is filed

Ideal predictability

- Online application, hosted by the CCAO. User inputs a commercial PIN, and sees:
- Gross Potential Income calculation with real data.
- Vacancy and expense ratios applied to that PIN, with justification and supporting data
- Capitalization rates applied to that PIN, with justification and supporting data
- Any other value-modifications.
- Current trends and data that may impact future values.

**We need your help to make this
a reality.**

Complete your 2021 RPIE filing now!

Poll #4

- How likely are you to file an RPIE or encourage others to file an RPIE before March of 2021?
 - I will certainly not.
 - Very unlikely
 - 50/50
 - Fairly likely
 - Certainly
 - Not sure/don't know/not applicable

Thank You.

ross@cookcountyassessor.com

Gitlab.ccao_ross

Sources and links

- [Real Property Income and Expense Online Portal](#)
- [CCAO's V1 of Commercial Apartment Modeling](#)
 - [Preliminary valuation report](#)
- CCAO Open Data
 - Apartment unit level data
 - PIN level data