Are Estimates of Rapid Growth in Urban Land Values an Artifact of the Land Residual Model?

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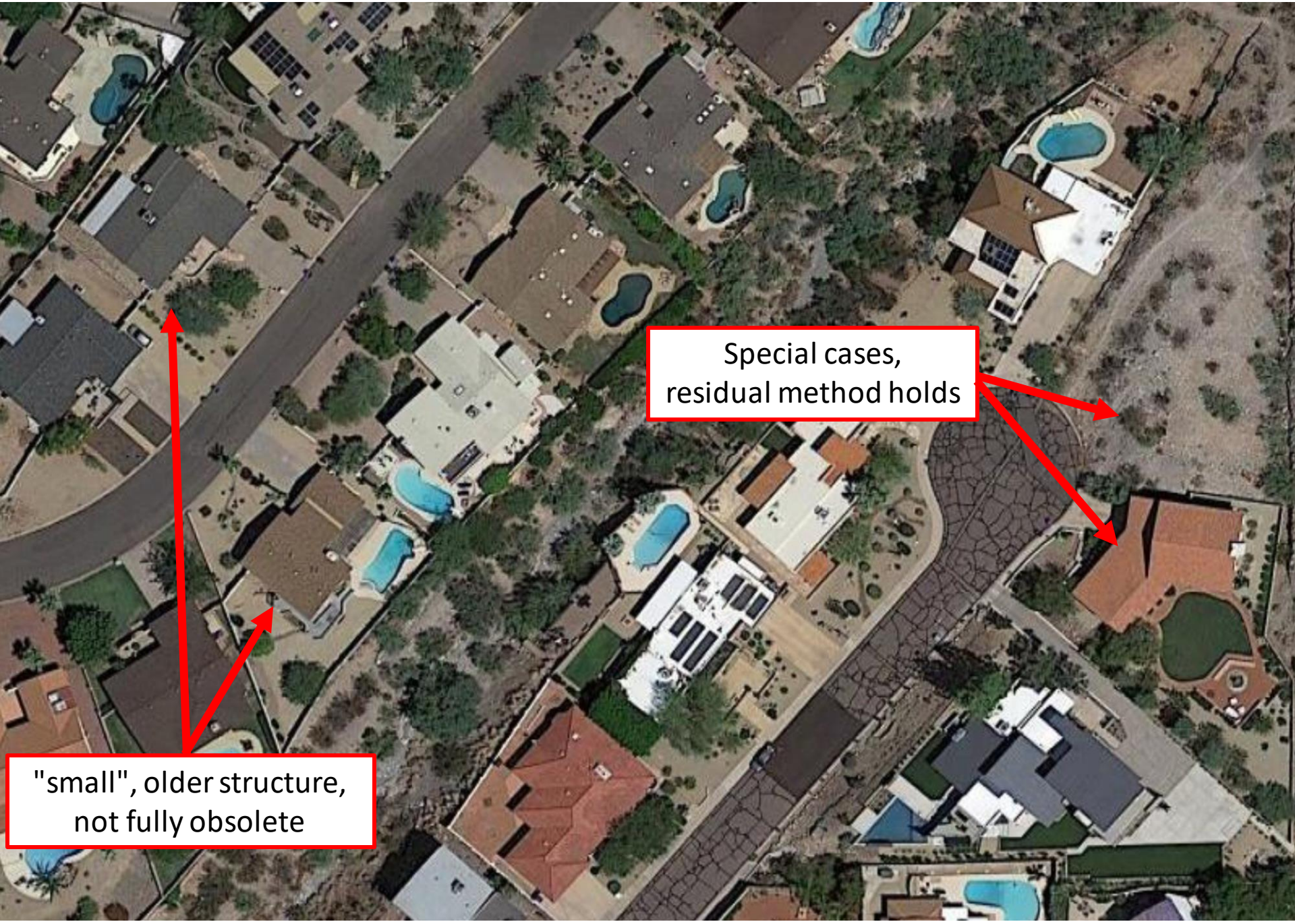
Our (Re)definition of Urban Land Value

- If a usable structure is present, urban land value is the value at the time a structure was built adjusted for changes in property value over time and adjusted for additional value from possible demolition, renovation or redevelopment of the structure.
- A possible change in the structure means legally, physically and financially feasible now or at some future time.
- This definition is intended to apply to the vast majority of urban land which has substantial usable structures present.

This Paper in a Nutshell

- Land valuation methods based on irreversibility are compared to
  - valuations based on vacant land sales and on
  - land residual methods (land value equals property value minus the depreciated cost to build)
- Both methods are nested in our option value model.
- Land residual theory holds as a special case when the redevelopment option is exercised.
- The large and influential land residual literature ignores this restriction, even when it takes a 10-year-old property as "new," ignoring changes in property value over the 10 years.
- The irreversibility assumption predicts that high urban land volatility and land value ("LV") ratios that increase (decrease) substantially during a boom (bust) are artifacts of the land residual method.


Special cases,
residual method holds
"small", older structure,
not fully obsolete

Key Findings

- We fit all three methods to Maricopa County assessor data during a recovery period (2012-2018).
- It remains difficult to use vacant land transactions to value land under existing structures
  - Are they real comparables? Probably not.
- Results show that the LV ratio (land value to total property value) behaves as predicted by irreversibility, not by the land residual or vacant land methods.
  - New CAMA assessment procedures should consider irreversibility, using land residual estimates at time of construction.

Irreversibility and Land Value
Suggesting a Simple Options Model

- Our model is designed to provide intuition for empirical work on the land value ratio.
- Since it is about intuition, we keep the math simple
  - e.g. Baseline has no uncertainty in the value of the underlying. Then we add uncertainty.
  - We use a simple linear production function that delivers intuition.
- The model may be compared to work in Section 2 of Davis et al. (2019)

Production function
For a fully built-up inner suburban neighborhood

- Each unit of housing (H) delivers one unit of services per time period:

$$H = aL + bS, \text{ given } a,\ b,\ L,\ S > 0$$

  - This avoids a problem with the more typical Cobb-Douglas production function: the implausible assumption of constant land share in the production process

$$\text{Land share in production} = aL/(aL + bS)$$

- Demand: p = Rent/intensity

$$\frac{Rent}{H} = p\frac{S^{-c}}{L}, \text{ given } \ 0 < c < 1$$

- Multiply, capitalize with r :

$$P(H)H = \left(\frac{p}{r}\right)aS^{-c} + \left(\frac{p}{r}\right)b\left(\frac{S^{1-c}}{L}\right)$$

Building Costs

… are a percentage of the value per unit intensity

- The cost to build a unit of structure is some percentage, *k* of the value per unit intensity, and total costs increase with the amount of structure:

$$\text{Building costs} = \left(\frac{p}{r}\right) kS^d, \text{ given } 0 < k < 1, d > 0.$$

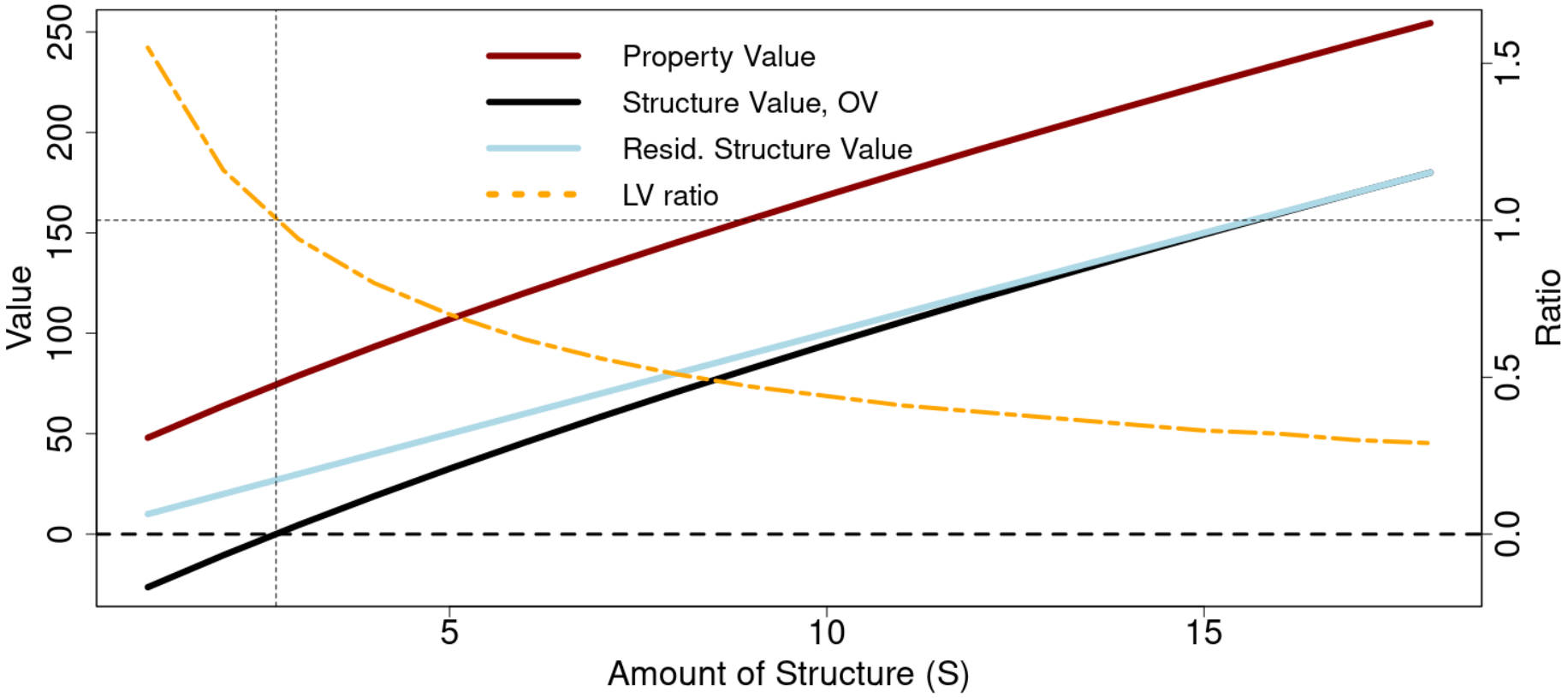
As if vacant land value

- V* is the land residual value at the point of reconstruction: i.e., after the existing structure becomes valueless and it has been demolished
- Land value is function of the highest and best use, which is the structure size S*
- The exchange of old S for S* occurs when the economic value of S=0, despite replacement value>0

$$V^* = \left(\frac{p}{r}\right)\{aS^{*(-c)} + b\left(\frac{S^{*(1-c)}}{L}\right) - kS^{*d}\}$$

Numerical Example

Structure between 1 and 18 (=optimal S*)



Data and empirical setup

- Geographic focus on Market 5
- Focus on boom, 2012-2018 corresponding to the positive shock innumerical solutions.
- Exploit the richness of hedonic variables
- Add GIS based distance measures and elevation dummy for hill locations to better capture location
- Depreciated cost to replace structure in year of sale from our CAMA adaptation of Marshall cost manuals.

Hedonic estimates look good

Expected signs for location- and structure-related vars.

Dependent Var.	*Price*	*Land Val.*	*Price*	*Price*
Land (sf)	-0.042***	-0.035***		-0.037***
Square root Land (sf)	0.854***	0.718***		0.755***
Dist. CBD	0.013	-0.001		0.003
Dist. primary road	0.000	0.006		0.005
Dist. secondary road	0.046	0.057		0.054
Dist. Parks	0.109	0.104		0.105
Dist. Water	-0.404**	-0.432**		-0.424**
Cul-de-sac	-0.105	-0.092		-0.095
Green belt	0.264***	0.216***		0.229***
Golf	0.674**	0.761**		0.738**
High elev.	0.496***	0.418***		0.439***
Dummy: neg. value	-0.381***	-0.382***		-0.381***
Interior space (sf)	1.226***	0.489***		0.689***
Prop. Age	-0.043***	-0.027***		-0.031***
Prop. quality=4	-0.001	-0.080		-0.058
Prop. quality=5	0.762***	-0.136		0.107
Prop. quality=6	1.963***	-0.069		0.482*
Pool	0.188***	-0.028		0.031
Depreciated cost to replace structure			1.261***	0.729***
Hedonic predictions for land residuals			0.908***	
Location, year and deed type controls	Yes	Yes	Yes	Yes
R-squared	0.814	0.656	0.800	0.819

Land residual value = Price – Repl. Cost

Constraining the coeff. on Repl. cost to 1

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Price = Land value + structure value?
Coeff. on replication cost > 1

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Wedge: Small, old buildings

- Remaining structure valued less by market than by land residual, as predicted by option value model

Dependent Var.	*Price*	*Price*	*Price*
Hedonic, location, year and deed type co	Yes	Yes	Yes
Small old structure=1	1.245***	0.412*	0.586**
Interior space (sf)	1.258***		0.699***
# Small old structure=1	-0.625***		
Depreciated cost to replace structure in year of sale		1.239***	0.721***
# Small old structure=1		-0.490**	-0.420**
Hedonic predictions for land residuals		0.911***	

Small, old buildings
Remaining structure valued less by market

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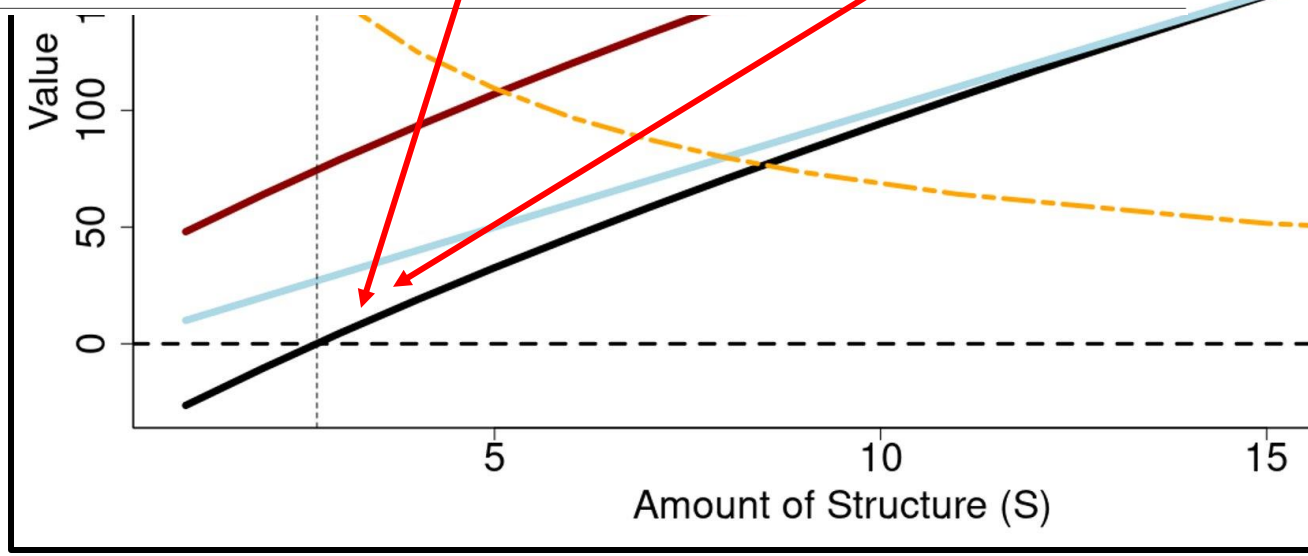
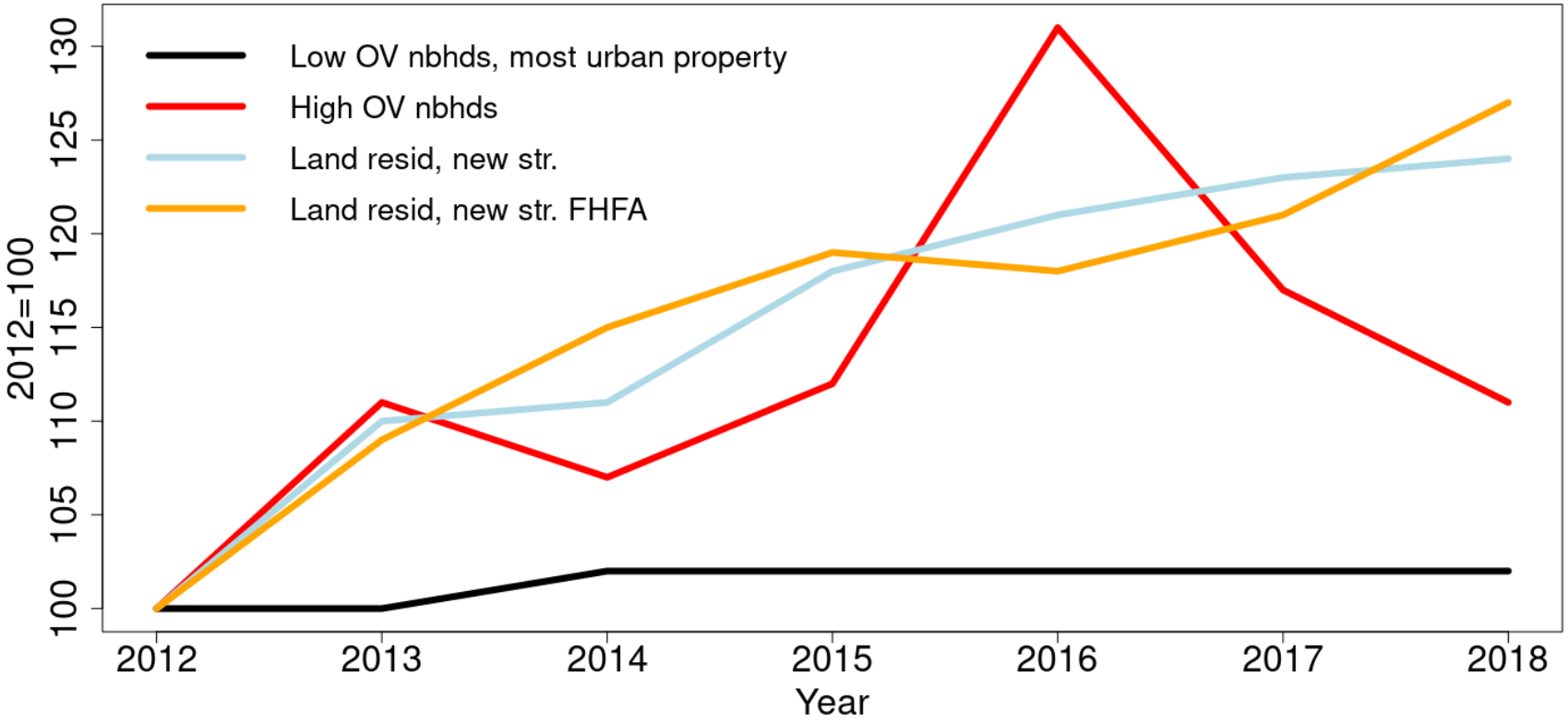


Land Value Shares

by Type of Neighborhood, Comparison to FHFA



Conclusion

- Land and structure values follow similar trends - they are irreversibly linked.
- As a result, LV ratios are relatively stable for most urban properties.
- Empirical results support our parsimonious OV model.
- We politely disagree:
  - "Land prices, not replacement costs, are the key to understanding the trajectory of house prices. **Rising land prices explain about 80 percent of the global house price boom** that has taken place since World War II."

— Knoll *et al*. (AER, 2017)