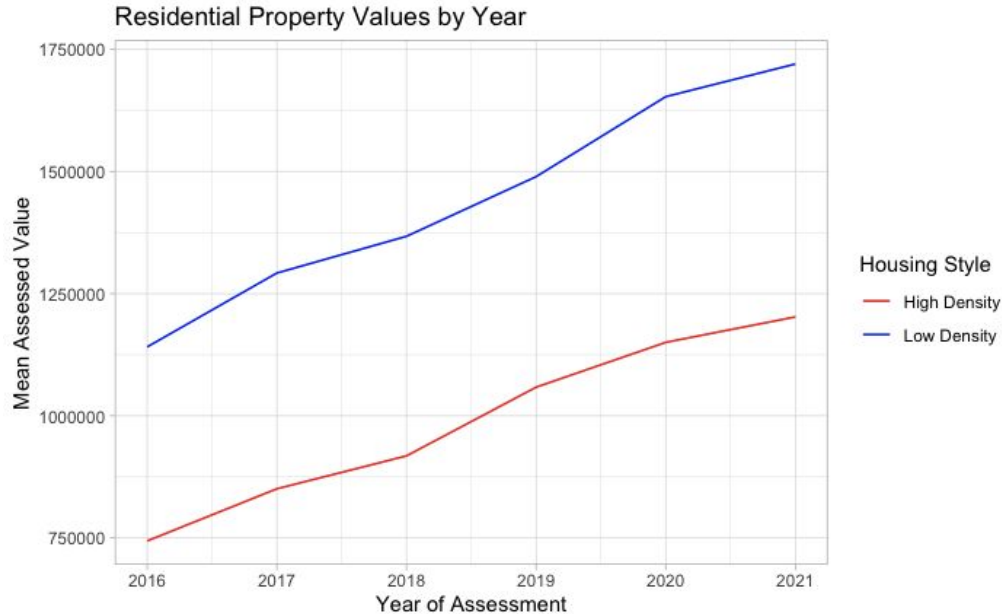


Housing Affordability in Cambridge

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Rising Property Values



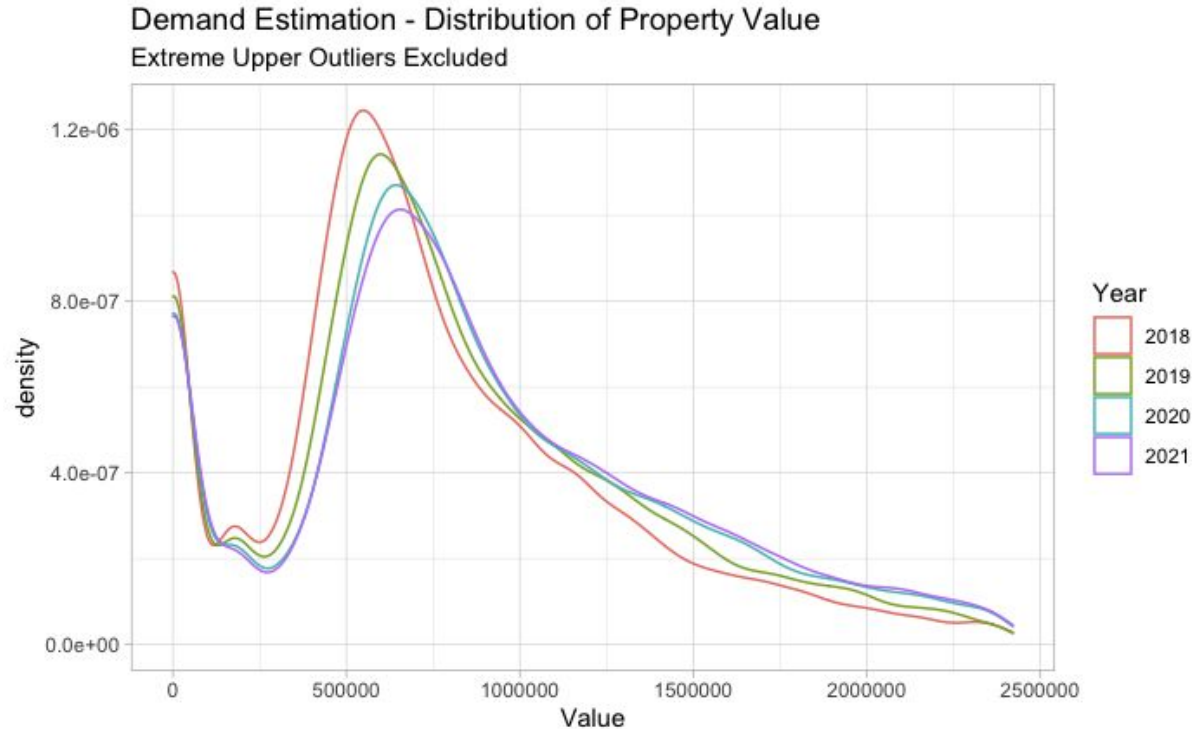
For both high- and low-density housing, property values have been rising over the last five years.

A renter has to earn three times the MA minimum wage to afford a two-bedroom apartment.

Low-income constrained affordable housing doesn't prevent middle class families from being priced out.

Exogenous increases in demand aren't preventable—the growing desirability of Cambridge isn't something to fight—so, what can we do?

Increasing Demand



The distribution of property values is shifting further and further to the right. Since supply is not becoming more constrained, this likely signifies rapidly increasing demand for housing in Cambridge.

In this particular plot, we've removed extreme outliers.

Potential Solutions

In response to a demand problem, we assume that lowering demand (i.e. making Cambridge worse) is not the right call. Thus, we focus our analysis on potential mechanisms for supply increase. In particular, we analyze:

1. High density housing
2. Lowering construction costs through decreasing zoning regulations
3. Direct intervention in supply

1. High Density

Background

Using state classifications of the density of housing, we hypothesize that higher density housing (apartments, condos) help mitigate the spike in property values.

Our reasoning is as follows. Higher density housing substantially increases supply of housing, thus lowering the value of the land in highly developing areas as opposed to a single-family dwelling, which might not be as valuable as a building but certainly lies upon extremely valuable land.

Result

We discover significant correlation in the direction hypothesized.

term	Percent Change in Value	p.value.x
(Intercept)	11.750994	0.000000e+00
high_density	-1.939785	8.138169e-171

Prices grow slower for high density housing units than for low density housing units.

Decomposition of Effects

Moreover, as the next regression shows, we can look at the impact of high-density housing on building values and land values. Higher density housing increases building values but decreases land values more, leading to overall reduced prices.

term	Building Value	p.value.y	Land Value	p.value
(Intercept)	659670.8	1.581010e-322	793085.1	0
high_density	242691.2	5.359849e-31	-597552.0	0

2. Zoning Regulations

Zoning Regulations in Cambridge, MA



Dark shading represents overlay zones with additional aesthetic regulations.

Background

Cambridge has zones, where areas set regulations on construction. The trouble is that very little data exists on the varying strengths of regulation in those zones. However, we attempt a separate strategy to determine level of regulation:

There are also special overlay zones, where smaller changes in regulations are made on top of the regulations of their underlying zones. We can classify these overlay zones into being “good” or “bad” for housing prices, as explained in the next two slides.

Bad Zones

Look out for the following language:

- “to encourage the retention of existing buildings of historic value; to encourage uses that will serve needs of residents of abutting neighborhoods or those persons enjoying the open space amenities along the Charles River; and to discourage new development inappropriate in both scale and design”
- “These regulations are intended to encourage retention of buildings of historic value and enhance the established streetscape; to maintain the visual character and open space patterns”
- “These regulations are intended to provide a transition between the character and scale of development existing and permitted in the abutting Residence C-1 district and the institutional development existing and permitted in the base Residence C-3 district.”
- to modify the base zoning requirements applicable in the Cambridge Highlands neighborhood with the intent of supporting the unique character of that district, which is predominantly modest-sized single-family and two-family homes”

Good Zones

Language like this:

- “to provide an **incentive for residential development** within the designated ECHO district”
- “to allow for the **creation of studio or one-bedroom apartment units in appropriate unused basement level space** of certain existing multifamily residential buildings”

Our Strategy

Using the most recent [zoning ordinance of Cambridge](#), we classified zones by whether their purpose was to encourage or discourage residential development.

We then tested for the effect of living on the zones.

Areas not in overlay zones or in overlay zones that did not affect building structure (ie zones intended to improve highways), excluded.

Our hypothesis is that zones that have discouraged development have increased property values due to lack of construction there and zones that encourage new development have decreased the percent change of property values.

Limitations

There are several limitations:

- 1) The neutral zones may overwhelm any analysis because they make up the significant majority of observations.
- 2) Due to limited data on the “heavy regulation” factor of zones, we were limited to using overlay zones as our strategy for identifying problematic
- 3) Effects reverse directions due to alternate causality: developers build in areas that are high-value or growing in value, which means that areas where development happens also are exogenously increasing in value or price at the same time.

Results

We have mixed results:

term	Percent Change in Value	p.value.x	Building Value	p.value.y	Land Value	p.value
(Intercept)	11.8171052	0.000000e+00	653661.3	2.654085e-293	783411.3	0.000000e+00
zone_types_newNO_DEVELOPMENT	0.1956122	6.725711e-01	-218629.0	1.173342e-01	-309643.6	4.998728e-06
zone_types_newYES_DEVELOPMENT	-1.1499246	1.486017e-06	155600.8	3.081845e-02	239724.5	7.564499e-12
high_density	-2.0202263	7.286002e-168	273533.9	2.159709e-35	-586320.1	0.000000e+00
zone_types_newNO_DEVELOPMENT:high_density	-2.9136271	1.036879e-06	-193163.6	2.829566e-01	112552.5	1.978710e-01
zone_types_newYES_DEVELOPMENT:high_density	1.5283199	1.306221e-08	-322551.0	6.940727e-05	-233855.8	2.916803e-09

Observe that often, the zones we identify as “high development” zones, in fact, increase the value of property. We conjecture that this is because those areas are experiencing particularly high spikes in demand that overwhelm efforts to mitigate them. Furthermore, note that being in a positive development zone decreases the price spike of low-density housing, which may support our theory of expanding supply and removing restrictions. So, the problem then arises -- we want to know, does decreasing regulation and building more residences help mitigate price spikes, but it is likely the case that you decrease regulation and build more residence where price spikes are already occurring!

The Land value regression leaves us some hope in the theory - good development zones decrease land value for high density housing and decrease land value for low density housing The opposite occurs in bad development zones.

3. Direct Residential Development

A New Strategy

Here, we use large scale [commercial residential unit development](#) to determine the effect on prices. However, we will run into the same problem - you're likely to build new residential units where demand is already spiking.

We attempt to control for this effect by adding in the [effect of trees](#). We conjecture that tree levels control for “niceness” between zones of Cambridge.

Results

Here, we estimate that the overall effect of new units of residence decreases the prices of housing. Adding new units decreases the price of low density units. The effect of high_density units on price overcomes the positive effect of new units * high_density.

term	estimate	p.value
(Intercept)	1697171.8454	0.000000e+00
new_units	-500.3635	3.415772e-02
high_density	-534394.0166	6.096375e-55
new_trees	-159.6586	3.994076e-14
new_units:high_density	1477.1322	2.525997e-15

Conclusions

There are four key takeaways:

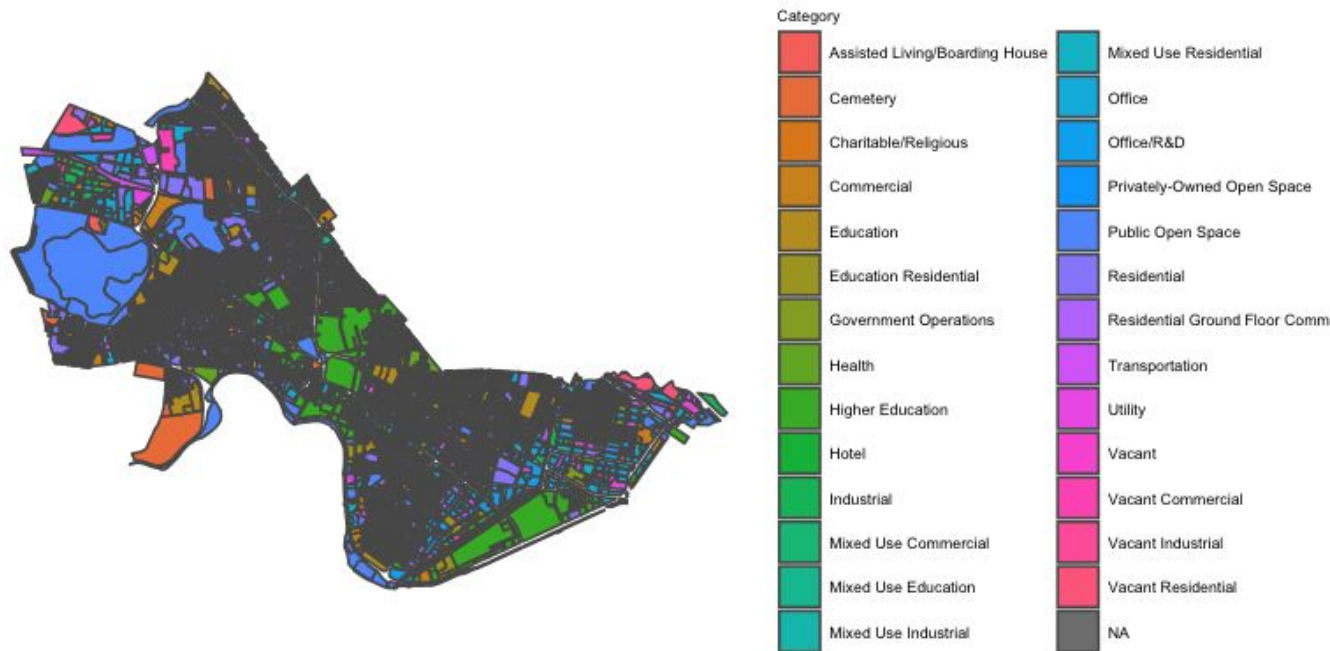
- 1) High density housing is extremely valuable in combating rising demand and price spikes.
- 2) Zoning regulations need to be studied more carefully, ideally with more robust data to control for the strength and type of regulations between zones.
- 3) The toughest problem is ensuring effective treatment assignment. Most empirical studies of intervention in price spikes - ie new units of housing or decreased regulations - are assigned to areas particularly experience high demand.
- 4) Our recommendation is a mixture of decreased regulation on high density housing construction and increased support of high density housing, like apartment complexes or condos.

Appendix 1: Dataset Construction Overview

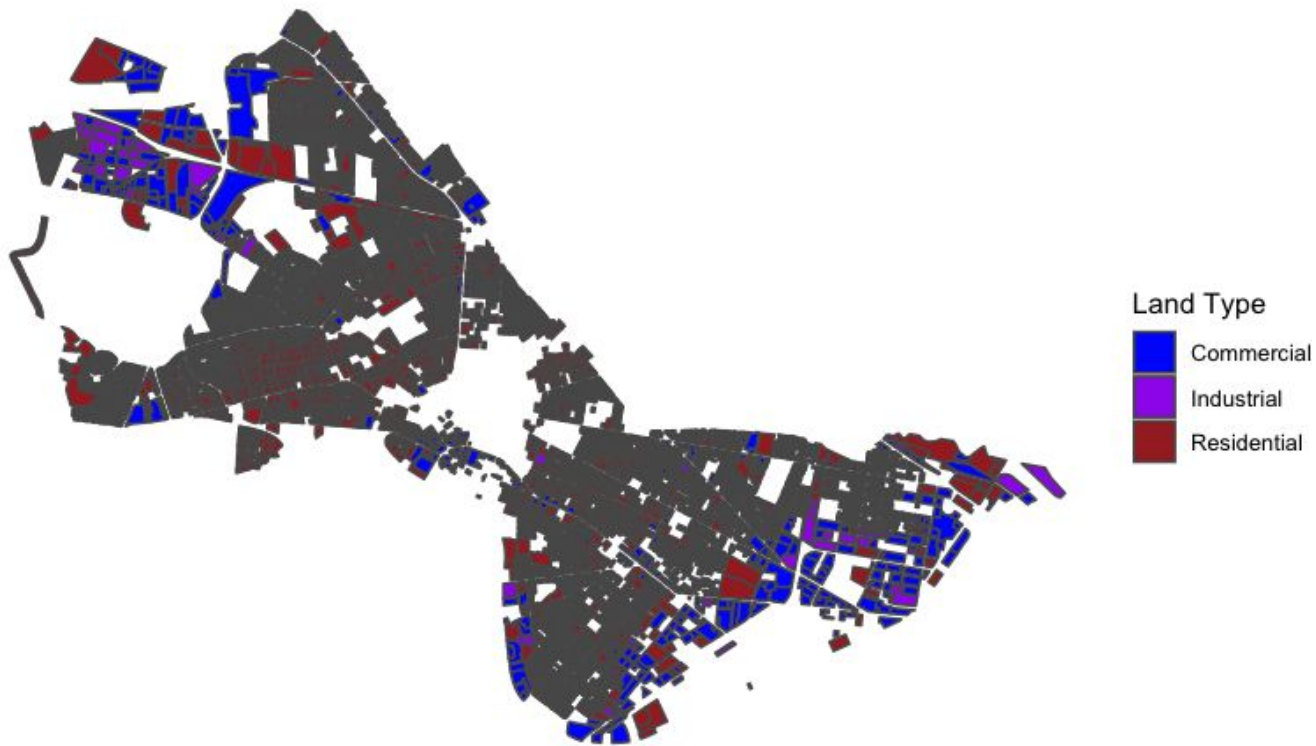
1. Assigning residential status to property observations through state class
2. Assigning categorical variables
 - a. High density buildings (apartment buildings) vs low density buildings (single family houses)
 - b. Assessed property value → quantiles (outlier resistance)
 - c. Created a percent change in value variable
3. Zoning:
 - a. We georeference observations by coordinates, using point-polygon intersections to assign each observation to a zone type.
 - b. We then coded “good” or “bad” zones by referencing the zone number in the Cambridge Ordinance with the purpose of the zone.
4. Direct supply increases
 - a. We took a dataset of large scale development projects and assigned areas that received this intervention.
 - b. We used foliage data and matched using zone codes.

Appendix 2

Land Use Regulations



Land Use Regulations (Grouped)

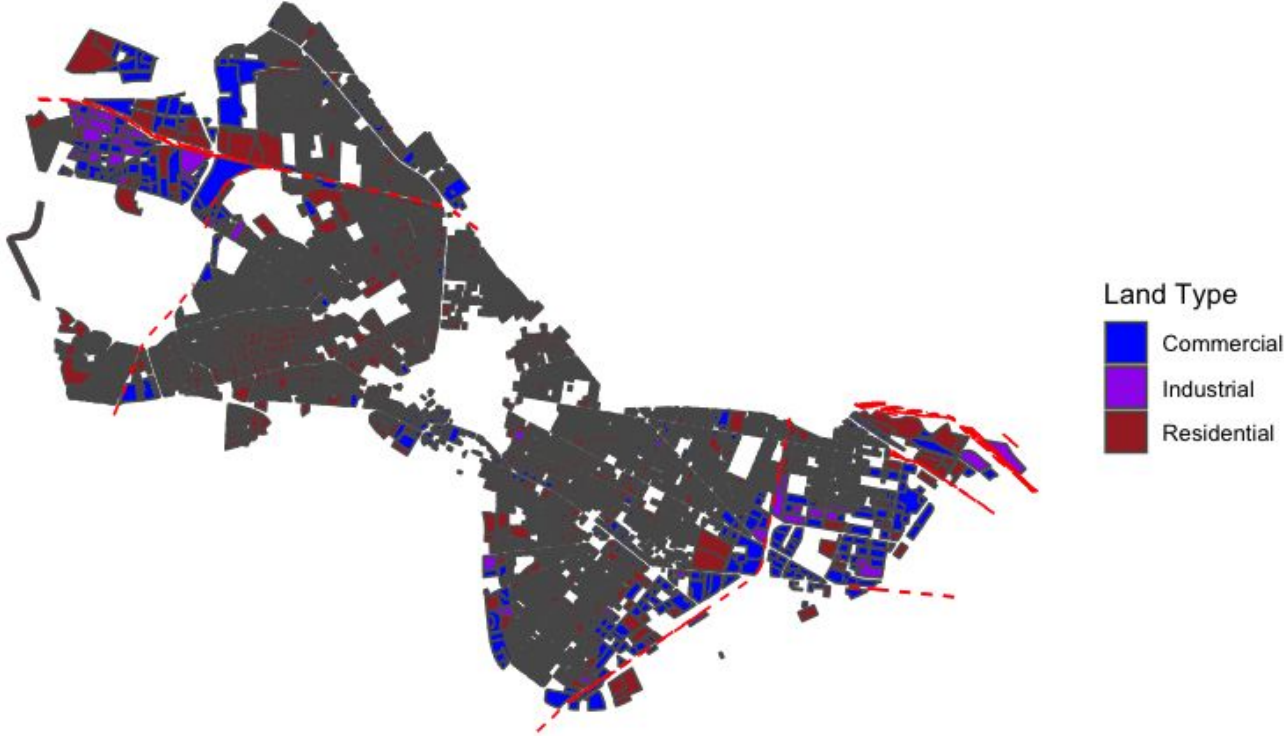


Transportation



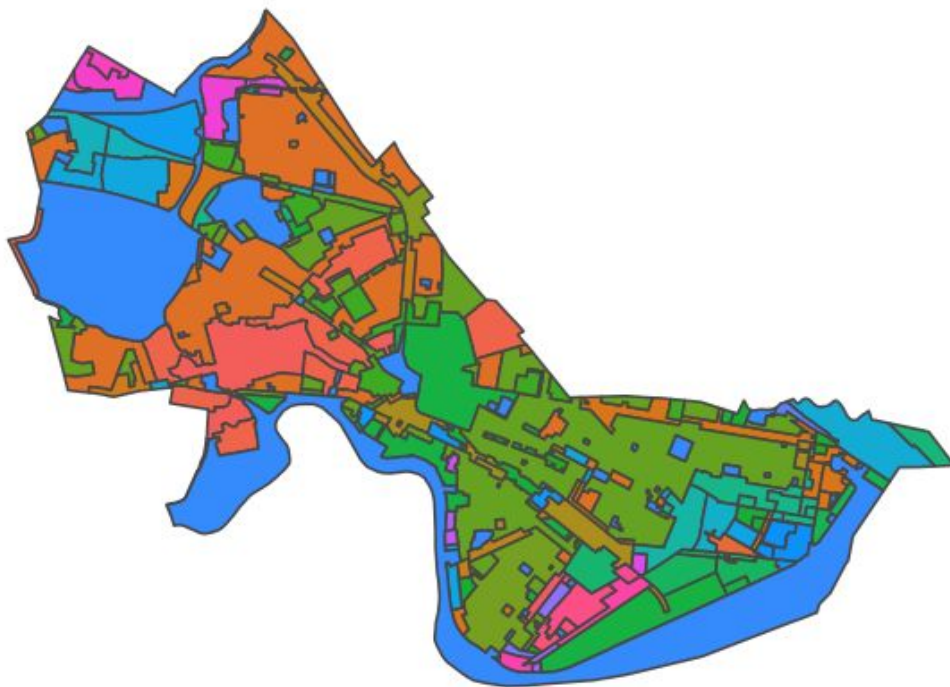
Dashed lines represent subway lines. Blue points represent bus stops.

Land Use w/ Rail Overlay



Dashed lines represent subway lines

Zoning Regulations



A-1	C-3	SD-10(F)
A-2	C-3A	SD-10(H)
ASD	C-3B	SD-11
B	CRDD	SD-12
BA	IA	SD-13
BA-1	IA-1	SD-14
BA-2	IA-2	SD-15
BA-3	IB	SD-2
BA-4	IB-1	SD-3
BB	IB-2	SD-4
BB-1	MXD	SD-4A
BB-2	NP	SD-5
BC	O-1	SD-6
C	O-2	SD-7
C-1	O-2A	SD-8
C-1A	O-3	SD-8A
C-2	O-3A	SD-9
C-2A	OS	
C-2B	SD-1	

Median Price by Zone

