Small Area Zoning Taxes: Better Tools To Better Unlock Housing *

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Abstract

We develop a framework to estimate small area zoning taxes — regulatory costs on housing development changing over sub-metropolitan scales. Using administrative property records, we produce two measures. One is based on how marked up home prices are over home production costs, while the other is based on uncaptured land value due to regulatory limits. Applying the measures to recent growing markets lets us identify where regulatory reform should focus, both to unlock development and to ease local fiscal burdens. These zoning taxes directly inform housing targets, giving a practical, market-based foundation to update metropolitan planning objectives when housing demand rises.

EXTENDED ABSTRACT FOR CONFERENCE SUBMISSION; PLEASE DO NOT CITE

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Introduction

Over the last decade, U.S. housing supply growth has not kept up with the demand to form families and own homes (Patel, Rajan and Tomeh, 2024). Evidence is plentiful on the association between lower housing production and regulations on what types of housing can be built in cities (Freemark, 2023). However, a plan to reform these regulations requires prioritizing over two dimensions: knowing where regulation drives up prices and where development is not following the location's highest and best use. Locations prioritized for housing supply growth in legislation are often areas showing the least opposition in the political process (Gabbe (2018), Hankinson and Magazinnik (2023)), not areas that economic analysis predicts are the most worth targeting.

In this paper, we apply general procedures for estimating *small area zoning taxes,* measures of additional regulatory costs on development, at below the metropolitan area level. Methods for estimating zoning taxes have evolved since Glaeser, Gyourko and Saks (2005; "GGS") and Glaeser and Gyourko (2003; "GG"), though the two papers set out distinct methodological directions that still well categorizes frontier work. The approach in GGS is a *markups-based measure,* where we derive the markup on observed property sale values relative to minimum profitable production costs. The approach in GG is an *expenditure-based measure,* where we derive the land value uncaptured by society because regulations stop developers from fully satisfying household demand for a certain location.

Either of these two measures can be defined to fit the market being studied. Each measure has separate requirements on what property-level data is observed and what latent variables must be inferred from a quantitative model. Using administrative data on deeds and on property assessments, we produce both measures to analyze multiple U.S. housing markets witnessing demand growth over the last decade.

We focus on analyzing single-family suburban development: due to regulatory and industry changes, the ability of single-family construction to meet demand still has not returned to pre-Financial Crisis levels (Bharadwaj and Gascon, 2018). We will select a subsample of local housing markets, which will range from unaffordable metros seeing limited suburban redevelopment to the periphery of fast-growing metros that could encounter stringent regulation. By calculating which small areas stand out with their zoning tax increases before and after 2020, we will identify where regulations either hold back units the market could supply, or where existing residents are unwilling to capture the fiscal gains from development.

When considering the economic importance of a rise in zoning taxes, the baseline level with which comparisons are made also matters. The economic literature as early as GGS not

only acknowledged that regulation can reduce disamenity effects of urban life, but has run back-of-the-envelope exercises to see if the value of disamenity reductions justifies the costs of regulation. In this paper, we also compare the magnitude of our zoning tax estimates to a level that is optimal from a local government perspective: if the locality could improve land value capture in their residential neighborhoods by allowing more density.

To attain their optimum, a locality with regulatory powers permits enough growth to maximize revenues from newcomers that demand the locality's neighborhood characteristics. Small areas with high levels of zoning taxes may not be priorities for regulatory reform if they also provide public goods and amenities for which household demand in the metro area is relatively inelastic. [1] Areas that are not maximizing land value capture, according to these tests for optimality, are more evidently places that should plan to reform their regulations on development, a process that could be coordinated by regional or state authorities.

This paper contributes to a burgeoning literature on the importance of regulations on housing supply for housing affordability and also for regional economic activity (Ganong and Shoag (2017), Glaeser and Gyourko (2018)). The main contribution is to present a workflow that generalizes methods used in the literature's frontier (Kulka (2019), Anagol, Ferreira and Rexer (2021)), with the explicit goal of finding small areas that appear to limit development in an economically suboptimal way. Additionally, we are interested in comparing measures calculated earlier and later in the latest housing cycle, to learn about the duration over which regulations can become economically suboptimal.

The debate around where such small areas are located is politically contentious, with state agencies tasked to discover these areas unable to establish a workflow (Biber et al., 2024). We also describe the close link small area zoning taxes can have with small area housing targets, the device through which state agencies evaluate regulatory reforms. In doing so, agencies have been litigated against or questioned for lacking a solid methodology behind those targets, beyond appeals to "fair share" doctrines (Hills, 2016). In contrast, Tulip (2023) notes local housing targets based on zoning tax calculations are transparent, explicitly use forward-looking price signals and can be produced from a reproducible workflow, making them harder to manipulate by local governments.

This paper's goal of producing measures of regulatory costs that can improve policy implementation sets it apart from the rest of the literature. On one hand, this paper complements the

[1] The zoning taxes considered here, which are consistent with revenue maximization at a local government level, do not account for general equilibrium effects if many local governments significantly loosen regulations at once. If there are positive externalities to a scaled-up policy, the tests of zoning optimality we use in this paper are if anything biased against finding positive effects of deregulation.

literature producing new indices of zoning strigency based on the text or supporting documents of localities' land use ordinances (Bronin et al. (2023), Bartik, Gupta and Milo (2024)). Open questions remain, however, on how one can test if a locality's regulatory complexity is optimal, given theory and evidence that more complex regulations may not always hinder growth (Ash, Morelli and Vannoni, 2022).

The methods described in this paper have been used to generate metro-level zoning tax indices, such as in Gyourko and Krimmel (2021). Sparsity in observations, like having access to only small numbers of land transactions, had limited applications of zoning tax methods to geographies within metropolitan areas. We are less limited by small sample issues by generalizing existing frameworks and introducing more flexible estimation techniques, though additional assumptions are required.

The rest of this document goes into further detail about the construction of small area zoning taxes; data requirements and assumptions; and the data sources we will employ to produce the measurements flexibly.

Empirical Approach

Flexible estimation of zoning taxes based on the markup-based or expenditure-based measures, as well as how they deviate from optimal levels, requires two kinds of variables. First, we need observed statistics constructed over the geographies of interest. Then, we also need latent variables that are derived from a sufficiently rich structural model. To summarize this section, Figure 1 provides a schematic overview of the various models, observable data and output measurements discussed below.

The buildings first studied with the markup-based approach in Glaeser, Gyourko and Saks (2005) were Manhattan apartment condominiums, over which the researchers calculated average sales price per square foot $\overline{P}$. Having multiple industry estimates of marginal construction costs per square foot CC, the researchers could easily calculate the markup $\overline{P}/CC$. While the markups consistently showed levels above 2, the authors also considered if high prices were rationalized by the additional congestion or urban disamenities produced by an even more populated Manhattan. Despite their analysis being unable to "pin down the level of the optimal tax (or subsidy) on new development, it does show that there is no negative externality (or combination of externalities) large enough to justify the current gap between prices and production costs..."

The above discussion can be generalized and expressed as a testable hypothesis. For any

geography of interest, we look at transactions data and calculate the markup $\overline{P}/CC$. We can first test how far the markup is from 1, which is the optimal markup if our social objective is solely to maximize construction.

Alternatively, we can base our social objective off of what maximizes local land value capture. Consider an environment where the construction sector is perfectly competitive, but the local governments in a geography of interest permit new development to maximize their joint profits from selling land. For any level of construction Q the localities permit, they capture $\pi = [\overline{P} - CC(Q)] \times Q$ of land value, where $\overline{P}$ is the realized mean sale value of housing units.

We close the model with an inverse demand curve for the geography, $P(Q)$. The markup that optimizes the land value capture objective is then the standard solution to a monopolist's pricing problem, i.e. it is the markup level satisfying

$$\frac{\overline{P} - CC}{\overline{P}} = \frac{1}{\varepsilon_L} \Rightarrow \frac{\overline{P}}{CC} = \frac{\varepsilon_L}{1 + \varepsilon_L}, \tag{1}$$

where $\varepsilon_L < 1$ is the local *price elasticity of location,* the main latent variable we need to derive.

For planning practice, comparing actual markups to optimal ones shows us a price decline target to aim for when evaluating whether reforms on local regulations have worked. Even more useful for practitioners is a conversion first suggested by Tulip (2023): By scaling the optimal proportional decline in markups with the own-price elasticity of housing demand ε_D, we can translate optimal price decline targets for small areas to optimal housing unit targets for small areas.[2]Heterogeneous estimates of housing targets could also simplify the design of how to upzone different small areas within a metropolitan market: for example, which areas only need "gentle" reforms like allowing accessory dwelling units while which areas should be prioritized for the redevelopment of high-density buildings.

The expenditure-based measure, as first proposed in Glaeser and Gyourko (2003) at first glance requires a separate set of assumptions and data. If we assume free entry into the housing market is able to arbitrage away any profits across space, two expenditures should be equal: the profits from selling property built on a land parcel, as well as the amount needed to buy the land parcel. If the per-unit land cost is greater than the unit profit on homes sold, this reflects an inability to build as densely as the developer expected due to regulatory constraints.

[2]Formally, if we find the parameter τ_P for which the relation

$$(1 - \tau_P)\frac{P}{C'(q)} = \frac{\varepsilon_L}{1 + \varepsilon_L}$$

is satisfied, then we can express the optimal housing target as a $(\tau_P \varepsilon_H)$%) increase in the small area's housing stock.

In early work, the best way to implement this measure remained partialling out land value from observing market value using construction cost estimates: if construction costs are required, then it is more efficient to calculate the markup-based measure directly. However, both Gyourko and Krimmel (2021) and Turner, Haughwout and van der Klaauw (2014) were able to back out expenditure-based measures using non-construction cost data. In doing so, they independently arrived at similar conclusions: the key requirement for expenditure-based measures are credible counterfactuals of price changes and new unit construction when regulations are removed.

In the Appendix, I detail how both papers conclude that in a geography where regulations do not distort development, we have

$$\frac{\tilde{p}(H)-\tilde{p}(H')}{\tilde{p}(H')}-\frac{H'-H}{H}\approx 0, \tag{2}$$

where $\tilde{p}(H)$ is the latent willingness to pay for a housing unit on a parcel with H units, and H' is the level of unconstrained supply we estimate as a counterfactual. In a context where GG would find a positive zoning tax, the left-hand side would be negative.

Finding the roots of the above equation, as a function of H, backs out the housing targets at which point regulations are not distortionary. A trivial housing target where regulations do not distort development is if $H = H'$, analogous to how an area's housing has price markup 1 only if developers are allowed to build up to where price equals marginal cost. A nontrivial housing target may exist, and if it does it is where a 1% marginal expansion in supply starts to cause a greater than 1% decline in unit prices.

The expenditure-based measure may still seem complex, requiring two independent computations of counterfactuals at small area scales. However, for one of these counterfactuals — unconstrained supply in the small area — we can take advantage of recent applications of bunching estimators in real estate (Brueckner, Leather and Zerecero (2024), Cui (2024), Song (2025)).

The common approach behind the recent literature is measuring, without strong functional form restrictions, how many housing units are constrained from building more densely than they could have. We can derive this measure for different housing types in the American regulatory context, as many jurisdictions prohibit density over scarce land through enduring bulk regulations on house size or on height (Gyourko, Hartley and Krimmel, 2021). With background knowledge on the regulations, the unconstrained supply is backed out of an estimate of how many properties bunch on the margin at certain regulatory limits, along with a forecast

of how densely developers would build on those same parcels.

Up to now, we have laid out the varying data requirements for calculating two kinds of small area zoning taxes, without detailing how the latent variables should be estimated. Our approach is to use a single structural model of neighborhood choice to back out a key latent variable in both approaches: price elasticities of location ε_L in the markups-based measure and willingness to pay for particular housing units $\tilde{p}(H)$ in the expenditures-based measure.

Following Bayer, Ferreira and McMillan (2007), we can estimate a mixed logit discrete choice model that encodes preferences for housing structure and for location. The model's primitives are household who choose where to live, knowing they will purchase a bundle of housing characteristics $\mathbf{X}_h$ as well as neighborhood amenities $\mathbf{Z}_n$. Their indirect utility functions over pairs (h, n) take the form

$$V^i_{h,n} = \alpha^X_i \mathbf{X}_h + \alpha^Z_i \mathbf{Z}_n - \alpha^P_i P_h + \xi_{i,n} + \varepsilon_{inh}$$

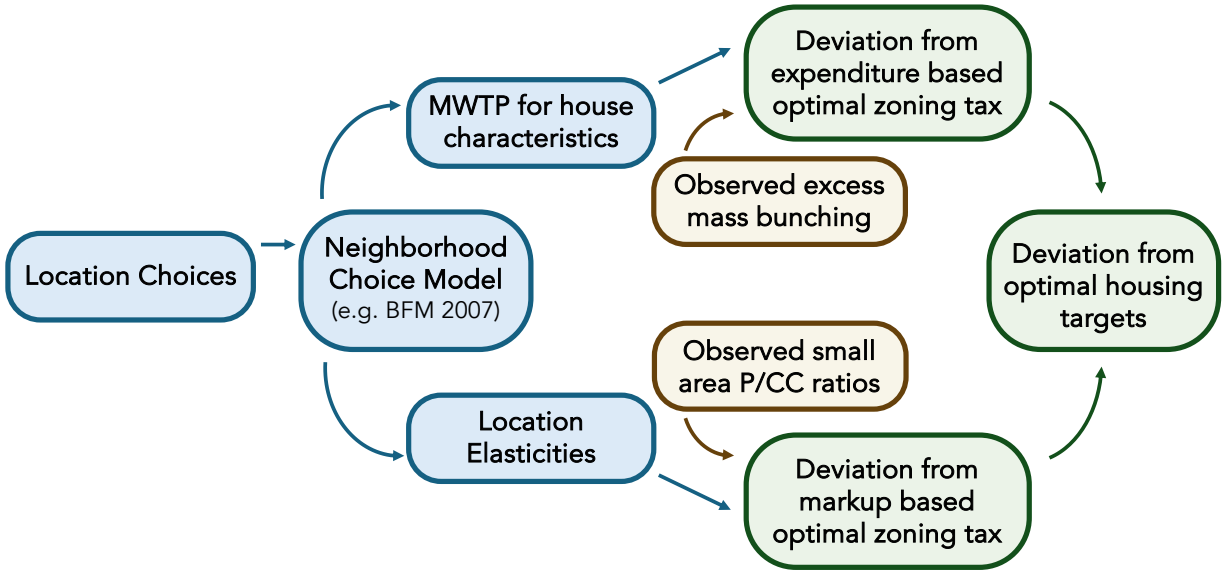
where unobservable neighborhood quality $\xi_{i,n}$ can be correlated with mean house values P_h. Conventional methods allow us to estimate and identify individual parameters α_i such that they vary based on households' observable characteristics. It is this added flexibility that lets us measure the price elasticities of location and willingness to pay for an area in the current market, as well as trace out how those variables change in counterfactuals where we allow more housing to be built.

Data Requirements

In order to demonstrate two separate methods to construct small area zoning tax measures, we focus on calculating them for single-family units. We concentrate in particular on new single-family construction on the periphery of growing metropolitan areas, some known to have more limits on land use far from the urban core than others. The general formulas for optimal zoning markups or expenditures could also be applied on various types of commercial real estate, like multifamily buildings. However, data availability is most complete for single-family developments and for the regulations by which they are bound.

To ensure maximum flexibility in applying our methodological framework across any small area of interest, we build our dataset from property-level, geocoded records from CoreLogic. For individual properties, the dataset provides detailed information like transaction history in sale prices and dates; physical characteristics, like building dimensions, lot size and structural features; and precise location coordinates.

Figure 1: Schematic for zoning tax estimation



Notes: This schema visualizes models and data sources used to produce the two measures of small area zoning taxes. The arrows link together the latent variables outputted from choice models, as well as the data requirements to produce latent measurements further downstream in the workflow.

Table 1: Overview of variables to estimate

Name & Symbol	Which Measure?	Observed or Latent?	Data Source
Average home sale prices: $\overline{P}$	Markup	Observed	Aggregation from CoreLogic transaction records
Construction costs of housing: CC	Markup	Observed	R.S. Means cost estimates
Market-adjusted construction costs: cc	Markup	Latent	CC along with Albouy and Ehrlich (2018) methods
Price elasticities of location: ε_L	Markup	Latent	Back out from neighborhood choice model
Own-price elasticities of housing: ε_D	Markup	Latent	Use 0.67, as estimated in Albouy, Ehrlich and Liu (2016)
Housing supply, observed & unconstrained: H, H'	Expenditure	Observed, for most part	CoreLogic housing unit counts + bunching estimators on lot sizes (Cui, 2024)
Marginal willingness to pay for housing: $\tilde{p}(H)$	Expenditure	Latent	Back out from neighborhood choice model

Table 1 outlines the variables required for our analysis, separating out observable variables with the latent variables that must be derived from additional modelling. For the markup-based measure, we observe average home sale prices aggregated from CoreLogic transaction records and a panel of single-family construction costs for U.S. housing markets from R.S. Means. In addition, we can adjust these costs using methods from Albouy and Ehrlich (2018) to account for regional variations in land and labour availability.

Our elasticities are either based in existing literature, or will be backed out from the neighborhood choice model. Critical for our analysis is including a measure of small area housing unit count, or housing density, in our choice model covariates $\mathbf{X}$; such data can be constructed from CoreLogic assessor records. We plan to include other neighbourhood characteristics commonly estimated with these models, and for which national data are publicly available: they include school district quality based on test scores, share of college-educated workers and access to work (using Census job-to-job flows data).[3]

For the expenditure-based measure, we use a flexible bunching estimator as employed in Cui (2024) to derive the excess mass around minimum lot sizes: we use the distribution of realized plots to net out the development at certain lot sizes that would have been built without regulations. What remains is a proportion of actual development that would have been built more densely without the implementation of districts that bind housing to a certain minimum lot size. This approach makes fewer assumptions about demand and supply behaviour in the small area we construct, using the data to infer the counterfactual unregulated supply.

We aim to select metropolitan areas that continue to grow in population, but which have different regulatory environments and growth patterns. In the Sun Belt, we prioritize three metropolitan areas — Phoenix, Atlanta, and Raleigh. All share relative affordability for owned housing compared to other national metropolitan areas, though trends have changed from 2023 onwards. By calculating separate zoning taxes over different sections of the urban periphery, we can detect if any area of expansion are seeing price growth that are economically suboptimal. We can contrast analyses in these high-demand Sun Belt metro areas with others that have varying institutional land use regimes, or has been studied in the literature as cases of land use regulations hindering housing supply. Examples include the Portland-Vancouver metropolitan area, the San Francisco Bay Area and the Boston metropolitan area.

In terms of geographic scale, we propose estimating separate small area zoning taxes for 2010 Public Use Microdata Areas (PUMAs), which align with Census geographies and enable

[3] A concern is that a model fit only on CoreLogic records will lack information on residents' characteristics, which limits the dimensions of household heterogeneity on elasticities we can estimate. Other work in the literature also estimate models on Census microdata, with CoreLogic aggregates merged onto them.

us to study relationships between zoning taxes and detailed demographic breakdowns. It is worth looking at even finer geographies, such as collections of cities beyond the central city which other sources claim practice exclusionary zoning. To demonstrate practical value to urban planners, we will also explore aligning our analysis with any planning regions already under study by the analyzed metropolitan areas' metropolitan planning organizations (MPOs).

Appendix

Optimality condition for expenditure-based zoning taxes.

In Gyourko and Krimmel (2021), $P(L)$ is observed and $\tilde{p}(H)$ beyond the parcel in question can be estimated, so $(P(L) - \tilde{p}(H)H)/H$ is their zoning tax measure.

Rewriting this differently, define $H' > H$ as the unconstrained units that is revenue maximizing for the developer. The Gyourko-Krimmel definition can be expressed as:

$$(\tilde{p}(H)H' - \tilde{p}(H)H)/H = \tilde{p}(H)\frac{\hat{H}}{H},$$

where $\hat{H} = H' - H$ is the *unconstrained supply growth* on the parcel.

More generally, we imagine a counterfactual where unit prices could decrease as $\hat{H}$ grows (i.e. density is a disamenity.) The general formula can be rewritten as

$$\begin{aligned}
\tilde{p}(H)H - \tilde{p}(H')H' &= \tilde{p}(H)H - \tilde{p}(H')H' \\
&= \tilde{p}(H)H - \tilde{p}(H')H + \tilde{p}(H')H - \tilde{p}(H')H' \\
&= (\tilde{p}(H) - \tilde{p}(H'))H + \tilde{p}(H')(H - H') \\
&= (\tilde{p}(H) - \tilde{p}(H + \hat{H}))H - \tilde{p}(H + \hat{H})\hat{H}
\end{aligned}$$

, which resembles the expression in Equation (17) of Turner, Haughwout and van der Klaauw (2014) on the foregone land value surplus due to regulation. Then, we divide by the "virtual" expenditures $\tilde{p}(H')H$ to get:

$$\frac{\tilde{p}(H)H - \tilde{p}(H')H'}{\tilde{p}(H')H} = \frac{\tilde{p}(H) - \tilde{p}(H + \hat{H})}{\tilde{p}(H + \hat{H})} - \frac{\hat{H}}{H} = 0.$$

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