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MINIMUM LOT SIZE RESTRICTIONS:
IMPACTS ON URBAN FORM AND HOUSE PRICE AT THE BORDER

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ABSTRACT

We estimate the impact of more stringent minimum lot size restrictions across small border areas of neighboring communities using data from the Wharton Residential Land Use Regulatory Index (WRLURI) surveys. Economically meaningful effects are found on the built environment, not just house prices. Within 100 meters of the borders, housing density as reflected in the number of single family homes per acre is about 11% lower on average in the most restricted communities compared to the least restricted communities in terms of minimum lot sizes. Individual homes are bigger by about 80 square feet, an amount equal to about 4% of typical unit square footage. Lots are over 3,000 square feet larger in the most restricted compared to the least restricted communities' border areas, an increase equal to 28% of the sample mean lot size. Hence, among the smaller number of homes that exist in the most regulated places, their physical structures are modestly bigger and they sit on appreciably larger lots. Finally, house prices are nearly $30,000 higher in the more regulated border areas compared to the least regulated border areas. This price impact can be accounted for by differences in house quality, structure and lot size specifically, on the two sides of a border.

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An online appendix is available at http://www.nber.org/data-appendix/w31710

I. Introduction

Interest in the potential impact of restrictions on residential building activity has exploded, as growing concerns about housing affordability raised the public salience of the issue.[1] Providing convincing causal estimates of the impact of regulation is quite challenging, not least because more highly regulated communities may differ systematically from less strictly regulated places in their local amenity sets. In this paper, we measure the impacts of density restrictions across small border areas using Wharton Residential Land Use Regulatory Index (WRLURI) data comprising 716 unique jurisdictions across 36 metropolitan areas.[2] These data are used to construct 635 border pairs that reflect the border areas of physically contiguous jurisdictions. Because homes close to a border, but on different sides of it, have access to the same local amenities that likely influence property values, our approach provides greater confidence that the results are not being driven by omitted local amenities.[3] Rich and precisely located microdata from CoreLogic allow us to form comparison groups using only the homes very close to each border.

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[1] While traditionally conceived of as a local issue, one sign of the growing importance of affordability concerns is in the activity of the executive branch of the national government. For more on the actions and policies of the Trump and Biden Administrations, see https://www.whitehouse.gov/presidential-actions/executive-order-establishing-white-house-council-eliminating-regulatory-barriers-affordable-housing/ and https://www.wsj.com/articles/biden-seeks-to-ease-housing-shortage-with-looser-zoning-rules-11617796817?page=1, respectively. Political activity at the state and local level also has been prevalent. California saw debate on a bill that would have limited a locality's ability to stop dense development around transit nodes (see the Vox article at https://www.vox.com/cities-and-urbanism/2018/2/23/1701154/sb827-california-housing-crisis for more on this). In late 2018, the Minneapolis City Council voted to eliminate single family zoning as a category and now permits up to three units on those sites (https://nytimes.com/2018/12/13/us/minneapolis-single-family-zoning.html.) Bills to pass or augment actual rent controls or enhance rent regulation in California, New York, and Oregon can also be seen as a response to growing concern with housing affordability. This debate also is related to the broader issue raised by Glaeser (2020) of a mismatch between capabilities of the private versus public sectors in some of our major urban areas that led to dominance by insiders (existing landowners in our context). The most recent academic review of the literature on supply side restrictions in housing markets is Gyourko and Molloy (2015).

[2] We use data from both the 2006 and 2018 surveys in the empirical analysis and discuss their usage below in Section III. Gyourko, Saiz & Summers (2008) and Gyourko, Hartley & Krimmel (2021) describe each cross section in detail.

[3] Because school district boundaries often change at the border, we also control for school quality with the third-grade reading score in the school district of the underlying border area. More on that below.

We estimate impacts on urban form, not just pricing. Price effects are important, of course, but changes to the built environment are likely to be long-lived. Hence, knowing whether they occur and if so, in what magnitude, is of first-order relevance. Density of single-family housing in the border area is one such outcome investigated. Other physical outcomes include the size of the homes themselves and the lots on which they sit.

The WRLURI data show minimum lot size regulation to be virtually omnipresent throughout the United States, so estimating their potential impacts is natural.[4] Controlling for border pair fixed effects, we find that housing density is materially lower—by 0.17 fewer homes per acre (roughly 109 fewer homes per square mile) or 11% of sample mean density—in border areas of jurisdictions that report having the most stringent minimum lot size requirements (i.e., a 1+ acre mandate in at least one neighborhood in the border area's jurisdiction) relative to that in jurisdictions we categorize as having the least stringent requirements (i.e., no minimum lot size in any neighborhood that exceeds one-half acre).

House quality is influenced by regulatory strictness, too. Making the same comparison of the most stringent to the least stringent communities in terms of minimum lot sizes finds just over 80ft^2 more living area for the typical home in the border area of the most restrictive community, an amount equal to 4% of sample mean structure size. The impact on lot size is larger, with the typical lot in the border area of the most-regulated community estimated to be 3,061ft^2 bigger than in the least-regulated community. This amounts to 28% of the sample mean. Not only are there fewer homes per acre in the most strictly regulated places, but among the smaller number of homes that do exist, they have slightly larger structures and use considerably

[4] Gyourko, Hartley and Krimmel (2021) report that 94% of WRLURI respondents to the 2018 survey had some type of minimum lot size regulation. The share was well over 80% in the first Wharton survey (Gyourko, Saiz and Summers (2008)). Recent research by Cui (2022), Shanks (2021) and Song (2023) also finds widespread adoption of this type of residential land use constraint using different data and samples.

more land. At the individual parcel level, these two impacts counterbalance one another to some extent, so that the structure-to-land ratio of the typical home is modestly lower in the more highly-regulated places.

Finally, we estimate house prices to be about $29,000 higher in the border areas of communities with the largest minimum lot sizes of at least one acre compared to those communities that never exceed 0.5 acres. Additional analysis reveals that this price gap can be accounted for by house quality differences across the border. More specifically, house structures and lots are bigger on the more regulated side of the border, and these traits can explain the price gap.

Our work is related to an expanding body of research into the impacts of residential building restrictions. While we use the more recently collected Wharton surveys, they are part of a longer running collection effort that dates back to the 1990s.[5] New research by Cui (2022) shows that the modern era of minimum lot size regulation from which our data are drawn largely was established between 1940-1970.

Until recently, empirical efforts to measure the impact of regulatory strictness has focused on the influence on price. Turner, *et. al.* (2014) is the classic examination of the impact of regulatory constraint on raw land value, reporting an economically meaningful negative effect on price. Their empirical strategy was based on what effectively was a comparison of two nearby vacant land parcels, only one of which was constrained by regulation. Hence, their negative price impact is as expected because regulation decreases the option value of one of the vacant parcels. In contrast, we observe house prices that reflect the combined value of structure

[5] See Linneman, et. al. (1990) and Glickfield & Levine (1991) for example. Pendall, Puentes & Martin (2006) is an example of a more recent survey. In addition, there are data collection and mapping efforts that focus on more narrowly defined geographies. The Terner Center's Land Use data (http://californialanduse.org/index.html) is a prominent example.

+ land. Our results indicate that regulation increases both living area and lot size square footage, so that neither is held constant in our empirical analysis of the impact on home prices. Glaeser & Gyourko (2018) provides an overview of work on house price impacts, which has documented large differences across metropolitan areas. Our within-metro price impacts are smaller, as expected, and are consistent with a recent estimate of price effects.[6]

This paper also is part of a small, but growing, body of newer research studying the impact of residential land use regulation on aspects of the built environment. Much of this other work is more geographically focused on individual metropolitan areas such as the Boston area and its surroundings (Zabel & Dalton (2011); Kulka, Sood & Chiumenti (2023); Shanks (2021)), or Portland, OR, (Grout, Jaeger & Plantinga (2011)). The relatively narrow geographic focus raises the question of whether their results generalize beyond their locales, which is something our use of a broader sample can help answer.[7]

There are clear benefits to the different research designs employed in these related papers in localized settings. For example, Kulka, Sood & Chiumenti (2023) and Song (2023) build theoretical frameworks so that they can evaluate counterfactuals in Boston and Connecticut, respectively, that could help us get at important, but challenging, questions such as what would happen to the density of a state or metropolitan area if minimum lot size restrictions were relaxed in a certain way. Our purely empirical approach cannot do this, but we can identify what effect regulation already has had on the built environment across a large number of metropolitan

[6] Within-metro area variation was not available until recently. For example, Song (2023) performs a border analysis across several metropolitan areas where minimum lot sizes restrictions are identified by structural break detection algorithm rather than survey data. She reports that a doubling of the minimum lot size results in a 12% increase in house price.

[7] See also Schoenholzer (2018) for a broader examination of the role of local and state public policy on urban form and economic development.

housing markets, which should be an important input into estimating key parameters of such models.

Shanks (2021) and Song (2023) present new methods to measure the regulatory environment in the absence of survey data like that employed in this paper--the former by natural language processing and the latter by a break detection algorithm. These methods are valuable as the data collection and measurement of land use restrictiveness are costly. Such methods may allow researchers to estimate land use restrictiveness in entire metro areas rather than only the jurisdictions where survey collection was possible. One can view our approach, based on traditional and relatively expensive survey collection, as both a useful comparison with and potential validation of the results of the studies using more novel, indirect data measurement methods.

The plan of the paper is as follows. The next section describes the data in detail. Section III then presents our baseline empirical specification and reports results. There is a brief conclusion that suggests paths for future research into regulation and housing markets.

II. Data

Our empirical strategy requires data on land use regulations, maps of administrative boundaries, house prices and characteristics such as lot and physical structure size. We also merge in data on school district reading test scores to control for school quality, which may change discretely at the administrative boundary.

II.A The Wharton Surveys and Administrative Boundaries

We use regulation data from both the 2006 and 2018 WRLURI surveys. Each contains responses from over 2,000 primarily suburban jurisdictions to an array of questions covering the myriad restrictions local governments use (e.g., capping the number of building permits, requiring zoning board approval, imposing density restrictions, etc.). We focus on density restrictions in the form of minimum lot size restrictions that exist anywhere within the community and how restrictive they are. The range of possible answers varied across the two surveys, which requires us to adopt a standardized set of ranges for density restrictions.

Both surveys asked if there was at least one neighborhood within the community's political boundaries that was in one of the following categories: (a) either no minimum lot size or the most stringent one is less than one-half acre; we call such places 'Least Strictly Regulated' in the regression analysis below; (b) those in which the largest minimum lot size ranges from one-half acre to (just under) one acre; these places are termed 'Moderately Regulated'; or (c) those in which the largest minimum is either from 1-2 acres or for 2+ acres; because there were so few communities that reported a 1-2 acre minimum, we group these two categories into a single one for 1+ acre minimums; these places are labelled 'Most Strictly Regulated' below.[8]

Because our research design relies on exploiting variation across administrative boundaries, we must restrict our sample to WRLURI survey respondents sharing a border. The U.S. Census provides maps of the administrative boundaries used in our analysis.[9] Along these boundaries, we construct border areas of four different depths—250, 175, 100 and 50 meters--and remove any area covered in water. We then separate each border area into its two administrative sides. As is discussed more fully below, it is important for our empirical strategy

[8] Each survey question is reproduced in the online appendix. Density restrictions of some kind exist in almost all WRLURI responding communities: As noted above, across all communities in the 2018 survey, 94% reported having some minimum lot size restriction; 25% reported a 2+ acre restriction somewhere in their jurisdiction.

[9] In the WRLURI data, local governments are typically at the Census Place level, and less frequently at the County Subdivision, or County level. Shapefiles for these geographies and bodies of water were downloaded from the U.S. Census Tiger/Line site at https://www.census.gov/geographies/mapping-files/time-series/geo/tiger-line-file.html

that the homes in each border pair share the same amenity set. A parcel that is 250 meters from the border is within 0.15 miles, so the homes at the maximum depths of the two border areas are within 0.3 miles of one another. The geographic area for a 250 meter depth border side ranges from 247 acres at the 25^{th} percentile to 559 acres at the 75^{th} percentile. The corresponding figures for the 50 meter depth border sides are 50 acres at the 25^{th} percentile and 115 acres at the 75^{th} percentile.

Figure 1 depicts one border pair for Allen City and Fairview Town, which are in the northeast corner of the Dallas, TX, metropolitan area. The thick blue lines mark the extent of each border area depth in both communities. Using smaller depths provides better comparison groups because the homes are very close to the border, but presents a tradeoff in statistical precision because effective sample sizes get much smaller. Given standard lot sizes, it typically is not feasible to have a large number of single-family homes within 50 meters of the boundary.

A complete list of markets and the number of contiguous respondents to the Wharton surveys from each of the 36 CBSAs in our sample is reported in Online Appendix Table 1. There is substantial variation in the number of respondents, with those from the Chicago (80), Los Angeles (72), and Detroit (63) areas comprising almost 34% of the borders in our sample. The other two-thirds of the observations are widely dispersed across the country's top urban agglomerations.

Our final sample contains 635 border pairs of adjacent WRLURI jurisdictions implying 1,270 sides. These border pairs are constructed from 706 unique WRLURI jurisdictions, which reflect the fact that some places have multiple borders with different communities. Ours is primarily a suburban sample comparing regulatory impacts across two such jurisdictions. There are only 20 central cities of metropolitan areas included, and they have only 95 distinct border pairings with suburban jurisdictions. At the border side level, 489 use data from the 2006 survey, with 781 using 2018 data. At the border pair level, there are 102 cases in which both sides of the border use 2006 data, 285 mix across surveys (i.e., one side uses 2006, the other uses 2018), and 248 cases in which both sides use 2018 data. At the parcel level, there are 300,572 observations in places using 2006 survey data and 431,470 observations in places using 2018 survey data. For those jurisdictions that answered both surveys, we rely on the 2018 vintage regulation data. As is discussed below, our results are robust to including a control for which survey the data are derived from.

II.B Housing Characteristics

We use parcel-level data from the CoreLogic tax assessment files to measure single-family unit density, lot size, and housing structure size. These parcels are precisely located by census block coordinates, allowing us to restrict observations to the parcels within the relevant WRLURI jurisdiction border area. Because of outliers and potentially faulty observations, we winsorize the data at the top (99^{th}) and bottom (1^{st}) percentile for living area, lot size, and house price. For the parcel-level structure-to-land ratio, we winsorize at the 5 percent level because the outliers were more extreme. We restrict our sample to border areas which have at least 100 single family housing parcels using the largest 250 meter depth area. The interquartile range for the number of observations on a border side for this depth runs from 246 to 701 parcels. Using a 100 meter range, which we focus on below in the results section, the analogous range runs from 80 to 429 parcels. Given this and the fact that there are 1,270 border areas implies that we have hundreds of thousands of observations on single family homes within those areas. For all border areas in jurisdictions for which regulation data come from the 2018 WRLURI survey, we use housing traits reported as of the 2019 CoreLogic files in our empirical analysis. For those whose regulation data come from the 2006 survey, we exclude all homes built after 2007 in our calculations and analysis. This reduces the micro samples of homes across all border areas by about 24,000, or about 3% of the total.

Two density measures are created with these data. One is the number of homes per acre in each border area. This is the count of single-family units from the CoreLogic data in a border area divided by the total acreage of that border area. The second is a parcel-level measure of the structure-to-land ratio for each house. This is the ratio of living space square footage-to-lot size square footage at the individual home level.

II.C House Prices

CoreLogic micro data on single-family house sales from 1990-2019 allow us to observe sales prices for virtually all such transactions in each border area. Because relatively few houses sell each year, we construct real 2021 values using the Federal Housing Finance Agency House Price Index (FHFA HPI ®) to adjust nominal values from different sales years.

II.D School District Test Scores

Because school district boundaries often coincide with administrative boundaries, school quality is an obvious potential confounder of the impact of regulation. Access to high quality schools likely affects housing characteristics and could be correlated with regulation itself. To address this issue, we include controls for school quality by matching school district test score data from the *Stanford Education Data Archive* (*SEDA*) to each side of a border.[10] Specifically, we measure a border side's school quality by the standardized average 3rd grade reading score in

[10] These data may be downloaded at http://purl.stanford.edu/db586ns4974 from the Stanford Education Data Archive (Version 4.1), Reardon, S.F., *et. al.*

its respective school district. By construction, every parcel on the same side of the border is associated with the same school district.[11]

We discretize our school quality measure as follows. Each border area is assigned its jurisdiction's 3rd grade reading score for 2018 or the most recent year available. We then assign each border area to one of three categories: (a) 'Lowest School Quality', which is comprised of those with scores in the bottom quartile of the sample distribution; (b) 'Average School Quality', which is comprised of those with scores in the interquartile range of the distribution; or (c) 'Highest School Quality', which is comprised of those with scores in the top quartile of the distribution.

II.F Summary Statistics

Table 1 provides summary statistics on the outcomes of interest using the border areas defined by a depth of 250 meters, as well as test scores, by level of density restriction in the broader community. We report means and standard deviations of the underlying values in each border area. There are 663 Least Strictly Regulated border areas, 239 Moderately Regulated border areas and 368 Most Strictly Regulated border areas. Within the Least Strictly Regulated areas, there are 428,794 observations on individual homes, with 271,044 having been sold between 1990 and 2019. The analogous figures for the Moderately Regulated area are 120,063 and 75,643, respectively; those for the Most Strictly Regulated areas are 183,185 and 118,546, respectively.

Note that our outcome measures covary as economic intuition would suggest with the degree of regulation as reported in the survey instrument. That is, density falls as one moves from low to high regulation areas, structure and lot size are larger in more regulated places, etc.

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[11] We also experimented with 8th grade reading scores, as well as math scores from the 3rd and 8th grades. None of our key conclusions is affected if one of these other proxies for school quality is used.

Moreover, many of these differences are economically meaningful. While suggestive, these patterns obviously do not imply causation, which lead us to employ a border effects estimation research design.

III. Empirical Specification and Results

We estimate the impact of local residential land use regulation on five outcomes. The first three outcomes are for the homes or land parcels themselves. Outcome #1 is lot size as reflected in the square footage of land on which each single-family housing unit in a border area sits. Outcome #2 is house size as reflected in the square footage of living area reported for each single-family unit in the border area. Outcome #3 is house price in constant 2021 dollars based on recorded sales transactions across various years. The final two outcomes are density measures. Outcome #4 is the structure-to-land intensity at the parcel level, which is created by taking the ratio of the first two outcomes (i.e., house size divided by lot size). Outcome #5 is housing density measured by the number of single-family homes per acre in a border area.

In terms of the specifications estimated, let a *border pair b* be the entire border area. Each border pair has two sides, one for each WRLURI jurisdiction *j*. Let the *jurisdiction j side* be the section of the border area only contained in jurisdiction *j*. For Outcomes #1-#4, our unit of observation is a parcel. Every *parcel p* sits in a jurisdiction *j* side of a border pair *b.* Given this, our baseline specification regresses each outcome on our measure of minimum lot size ($MinLotSize_j$), 3rd grade reading scores from the relevant jurisdiction ($School_j$), and a full set of border pair fixed effects (δ_b) as in equation (1):

$$(1)\ Outcome_{p,j,b} = \beta * MinLotSize_j + \gamma * School_j + \delta_b + \varepsilon_{p,j,b.},$$

where all terms are defined as above.

For Outcome #5, our baseline specification regresses the density of homes in the jurisdiction *j* side of border pair *b* on the same set of controls as in equation (2):

(2) $HomesPerAcre_{j,b} = \beta * MinLotSize_j + \gamma * School_j + \delta_b + \varepsilon_{j,b.}$

Because parcels can sit on either of the two sides of a border depending on which jurisdiction they are in, we expect the exposure to regulatory strictness to vary by the respective jurisdiction. The border pair fixed effects then allow us to compare average outcomes across jurisdiction boundaries.[12,13]

Table 2 reports a summary of the impacts implied by our regression results. In all specifications, the Least Strictly Regulated and Lowest School Quality categories always are omitted. We report estimated coefficients on minimum lot size severity for the four border depths noted above.[14] We focus our discussion on the results for the 100 meter depth in the third column of Table 2, noting that it is a quite small geographic area itself in which most of the observations are within one-tenth of a mile of one another. Hence, the amenity sets defining each border area are likely to be virtually identical, which minimizes omitted variable bias.[15]

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[12] One could expand the border area and then estimate heterogenous impacts based on distance to the border, but those results certainly would be contaminated by omitted amenities influencing prices and possibly the built environment. Hence, we prefer our approach which limits observations to those quite close to the border. That said, for completeness we also provide formal regression discontinuity results within our various border areas following Lee and Lemieux (2010) and Cattaneo et al. (2020) that use observations within the 250 meter border depth. Those findings, which are reported in Online Appendix Table 5 and Online Appendix Figure 3, allow the outcomes to be local linear functions of the score variable (distance to the border) on either side of the discontinuity. These results are discussed more fully below in the section on robustness.

[13] In work not reported in this paper, we also investigated whether other aspects of local residential land use regulatory regimes impacted housing density, structure size, lot size and house prices. No other subcomponent of the overall WRLURI index approaches the economic (and typically the statistical) significance of minimum lot size restrictions on housing density. Hence, this is the aspect of the local regulatory environment that researchers and policy makers must focus on if they want to understand or alter single family housing density *per se*.

[14] The full set of regression results is reported in the Online Appendix Table 2. Standard errors are clustered at the metropolitan area level. Different clustering choices, including at the border pair level, do not change any conclusion reached below in a meaningful way.

[15]There also are more observations available at the 100 meter depth compared to the shallower 50 meter depth. If we restrict observations to be within 50 meters of the border, there are multiple cases where the sample size becomes quite small. For example, the interquartile range for the number of observations ranges from 30 to 113 at that depth.

The results in the top section of column 3 suggest being moderately regulated increases lot size to some extent, and show an economically large impact of being strictly regulated on lot size. Being Moderately Regulated is associated with an 819ft^2 larger lot compared to being in one of the Least Strictly Regulated communities, an impact equal to 8% of the sample mean of lot size, but which is not statistically significant at standard confidence levels. In contrast, lot sizes are much larger—by 3,061ft^2 or nearly 7% of an acre—on average in the border areas of the Most Strictly Regulated communities. This is economically meaningful, as it amounts to 28% of the overall sample mean (and is 22% of the larger mean among only the most highly-regulated communities). Note also that this impact is quite consistent (and remains statistically significant) across the samples using different border depths, including at the 50 meter depth (column 4).

The second section of column 3 reports the estimated impact on house structure. In this case, being Moderately Regulated is associated with having a slightly larger house, although the statistically insignificant impact of 34ft^2 is small in economic terms, too. The effect is more than two times larger at 83ft^2 in the border areas of the Most Strictly Regulated communities compared to those in the Least Strictly Regulated places. This is a bit more economically meaningful, as it is 5% of the sample mean house size. However, the results across the four border depths show that this effect attenuates the closer the homes are to the border. While still statistically significant for homes within 50 meters of the boundary, the impact is only 39ft^2 in that area, although we caution that there are very few observations in some of those areas.

The third section in column 3 documents that more stringent minimum lot sizes also influence average house prices across jurisdiction borders within a metropolitan area. The price impact of being in a Moderately Regulated community is a marginally insignificant $16,041, compared to a highly significant $29,070 in the Most Strictly Regulated category (all relative to the Least Strictly Regulated areas). This is less than the much higher cross-market price differences noted in the Introduction, but it still amounts to well over one-quarter of median household income even in the highest paid labor markets in the country.[16] Note that the price impact also attenuates the closer the underlying regression sample is to the border, but remains statistically significant, ranging from $17,526 at the 50 meter depth (column 4) to $40,469 at the 250 meter depth (column 1). Finally, it is noteworthy that this impact can be mostly explained by adding a few controls for house quality. The results for that augmented specification which includes structure and lot size are reported in Online Appendix Table 3. Adding just those two variables eliminates all statistical significance of being more strictly regulated and reduces the analogous point estimate at the 100 meter border depth level by a factor of five from $29,070 to $5,567.[17]

Turning next to the impact on density, we first examine the results for the parcel-level structure-to-lot size ratio. Given the relative sizes of the impacts just reported for lot and structure size, we would expect a negative coefficient for this variable. Section four of column 3

[16] For example, the Census reports a median household income of $75,157 in 2021 dollars based on *American Community Survey* (*ACS*) samples spanning 2017-2021 for the New York City CBSA. It is also the case that the influence of density regulation on prices pales in comparison to that of good schools. Being in the interquartile range of school quality is associated with a price impact comparable to that of being in a community with at least one neighborhood with a one acre+ minimum lot size regulation. Moreover, being in the top quartile of school quality is associated with a $82,005 higher house price compared to being in the bottom quartile of the reading score distribution. See the full results in Online Appendix Table 2 for more on these effects. Finally, not controlling for reading scores is associated with about a 20% higher price impact for the Most Strictly Regulated places using the 100 meter sample.

[17] It is possible that other factors such as differences in household type or a Turner, *et. al*. (2014)-like option value also could influence the estimated price impact of density restriction. In results not reported due to data limitations, we do find some evidence of sorting by household type at the border, but inclusion of demographic controls does little to change the estimated coefficient on the density restriction. While focused mostly on multifamily housing, Kulka, Sood & Chiumenti (2023) do report some findings for the single family sector. They also find that changes in structure and lot size explain the vast majority of the observed single family home price difference due to density restrictions. Song (2023) reports that controlling for house characteristics reduces the price impact by roughly two-thirds. In contrast to our results, she finds more significant changes from controlling for neighborhood demographics, which further reduces the remaining estimated price difference towards zero.

in Table 2 confirms that expectation. Being in the border area of a Moderately-Regulated community in terms of lot size minimums has a small and insignificant negative impact on this measure of density. The impact of being in the border area of one of the Most Strictly Regulated communities is nearly double in size and is statistically significant at the 95% confidence level. Our point estimate is about one-tenth of the overall sample mean. Looking across the columns of Table 2 shows that this impact is modestly higher when we restrict the samples to observations closer to the boundary, but it never is economically large. One reason for the relatively small impact is that both the numerator and denominator of this variable are increasing, with the impact on the denominator larger.

We find more economically important effects when we turn to our last outcome that reflects the effect of variation in minimum lot size on housing density measured as the number of single-family homes per acre in a border area. As the fifth and bottom section of column 3 in Table 2 documents, being Moderately Regulated is associated with 0.10 fewer homes per acre compared to the Least Strictly Regulated areas, but this effect is not close to being statistically significant. Being in one of the Most Strictly Regulated border areas is associated with a statistically significant 0.17 fewer homes per acre. Translated into per square mile terms, this effect implies 109 fewer homes per square mile compared to the sample mean of 992 homes per square mile. Note that this impact does not attenuate much as border depths become shallower, but statistical significance disappears at the 50 meter depth level. As noted previously, there are costs, not just benefits, to using samples closer to the border, and we leave it to the reader to decide how much weight to put on any specific finding.[18]

[18] Finally, while our interest in school quality is primarily as a control for the possible compound treatment effect of regulation and school districts changing simultaneously at the border, it is interesting that higher school quality is not as strongly associated with materially lower housing density at the border area level. Again, see the full set of results in Online Appendix Table 2 for those details.

III.A. Robustness Checks

Our findings are robust to a number of alternative specifications. For example, controlling for the survey year from which a border area's regulatory intensity measure comes from does not change the findings in a meaningful way as shown in Online Appendix Table 4. Thus, there is no evidence that mixing observations from the 2006 and 2018 surveys is driving our results.

In Online Appendix Table 5 and Figure 3, we report regression discontinuity estimates and binned scatter plots that follow Lee and Lemieux (2010), and Cattaneo et al. (2020) in allowing the outcomes to be local linear functions of the score variable, distance to the border in this case, on either side of the discontinuity. These estimates are based on pooling the subsample of borders where one side of the border is in the Least Strictly Regulated category and the other is in the Most Strictly Regulated category using observations that are within 250 meters of a border. These estimates are qualitatively and quantitatively similar to those for the 50 meter depth estimates in the Most Strictly Regulated category presented in Table 2.

Additional robustness checks reported in the Online Appendix include testing for whether logging house prices matters. It does not (see Online Appendix Table 6 for the details). Finally, Online Appendix Table 8 reports on the impact of regulation on house age. The effect on this outcome is always minimal in economic and statistical significance.

To obtain substantially different impacts, one has to drop the border pair fixed effects. Doing so results in far higher estimated impacts of more stringent regulation. These magnitudes, which can be gauged by taking differences across columns in the summary statistics in Table 1 are on the order of 250ft^2 in terms of house size and well over 5,000ft^2 in terms of lot size. However, we cannot envision a justification for not including border pair fixed effects.

IV. Conclusion

On average, we find that, just 100 meters into more restrictive jurisdictions, homes sit on much larger lots, are modestly larger in structure size, and cost $30,000 more. That minimum lot size constraints affect urban form, not just house prices, raises important questions for future research about whether the broader nature of the housing stock, not just the quality of single-family product, has been affected by regulation.

In other analysis included in the Online Appendix (Table 7), we investigated whether there is less multifamily housing in places with more stringent minimum lot size controls pertaining to single-family units. Unfortunately, data limitations prevent us from using the border analysis approach employed above in Table 2. However, using Census data at the jurisdiction level allowed us to estimate a similar specification which showed that being in the most strictly regulated category of communities is associated with about a 7 percentage point lower share of multifamily units in the overall housing stock than exists in the least strictly regulated places. That difference is large economically, as it amounts to over one-quarter of a standard deviation change in multifamily unit share in our sample of jurisdictions. This is consistent with an implication of Cui (2022) that adoption of minimum lot size restrictions in the past could lock a jurisdiction into certain types of land usage and housing types. Panel data will be needed for this analysis, but our preliminary results suggest that developing it will be worth the effort.

The need for panel data is underscored by the results in Online Appendix Table 9, which suggest a marked difference in the impact on lot size in houses built after 1970 in particular.

Using a 100 meter border depth and dividing the sample by whether the home was built prior to 1970 finds that being in the most highly regulated category (as of 2006 or 2018) is associated with a 2,041 square foot larger lot size relative to being in the least regulated category. After 1970, the coefficient jumps to 3,892 square feet. This suggests the initial change in density regulation happened sometime in the past, possibly around 1970.[19] Panel data will be needed to model and capture the dynamics necessary to address issues like this.

Additionally, that we find bigger homes on the more regulated side of the border raises the possibility that regulation could have just reallocated where higher quality homes are located. The potential role that sorting by demographics might have played in generating regulation or that might have occurred in response to regulation is not yet fully understood and needs more research. Finally, the upsurge of interest in density restrictions should not blind economists to other forms of regulation that could be affecting other outcomes of interest (e.g., overall housing supply). Not all regulation is the same, and we should begin to study how they might impact housing markets and the broader urban environment.

[19] Experimentation with finer breakdowns showed no appreciable changes in results if we estimated impacts for homes built between 1970 and 1990 versus 1990-2019. Finally, the impacts on structure size follow a similar pattern: homes built prior to 1970 are 80ft^2 larger in the most regulated category while homes built after 1970 are 137ft^2 larger.

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Figure 1: Border Pair Example from the Dallas, TX, Metropolitan Area

Allen City-Fairview Town Border
Border Areas Marked by Blue Lines. WRLURI Boundary in Red.

Table 1: Sample Characteristics by Density Restriction

	Level of Density Restriction		
	Least Strictly Regulated (<½ acre)	Moderately Regulated (½ - 1 acre)	Most Strictly Regulated (1+ acre)
Lot Size (ft^2)	9,026 (8,760)	12,422 (12,037)	13,939 (16,163)
Living Area (ft^2)	1,734 (760)	1,966 (889)	1,995 (905)
House Price (ft^2)	$447,510 (406,516)	$509,516 (493,751)	$502,523 (484,789)
SF Homes per Acre	1.80 (1.09)	1.45 (0.85)	1.16 (0.84)
Reading test Score	0.12 (0.44)	0.27 (0.49)	0.28 (0.38)
# Obs (parcel level)	428,794	120,063	183,185
# Obs (sales price)	271,044	75,646	118,546
# of Border Sides	663	239	368
# of Jurisdictions	360	117	239

Notes: Standard deviations in parentheses.

Table 2: Minimum Lot Size Regressions

	BORDER DEPTH			
	250 meters	175 meters	100 meters	50 meters
Lot Size (ft^2)				
Moderately Regulated	912**	844*	819	1,122*
	(429)	(438)	(524)	(577)
Most Strictly Regulated	3,053***	3,060***	3,061***	2,094***
	(611)	(640)	(712)	(749)
# obs	732,042	494,114	259,268	110,238
Living Area (ft^2)				
Moderately Regulated	54*	52**	34	17
	(28)	(24)	(23)	(18)
Most Strictly Regulated	118***	108***	83***	39*
	(33)	(32)	(28)	(20)
# obs	732,042	494,114	259,268	110,238
House Price (ft^2)				
Moderately Regulated	$17,690	$20,334**	$16,041	$8,745
	(11,297)	(9,868)	(9,522)	(6,097)
Most Strictly Regulated	$40,469***	$35,922***	$29,070***	$17,526**
	(11,268)	(10,778)	(10,546)	(8,193)
# obs	465,236	314,196	164,986	69,316
Living Area / Lot size				
	-0.009	-0.010	-0.012	-0.014*
Moderately Regulated	(0.007)	(0.008)	(0.008)	(0.008)
Most Strictly Regulated	-0.015**	-0.018**	-0.021***	-0.020**
	(0.008)	(0.008)	(0.007)	(0.008)
# obs	732,042	494,114	259,268	110,238
SF Homes per Acre				
Moderately Regulated	-0.15**	-0.14**	-0.10	-0.09
	(0.06)	(0.06)	(0.08)	(0.14)
Most Strictly Regulated	-0.19***	-0.16**	-0.17***	-0.16
	(0.06)	(0.07)	(0.06)	(0.12)
# obs	1,270	1,270	1,270	1,270

Note: All regressions include 635 border pair fixed effects. Controls for school quality as described in equations (1) and (2) in the text always are included. See the full results in Online Appendix Table 2 for those results.

*p<0.10; **p<0.05; ***p<0.01

Standard errors clustered by CBSA.