Do Strict Land Use Regulations Make Metropolitan Areas More Segregated by Income?

Michael C. Lens & Paavo Monkkonen

Published online: 28 Dec 2015.

Submit your article to this journal ⬈

View related articles ⬈

View Crossmark data ⬈

Do Strict Land Use Regulations Make Metropolitan Areas More Segregated by Income?

Michael C. Lens and Paavo Monkkonen

Problem, research strategy, and findings: Income segregation has risen in each of the last four decades in U.S. metropolitan areas, which can have lifelong impacts on the health, economic productivity, and behaviors of residents. Although it is widely assumed that local land use regulations—such as minimum lot sizes and growth controls—exclude low-income households from wealthier neighborhoods, the empirical research is surprisingly limited. We examine the relationship between land use regulation and segregation by income using new measures for the 95 biggest cities in the United States. We find that density restrictions are associated with the segregation of the wealthy and middle income, but not the poor. We also find that more local pressure to regulate land use is linked to higher rates of income segregation, but that more state control is connected to lower-income segregation.

Takeaway for practice: Density restrictions do drive urban income segregation of the rich, not the poor, but should be addressed because rich enclaves create significant metropolitan problems. Planners at the local level need assistance from regional and state efforts to ameliorate income segregation. Inclusionary housing requirements have a greater potential to reduce income segregation than bringing higher-income households into lower-income parts of the city. Finally, comprehensive and consistent data on the impacts of local land use regulations should be collected to inform future research and planning practice.

Keywords: income segregation, land use regulations, exclusionary zoning

The rise in income inequality in the United States and other developed countries has garnered significant media attention. Yet another type of income gap is also on the rise: segregation by income. Segregation by income increased every decade from 1970 to 2010, and in this same time period the share of households living in both poor and affluent (as opposed to mixed-income) neighborhoods doubled (Bischoff & Reardon, 2014). This rise in income segregation stands in contrast to recent data showing that racial segregation in the United States is on the decline (Glaeser & Vigdor, 2012; Logan & Stults, 2011). The steady and substantial rise in income inequality certainly contributes to this trend, but does not fully explain the increase in income segregation (Reardon & Bischoff, 2011).

What, then, accounts for the increasing separation of high- and low-income households? Many believe that local land use regulations play an important role, although the empirical evidence is scant. Scholars (Mills & Hamilton, 1997; Pendall, 2000), planners (APA, 2006) and the popular press (Applebaum, 2012; Thompson, 2014) argue that regulations such as minimum lot sizes and growth controls make jurisdictions more socioeconomically homogeneous and metropolitan areas more segregated. Yet, we identify only one existing study on the topic (Rothwell & Massey, 2010).

Income segregation is particularly important for planners concerned with social and spatial equity. The segregation of the rich—which is growing rapidly in U.S. metropolitan areas—results in the hoarding of resources, amenities, and disproportionate political power. The segregation of the poor often creates neighborhoods besieged by crime and severely limits life chances

About the authors: Michael C. Lens (mlens@ucla.edu) is an assistant professor of urban planning in the University of California, Los Angeles (UCLA) Luskin School of Public Affairs. He conducts research on low-income housing subsidies, neighborhood effects, and segregation by income and race. **Paavo Monkkonen** (paavo@luskin.ucla.edu) is an assistant professor of urban planning in the UCLA Luskin School of Public Affairs. He studies how housing policies shape property markets and patterns of social segregation.

in schooling, employment, health, intergenerational mobility, and other vital outcomes. More pragmatically, local economies require income diversity: It is not sustainable or efficient for low-wage workers to travel long distances to work where higher-income households spend money.

The minimal scholarship on the nexus between land use regulations and income segregation is noteworthy because while local governments have little direct control over an issue like income inequality, land use regulation is one of the major powers held by local governments in the United States. If modifications to land use regulations can combat income segregation, it is vital that planners and policymakers know specifically how those modifications should be made.

In this study, we take advantage of recent advances in tools to measure income segregation and land use regulations (Gyourko, Saiz, & Summers, 2008; Reardon, 2009; Reardon & Bischoff, 2011; Reardon & O'Sullivan, 2004). These tools allow us to determine the precise land use regulation processes that have the greatest effect on overall levels of segregation, and the segregation of the rich and poor specifically.

We conclude that land use regulation affects income segregation, but some aspects matter much more than others. First, the local nature of planning and greater pressure from multiple local interest groups on residential development exacerbates the tendency to segregate by income. At the same time, income segregation is lower when state governments have more power over land use decision-making processes. Taken together, this suggests planners and policymakers should push for greater state or regional land use authority.

Echoing previous research (Rothwell & Massey, 2010), we also find that density restrictions are associated with higher-income segregation, and should be relaxed where possible. However, density restrictions appear to lead to the segregation of the affluent, not the poor, which go against assumptions that connect density restrictions to the exclusion of the poor from suburban jurisdictions. We also find that the complexity of the municipal review process, measured by the number of approvals that local governments require for new housing developments, is strongly related to the segregation of low-income households.

Here, we first discuss the mechanisms through which land use regulations are thought to shape income segregation and summarize relevant empirical research on the topic. In the next section, we describe the data and methods used, and then report the results of the econometric analysis in the penultimate section. We describe how we come to our recommendations for planning practice in the final section.

How Might Land Use Regulations Affect Income Segregation?

There are two primary explanations for income segregation, or the tendency of households with similar levels of income to live near one another. Some scholars argue that income segregation results from an efficient sorting process: Households move into neighborhoods that offer them the best combination of housing and local amenities that they can afford (Oates, 1981; Tiebout, 1956). Yet, other scholars argue that segregation (by race or income) also arises from policies and collective efforts to exclude certain groups—low-income or minority households, for example—from areas preferred by those with the power to do so. Although this structural source of racial segregation is well documented (Massey & Denton, 1993; Pendall, 2000), there are few empirical studies on income segregation.

Many factors shape a metropolitan area's overall level of income segregation, including a) inequality, b) population size, c) growth rates, d) density, and e) political fragmentation. To begin, the presence of income inequality itself is a critical if insufficient catalyst for income segregation: A number of studies have shown that income inequality is positively associated with income segregation across cities (Reardon & Bischoff, 2011; Watson, 2009; Watson, Carlino, & Ellen, 2006). Interestingly, income inequality at the upper end of the distribution—income concentration in the hands of the very rich, as opposed to just the rich—plays a bigger role in explaining income segregation than the concentration of poverty among the very poor. That is to say, recent increases in income segregation are driven more by the rich getting richer than the poor getting poorer. Reardon and Bischoff (2011) also find that the rise in economic inequality seems to have increased the segregation of affluence, but not of poverty.

The size and growth rate of a metropolitan area also help explain the extent to which income segregation occurs. There is less segregation by income in smaller metropolitan areas (Reardon & Bischoff, 2011), probably because households have fewer residential choices and neighborhoods are less differentiated (Mills & Hamilton, 1997). The relationship between population growth and income segregation is nonlinear: It appears that income segregation advances most rapidly when metropolitan areas are either stagnant or fast growing, and not during periods of steady population growth (Watson et al., 2006).

The relationship between urban form and income segregation is complex, but certain types of urban form, in particular low-density development patterns, can contribute to income segregation. Higher population densities, in contrast, could lead to greater integration if

neighborhoods include more multifamily and smaller housing units. However, density is also associated with larger cities and more competitive land and housing markets (Pendall & Carruthers, 2003; Yang & Jargowsky, 2006). Pendall and Carruthers (2003) find that higher density is associated with greater levels of income segregation, although this does not hold in the highest-density metropolitan areas. Yang and Jargowsky (2006) show that decentralized development patterns and sprawl encourage income segregation.

Last, metropolitan fragmentation is also thought to contribute to income segregation. The U.S. system of multiple incorporated cities in each metropolitan area, most of which have the power to regulate land use within their borders, differs from most countries. Metropolitan areas with more than a million residents in the United States can have dozens or even hundreds of separate jurisdictions, each of which have control over their land use. Given that many suburban jurisdictions are created to cater to households with similar tax and spending preferences (Oates, 1981; Tiebout, 1956), it follows that fragmentation would lead to relatively homogenous communities. Thus, metropolitan areas with a greater number of jurisdictions are expected to have greater levels of income and racial segregation (Jimenez & Hendrick, 2010). Empirical research confirms this. For example, Yang and Jargowsky (2006) find that the number of governments per 100,000 persons in a metropolitan area is positively associated with income segregation.

The wider planning community assumes a direct connection between land use regulation and income segregation in spite of limited empirical evidence. The APA (2006) adopted its most recent policy guide on housing in 2006; one of its central positions is to reduce barriers to housing opportunity, which include "…large lot zoning, restrictive single family definitions, minimum square footage for single family homes, housing location policies, expensive subdivision design standards, prohibitions against manufactured housing, [and] time-consuming permitting and approval processes" (p. 5).

APA's underlying assumption is that these regulations reduce housing options for low-income households who cannot afford large single-family homes. This makes some cities and neighborhoods unaffordable for lower- and middle-income households, leading to greater neighborhood homogeneity and higher metropolitan income segregation. The popular media also often cites the impact of housing regulation on affordability and by extension their role in income segregation (Applebaum, 2012; Thompson, 2014). However, the social science evidence on this relationship is scant.

Low-density zoning is the most heavily studied dimension of municipal land use control because it is thought to be the zoning practice most likely to exclude low-income and minority groups from neighborhoods and cities (Ihlanfeldt, 2004). Pendall (2000), for example, finds that low-density zoning is a "potent exclusionary land use control and that building permit caps warrant caution" (p. 130). Further, he finds little evidence connecting other types of land use regulations with the exclusion of minority households. Pendall connects low-density zoning to economic and racial exclusion through a multipart chain: The first and second links are the low-density zoning reduction in overall housing growth and multifamily housing, followed by a reduction in rental units and affordability that constitute the third and fourth links. This leads finally to "dampened growth in the minority population" (Pendall 2000, p. 138).

Another study looks at the effects of urban containment policies designed to influence urban form, such as growth boundaries, on racial segregation (Nelson, Sanchez, & Dawkins, 2004). Its authors find that growth boundaries are associated with a decrease in segregation between White and Black households, providing contrary evidence to the broad argument that more heavily regulated cities are more segregated. Nelson et al. (2004) did not examine income segregation in this study.

The most recent and germane study on this topic is by Rothwell and Massey (2010). In an analysis of 50 metropolitan areas, Rothwell and Massey use survey data developed by Pendall, Puentes, and Martin (2006) to measure land use regulation and measures of income segregation. Rothwell and Massey suggest that simple models are insufficient to identify the contribution of land use regulations to income segregation. In some cases, they argue, the income segregation could have come first, and jurisdictions with high proportions of wealthy households might later implement restrictive land use policies to protect this status quo. In prior work, Ihlanfeldt (2004) also argues that it is difficult to isolate the effects of land use regulations on income segregation because of the tendency for higher-income jurisdictions to enact such regulations. To address this problem, Rothwell and Massey use the year of statehood and population density in 1910 as instrumental variables to test their hypothesis. They find that places with more restrictions on density have higher levels of income segregation.

In sum, existing research finds that several factors under the purview of planners affect segregation by income and/or race, including metropolitan fragmentation, urban form, and land use zoning. With respect to zoning—the focus of this study—existing research fails to provide

planners with specific pathways through which land use regulations affect income segregation. We can conclude that density restrictions lead to increased income and racial segregation, but it is less clear how other forms of land use regulation affect income segregation. Furthermore, income segregation is complex: It is unclear from existing research if density restrictions increase segregation by isolating the poor, the wealthy, or both. If planners can help reduce income segregation, these efforts will have effects beyond merely influencing where people live. Spatial concentrations of poverty and wealth lead to unequal access to jobs, schools, and safe neighborhoods, and exacerbate negative life outcomes for low-income households.

Measuring Income Segregation and Land Use Regulation

To examine whether certain types of land use regulations exacerbate income segregation, both concepts must be measured accurately. In this study we improve upon Rothwell and Massey (2010) with a new source of data on land use regulation (Gyourko et al., 2008) and new measures of income segregation (Reardon & O'Sullivan, 2004) across 95 metropolitan areas in 2000 and 2010. These new measures and data sources allow for a rich investigation: We have comprehensive detail on the nature of land use regulations, and we can measure income segregation for different income groups to identify effects on the segregation of the rich and the segregation of the poor, separately. (For a detailed discussion of the data sources and methods used, please see the Technical Appendix.)

Land use regulation is a broad concept, and the rules that govern land use range from building safety requirements to urban growth boundaries to direct control over the specific uses of land. Gyourko et al.'s (2008) survey, the Wharton Residential Land Use Regulation Index (WRLURI), was developed from surveys of nearly 2,000 municipalities across the country in 11 categories or subindexes of regulation, which range from the number of approvals needed for a project to the presence of open space requirements. Table 1 lists the different subindexes and their definitions.

For each of the 11 categories of the WRLURI, higher numbers indicate more restrictiveness or stringent rules that can provide barriers to housing development. The idea of stringency differs across categories of regulation; for example, in the case of project or zoning approvals, a more stringently regulated city is simply one with more independent agencies from which developers must get permission. Cities with open space requirements or impact fees are considered to be more restrictive, and these subindexes indicate this. The local political pressure subindex is more complex. It is a sum of a number of rankings (from 1 to 5) of the level of involvement and the importance of various local groups (e.g., city council, community groups, and citizens) in local development decisions.

The overall WRLURI is a summation of standardized values of these subindexes; thus, it is interpreted as a broad measure of regulatory restrictiveness. While the WRLURI is not a perfect measure of land use regulation, it has become a common indicator of regulation for various studies of housing markets and has important impacts on prices and volatility (Huang & Tang, 2012; Saiz, 2010).

Table 1. Subindexes of the Wharton Residential Land Use Regulation Index.

Subindex	Definition	Number (type) of component variables
Local assembly	Are community meetings or assemblies required prior to rezoning requests?	1 (yes/no variable)
Supply restrictions	Explicit caps on new units	6 (yes/no variables)
Density restrictions	Minimum lot size	2 (yes/no variables)
Open space	Are there open space requirements?	1 (yes/no variable)
Exactions	Are developers required to pay their share of costs of infrastructure improvement?	1 (yes/no variable)
Approval delay	What is the average duration of the approval process?	8 (months for different types of projects)
Local political pressure	Involvement by local actors in the development process	11 (rankings of level of importance/ involvement)
State political involvement	Degree to which state facilitates land use restrictions	2 (rankings)
State court involvement	Tendency of courts to uphold impact fees, fair-share development requirements, building moratoria, and exclusionary zoning	1 (ranking)
Local zoning approval	How many groups have to approve zoning changes?	7 (yes/no variables)
Local project approval	How many groups have to approve projects that do not require zoning changes?	6 (yes/no variables)

Source: Data from Gyourko et al. (2008).

Rothwell and Massey (2010) use a survey on density restrictions conducted by Pendall et al. (2006); there are costs and benefits to using the WRLURI in its place. The first advantage of the WRLURI is that it covers more metropolitan areas. We are able to cover the 95 metropolitan statistical areas (MSAs) with a population greater than 500,000, a sample that is nearly double the size that would be possible with the Pendall et al. (2006) survey. On the other hand, the Pendall et al. survey covers more jurisdictions per MSA than does the WRLURI. Because the metropolitan measure of regulation is an aggregation of measures calculated for each city, it is important to have data for a significant number of cities in each metropolitan area.

The availability of more recent data also makes our study's contribution significant. Rothwell and Massey (2010) use 2003 survey data on land use regulations to predict income segregation levels in 2000 and the change in income segregation from 1990 to 2000. Pendall et al.'s (2006) survey includes questions on the regulatory environment 10 years ago, finding that regulations do not change over that time period. However, survey responses about the past are notoriously unreliable (Sudman & Bradburn, 1973; Tourangeau, 1999). The WRLURI survey data we use is from 2005, and is used to predict segregation outcomes in 2010. This is not perfect, but is better than using determinants measured in the future to predict outcomes in the past.

Finally, the WRLURI is substantively broader than the Pendall et al. (2006) survey, which also creates advantages and disadvantages. Pendall et al. likely collected more accurate data given the reduced scope of the survey. On the other hand, the vast array of zoning mechanisms available in the WRLURI survey allows for tests of the effects of various aspects of zoning on income segregation.

Segregation is a phenomenon that occurs at the metropolitan scale, whereas most land use regulations in the United States are enacted and implemented by much smaller jurisdictions within metropolitan areas. This creates a challenge for research; it might be preferable to assess the relationship between regulations and income segregation within a multilevel framework that includes city-level observations as well as those at the metropolitan level. However, the available data do not allow for this; we lack sufficient surveys of regulation within metropolitan areas to allow us to measure variation in a valid way (in the typical MSA, only about a quarter of that MSA's incorporated cities have data in the WRLURI).

Therefore, in this study we follow other researchers and aggregate the city-level data on regulations to MSAs using weights developed by Gyourko et al. (2008), assuming that collectively, highly regulated cities make highly regulated metropolitan areas. This is defensible in part because a few highly regulated places can increase MSA-level income segregation by excluding low-income households and maintaining homogenous communities. We acknowledge that having limited coverage within MSAs limits the extent to which we can test this hypothesis. Accordingly, we run models where the independent variable is the ratio between central city and the MSA's WRLURI to identify whether income segregation is driven by stringent rules in suburban areas relative to less-regulated central cities.

The dependent variables in our models are state-of-the-art segregation indexes developed by Sean Reardon and colleagues (Reardon & O'Sullivan, 2004). More information about their construction is provided in the Technical Appendix. Their most notable feature is that they enable us to assess overall levels of income segregation as well as the segregation of high- and low-income households. Theses indexes have been used to show, for example, that the increase in overall income segregation in U.S. metropolitan areas has been caused largely by the segregation of affluent households (Reardon & Bischoff, 2011). It is thus possible to analyze whether more stringent regulation of urban development, as measured with the WRLURI, contributes to the segregation of higher- or lower-income households, or both.

Evaluating the Impact of Land Use Regulations on Income Segregation

To test the hypothesis that MSAs with more restrictive regulations are more segregated, we run a number of statistical models that do this by controlling for a large number of metropolitan characteristics. We use models similar to those used by Rothwell and Massey (2010). In their analysis, they first run regressions that employ extensive housing market and demographic controls and then pick the variables with the strongest associations as a set of more parsimonious controls. We consider these simpler, straightforward models preferable because of the high degree of correlation between city-level demographic and housing variables that make up the larger set of controls.

Thus, our basic model has income segregation in 2010 as the dependent variable, land use indexes as the independent variables, and a set of control variables that includes population, household income Gini (a measure of income inequality), affluence rate (percentage of households earning four times the federal poverty line amount), poverty rate, percentage non-White, population, and the number of jurisdictions, all measured at the MSA level in 2010. We

obtain control variables from the U.S. Census. We also run models where the independent variable is the ratio between the WRLURI of the central city and the MSA to identify whether segregation is driven by stringent rules in suburban areas relative to less-regulated central cities.

It is a challenge to isolate land use regulation as a causal determinant of income segregation. Even if one establishes a correlation, the relationship may go in either direction; it is not clear whether exclusionary zoning causes jurisdictions to be more homogenous in terms of race or income, or if more homogenous jurisdictions tend to enact these regulations. To address the fact that income segregation may also affect land use regulations, Rothwell and Massey (2010) use an instrumental variable to isolate the direction of the relationship. Their results are essentially the same with or without the instruments, however, suggesting that simple models are sufficient to provide reliable estimates. In our analysis, we replicate the instrumental variable approach with our preferred measures of segregation and regulation, but do not use two-stage least squares models in the more detailed analysis of the subcategories of regulation. We discuss this more extensively in the Technical Appendix.

Do Strict Zoning Laws Affect Income Segregation?

Our first notable finding is that density restrictions are not statistically associated with higher levels of segregation of low-income households. We find that density restrictions directly lead to the concentration of affluence, not poverty. This goes against the widely accepted notion that exclusionary zoning techniques such as density restrictions are largely responsible for the isolation of the poor. Planners addressing income segregation must also focus on other types of local land use regulations. It is important to note, however, that our results do not imply that metropolitan areas with more minimum density requirements are less segregated. In fact, more density restrictions are strongly associated with elevated levels of income segregation overall and the segregation of affluent households specifically.

Our second major finding is that levels of income segregation are higher in metropolitan areas where local governments are considered to be more involved in the process of residential development and where there are more factors pressuring local governments to control growth. This index is the combination of almost a dozen factors that assess the degree to which pressures on schools, local budgets, and general concern from citizens and city councils about growth are considered to affect permitting, zoning, and growth management.

At the same time, we also find that a higher degree of state political involvement is associated with lower levels of income segregation. The state political involvement index combines two variables, one ranking the extent to which the state legislature is involved in residential development and growth management, and another that measures the level of activity on the part of state legislatures and executives in regards to land use and growth management. Therefore, if planners wish to ameliorate income segregation, regional or state intervention may be required to curb exclusionary local tendencies.

Two other WRLURI subcategories—local zoning approvals and local project approvals—were positively associated with higher levels of segregation. These measures add up the number of independent reviews needed for project and zoning change approval from the following groups; a planning commission, zoning board, city council, a county board of commissioners, an environmental review board, town meeting, and design review board. Places where cities have more of these separate oversight mechanisms for development are more segregated. In other research, these oversight mechanisms are the most strongly associated with a more inelastic housing supply and higher housing prices at the metropolitan (Saiz, 2010) and local levels (Kok, Monkkonen, & Quigley, 2014). This finding suggests that multiple levels of regulatory approvals limiting the development of new housing also create metropolitan areas that are more economically segregated.

Scholars and practitioners often assume that cities that exert more control over land use are more segregated. However, our analysis shows that the correlation between land use regulation and income segregation depends on the way each is measured. The WRLURI is a broader measure of regulation than the commonly used permitted density zoning measure, as is our measure of income segregation. The WRLURI is significantly associated with the measure of segregation used by Rothwell and Massey (2010), but not with our preferred measures of segregation. This reflects the fact that the relationship between land use regulation and income segregation is not as strong as many suspect. A metropolitan area with many regulations on residential development can exhibit low levels of segregation.

We also find that not all aspects of land use regulation are positively associated with higher levels of segregation. In fact, the omnibus WRLURI measure, which has been found to exert a significant influence on housing markets, is not significantly associated with the segregation of high- or low-income households. Neither are the subcategories of

the WRLURI that measure state court involvement, local assembly, exactions, open space requirements, supply restrictions, and approval delay. Thus, not all regulation contributes to this problem, and planners should target their efforts accordingly.

Finally, we find that MSAs with central cities that regulate land use in a more restrictive manner relative to the surrounding suburbs have higher levels of income segregation. We expected that if the commonly told suburban exclusionary zoning story—that exclusionary suburban cities prevent integration by restricting housing options for low-income households—were driving MSA segregation, these coefficients would be negative and statistically significant. Our results demonstrate that the regulatory environment of the central city also plays an important role in metropolitan segregation patterns, adding nuance to but also demonstrating the need for more and better data. Data on land use regulations are missing for too many central and suburban cities to run a valid model specifically focused on the interaction between within-MSA variation in regulation and MSA-level segregation.

Conclusions and Implications for Practice

Affluence and poverty are more concentrated in U.S. metropolitan areas than they have been in at least four decades. These facts likely contribute to several social problems, including fractured politics and the concentration of negative outcomes in health, employment, education, and public safety. Although it is widely assumed that local land use regulations—such as minimum lot sizes and growth controls—exclude low-income households from wealthier neighborhoods, empirical research on this relationship is surprisingly limited. Existing studies do not take advantage of recent advances in the measurement of income segregation or nuanced survey data on different types of land use regulation.

In this study, we use state-of-the-art measures on land use regulation and income segregation on the 95 biggest metropolitan areas in the United States. We demonstrate that the relationship between land use regulation and income segregation is more complex than often assumed. We find that particular types of regulation, such as density restrictions, more independent reviews for project approval and zoning changes, and a greater level of involvement by local government and citizenry in the permitting process, are significantly associated with segregation overall and of the affluent, specifically when we control for a range of metropolitan area characteristics.

These results have important implications for planners interested in reducing income segregation. First and foremost, we confirm that the local nature of planning and greater pressure from multiple local interest groups regarding residential development exacerbates the tendency to segregate by income. At the same time, income segregation is ameliorated by a higher level of involvement from state institutions. Taken together, these findings suggest that land use decisions cannot be concentrated in the hands of local actors. Planners and policymakers will have to be creative in bringing state or regional land use decision making to fruition, as local actors will not easily give up these powers.

We also find that density restrictions are a culprit in the social fragmentation of metropolitan areas and should be relaxed where possible. Yet, density restrictions appear to lead to the segregation of the affluent, not the poor. This is surprising given the literature on exclusionary zoning, of which density restrictions are a prime example. Relatedly, our findings imply that efforts to force wealthier parts of city to build housing for low-income households, or *inclusionary* housing, are more effective at reducing segregation than bringing higher-income households into lower-income parts of the city.

Throughout this study, we emphasize that this important area of research is limited by a dearth of data and complications in measurement. Given the importance of the phenomenon of income segregation, planning scholars and practitioners should develop and implement better ways of collecting data on land use regulations. Further studies should, for example, consider the role of regulations that specifically seek to integrate the residences of different income groups such as inclusionary zoning. Our study begins to pinpoint which regulations are more important determinants of income segregation; research on the impact of relaxing regulations would provide concrete steps for practicing planners seeking to reduce segregation in their cities.

References
American Planning Association. (2006). *Policy guide on housing*. Chicago, IL: American Planning Association. Retrieved from https://www.planning.org/policy/guides/pdf/housing.pdf

Applebaum, B. (2012, October 17). Housing prices and income inequality. *The New York Times.* Retrieved from http://economix.blogs. nytimes.com/2012/10/17/housing-prices-and-income-inequality/

Bischoff, K., & Reardon, S. (2014). Residential segregation by income, 1970–2009. In J. Logan (Ed.), *Diversity and disparities: America enters a new century* (pp. 208–234). New York, NY: Russell Sage Foundation.

Glaeser, E., & Vigdor, J. (2012). *The end of the segregated century: Racial separation in America's neighborhoods, 1890–2010* (No. 66). New York, NY: Manhattan Institute. Retrieved from https://www.manhattan-insti-tute.org/html/cr_66.htm

Gyourko, J., Saiz, A., & Summers, A. (2008). A new measure of the local regulatory environment for housing markets: The Wharton residential land use regulatory index. *Urban Studies, 45*(3), 693–729. doi:10.1177/0042098007087341

Huang, H., & Tang, Y. (2012). Residential land use regulation and the U.S. housing price cycle between 2000 and 2009. *Journal of Urban Economics, 71*(1), 93–99. doi:10.1016/j.jue.2011.08.001

Ihlanfeldt, K. R. (2004). Exclusionary land use regulations within suburban communities: a review of the evidence and policy prescriptions. *Urban Studies, 41*(2), 261–283. doi:10.1080/004209803200165244

Jimenez, B. S., & Hendrick, R. (2010). Is government consolidation the answer? *State and Local Government Review, 42*(3), 258–270. doi:10.1177/0160323X10386805

Kok, N., Monkkonen, P., & Quigley, J. M. (2014). Land use regulations and the value of land and housing: An intra-metropolitan analysis. *Journal of Urban Economics, 81*, 136–148. doi:10.1016/j.jue.2014.03.004

Logan, J. R., & Stults, B. J. (2011). *The persistence of segregation in the metropolis: New findings from the 2010 Census.* New York, NY: Russell Sage Foundation. Retrieved from http://www.s4.brown.edu/us2010/ Data/Report/report2.pdf

Massey, D. S., & Denton, N. A. (1993). *American apartheid: Segregation and the making of the underclass.* Cambridge, MA: Harvard University Press.

Mills, E. S., & Hamilton, B. W. (1997). *Urban economics* (5th ed.). New York, NY: Prentice Hall.

Nelson, A. C., Sanchez, T. W., & Dawkins, C. J. (2004). The effect of urban containment and mandatory housing elements on racial segrega-tion in U.S. metropolitan areas, 1990–2000. *Journal of Urban Affairs, 26*(3), 339–350. doi:10.1111/j.0735-2166.2004.00203.x

Oates, W. E. (1981). On local finance and the Tiebout model. *American Economic Review, 71*(2), 93–98. Retrieved from https://www.aeaweb. org/aer/index.php

Pendall, R. (2000). Local land use regulation and the chain of exclusion. *Journal of the American Planning Association, 66*(2), 125–142. doi:10.1080/01944360008976094

Pendall, R., & Carruthers, J. I. (2003). Does density exacerbate income segregation? Evidence from U.S. metropolitan areas, 1980 to 2000. *Housing Policy Debate, 14*(4), 541–589. doi:10.1080/10511482.2003.9521487

Pendall, R., Puentes, R., & Martin, J. (2006, August). *From tradi-tional to reformed: A review of the land use regulations in the nation's 50 largest metropolitan areas.* Washington, DC: Brookings Institution. Retrieved from http://www.brookings.edu/research/reports/2006/08/ metropolitanpolicy-pendall

Reardon, S. F. (2009). Measures of ordinal segregation. In S. F. Reardon, Jacques Silber, & Yves Flückiger (Eds.), *Occupational and Residential Segregation* (Vol. 17, pp. 129–155). Bingley, UK: Emerald Group. Retrieved from http://www.emeraldinsight.com/doi/abs/10.1108/ S1049-2585%282009%290000017011

Reardon, S. F., & Bischoff, K. (2011). Income inequality and income segregation. *American Journal of Sociology, 116*(4), 1092–1153. doi:10.1086/657114

Reardon, S. F., & O'Sullivan, D. (2004). Measures of spatial segregation. *Sociological Methodology, 34*(1), 121–162. doi:10.1111/ j.0081-1750.2004.00150.x

Rothwell, J. T., & Massey, D. S. (2010). Density zoning and class segregation in U.S. metropolitan areas. *Social Science Quarterly, 91*(5), 1123–1143. doi:10.1111/j.1540-6237.2010.00724.x

Saiz, A. (2010). The geographic determinants of housing supply. *Quarterly Journal of Economics, 125*(3), 1253–1296. doi:10.1162/ qjec.2010.125.3.1253

Sudman, S., & Bradburn, N. M. (1973). Effects of time and memory factors on response in surveys. *Journal of the American Statistical Associa-tion, 68*(344), 805–815. doi:10.1080/01621459.1973.10481428

Thompson, D. (2014, January). Stuck: Why Americans stopped moving to the richest states. *The Atlantic Monthly.* Retrieved from http://www.theatlantic.com/business/archive/2014/01/stuck-why-americans-stopped-moving-to-the-richest-states/282969/

Tiebout, C. M. (1956). A pure theory of local expenditures. *Journal of Political Economy, 64*(5), 416–424. http://www.jstor.org/journal/jpolieecon

Tourangeau, R. (1999). Remembering what happened: Memory errors and survey reports. In A. A. Stone, C. A. Bachrach, J. B. Jobe, H. S. Kurtzman, & V. S. Cain (Eds.), *The Science of self-report: Implications for research and practice* (pp. 29–48). New York, NY: Psychology Press.

Watson, T. (2009). Inequality and the measurement of residential segregation by income in American neighborhoods. *Review of Income and Wealth, 55*(3), 820–844. doi:10.1111/j.1475-4991.2009.00346.x

Watson, T., Carlino, G., & Ellen, I. G. (2006). Metropolitan growth, inequality, and neighborhood segregation by income [with comments]. *Brookings-Wharton Papers on Urban Affairs*, 1–52. doi:10.2307/25067427

Yang, R., & Jargowsky, P. A. (2006). Suburban development and income segregation in the 1990s. *Journal of Urban Affairs, 28*(3), 253–273. doi:10.1111/j.1467-9906.2006.00291.x

Technical Appendix

In this study we use the results of two surveys of land use regulation developed by Pendall, Puentes, and Martin (2006) and Gyourko, Saiz, and Summers (2008). Rothwell and Massey (2010) use the former survey in the most comprehensive paper on the relationship between land use regulation and income segregation to date. In our study, we take the work by Rothwell and Massey as a point of departure, and we use the more recent survey by Gyourko and colleagues and new measures of income segregation developed by Reardon and O'Sullivan (2004) to measure land use regulation and income segregation across more metropolitan areas in the years 2000 and 2010.

The regulation data provided by Gyourko and colleagues (2008)—the Wharton Residential Land Use Regulation Index (WRLURI)—was developed from sur-veys of nearly 2,000 municipalities across the country in 11 subcategories of regulation. Table 1 in the main text details the names and definitions of these subcategories. They range from measures of the number approvals needed for a project approval to open space requirements to the

duration of approvals. These data have been used in various studies of housing markets and are found to have important impacts on prices and volatility (Huang & Tang 2012; Saiz 2010).

There are costs and benefits to using the WRLURI rather than the Pendall et al. (2006) survey on density restrictions. The first advantage of the WRLURI is that it covers many more metropolitan areas: The surveys come from 1,904 places within metropolitan areas, representing all 50 states and 293 metros. We follow Saiz (2010)—one of the authors of the WRLURI—and focus on the 95 metros with population greater than 500,000. This still provides us with a sample size that is nearly double what would be possible with the Pendall et al. (2006) survey. On the other hand, the WRLURI received responses from fewer jurisdictions per metropolitan statistical area (MSA) than did Pendall et al., meaning the coverage in the average MSA is lower in the WRLURI.

Another advantage is that the MSA definitions used to gather data for the WRLURI are preferable to those used by Rothwell and Massey. Rothwell and Massey's data set includes the 50 largest consolidated MSAs (CMSAs) and MSAs based on 1999 U.S. Census Bureau definitions. We use the 95 largest MSAs and primary MSAs (PMSAs), also based on 1999 Census definitions. PMSAs are nested pieces of broader CMSAs. For example, the U.S. Census Bureau defines the five-county Los Angeles–Riverside–Orange County (CA) area as a CMSA. In our study, this large Southern California CMSA is parsed into its four component PMSAs: Los Angeles–Long Beach, Orange County, Riverside–San Bernardino, and Ventura. The definitions of MSAs—that is, the metropolitan areas not classified as a CMSA—are consistent between the two studies. But in the 16 cases in which Rothwell and Massey are using CMSA data, the geographic coverage is often so vast that they constitute several housing markets.

An additional advantage is timing. The Rothwell and Massey (2010) study uses 2003 survey data on land use regulations to predict income segregation levels in 2000 and the change in income segregation from 1990 to 2000. Although the Pendall et al. (2006) survey includes questions on the regulatory environment 10 years ago, and they find that regulations do not change over that time period, survey responses about the past are notoriously unreliable (Sudman & Bradburn 1973; Tourangeau 1999). In our study, the WRLURI survey data is from 2005 and is used to predict segregation outcomes in 2010. This is not perfect, but is better than using the future to predict the past.

Finally, the WRLURI is substantively broader than the Pendall et al. (2006) survey. This has advantages and disadvantages. Pendall et al. likely collected more accurate data given the reduced scope of the survey. On the other hand, the vast array of zoning mechanisms available in the WRLURI survey allows for tests of the effects of various aspects of zoning on income segregation.

An obvious disadvantage of the WRLURI survey is the response rate, and the likelihood that selection bias was a bigger issue. For Pendall et al.'s (2006) survey, if the initial response rate was less than 50% of an MSA's population or covered less than 50% of its land area, they followed up with a second round. Overall, the average MSA response rate was 70%. For the WRLURI, the overall response rate was 38%, representing 60% of the population surveyed. To combat selection bias, Gyourko et al. (2008) developed a weighting scheme to aggregate the data to MSA-level regulation indexes. They ran a series of models using city demographics (i.e., population, age breakdown, share of children, median house values, education) to predict the probability of a city being included in the sample. They then calculated sample weights based on the inverse of the probability of selection. We use the same weights provided by Gyourko et al.

The weighting scheme gets to one of the central challenges in measuring the impacts of land use regulations on segregation: that segregation is a phenomenon measured at the scale of the urban (or metropolitan) area, whereas regulations are enacted and implemented by much smaller jurisdictions, such as incorporated cities or townships. This is an issue with both surveys. We acknowledge that the right way to study this relationship is using a multilevel framework that includes city-level observations as well as those at the metropolitan level. However, the available data do not allow for this, as there are not sufficient surveys of regulation within metropolitan areas to measure variation in a valid way (in the typical MSA, only about a quarter of that MSA's incorporated cities have data in the WRLURI). This problem can and should be addressed through more comprehensive data collection efforts.

Therefore, in this study we follow other researchers and make the assumption that collectively, highly regulated cities make highly regulated metropolitan areas, and aggregate the city-level data on regulations to MSAs using population weights (Gyourko et al., 2008). This is defensible in part due to the fact that a few highly regulated places can exclude low-income households, maintain homogenous communities, and increase MSA-level segregation. We acknowledge that having limited coverage in MSAs limits the extent to which we can make these connections. Accordingly, we run models where the

independent variable is the ratio between central city and MSA land use regulation stringency to identify whether segregation is driven by stringent rules in suburban areas relative to less-regulated central cities.

The dependent variables in our models are segregation indexes based on the rank-order information theory index (Reardon & O'Sullivan, 2004). This index depends first on creating cumulative income groups and calculating an entropy measure of segregation for each. The index is essentially a comparison of the percentage difference between the city's overall income diversity and the population-weighted sum of each census block group's income diversity. In this case, there are data on 15 income groups in each city. Each of these groups is at a slightly different percentile on the income distribution in each city due to differences in absolute levels of income. However, it is straightforward to estimate segregation for the 10th, 50th, and 90th percentiles of the income distribution, and then compare across cities.

Crucially, the new segregation measures disaggregate across the income distribution. This type of disaggregation has been used to show, for example, that the increase in overall income segregation in U.S. metropolitan areas has been largely caused by the segregation of affluent households (Reardon & Bischoff, 2011). Monkkonen and Zhang (2011) provide an example of this type of comparison. Figure A-1 juxtaposes levels of income segregation across the income distribution in Hong Kong and the San Francisco Bay Area. These two metropolises have roughly

the same population and the same level of economic segregation if measured with an overall index. However, as Figure A-1 makes clear, low-income households are much more isolated in San Francisco, whereas high-income households are much more segregated in Hong Kong. With this disaggregated index, it is thus possible to analyze whether more stringent regulation of urban development contributes to the segregation of higher- or lower-income households, or both.

In contrast, Rothwell and Massey (2010) use a segregation index based on a neighborhood Gini coefficient. This measure uses the median income of each tract to estimate inequality between census tracts across the MSA, which is effectively a clustering or larger-scale measure of segregation. The rank-order information index, which we use, estimates a measure of income diversity for each tract and then compares the population-weighted sum of these measures with the diversity of the city overall. Although this is an evenness measure in this form and does not consider large-scale variations in spatial scale, it is preferable because it measures neighborhood diversity and is a more conventional method of measuring segregation.

Model Summary

Rothwell and Massey's strategy was to specify a model with extensive controls that are assumed to be associated with land use regulations and income segregation, pick the variables with the strongest associations, and run a more parsimonious model with those control variables in
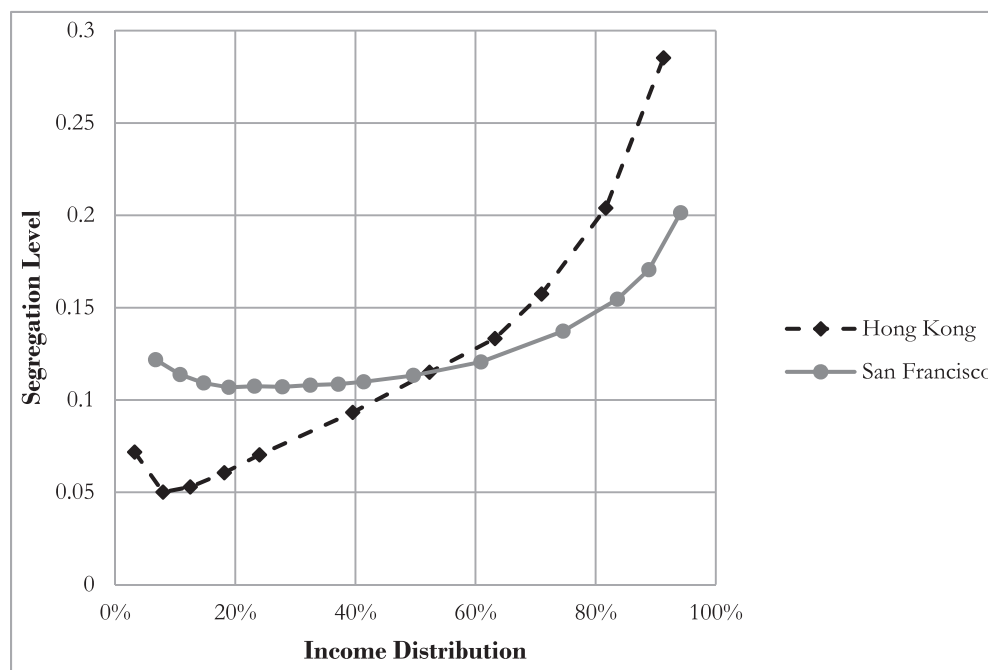

Figure A-1. Income segregation in Hong Kong and the San Francisco Bay Area.

ordinary least squares (OLS) and two-stage least squares (2SLS) frameworks.[1] The parsimonious models were desirable given the limited sample size and the high degree of correlation between city-level demographic and housing variables that make up the controls. Given we are under similar constraints, we use the same approach with our alternate measures of land use regulation and segregation in addition to the minor tweak of controlling for population size. However, as we describe below, we favor the OLS approach over the instrumental variables strategy in Rothwell and Massey.

Table A-1 provides summary statistics on key variables for the 95 MSAs in our sample. In addition to the WRLURI and segregation indexes described above, we obtain control variables from the U.S. Census. The basic model can be represented as:

$$IS_i = \alpha + \beta_1 WRLURI_i + \beta_2 X'_i + e_i ,$$

where $WRLURI_i$ and IS_i are the WRLURI and the income segregation index, respectively. X' is a set of control variables, following Rothwell and Massey (2010): the natural log of population (our addition), household income Gini (a measure of income inequality), affluence rate (percentage of households earning four times the federal poverty line amount), poverty rate, percentage non-White, and the number of jurisdictions, all measured at the MSA level in 2010.

Table A-1. Summary statistics (2010 values, unless otherwise noted).

Variable	Obs	*M*	*SD*	Min	Max
Ordinal income segregation	95	0.109	0.019	0.057	0.154
Segregation of poor	95	0.101	0.020	0.051	0.146
Segregation of middle-income	95	0.103	0.021	0.051	0.155
Segregation of affluent	95	0.155	0.031	0.088	0.241
Population (thousands)	95	1,929.797	1847.502	525.518	9,758.256
Population per square mile	95	824.364	1585.925	54.300	13,468.490
Median household income	95	54,698.640	9377.932	31,879.000	86,850.000
% bachelor's degree or more	95	0.294	0.064	0.147	0.489
% non-White	95	0.270	0.104	0.062	0.520
% owner-occupied	95	0.660	0.065	0.343	0.760
Poverty rate	95	0.099	0.034	0.049	0.305
Affluence rate	95	0.305	0.059	0.160	0.566
% detached single-family housing	95	0.613	0.107	0.100	0.756
Municipalities in metro (2005)	95	53.968	58.054	5.000	365.000
% population change (2000 to 2010)	95	0.108	0.101	-0.157	0.508
Average January temperature	95	38.440	12.684	13.100	68.100
% voting Democrat (2008)	95	0.544	0.096	0.342	0.792
% manufacturing jobs	95	0.107	0.041	0.034	0.222
WRLURI	95	0.110	0.697	−1.239	1.936
Local political pressure index	95	0.126	0.447	−0.878	1.253
State political involvement index	95	−0.012	1.014	−1.976	2.416
State court involvement index	95	2.173	0.660	1.000	3.000
Local zoning approval index	95	2.009	0.381	1.268	3.685
Local project approval index	95	1.571	0.514	0.000	3.630
Local assembly index	95	0.012	0.078	0.000	0.658
Density restrictions index	95	0.231	0.228	0.000	1.000
Open space index	95	0.649	0.227	0.000	1.000
Exactions index	95	0.805	0.208	0.216	1.000
Supply restrictions index	95	0.280	0.524	0.000	3.525
Approval delay index	95	6.075	2.266	2.417	14.794

We do not take the instrumental variable approach to addressing the possible threat of endogeneity, as Rothwell and Massey do, for several reasons. First, in studies of urban phenomena, it is difficult to create convincingly causal two-stage models. The instruments used are usually not strong and often there are theoretical problems with their exogeneity to outcome variables. Moreover, even if regulations are more likely to be adopted by certain types of jurisdictions, we believe we capture the most important characteristics in our control variables, and therefore the coefficients on regulation still have meaning. Evidence of this is found in studies that, when controlling for the most important socioeconomic and demographic features of cities, find regulation variables to be insignificant predictors of expected impacts (Glaeser & Ward, 2009; Monkkonen & Quigley, 2008). Finally, the results from Rothwell and Massey are almost identical whether using OLS or 2SLS. In the eight pairs of coefficients relevant to our study, there are very minimal differences in magnitude and statistical significance, suggesting either the bias is small or their instruments are not effective at combating it.

As mentioned, timing is an issue when examining potential impacts of land use regulations. Again, this is a problem that results from a lack of a systematic effort to collect data on land use regulation in the United States in a longitudinal fashion. This means that measures of the regulatory environment are almost always cross-sectional, depending as they do on the resources of scholars and not the U.S. Census Bureau. Although a detailed study of the Boston metropolitan area over several decades (Glaeser & Ward, 2009) revealed that regulations are amended relatively frequently, substantial changes to the regulatory environment is a heroically difficult and politically contested undertaking. In fact, Pendall et al. (2006) report that fewer than 20% of jurisdictions that they surveyed reported significant changes to maximum permitted density between 1994 and 2003. Therefore, our five-year lag (2005 regulations and 2010 segregation) is arguably a nice feature in the absence of multiple years of data.

Discussion of Regression Output

In this section, we present four sets of regression output. Tables A-2 and A-3 display results from two sets of regression models that replicate OLS and 2SLS used by Rothwell and Massey (2010), but vary the key independent and dependent variables with our preferred measures. Table A-4 reports results of a large number of regressions of different measures of segregation on the 11 components of the WRLURI and a set of control variables using data from

Table A-2. Ordinary least squares model results: Rothwell and Massey (2000) replication plus the Wharton Residential Land Use Regulation Index.

	Neighborhood income Gini	Neighborhood income Gini	Ordinal income segregation	Ordinal income segregation
Permitted density zoning	−0.0433[a] (0.0123)		−0.00259 (0.00409)	
WRLURI		−0.0245[c] (0.0144)		−0.00325 (0.00437)
Household income Gini	0.238 (0.315)	0.353 (0.343)	0.00711 (0.104)	0.0121 (0.105)
Affluence rate	−0.0341 (0.159)	0.184 (0.189)	0.0962[c] (0.0528)	0.119[b] (0.0574)
Poverty rate	0.405 (0.456)	0.977[c] (0.487)	−0.00773 (0.151)	0.0320 (0.148)
% Black or Latino	0.0392 (0.0817)	−0.0937 (0.0812)	0.0783[a] (0.0271)	0.0706[a] (0.0247)
Number of jurisdictions (00s)	0.0121 (0.00871)	0.0197[b] (0.00920)	0.00463 (0.00289)	0.00495[c] (0.00280)
Constant	0.253[c] (0.139)	−0.0579 (0.131)	0.0556 (0.0462)	0.0338 (0.0398)
Observations	50	49	50	49
Adjusted R^2	0.365	0.238	0.295	0.292

Notes: Standard errors in parentheses.
a. $p < .01$.
b. $p < .05$.
c. $p < .1$.

Table A-3. 2SLS model results: Rothwell and Massey (2000) replication plus Wharton Residential Land Use Regulation Index instrumental variables: year of statehood and population density in 1910.

	Neighborhood income Gini	Neighborhood income Gini	Ordinal income segregation	Ordinal income segregation
Permitted density zoning	−0.0479[a]		0.00138	
	(0.0175)		(0.00585)	
WRLURI		0.335		0.0218
		(0.355)		(0.128)
Household income Gini	0.222	0.406	0.0208	0.000331
	(0.296)	(0.436)	(0.0990)	(0.157)
Affluence rate	−0.0419	1.010[b]	0.103[b]	0.0142
	(0.150)	(0.505)	(0.0501)	(0.182)
Poverty rate	0.356	−0.0701	0.0350	0.0580[c]
	(0.447)	(0.0932)	(0.150)	(0.0336)
% Black or Latino	0.0530	0.0184[c]	0.0662[b]	0.00563
	(0.0858)	(0.00972)	(0.0287)	(0.00350)
Number of jurisdictions (00s)	0.0110	−0.0695	0.00553[c]	0.0209
	(0.00863)	(0.0806)	(0.00289)	(0.0290)
Constant	0.281[c]	−0.136	0.0312	0.0754
	(0.153)	(0.192)	(0.0511)	(0.0690)
Observations	50	49	50	49
Adjusted R^2	0.441	0.177	0.368	N/A

Notes: Standard errors in parentheses.

a. $p < .01$.

b. $p < .05$.

c. $p < .1$.

2010. Finally, we estimate the same framework using the ratio between the WRLURI in the central city to the WRLURI of other jurisdictions in the MSA to test for effects of within-metropolitan variation in regulation on segregation.

In Table A-2, the OLS models, we see that the WRLURI is associated with the neighborhood Gini measure of segregation, but not with the rank-order index. The permitted density zoning measure of regulation used by Rothwell and Massey (2010), although strongly connected to the neighborhood Gini, is also not significantly associated with the rank-order index. The explanation for this discrepancy lies chiefly with differences in the measures of segregation, which have been outlined previously. The neighborhood Gini measures income segregation in a rougher manner than the rank-order measure and at a larger geographic scale. It is only moderately correlated with the rank-order measure (0.4).

Table A-3 presents the results from models using instrumental variables. Rothwell and Massey (2010) use the year of statehood and population density in 1910 as instruments to deal with bias from omitted variables and the fact that jurisdictions may respond to levels of income segregation by enacting particular zoning frameworks. We

replicate these results and add results with our preferred measures, but from here on do not take the instrumental variable approach because the results from Rothwell and Massey are almost identical whether or not they use instrumental variables.

The goal of this analysis is not to contest the work of Rothwell and Massey (2010); instead, we seek to take advantage of the ability to assess nuanced aspects of segregation and regulation (i.e., for different income groups and different types of regulations). To do this, we regress different measures of segregation—in the year 2010—on the 11 components of the WRLURI and a set of control variables. Table A-4 displays the condensed results of a large number of models, only reporting the coefficients for the regulation measures. It is in these models that a more nuanced picture of the relationship between regulation and segregation emerges. Importantly, several aspects of regulation—the omnibus WRLURI, state court involvement, local assembly, exactions, open space requirements, supply restrictions, and approval delay—are not significantly associated with higher levels of segregation.

Similar to previous research, we find that density restrictions are strongly associated with elevated levels of income segregation overall, and the segregation of

Table A-4. Wharton Residential Land Use Regulation Index and subindexes with segregation of the poor, middle-income, and affluent (2010).

	Ordinal income segregation	Segregation of poor	Segregation of middle-income	Segregation of affluent
WRLURI	0.000499	−0.00117	0.00146	−0.00281
	(0.00289)	(0.00318)	(0.00307)	(0.00430)
Local political pressure index	0.0111[a]	0.00505	0.0111[b]	0.0124[c]
	(0.00413)	(0.00469)	(0.00439)	(0.00625)
State political involvement index	−0.00504[a]	−0.00660[a]	−0.00394[c]	−0.00670[b]
	(0.00184)	(0.00199)	(0.00199)	(0.00277)
State court involvement index	−0.000467	−0.00504	0.00128	−0.00155
	(0.00303)	(0.00330)	(0.00322)	(0.00451)
Local zoning approval index	0.00935[c]	0.00189	0.00795	0.0182[b]
	(0.00493)	(0.00553)	(0.00527)	(0.00724)
Local project approval index	0.0102[a]	0.0103[a]	0.00974[a]	0.00937[c]
	(0.00345)	(0.00382)	(0.00369)	(0.00529)
Local assembly index	−0.0291	−0.00888	−0.0316	−0.0538
	(0.0239)	(0.0265)	(0.0253)	(0.0354)
Density restrictions index	0.0222[a]	0.0111	0.0229[a]	0.0279[b]
	(0.00773)	(0.00881)	(0.00822)	(0.0117)
Open space index	0.00735	0.00147	0.00969	0.00277
	(0.00838)	(0.00926)	(0.00887)	(0.0125)
Exactions index	0.00878	−0.00304	0.0118	0.0146
	(0.00917)	(0.0101)	(0.00969)	(0.0136)
Supply restrictions index	0.00139	0.00510	0.000985	−0.00388
	(0.00355)	(0.00387)	(0.00376)	(0.00527)
Approval delay index	−0.000423	−0.000252	−0.000180	−0.00164
	(0.000860)	(0.000947)	(0.000913)	(0.00127)

Notes: Each row provides a set of coefficients from a different model. Standard errors in parentheses. All models include ln population (2010), household income Gini (2010), affluence rate (2010), poverty rate (2010), percentage non-White (2010), and number of jurisdictions (in hundreds).

a. $p < .01$.

b. $p < .05$.

c. $p < .1$.

middle-income and affluent households specifically. However, density restrictions did not affect the segregation of the lowest-income households. This finding provides an important nuance to the widely accepted notion that exclusionary zoning techniques such as density restrictions are largely responsible for the isolation of the poor. We do not find that density restrictions directly lead to the concentration of poverty. Rather, they appear to lead to the concentration of affluence, which is associated with overall higher levels of segregation.

Four other subindexes of the WRLURI have a significant relationship with levels of income segregation. Three measures of local involvement in the regulatory process are associated with higher levels of segregation (local political pressure, local zoning approval, and local project approval). The latter two indexes measure the number of independent reviews needed for project and zoning change approval and in other research are associated with a more inelastic housing supply and

higher housing prices (Saiz, 2010). Places where cities have more separate oversight mechanisms are more segregated. In contrast, the measure of state political involvement is associated with lower levels of income segregation. This is an important finding, as it suggests that segregation is higher where regulatory power is more concentrated in the hands of local decision makers, but lower where higher levels of government have greater influence.

The question of geographic scale is central to this analysis. Regulation occurs at the level of the incorporated city or township (there are from dozens to hundreds in one metropolitan area), and segregation occurs at the level of the metropolitan area. To date, scholars have only used aggregated measures of regulation at the metropolitan level. Variation in the stringency of land use regulation within MSAs should also matter. An MSA with high average levels of land use regulation might have consistently high regulations across its component cities, or some jurisdictions

with very high levels and some with low levels. The MSA with greater variation is likely to have greater levels of segregation. Unfortunately, the most comprehensive source of data on local land use regulations—the WRLURI—does not cover enough cities within most MSAs to get a statistically valid read on the importance of variation within MSAs.

Nonetheless, the WRLURI data do allow us to approximate a test of a common hypothesis about the role of regulation in segregation: the idea that suburban jurisdictions implement density restrictions to exclude lower-income households, and that those households are restricted to higher-density (and lower-cost) central cities. We assess whether differences in regulatory stringency between central cities and the surrounding suburbs has any relationship to metropolitan levels of segregation.

An interesting feature of the data is that they show the regulatory climate in central cities tends to be less strict according to our calculations. The mean WRLURI value for central cities in our sample is –0.14, with a median of –0.25. There is considerable heterogeneity across central cities, but they have a less-restrictive land use regulatory

environment on average than their suburbs. The gap between their mean and that for the suburbs is about one-third of a standard deviation (see Gyourko et al. [2008] for more detail).

Table A-5 displays the results of four regression models where the independent variable is the ratio between the WRLURI in the central city to the WRLURI of other jurisdictions in the MSA. The coefficients on these models are weakly significant (at the 10% level) in two models: the overall segregation level and the segregation of the poor. Surprisingly, however, these coefficients are positive, suggesting that MSAs with more stringent central cities relative to the surrounding suburbs have more segregation. We would expect that if the suburban exclusionary zoning story were driving MSA segregation, these coefficients would be negative (and statistically significant). These results lead to more questions than answers. It should be noted that only 88 of the 95 largest cities have data on land use regulation in their central city; thus, the model is not as complete as those presented before. Similarly, the fact that there are data missing on regulation from the

Table A-5. Central City–MSA (metropolitan statistical area) Wharton Residential Land Use Regulation Index ratio (2010).

	Ordinal income segregation	Segregation of poor	Segregation of middle-income	Segregation of affluent
Ratio of central city to metro WRLURI	0.0003[c]	0.0003[c]	0.0002	0.0003
	(0.0002)	(0.0002)	(0.0002)	(0.0002)
Population ln (2010)	0.0069[c]	–0.0012	0.0081[b]	0.0154[a]
	(0.0037)	(0.0039)	(0.0038)	(0.0052)
Household income Gini (2010)	–0.0844	–0.122	–0.143	0.323[c]
	(0.126)	(0.133)	(0.132)	(0.177)
Affluence rate (2010)	0.0505	0.0362	0.0658	0.131[c]
	(0.0522)	(0.0554)	(0.0548)	(0.0737)
Poverty rate (2010)	0.106	–0.0295	0.128	0.153
	(0.0861)	(0.0913)	(0.0904)	(0.122)
% non-White (2010)	0.0192	–0.0075	0.0296	0.0263
	(0.0235)	(0.0250)	(0.0247)	(0.0332)
Number of jurisdictions (00s)	0.00636	0.0127[b]	0.00376	0.0089
	(0.0046)	(0.0049)	(0.0048)	(0.0065)
Constant	0.0118	0.154[b]	0.00394	–0.262[a]
	(0.0656)	(0.0696)	(0.0689)	(0.0926)
Observations	88	88	88	88
Adjusted R^2	0.142	0.092	0.156	0.319

Notes: Standard errors in parentheses.

a. $p < .01$.

b. $p < .05$.

c. $p < .1$.

suburban districts—the typical MSA only has information for 25% of their incorporated cities—means that these results are not conclusive, and motivates further work on this topic.

Note

1. Rothwell and Massey's full specification included the percentage Black and Latino, the number of recent in-migrants, population density, poverty rate, affluence rate, the share of the adult population without a diploma, the adult college attainment rate, the manufacturing share of employment, union membership, union membership interacted with the manufacturing sector, the share of local revenue from local sources, per capita state taxes, median household income, the unemployment rate, the ratio of suburban to central city housing, the share of rural housing in the metropolitan area, and the share of commuters with long commute times, as well as average January temperatures from 1971 to 2000. We ran models with many of these variables included and found that they did not affect the core results.

References

Glaeser, E. L., & Ward, B. A. (2009). The causes and consequences of land use regulation: Evidence from greater Boston. *Journal of Urban Economics*, *65*(3), 265–278. doi:10.1016/j.jue.2008.06.003

Gyourko, J., Saiz, A., & Summers, A. (2008). A new measure of the local regulatory environment for housing markets: The Wharton residential land use regulatory index. *Urban Studies, 45*(3), 693–729. doi:10.1177/0042098007087341

Huang, H., & Tang, Y. (2012). Residential land use regulation and the U.S. housing price cycle between 2000 and 2009. *Journal of Urban Economics*, *71*(1), 93–99. doi:10.1016/j.jue.2011.08.001

Monkkonen, P., & Quigley, J. M. (2008). The spatial consequences of autarky in land use regulation: Strategic interaction or parallelism? *Berkeley Program on Housing and Urban Policy*. Retrieved from http://escholarship.org/uc/item/69p752cd

Pendall, R., Puentes, R., & Martin, J. (2006, August). *From traditional to reformed: A review of the land use regulations in the nation's 50 largest metropolitan areas.* Washington, DC: Brookings Institution. Retrieved from http://www.brookings.edu/research/reports/2006/08/metropolitanpolicy-pendall

Reardon, S. F., & Bischoff, K. (2011). Income inequality and income segregation. *American Journal of Sociology*, *116*(4), 1092–1153. doi:10.1086/657114

Reardon, S. F., & O'Sullivan, D. (2004). Measures of spatial segregation. *Sociological Methodology*, *34*(1), 121–162. doi:10.1111/j.0081-1750.2004.00150.x

Rothwell, J. T., & Massey, D. S. (2010). Density zoning and class segregation in U.S. metropolitan areas. *Social Science Quarterly*, *91*(5), 1123–1143. doi:10.1111/j.1540-6237.2010.00724.x

Saiz, A. (2010). The geographic determinants of housing supply. *Quarterly Journal of Economics*, *125*(3), 1253–1296. doi:10.1162/qjec.2010.125.3.1253

Sudman, S., & Bradburn, N. M. (1973). Effects of time and memory factors on response in surveys. *Journal of the American Statistical Association*, *68*(344), 805–815. doi:10.1080/01621459.1973.10481428

Tourangeau, R. (1999). Remembering what happened: Memory errors and survey reports. In A. A. Stone, C. A. Bachrach, J. B. Jobe, H. S. Kurtzman, & V. S. Cain (Eds.), *The Science of self-report: Implications for research and practice* (pp. 29–48). New York, NY: Psychology Press.