Constraints on Housing Supply: Natural and Regulatory

Wendell Cox[1]

LINK TO ABSTRACT

Suppose you had a dog, and a lakeside home with a yard. The lake borders your yard. Now suppose that we wanted to calculate how much area the dog has to run around in. One relevant constraint would be the lake. However, if you put up a fence enclosing the dog, the lake would not in fact bound the area the dog has. The relevance of the lake boundary depends on the fencing in a particularistic way.

Now suppose that we were interested not just in your dog's run-area, but the run-area of homeowners' dogs in general. In each case, the relevance of natural boundaries like the lake depends on the particular fencing and enclosure decisions of the specific homeowner. Simply measuring the distance to natural constraints like the waterfront, without minding the relation it has to local fencing enclosures, would be a problematic approach to estimating the bearing of such natural boundaries.

Moreover, if one were to consider natural boundaries within an invariant distance of the midpoint of each yard, the problems would be compounded. Yards differ greatly in size. A yard might be so small that, applying the invariant distance, far-off lakes would be counted as though they mattered when they do not. Or a yard might be so large that the invariant distance used did not include all the lake boundaries that do matter. This is a second way in which the relevance of the natural boundaries is particular to the case.

If one were to ignore these particularistic factors, one might do an aggregate calculation about the determinants of dog run-areas—how much natural boundaries matter versus how much enclosure decisions matter—a calculation that

1. Demographia, Belleville, IL 62222.

tends to overstate the importance of the natural boundaries. Simply using measurements without minding the particulars to the locale might produce results not merely crude but highly misleading.

Two recent papers examined the association between house price increases and geographical and regulatory restrictions in US metropolitan areas. The first, by Albert Saiz (2010), reviewed natural geographical constraints—water bodies and terrain slopes, while the second, by Haifang Huang and Yao Tang (2010) looked at general regulatory restrictions and also included a natural geographical constraint, using Saiz. Both papers used the Wharton Residential Land Use Regulatory Index (WRI) to gauge the extent of land use regulation in the metropolitan areas studied.

The papers offer conclusions about the extent to which house-price increases are determined by natural geographical constraints. Their conclusions are based on methods suffering from problems analogous to those raised in the thought experiment about dog-runs. I am inclined to think that, in estimating influences of natural geographical and regulatory geographical constraints, the papers do not adequately incorporate the particularistic interrelations between the influences of the two different kinds of geographical constraints, which by their very nature would involve the more proximate constraint nullifying the influence of the other. At the same time, the measurement of the *non-geographical* regulatory constraints may not be sufficiently robust.

The present essay is not intended or designed as a close commentary on the two papers just mentioned (Saiz 2010, Huang and Tang 2010). Rather, it is offered as a comment on the some of the core features of those papers. Both are ambitious pieces of work. Moreover, both papers come to conclusions that are consistent with previous research, particularly about regulatory restrictions having a measurably significant impact on housing supply (Saiz 2010) and on local housing booms and busts (Huang and Tang 2010). It is the fundamental methods of estimating the impact of geographical constraints developed in Saiz and their subsequent use by Huang and Tang that I see as problematic. These are not problems of econometrics, but rather of geography and demography, problems that might lead to the *understating* of the impact of regulatory restrictions.

The key points of my critique generally are as follows:

1. Saiz uses an invariant 50 kilometer radius from the urban focal-point of the metropolitan area to analyze geographical constraints. Given the huge differentials in the geographic sizes among the principal urban areas[2] in the sample of the metropolitan areas over 500,000 population, the invariant 50-km radius is blunt in the extreme. In the largest urban areas, it would seem to be too small to capture fully the impact of geographical constraints, and in the smallest metropolitan areas it is so large that much of the water or steep-areas measured would in fact pose little or no constraint on urban growth.

2. Huang and Tang use both a land regulation restriction and a natural geographic constraint. It seems likely that the presence of restrictions that effectively contain urban development (such as an urban growth boundary or substantial developable areas[3] on which new housing is prohibited) would assume virtually all of the impact of any more remote natural geographical constraint—as when the dog is constrained by the fence, not the lake. As a result, any approach that includes natural geographical constraints where there are interior regulatory geographical restrictions would have the potential to virtually negate coefficients for the restrictions and exaggerate coefficients for the natural geographical constraints.

The extent to which geographic regulatory restrictions can drive up prices is illustrated by the differences between the values of undeveloped lands just a few steps from each other, but across the urban growth boundary. In Portland and Auckland, New Zealand, virtually adjoining undeveloped lands value differences have been estimated at 10 times or more (Mildner 2009, 2025 Task Force 2009). My own more recent review on the western Portland suburbs found a differential of 11 times virtually across the road at the urban growth boundary (Cox 2010). Without an urban growth boundary, it would be expected that land on both sides of an urban growth boundary would have similar values. Research in the London area indicates that this difference can be as much as 500 times (Leunig 2007).

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2. This paper generally uses the urban area rather than the metropolitan area or sub-metropolitan area (formerly called a primary metropolitan statistical area and now called, more accurately, a metropolitan division). Generally, new housing is built on the fringe of or within the urban area and relatively little housing is built in the more remote, rural areas within metropolitan areas. All metropolitan areas have a principal urban area (called an "urbanized area" by the Bureau of the Census and may also be called an urban footprint or agglomeration) around which the metropolitan area is defined. . This urban area is a continuously developed area that is usually similar in population to the metropolitan area, but excludes the rural territory that constitutes most of the metropolitan area. The urban area is the urban form in its physical sense (excluding rural areas), while the metropolitan area is the urban form in its labor-market sense (including rural areas that are within the "commute shed"). US metropolitan areas are generally composed of complete counties, which means that any spatial comparison tends to be an artifact of county geographical size. As a result, many US metropolitan areas have huge rural areas that can render geographic comparisons meaningless or misleading. For example, the Riverside-San Bernardino metropolitan area covers 27,500 square miles (more than the state of West Virginia). From the focal point in Riverside to the eastern boundary of the metropolitan area can be as much as 225 miles. On the other hand, the Boston metropolitan area, with a slightly higher population covers 3,500 square miles. Much of the Riverside-San Bernardino metropolitan area would be excluded from its definition if its constituent units were as small as in Boston. This is despite the fact that the principal urban area in Riverside-San Bernardino is 50 percent more dense than the Boston principal urban area.
3. Generally, as used in this paper, "developable" land refers to "Greenfield" land that is typically on or near (inside or outside) the fringe of the urban area. While virtually any land in an urban area can be developable through redevelopment, the overwhelming majority of new housing in US urban areas has historically been built on or near the urban fringe.

3. Despite its ground-breaking nature, the Wharton Residential Land Use Regulatory Index (WRI) may not be a reliable indicator of the relative impact of non-geographic regulatory constraints on house prices, because it is based partially on loose, "black box" opinions and judgments, and does not include responses from private housing industry participants.

Background: House Prices

Until the early 1970s, around the nation, housing was priced in proportion to incomes. The Median Multiple (median house price[4] divided by median household income) was generally in the range of 2.0 to 3.0 in the nation's metropolitan areas. After 1970, house prices started to escalate substantially relative to incomes in California, a dynamic that Fischel (1995, 218ff) associated with the imposition of strong land use regulation. In later years, various metropolitan areas in other parts of the nation adopted stronger land use regulations and this was generally associated with higher house prices. Saiz (2010) indicates that the previous research confirms the "well-known empirical link between land use regulations and housing price growth" (1272).

Saiz and the Invariant 50-km Radius

Saiz examines house prices and geographical constraints using an invariant 50 kilometer radius from the focal point of metropolitan areas over 500,000 population in 2000.[5] From this, he calculates undevelopable areas, such as water areas and areas with excessive slopes. The focal point is not at issue and may generally be thought of as a point in the historic central city (municipality), such as city hall.

The 50 kilometer radius (7,850 square kilometers) is far too blunt an instrument. The fundamental problem is that it treats all metropolitan areas the same, despite the huge differences in population and land area. Saiz includes the range of US metropolitan areas from a year 2000 population of 500,000 to more than 10,000,000.

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4. Median house value is used from 1950 to 1970 because median house price is unavailable.
5. Saiz uses primary metropolitan statistical areas (PMSA), which are portions of metropolitan areas, rather than complete metropolitan areas. Early in the 2000s, the Bureau of the Census discontinued reporting PMSAs and now reports "metropolitan divisions," which are, as a result, more obviously identified as "sub-metropolitan" areas. This article focuses on currently defined metropolitan areas.

The principal urban areas[6] within these metropolitan areas can vary from 190 square miles (Stockton, California urban area) to 8,700 square kilometers (New York urban area). The principal urban area of New York is more than 45 times larger than that of Stockton. Figure 1 shows the metropolitan areas of New York, and Figure 2 shows that of Stockton.[7] In each figure, the darkened areas represent continuous urbanization (the Census defined urban area). One can see that urbanization covers virtually all of the land areas in the 50-km radius circle in the New York, whereas urbanization covers little of the Stockton counterpart.

Figure 1: New York Metropolitan and Urban Area, and Saiz's 50-km Radius
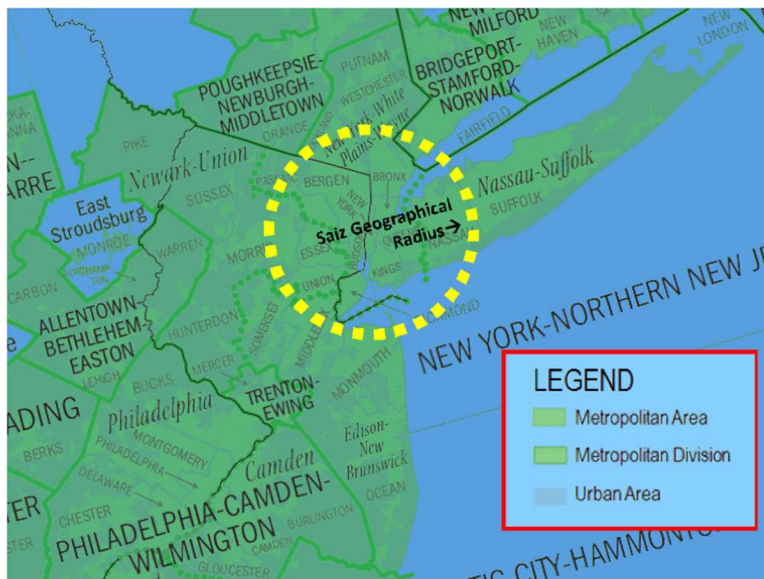

In the case of New York, the 50-km-radius circle's area that is not taken up by water is virtually contained within the present urbanization. If the New York urban area were a perfect circle, its radius would be nearly 53 kilometers. Thus, the 50 kilometer radius cannot measure the effect of geographical constraints, since the radius has already been exceeded. On the other hand, in Stockton, with a theoretical urban area radius of 8 kilometers, an ocean just 15 kilometers, say, from

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6. "Principal urban area" is our term to describe the urban area that meets the necessary criteria to justify delineation of a metropolitan area. It is, by definition, the largest urban area in the metropolitan area.

7. Metropolitan areas are defined based upon and generally surround a principal urban area and consist of complete counties excepting the six New England states, where they consist of complete towns (a sub-county jurisdiction).

the focal point would likely have no more impact on house prices than if it were 50 kilometers away. Indeed, as seen in Figure 2, much of the area contained within the 50 mile radius lies in *other* metropolitan or non-metropolitan areas.

Figure 2: Stockton Metropolitan and Urban Area, and Saiz's 50-km Radius
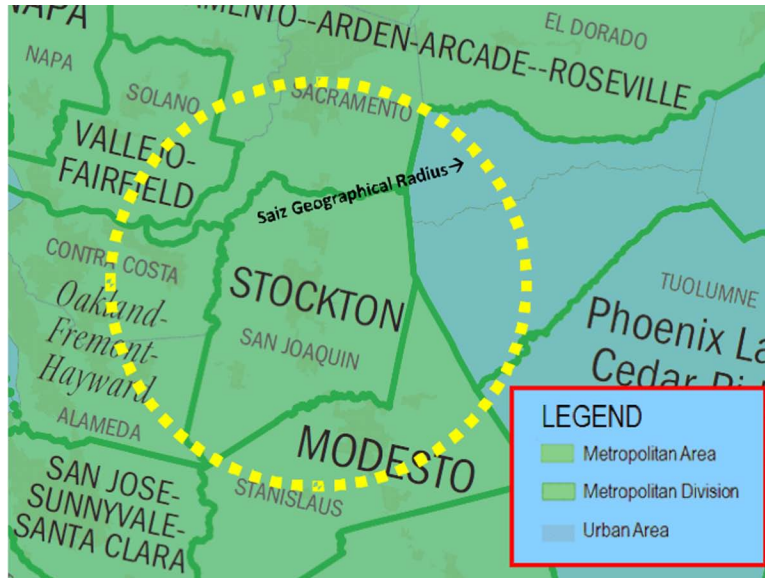
Sources: Idealized radii based upon 2000 urban areas as defined by the Bureau of the Census. Geographical constraint radius is based upon Saiz.

There are two additional difficulties with the Saiz natural constraint area. The first is that, as indicated in the dog example above, there may be enforced regulatory geographic constraints, such as urban growth boundaries or large areas on which development is not permitted that would exert virtually the same influence on house prices as a natural geographic constraint (on the assumption that a suitable geographic area were identified based upon the geographic size of the urban area). It is arguable that the regulatory geographic constraints would have virtually the same impact on house prices as the natural geographic constraint.

The second problem is that the Saiz natural constraint area does not take into consideration the area of existing development (the urban area), which by virtue of it being largely occupied by buildings, also represents a geographical constraint (a development geographic constraint). It is, of course possible, that the development geographical constraint would have a somewhat different impact

than either the natural or regulatory geographical constraints and it could be appropriate to include it in a formula as an independent variable.

Interior Regulatory Constraints Trump Natural Constraints

Huang and Tang attempt to quantify the association between the size of price increases and the restrictiveness of land use regulation. In so doing, they also use the Saiz geographical constraint. But it is doubtful that a natural constraint can impact house prices where there is an effective intermediate urban containment device (regulatory geographical constraint), just as the dog cannot wander beyond the fence to the lake.

Thus, where there is strong land use regulation, especially an imposition of a highly restrictive and stringently enforced-urban containment device, any natural constraint is likely to be of little relevance.

Regulatory geographical constraints are associated with rising and higher house prices even in the relative absence of natural constraints. This is illustrated by Australia, where strong urban growth boundaries have been adopted in all of the large urban areas over 1,000,000 population. The Median Multiple has doubled or even tripled in relation to the levels that preceded adoption (Richards 2008). The Median Multiple in Australia has risen to a point well above that of the US and Canada, despite having been similar before adoption of urban containment devices (Cox and Pavletich 2010).

These house-price increases relative to incomes have occurred in the absence of material natural constraints. While Sydney has the Blue Mountains as a natural barrier to its west, much of the considerable developable land to the southwest and northwest in the Cumberland Plain is off-limits to new housing, likely neutralizing the impact of the more distant mountains.

There is sufficient developable land for Melbourne and Brisbane to grow in three directions for distances well beyond their urban peripheries. Perth and Adelaide have considerable land for growth to the south and across narrow hill ranges to the east. Adelaide's natural barrier to the north is 2,000 kilometers away, though Perth is more constrained at 500 kilometers. Yet, in each of these cases, urban containment devices virtually coincide with the urban periphery,[8] with the expected upward impact on house prices.

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8. In 2010, the state government of Victoria has expanded the Melbourne urban growth boundary significantly, an action largely unprecedented since the adoption of urban containment devices in Australia.

That the highest documented Median Multiples occur in a nation with scant natural constraints illustrates the primacy of the association with intermediate regulatory barriers.

## It Doesn't Take Much Land to Keep Down Price Escalation

However, US experience indicates that a comparatively small amount of developable land beyond the urban fringe may be enough to keep land and house prices from escalating. This is illustrated by time trends in the cases of Portland, Las Vegas, and Phoenix.

Portland: The Portland[9] urban growth boundary (UGB) was established in 1979. The UGB in 1980 contained approximately 20 percent more land than the urbanized land that was interior to the UGB. By 1990, the figure had dropped to 10 percent. And, as shown in Figure 3, by 2000 the urbanized area had essentially bumped up against the UGB. There was virtually no land left to develop. The house price escalation only started in the 1990s as the "cushion" had been seriously reduced. Between 1980 and 1990, developable land of just 75 to 150 square kilometers kept fast-growing Portland from having house price escalation relative to incomes. In 1980, the developable ring (that is, land within the urban growth boundary) was the equivalent of a radius of 1.5 kilometers round the urban area. But as the cushion disappeared in the 1990s, Portland led the nation in house price escalation (Cox 2002).

The Portland example shows that a 50 km radius, in an urban area of more than 1,000,000 population is an excessively large measure for natural constraints. Even once we take away the water and steep-slope areas, and then reduce further by taking away the already urbanized area, Saiz's "developable" area is 4,900 square kilometers. As calculated in Table 1, Saiz's "developable" area is from 32 (1980) to 65 (1990) times the area within the 1980 urban growth boundary that had been sufficient to maintain house prices within historic norms.

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9. My discussion relates to the Oregon portion of the Portland urban area; it excludes the part in the state of Washington.

Figure 3: Bumping Up Against the Urban Growth Boundary in Portland
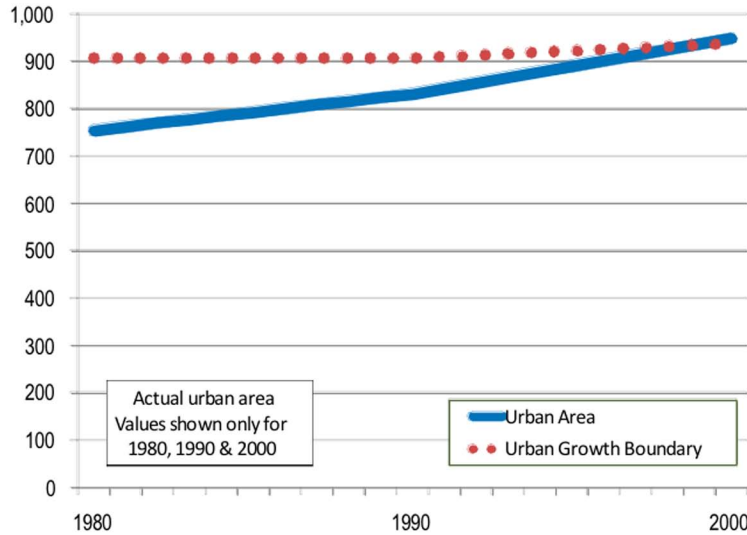
Sources: Urban area data from the Bureau of the Census for the Oregon portion of the urban area, land area within the urban growth boundary from Portland Metro.

Table 1: Comparison: Saiz Developable Area with Portland Developable Area within Urban Growth Boundary (UGB)

Saiz Undevelopable Area portion (Saiz 2010, 1258)	0.3754
Saiz Undevelopable Area	2,948 sqkm
Saiz Developable Area	4,906 sqkm
Fringe Developable Area within UGB, 1980	153 sqkm
Saiz Developable Area/1980 Fringe Developable Area	32
Fringe Developable Area within UGB, 1990	75 sqkm
Saiz Developable Area/Fringe Developable Area	65

As the developable land became scarcer, house prices escalated. Now, Portland is more than one-third above the historic Median Multiple norm (and Portland 1995 value) of 3.0, and during the housing bubble Portland house prices peaked at more than 60 percent above the 3.0 norm.

Las Vegas and Phoenix: There are *virtual urban growth boundaries* in Las Vegas and Phoenix, namely, the boundaries defined by *circumferential government owned land*. Some government land has been released to the market through auctions intended to maximize revenues, a goal in conflict with maximizing housing affordability.

In 2000, the privately owned, and thus theoretically developable, land on the fringe of the Las Vegas amounted to a cushion of land between the virtual urban growth boundary and the urban area that was equal to 40 percent of the land area in the principal urban area,[10] the equivalent of a 2.7 kilometer ring around the existing principal urban area, which is far less than the additional 35 kilometer ring the Saiz geographic barrier would represent beyond the 2000 urbanization (see Figure 4). Yet, house prices remained near historic norms through 2002. Through the entire period, Las Vegas was the nation's fastest growing metropolitan area above 1,000,000 population, which placed considerable development pressure on this reserve of land.

## Figure 4: Las Vegas Developable Area & Saiz Geographical Constraint: 2000
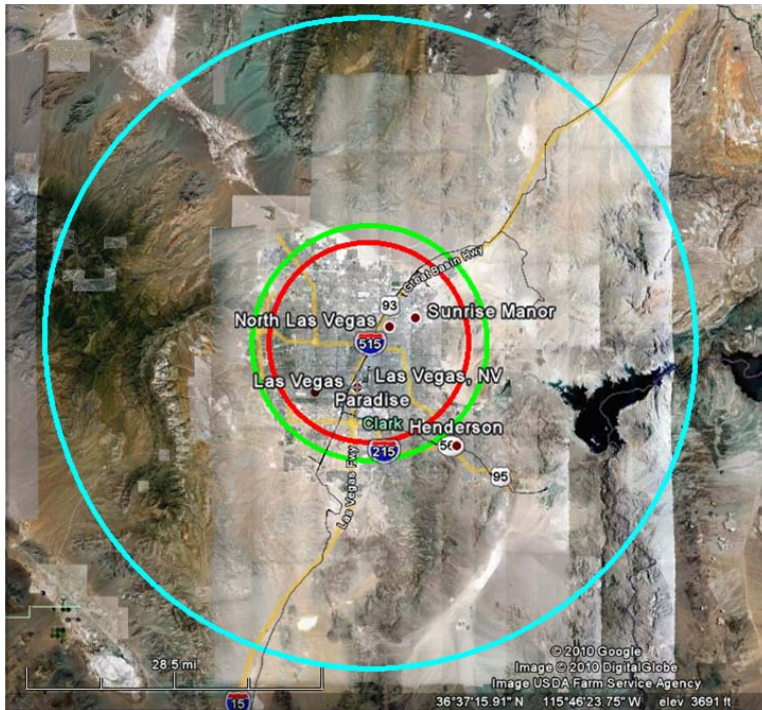
Sources: 2000 idealized radii from Bureau of the Census (urban area) and Bureau of Land Management Las Vegas Field Office data (developable land radius). Geographical constraint radius is based upon Saiz.

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10. Calculated from Bureau of Land Management, Las Vegas Field Office data.

But from 2002 to 2006 there occurred an escalation of approximately 85 percent in house-prices relative to incomes. Over the same period, federal government land auctions prices for urban fringe land rose from $50,000 per acre in 2001-2, to $229,000 in 2003-4 and $284,000 at the peak of the housing bubble (2005-6).

A similar situation exists with respect to the federal and state owned land that rings the Phoenix urban area. During the housing bubble, state auction prices rose nearly as much as in Las Vegas. Indeed, the rate of increase per acre in Las Vegas and Phoenix rivaled the rate over a somewhat longer period in Beijing (Wu, Gyourko and Deng 2010) which may have had the greatest price escalation in the world (see Figure 5).

Figure 5: Auction Land-Price Changes for Las Vegas, Phoenix, and Beijing
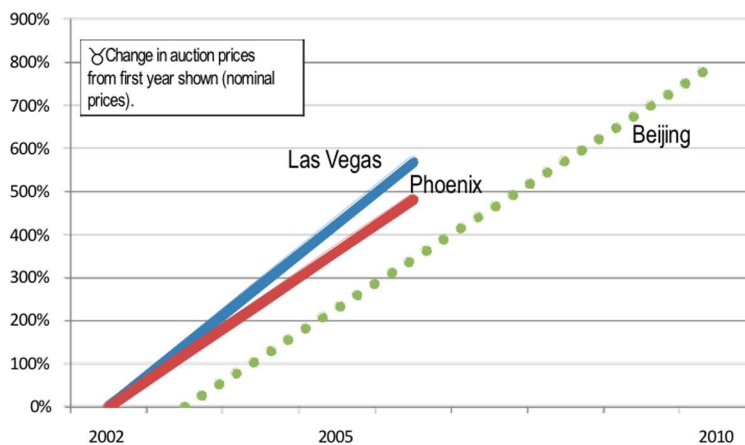
Sources: Bureau of Land Management Las Vegas Field Office data, Arizona State Land Department data and Wu, Gyourko and Deng (2010).

Experience in Portland, Las Vegas and Phoenix suggests that there does not have to be much developable land beyond the periphery of the urban area to negate the house price increasing impact of a regulatory (or for that matter a natural) constraint. The constraint only needs to leave enough of a "cushion" for there to be sufficient competition between buyers for land sufficiently proximate to the urban area to attract home purchasers at affordable prices. In the examples examined, the cushion was *far* smaller than the area associated with Saiz's 50-km-radius area minus waters etc. I might add, as an impressionistic assessment, that the cushion needs also to be ample enough so that it cannot be cartelized by large developers. Given those modest conditions, the market itself establishes the

bounds to urban growth. Granted, it does not create a "clear edge" for the urban area, but in return, this relatively free market can keep house prices from escalating ahead of incomes.

All three of these cases suggest that regulatory geographical constraints exert a substantial impact on house prices. It seems likely that any natural geographical influence would be eclipsed by the urban containment device except where the geographical constraint is co-extensive with or less remote than the regulatory geographical constraint.

The Wharton Residential Land Use Regulatory Index

Both Saiz and Huang and Tang use the Wharton Residential Land Use Regulatory Index (WRI) to gauge the extent of land use regulation. The WRI is based upon a questionnaire circulated to municipal officials around the nation and deals only with *non-geographic* land regulation issues, which can, of course impact house prices. Examples of non-geographic regulations are building moratoria, building quotas, inclusionary zoning, and longer and more expensive project approval times.

The WRI includes some questions that should be fairly straightforward and factual, such as whether the jurisdiction places any limit on the number of single family home building permits (Question 5).[11] The WRI also includes less straightforward questions, some requiring quantitative data that is generally not available and others relying upon loose judgments alone.

For example, WRI asks "How does the acreage of land zoned for the following land uses compare to demand?" (Question 7). The possible answers are "far more than demanded," "more than demanded," "about right," "less than demanded," and "far less than demanded." There are at least two difficulties with such a question. The first difficulty is that the answers are inherently loose and vague (what does "demanded" mean when price is not specified?). The second difficulty is that judgments vary considerably. A planner in highly regulated Portland, for example, would likely consider the land supply "about right" for the demand. Yet land prices for practically adjoining land diverge greatly when the two plots are on opposite sides of the urban growth boundary.

Finally, other questions simply ask for an opinion. For example, question #4, rating of the importance of 11 factors in restricting residential development, asks for a "1-not at all important" to a "5=very important."

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11. This presumes honest answers and that the responders are informed on the matter.

Again the respondents are government employees and officials. Obtaining responses from market participants might have produced a substantially different picture even on the more straightforward questions. It seems unlikely, for example, that home builders and developers would share the views of municipal officials, especially in a highly regulated area, on issues of the sufficiency of land supply or the most important factors in regulating land development. A land developer or home builder who carries out business on a metropolitan or even national scale would probably respond that in Portland the developable land is "far less than demanded." Recall what I noted about prices of lands just steps away but separated by an urban growth boundary.

Thus, the WRI yields some surprising regulatory scores. For example, Baltimore is rated as having six times the regulation of Portland, yet Portland would be considered by many analysts among the most regulated. The California metropolitan areas of Los Angeles, San Diego, and San Jose, which are generally considered to be restrictively regulated, including jurisdictions with building moratoria and expensive development impact fees, have a lower WRI than Harrisburg, PA, which is generally considered lightly regulated.[12]

For doing nationwide aggregative estimates, the task of developing a regulatory index of sufficient integrity must remain daunting. It would need to include all forms of urban containment devices, from urban growth boundaries to government land ownership. Even if it included containment devices, it would also need a variable to capture the extent of land available for development. As the Portland and Las Vegas cases indicate, an urban containment device's impact on prices is dependent upon the extent to which a land shortage is created. Similar "cushion" considerations would be required with respect to other restrictions, such as building moratoria. A building moratorium that allows sufficient supply to meet the demand is unlikely to have much of a price impact. On the other hand, a building moratorium that does not allow the demand to be met is likely to materially increase house prices. Such an index would need to include a measure of the restrictiveness of any such regulation.

In light of the current state of the art, any land use regulatory index seems likely to be, at best, predictive of the general relationship of house price changes where there are substantial regulatory differences (more regulated areas will have larger price increases), but the aggregative magnitudes thusly estimated may well be *far* off. Also, such analysis is likely to be unreliable at explaining the price differentials between the specific markets.

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12. The California metropolitan areas have routinely been classified as among the most highly regulated (see **link**).

Conclusion

The two papers touched on here (Saiz 2010, Huang and Tang 2010) help us to focus our attention on the role of constraints, natural and regulatory, in the level and movement of home prices across a large sample of metropolitan areas. There remains the need, however, to exercise caution in relying on regulation indexes that, for all of their value, have great difficulty incorporating the particularistic factors that really frame a locale. The interaction between different types of geographical constraints—the natural and the regulatory—needs close attention, and I suspect that the procedures employed by the papers have the tendency to understate, at the aggregative level, the pernicious impact of regulatory restrictions. Any such understating would be especially important. In principle, it is easier to alter regulatory policy than it is to level a mountain or push back an ocean.

References

2025 Task Force. 2009. The $64,000 Question: Closing the Income Gap with Australia. **Link**

Cox, Wendell. 2010. Property Values 11 Times Higher Across Portland's Urban Growth Boundary. *newgeography.com*. **Link**

Cox, Wendell. 2002. *Smart Growth and Housing Affordability*. Millennial Housing Commission. **Link**

Cox, Wendell, and Hugh Pavletich. 2010. *Demogaphia International Housing Affordability Survey*. Demographia. **Link**

Fischel, William. 1995. *Regulatory Takings, Law, Economics and Politics*. Cambridge, MA: Harvard University Press.

Haifang, Huang, and Yao Tang. 2010. Residential Land Use Regulation and the US Housing Price Cycle between 2000 and 2009. Department of Economics, University of Alberta. **Link**

Leunig, Tim. 2007. *In My Back Yard: Unlocking the Planning System*. Centre Forum. **Link**

Mildner, Gerard. 2009. Public Policy and Portland's Real Estate Market. *Quarterly & Urban Development Journal* 4th Q.: 9-16. **Link**

Richards, Anthony. 2008. *Some Observations on the Cost of Housing in Australia*. Reserve Bank of Australia. **Link**

Saiz, Albert. 2010. The Geographic Determinants of Housing Supply. *Quarterly Journal of Economics*: 1253-1296. **Link**

Wu, Jing, Joseph Gyourko, and Yongheng Deng. 2010. Evaluating Conditions in Major Chinese Housing Markets, NBER Working Paper No. 16189. **Link**

About the Author

Wendell Cox is principal of Demographia, an international public policy consultancy located in the St. Louis metropolitan area. He also serves as a visiting professor at the Conservatoire National des Arts et Metiers in Paris. He is author of the *Demographia Residential Land & Regulation Cost Index* and co-author of the *Demographia International Housing Affordability Survey*. He was appointed by Mayor Tom Bradley to three terms on the Los Angeles County Transportation Commission. Speaker of the House of Representatives Newt Gingrich appointed him to a term on the Amtrak Reform Council. He holds a BA in Government from California State University in Los Angeles and an MBA from Pepperdine University. His email address is: demographia2@earthlink.net.

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