Response to Furth (2025) [*]

Louie, Mondragon, Wieland

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Abstract

Furth (2025) provides a critique of both the demand-supply framework and empirical results in Louie, Mondragon and Wieland (2025a), notably that: (1) using total income growth invalidates the empirical and theoretical work because it is itself a function of housing supply elasticities; (2) the "indicator" or "intercept" estimates point to differential house price growth consistent with the standard view or at least inconsistent with our interpretation; (3) that the empirical focus should be narrowed to only very large cities; (4) that our results do not point to reevaluating the consensus view on the importance of regulatory constraints in driving housing market outcomes. Here we reply that: (1) is incorrect; (2) the intercept estimates are only consistent with the standard view if one believes in implausibly large and ad hoc unobserved supply shocks and instead these terms are more likely explained by differences in the pricing of amenities; (3) our estimates already allow for supply effects to matter within more narrow subsets of the data and we find no evidence consistent with the standard story; (4) we agree that different interpretations of our results are possible, but none of the valid interpretations support the standard view and, we believe, that the emphasis on regulatory constraints should be commensurate with the empirical evidence. *Dog shoots man:* we conclude that housing supply constraints do not explain growth in house prices or quantities across U.S. cities.

[*]The views expressed here are those of the authors and do not necessarily reflect those of the Federal Reserve Bank of San Francisco or the Federal Reserve System.

1 Summary

We are grateful to Furth for his close reading of our paper and his detailed comments. Our response is long and detailed, so we first summarize the key points:

- Many commentators, including Furth, have objected to our use of total income growth, which combines per capita income and population growth. We show that this concern is empirically irrelevant and theoretically misguided. Empirically, we get the same results using total income, per capita, and population growth: supply constraint measures do not matter. Theoretically, we show that total income is a completely valid measure of demand in both the standard local labor market model and even in the specific extension suggested by Furth in his comment. Readers concerned about the use of total income growth are misunderstanding the core mechanisms of this class of model. See Section 2.

- Furth argues that because total income growth is endogenous, or correlated with unobserved demand and supply shocks, our empirical estimates are invalid. But this concern misunderstands identification in demand-supply frameworks: it is only correlations with supply shocks, not supply elasticities or demand shocks, that pose a problem when estimating supply elasticities. See Section 3.

- Furth argues that the negative correlation between price growth and the less-constrained indicator is inconsistent with our conclusions and that it points to an invalid empirical approach. This argument misunderstands how to interpret these intercept effects. We show that if the standard story is correct and cities truly have different housing supply elasticities, then one must conclude that housing markets are subject to implausibly large, epicyclic housing supply shocks. Instead, a model alluded to by Furth that incorporates housing quality and quantity can easily explain these correlations and is consistent with broader evidence on housing markets. Intuitively, some changes in housing demand, like per capita income growth, will show up in prices but not in quantities and these shifts in demand are likely correlated with measures of housing constraints. See Section 4.

- Furth suggests that we limit our empirical focus to a narrow set of large, constrained cities. We disagree that this is necessary, useful, or advisable. The constraint measures that we use were designed to be compared across their full samples and our empirical approach is designed to appropriately use all of this variation. Moreover, we already provide analysis that allows for more narrow comparisons and these results deliver the same results. See Section 5.

- While there are alternative interpretations of our results, none of the appropriate interpretations suggest that variation in local supply curves is the critical factor driving variation in housing affordability across cities. See Section 6.

Our response reinforces the central claim of our paper: supply constraints do not explain house price and quantity growth across U.S. cities. This result is surprising, but that does not mean it is incorrect.[1]

2 Total Income

Much attention has been directed at our use of total income growth, defined as growth in both per capita income and population, as an explanatory variable in our empirical work. First, it is important to note that we do not ever claim that total income growth measures *all housing demand*.[2] We do not make this claim because it is unnecessary for our analysis. All we need is for total income growth to be *correlated* with housing demand, which is both obviously true and verified by the strong empirical relationship between total income growth and prices and quantities. Other sources of housing demand, such as wealth or demand from households outside of the region, are unproblematic and incorporated in our theoretical framework through the residual demand shifters (θ).

Setting aside this misunderstanding, the core of the concern appears to be that population growth is endogenous, with Furth claiming this is "a core flaw" (p. 5) in our approach.[3] By endogenous it is meant that total income growth depends on changes in other variables like growth in local productivity or wages, and that its response to these other variables is mediated by the local housing supply elasticity. *We agree that this is true, but disagree that it is an empirical or theoretical problem.* In our recently updated version of the paper (dated July 2025) we separate out per capita income growth and population growth and show that the empirical results are the same: measured supply constraints do not affect the relationships between per capita income growth or population growth and house price or quantity growth, settling any questions about the empirical relevance of this critique. These results are reproduced here in Table I, Table II, Table III, and Table IV.

[1] "To spell out the obvious is often to call it in question." – Hoffer (1955).

[2] This is in contrast to Furth's statement on page 3 that we argue that "total metro income [...] is housing demand [...]."

[3] Essentially the same critique is contained in the subsection "Housing supply is not independent of total income" p.6, so we combine our response to that argument in this section.

But Furth and others are also incorrect *in principle* that the use of total income growth is a concern even within any of the standard local labor market models that he cites (p. 6). To demonstrate this we first present a simple but quite general local labor market model and derive the equilibrium relationships between prices and quantities and wages and total income growth, and then we extend this model in the direction suggested by Furth in his comment to incorporate two margins of housing consumption. Because this concern is focused on the causal relationship between population growth/quantities and housing supply elasticities, we abstract from unobserved demand and supply shocks. But unobserved shocks would affect the empirical estimates in a parallel manner to what we describe in our paper. This exercise shows that in the standard models there is no theoretical or empirical issue raised in relating price or quantity growth to total income growth. In fact, it is *because* total income growth depends on housing supply elasticities that the empirical coefficients relating total income growth to housing market outcomes will be informative.

2.1 Standard Model

Housing Demand

Assume that households in city i consume a non-housing good c and housing h where we ignore the distinction between quality and quality (we return to this margin below in Section 2.2).[4] Household utility in city i is given by the Cobb-Douglas function (Davis and Ortalo-Magné, 2011)

$$U_i = (1-\alpha)\log(c_i) + \alpha\log(h_i).$$

Given a wage w_i and a city-specific cost of housing p_i, the budget constraint is $c_i + p_i h_i = w_i$. This implies that the per capita demand for housing is simply

$$h_i^D = \frac{\alpha w_i}{p_i}.$$

Let total population in city i be L_i. Then aggregate housing demand in that city is equal to

$$H_i^D = h_i^D L_i = \frac{\alpha w_i L_i}{p_i} = \frac{\alpha Y_i}{p_i} \tag{1}$$

where Y_i is total income in city i.

[4] We also present this model in the appendix of our updated version of the paper.

Housing Supply

The total supply of housing is given by the following supply function with city-specific elasticity ψ_i

$$H_i^S = p_i^{\psi_i}. \tag{2}$$

Labor Market

All workers provide one unit of labor so that there is no intensive margin of labor, but the number of workers depends on the real wage offered. For simplicity, assume there is some outside option (such as another region) so that if real wages are too low, more workers will simply take their outside option and leave the region. The labor supply curve is then given by the following where η is the labor supply elasticity between regions

$$L_i^s = \left(\frac{w_i}{p_i^\alpha}\right)^\eta.$$

Output (apart from housing) has the following production function with productivity shocks Z_i

$$Y_i = Z_i L_i^\gamma$$

So the total number of workers or population demanded is given as

$$w_i = Z_i \gamma (L_i^D)^{\gamma-1}.$$

We do not solve for the total distribution of workers across locations as this is irrelevant for the questions at hand, but such a clearing condition across regions could be easily imposed.

Equilibrium

Equilibrium in the housing market means the total quantity of housing will match the total housing demand,

$$H_i^S = H_i^D = H_i \tag{3}$$

In the labor market labor supply must equal labor demand

$$L_i^D = L_i^S = L_i. \tag{4}$$

We can linearize and re-arrange these conditions along with the equations above to get the following linearized equilibrium conditions, where hats represent deviations from the approximation point

$$\begin{aligned}
\widehat{h}_i &= \widehat{w}_i - \widehat{p}_i, \\
\psi_i \widehat{p}_i &= \widehat{H}_i, \\
\widehat{H}_i &= \widehat{h}_i + \widehat{L}_i \\
\widehat{w}_i - \widehat{Z}_i &= (\gamma - 1)\widehat{L}_i \\
\widehat{L}_i &= \eta(\widehat{w}_i - \alpha \widehat{p}_i)
\end{aligned}$$

It is straightforward to derive the relationships between prices and quantities and wages and total income growth, defined as $\widehat{Y}_i = \widehat{w}_i + \widehat{L}_i$.

$$\widehat{p}_i = \frac{1+\eta}{1+\alpha\eta+\psi_i}\widehat{w}_i, \tag{5}$$

$$\widehat{p}_i = \frac{1}{1+\psi_i}\widehat{Y}_i, \tag{6}$$

$$\widehat{H}_i = \psi_i \frac{1+\eta}{1+\alpha\eta+\psi_i}\widehat{w}_i, \tag{7}$$

$$\widehat{H}_i = \psi_i \frac{1}{1+\psi_i}\widehat{Y}_i. \tag{8}$$

Thus, simple regressions of prices or quantities on wage growth (per capita income) or total income growth will be straightforward functions of housing and labor supply elasticities and housing's expenditure share. Consider the example, in which two groups of cities have high and low supply elasticities respectively, which we denote by ϕ_H and ϕ_L. Denote the group of cities by Ω_H and Ω_L. Then the coefficients in the group-specific price regressions

$$\widehat{p}_i = \frac{1+\eta}{1+\alpha\eta+\psi_j}\widehat{w}_i, \qquad i \in \Omega_j,\ j \in L, H, \tag{9}$$

$$\widehat{p}_i = \frac{1}{1+\psi_j}\widehat{Y}_i, \qquad i \in \Omega_j,\ j \in L, H, \tag{10}$$

map directly into the supply elasticities, and similarly for the quantity regressions.[5]

In fact, the total income specifications are *simpler* than the per capita specifications because they incorporate the endogenous response of population growth to housing supply's effects on prices. This means the resulting coefficients depend *only* on the supply elasticities.

[5]If groups of low and high elasticity cities have heterogeneous elasticities within each group, then this does not pose an issue for identification but instead gives our estimates a heterogeneous treatment effect interpretation (Louie, Mondragon and Wieland, 2025b).

This is because (6) and (8) depend only on the supply curve (2) and the within-city housing demand curve (1), and are independent of the specific migration model. Models with more general demand-side features will therefore give similar results.[6]

The intuition is simple: the fact that housing supply elasticities mediate population growth through differential price growth implies that the relationships between price and quantity growth and total income growth will be observably different. That is, the same population growth should lead to *more* price growth and *less* quantity growth in relatively inelastic areas *because* population growth is a function of housing supply elasticities.

Note that the labor demand function is not actually needed for these derivations. This points to a broader result that the relationships between housing market outcomes and measures of housing demand really only depend on the structure of the housing market (the local supply elasticity) and the structure of housing demand (incomes and labor supply). Of course, unobserved shocks to demand or supply may introduce biases, but these are exactly the cases that we discuss in our paper. Ultimately, only supply shocks are a threat to the identification of differences in supply elasticities. Therefore, we conclude that there is no theoretical objection to using total income growth when examining the importance of housing supply elasticities in the standard model.

2.2 Total Income with a Quality Margin

Furth writes down a model (p. 6) with two margins of housing, quality (rooms per person) and the number of units, and argues that this presents a problem for using total income. In the model above we allowed only one margin and showed that there was no problem, but here we allow for two margins as suggested by Furth.[7] While the expressions are different from those above, the conclusion is the same: there is no theoretical issue in using total income to try and infer differences in housing supply elasticities across locations.

Housing Demand

Housing demand is the same as above except that while each household consumes only one unit of housing, they can also consume more or less quality where we can interpret quality as being both the physical quality of a unit as well as the amenities provided by a unit's location. The budget constraint is $c_i + p_i h_i = w_i$ where $h_i = u_i q_i = 1 q_i = q_i$. This implies

[6] For example, with non-homothetic CES preferences, aggregate housing demand is $\widehat{H}_i^D = -\epsilon_p \widehat{p}_i + \epsilon_Y \widehat{Y}_i$, which combined with the supply equation yields the equilibrium prices and quantities $\widehat{p}_i = \frac{\epsilon_Y}{\epsilon_p + \psi_i} \widehat{Y}_i$ and $\widehat{H}_i = \psi_i \frac{\epsilon_Y}{\epsilon_p + \psi_i} \widehat{Y}_i$ as in the paper (equations 1 and 2 with shocks set to zero).

[7] In private communications with Furth we proposed this kind of model as an explanation for the intercept term (see Section 4).

that the per capita demand for quality of housing is simply

$$q_i^D = \frac{\alpha w_i}{p_i}.$$

Total demand for quality in a city is then given as per capita quality demand multiplied by the population L_i

$$Q_i^D = q_i^d L_i.$$

Housing Supply

By writing down two margins of housing consumption, Furth is implying that there are two margins of supply (otherwise the model would collapse to the single margin model above). We adopt the simplest possible specification and assume the two margins are separable. The supply of each margin of housing is then given by the following supply functions where p_{ui} is the price of a unit of housing and p_{qi} is the price of quality so that $p_i = p_{ui} p_{qi}$:

$$u_i^S = p_{ui}^{\psi_{ui}},$$
$$Q_i^S = p_{qi}^{\psi_{qi}}.$$

Labor Market

The labor market is identical to that in the model above.

Equilibrium

Equilibrium in the housing units and quality markets is given as

$$u_i^S = u_i^D = L_i,$$
$$Q_i^S = Q_i^D = Q_i.$$

In the labor market labor supply must equal labor demand

$$L_i^D = L_i^S = L_i.$$

We can linearize and re-arrange these conditions to get the following equilibrium conditions, where hats represent deviations from the approximation point

$$\begin{aligned}
\widehat{q}_i &= \widehat{w}_i - \widehat{p}_i, \\
\widehat{Q}_i &= \widehat{q}_i + \widehat{L}_i, \\
\psi_{qi}\widehat{p}_{qi} &= \widehat{Q}_i, \\
\psi_{ui}\widehat{p}_{ui} &= \widehat{u}_i, \\
\widehat{u}_i &= \widehat{L}_i, \\
\widehat{w}_i - \widehat{Z}_i &= (\gamma - 1)\widehat{L}_i, \\
\widehat{L}_i &= \eta(\widehat{w}_i - \alpha\widehat{p}_i).
\end{aligned}$$

We can then solve for the equilibrium relationships between total housing prices $\widehat{p}_i = \widehat{p}_{qi} + \widehat{p}_{ui}$, housing units $\widehat{u}_i$, and wages and total income $\widehat{y}_i = \widehat{w}_i + \widehat{L}_i$.

This model is less standard, so we walk through the first steps of the solution to aid the reader. We start by substituting for quality and unit prices in the total price expression

$$\widehat{p}_i = \frac{1}{\psi_{qi}}\widehat{Q}_i + \frac{1}{\psi_{ui}}\widehat{L}_i.$$

We then substitute for the changes to total quality and units demanded:

$$\begin{aligned}
\widehat{p}_i &= \frac{1}{\psi_{qi}}(\widehat{q}_i + \widehat{L}_i) + \frac{1}{\psi_{ui}}\widehat{L}_i, \\
\widehat{p}_i &= \frac{1}{\psi_{qi}}(\widehat{w}_i - \widehat{p}_i + \eta(\widehat{w}_i - \alpha\widehat{p}_i)) + \frac{1}{\psi_{ui}}\eta(\widehat{w}_i - \alpha\widehat{p}_i).
\end{aligned}$$

We rearrange to get an expression between the total price change on the left-hand side and wages on the right-hand side

$$\widehat{p}_i = \underbrace{\frac{(1+\eta)\psi_{ui} + \eta\psi_{qi}}{\psi_{ui}\psi_{qi} + (1+\alpha\eta)\psi_{ui} + \alpha\eta\psi_{qi}}}_{\equiv A_i}\widehat{w}_i. \tag{11}$$

The price/wage elasticity A_i is a key parameter, so it is useful to examine its properties. Consider if the elasticity of labor supply went to zero, then the elasticity of prices would just be $1/\psi_q$, the inverse of the supply elasticity of quality since the elasticity of units would be irrelevant. Similarly, as the labor supply elasticity tends to infinity $A \to 1/\alpha$, so that prices depend only on the inverse of the housing expenditure share. This large price response is needed to balance the large flows of labor in response to the higher wages.

Changes in the housing supply elasticities are similarly intuitive with A_i decreasing in both housing supply elasticities, so that an increase in wages translates into less of a price increase. As long as the expenditure share α is less than 1, which is always true, then A will decline as the unit supply elasticity increases. As the unit elasticity tends to infinity this expression tends to $(1+\eta)/(\psi_q + (1+\alpha\eta))$ so that the combination of quality supply elasticity and labor supply elasticities govern the price response. As the supply elasticity of units tends to zero, the price/wage elasticity will tend again to $1/\alpha$. The intuition is similar to above where high prices ensure that additional migration and units are not added. As the elasticity of quality tends to zero, the expression will tend to the ratio $(1+\eta)/(1+\alpha\eta)$ so that the price/wage elasticity depends on the combination of labor supply elasticities and the importance of housing in the budget. Overall, as both housing supply elasticities get smaller, the numerator will decline faster than the denominator and the price/wage elasticity will increase. *Therefore, A_i is decreasing in the housing supply elasticities.*

We can derive expressions for the unit/wage elasticity, the price/total income elasticity, and the unit/total income elasticity. Defining $B_i \equiv \frac{\eta(1-\alpha A_i)}{1+\eta(1-\alpha A_i)}$ and then collecting the four key relationships, we have:

$$\widehat{p}_i = A_i \widehat{w}_i, \tag{12}$$

$$\widehat{p}_i = (1 - B_i) A_i \widehat{Y}_i, \tag{13}$$

$$\widehat{u}_i = \eta(1 - \alpha A_i)\widehat{w}_i, \tag{14}$$

$$\widehat{u}_i = B_i \widehat{Y}_i. \tag{15}$$

The unit/wage elasticity (14) is somewhat positive empirically and would be positive in the vast majority of theoretical scenarios, so we go forward assuming this is the case. If this were negative it would still mean that these regressions are informative about supply elasticities, but the signs of the quantity relationships would change.

We have already established that A is declining in the housing supply elasticities, so regressions of prices and units on wages ((12) and (14)) should clearly vary in the expected manner with measured differences in housing supply elasticities. That is, places with more elastic housing supply elasticities should have less price growth and more unit growth for a given change in wages relative to places with less elastic housing supply.

Regressions of prices and units on total income maintain those intuitive relationships. It is simplest to start with the unit/income elasticity (15), since that depends only on B, which in turn is declining in A. As housing supply elasticities increase, A declines which then increases B. Intuitively, if housing supply is relatively elastic, then prices are less responsive to wages and units will be more responsive to total income as more people move into the city. Turning to the price/income elasticity, (13) shows that the response depends inversely on the supply elasticities and is directly declining in B. Since B is increasing in the supply elasticities, any increase in supply elasticities will lower A and in turn increase B, leading to a reduction in the price/income elasticity. Once again, the empirical relationships between prices and quantitites and total income will be informative about differences in supply elasticities.

While the total income elasticities are different objects than the wage elasticities, the model shows that different housing supply elasticities imply different relationships between prices and units and total income, consistent with the basic demand-supply framework outlined in the paper and with the standard local labor market model with only one housing margin. There is no theoretical issue with using total income, and the introduction of unobserved demand or supply shocks will affect the resulting estimates in the manner discussed in the paper.

3 Endogeneity and IVs

A distinct concern about total income growth arises in footnote 2 of Furth (2025), which refers to the fact (about which we are explicit in our paper) that total income growth is endogenous. Here endogeneity means that total income growth is correlated, either causally or non-causally, with unobserved shocks that also affect growth in housing quantities. It is important to distinguish endogeneity in this sense from the fact that total income growth is also determined by the housing supply elasticity. As the discussion above demonstrates, that total income growth depends on the housing supply elasticity does not prevent us from recovering the supply elasticities by instrumenting for price changes with growth in wages or total income (to see this, simply take the ratios of the quantity/price relationships above, which are identical to the IV estimator).

As we demonstrate in our paper, endogeneity in terms of unobserved *demand shocks* is also not a problem for recovering supply elasticities. That is, if places where income is growing are also places where local amenities improve for unrelated reasons, we can still use total income growth to instrument for house prices and we will recover the housing supply elasticities. It is a core result from demand/supply frameworks that the econometrician one does not need an instrument that is uncorrelated with other demand shifters in order to estimate a supply elasticity (Angrist and Krueger, 2001), instead the instrument need only be uncorrelated with unobserved shocks to *supply*. Any correlation with unobserved shocks to demand will only affect where on the supply curve a unit has been shifted, which will still allow the econometrician to recover the slope of the supply curve.

However, as we discuss at length in the paper, unobserved shocks to supply that are correlated with total income growth can bias our IV estimates. Specifically, if supply shocks are more positively correlated with income growth in *more constrained* cities, then one could generate the results that we report. We maintain that this would be an unexpected result; to our knowledge no one in the literature has discussed this kind of mechanism where income growth is more likely to be accompanied by positive supply shocks in more constrained cities. Moreover, it would still be true that measured supply constraints do not explain price and quantity growth across cities.

We also disagree with Furth's characterization of our results from the plausibly exogenous work-from-home shock. Note that these have now been updated to use continuous measure of exposure to work-from-home, which is more consistent with the approach taken in the rest of our empirics, but the results have not materially changed. It is true that some estimates of the permit results, although they are extremely imprecise, could point to less constrained cities building more in response to the shock. However, *all* of the price regressions also recover positive coefficients on the interaction terms, including the only estimate which meets standard levels of statistical precision (the regulatory index). Viewed as a whole, these results are inconsistent with the standard story as *none* of the measures gives the expected result where less constrained cities exhibit less house price growth and more quantity growth. We also find that quantile regressions, which are less sensitive to outliers, generally find much smaller interaction term estimates, consistent with the rest of our results.

4 Intercept Effect

The central claim of the supply-centric view of housing is that differently sloped supply curves explain differential growth in prices and quantities.[8] We document that the interaction of income growth and supply constraints does not predict differential growth in prices or quantities, which is inconsistent with this view. However, in some of our results we do find a correlation between prices and constraints, with less constrained cities appearing to have less price growth. We will call this correlation the "intercept" term for brevity. In our paper, we document that this correlation is economically small and that there is no correlation with quantities, thus concluding that this price correlation does not validate the standard view (Section 4.5). Nevertheless, Furth and other readers still harbor discomfort about how this intercept can be consistent with our central claim that differential supply constraints do not explain differential price and quantity growth.

We first demonstrate that this term is not evidence of different supply elasticities, but rather must point to large *shifts* in housing supply in more elastic cities. Intuitively, if supply

[8] This section is largely copied from Appendix A2 from the July 2025 version of our paper.

elasticities are truly higher in cities that appear less constrained, then the differential price growth implies differential growth in housing quantities. However, there is no correlation between estimated elasticities and growth in quantities, and this fact can only be reconciled in the standard model by shifts in housing supply. The average shift in housing supply implied by the elasticity estimates and the standard framework is extremely large, equivalent to average growth in housing quantities overall. Therefore without these shifts in housing supply, overall growth in housing quantities would have been *essentially zero on average* in less constrained cities. While Furth argues that our conclusions can only be reconciled with these intercept estimates through implausible shifts in supply curves, we show that the opposite is the case: implausible shifts in supply curves are *required* to reconcile these estimates with the *standard view* that local supply elasticities are different.[9]

We think these shifts in supply are problematic explanations of the data for a number of reasons. First, shifts in supply functions are not the central argument for why cities with elastic housing supply functions have lower prices and higher quantities. Instead the argument is that more- and less-elastic supply functions explain more and less growth in house prices and quantities, but that mechanism cannot explain these intercepts. Second, these implied shifts are far too large to be plausible, or at least they would imply enormous changes in construction productivity that have not been documented.[10] Finally, this explanation requires a kind of epicyclic combination of shocks to supply: supply shocks uncorrelated with income growth must be *positively* correlated with elasticities to explain the intercept term, but it must also be the case that supply shocks correlated with income growth are *negatively* correlated with elasticities in order to explain our estimates of the interaction terms. It is unclear why the productivity of housing construction would have the opposite correlation with elasticities conditional on whether or not there is income growth present and to the best of our knowledge no theory with this kind of implication has ever been proposed in the literature. We conclude that the more plausible inference is that housing supply elasticities are not so different across these groups of cities.

Instead of such shifts in supply, we suggest that this term likely points to differential growth in the pricing of the underlying quality of housing, where quality is broadly understood as reflecting differences in physical characteristics such as an updated kitchen as

[9] Furth also makes an argument (p. 4) that these results point to our empirical model leaving lots of "unexplained variation" that then loads on this intercept term, suggesting that our empirical approach is flawed. This claim is empirically wrong: the constraint measures do not materially explain much of the variation in prices or quantities while total income actually explains significant fractions of variation in prices and quantities. But this claim also does not address our argument in this section, that the correlations we do estimate are deeply problematic for the standard view.

[10] Such magnitudes would be well beyond the trends discussed in Goolsbee and Syverson (2023) and in conflict with those documented by Sveikauskas, Rowe and Mildenberger (2018).

well as local amenities such as a pleasant climate or wealthy neighbors. If house prices are not perfectly adjusted for quality, so that the valuation of differences in both physical and amenity quality are captured in standard house price indexes, then this intercept term is easily explained by differential growth in housing quality. An increase in the demand for housing quality may then increase prices, but actually have no effect on the demand or supply of housing units, which would generate the intercept terms we find.

We believe this is a very plausible explanation of the intercept term. It is a fact that house price indexes are not, and cannot, be perfectly adjusted for differences in the quality of physical features and endogenous amenities across cities (Harding, Rosenthal and Sirmans, 2007; Billings, 2015; Diamond, 2016) and that cities considered to be inelastic are also likely to have attractive amenities (Davidoff, 2016).[11] Additionally, our estimates show that per capita income growth is strongly correlated with growth in prices while it has essentially no correlation with growth in the number of housing units (see Table I and Table III), consistent with the discussion above. Therefore, if cities measured as inelastic actually are more exposed to increases in the demand for high-quality, high-amenity housing (due to, for example, booming tech industry valuations or endogenous amenities ala Diamond (2016)) then this intercept term is *exactly* what one would expect to observe.

We next walk through the decomposition of the intercept term if we assume that the measured supply elasticities are truly different and show that this implies implausibly large shifts in supply. Then we make additional use of the quality model from Section 2.2 that was suggested by Furth when critiquing our use of total income, and show that this model can explain the intercept term without relying on shifts in supply functions.

4.1 Decomposing the Intercept Term

We start with the reduced form solutions to the demand and supply equations in our paper:

$$\widehat{P}_i = \frac{1}{\psi_i + \epsilon_p}(\epsilon_y \widehat{Y}_i + \hat{\theta}_i) - \frac{1}{\psi_i + \epsilon_p}\widehat{\sigma}_i,$$

$$\widehat{H}_i = \frac{1}{1 + \frac{\epsilon_p}{\psi_i}}(\epsilon_y \widehat{Y}_i + \widehat{\theta}_i) + \frac{\frac{\epsilon_p}{\psi_i}}{1 + \frac{\epsilon_p}{\psi_i}}\widehat{\sigma}_i.$$

[11] To see how price indexes fail to adjust for amenities, imagine that state-level funding improves for a neighborhood school. The improvement in school quality will translate into higher prices in the neighborhood, but quality-adjusted indexes relying on a repeat sales methodology will not correct for any of the change in the quality of local amenities, so all of the price change will be reflected in the price index.

The intercept terms we want to understand come from the following regressions, reproduced from our paper:

$$\widehat{P}_i = \alpha + \beta_1 \widehat{Y}_i + \beta_2 \mathbb{I}_i(\text{Less Constrained}) + \beta_3 \widehat{Y}_i \times \mathbb{I}_i(\text{Less Constrained}) + e_i, \quad (16)$$
$$\widehat{H}_i = \delta + \gamma_1 \widehat{Y}_i + \gamma_2 \mathbb{I}_i(\text{Less Constrained}) + \gamma_3 \widehat{Y}_i \times \mathbb{I}_i(\text{Less Constrained}) + v_i.$$

The coefficients β_2 and γ_2 give the relative growth in prices and quantities for more elastic cities ($j = H$), conditional on growth in income, relative to more constrained cities. So the two intercept terms can be decomposed into the following

$$\beta_2 = E\left[\frac{1}{\psi_H + \epsilon_p}(\epsilon_y \widehat{Y}_i + \widehat{\theta}_i) - \frac{1}{\psi_H + \epsilon_p}\widehat{\sigma}_i \middle| \widehat{Y} = 0, j = H\right] - \underbrace{E\left[\widehat{P}_i | \widehat{Y} = 0, j = L\right]}_{=\alpha},$$
$$\gamma_2 = E\left[\frac{1}{1 + \frac{\epsilon_p}{\psi_H}}(\epsilon_y \widehat{Y}_i + \widehat{\theta}_i) + \frac{\frac{\epsilon_p}{\psi_H}}{1 + \frac{\epsilon_p}{\psi_H}}\widehat{\sigma}_i \middle| \widehat{Y} = 0, j = H\right] - \underbrace{E\left[\widehat{H}_i \middle| \widehat{Y} = 0, j = L\right]}_{=\delta}.$$

These expressions can be reduced to the following where, we simplify the notation so that $E[\widehat{\theta}_i | \widehat{Y}, j = H] \equiv E[\widehat{\theta}_{iYH}]$ and substitute in the constant terms from (16):

$$\beta_2 + \alpha = \frac{1}{\psi_H + \epsilon_p}(E[\widehat{\theta}_{iYH}] - E[\widehat{\sigma}_{iYH}]),$$
$$\gamma_2 + \delta = \frac{1}{1 + \frac{\epsilon_p}{\psi_H}}(E[\widehat{\theta}_{iYH}] + \frac{\epsilon_p}{\psi_H} E[\widehat{\sigma}_{iYH}]).$$

Given estimates of the intercept terms α, δ, β_2, and γ_2, we have two equations in two unknowns: the conditional expectations of demand and supply shocks. We can solve for the conditional expectation of supply shocks in more elastic cities as a function of the supply elasticity and the estimates, where the demand shocks drop out

$$E[\widehat{\sigma}_{iYH}] = \underbrace{\gamma_2 + \delta}_{\text{actual quantity growth}} - \underbrace{\psi_H(\beta_2 + \alpha).}_{\text{quantity growth implied by price growth}} \quad (17)$$

This expression is nothing other than the supply function $\widehat{H}_i = \psi_i \widehat{P}_i + \sigma_i$ re-written in terms of the empirical estimates. So the conditional supply shocks are implied by the difference between realized growth in quantities and the growth in quantities consistent with the realized growth in prices and the supply elasticity. Thus, if there were positive growth in quantities, but no average price growth, then we would have to infer that less-constrained cities experienced positive supply shocks. Similarly, if the change in quantities was exactly what would be expected given the price growth and the average supply elasticity, then expected supply shocks would be zero and these intercepts would be strong evidence for the standard view of housing markets. Notice that we do not need to make any assumptions about the price or income elasticities as these demand-side factors merely rescale the demand shocks that move prices around.

Empirically, we estimate that $\psi_H = 3.56$ (Saiz, 2010), $\beta_2 = -0.868$, $\gamma_2 = 0.031$, $\alpha = 0.52$ and $\delta = -0.34$ which implies that $E[\widehat{\sigma}_{iYH}] \approx 0.93$. So if less-constrained cities truly have high elasticities on average, then their observed price and quantity growth imply that less constrained cities experienced positive shocks to housing supply equivalent to a little less than 1% annualized increase in housing quantities over 20 years (that is, about 22% over 20 years).

Similarly, in less elastic cities, the average supply shock is

$$E[\widehat{\sigma}_{iYL}] = \delta - \psi_L \alpha. \tag{18}$$

Given an average $\psi_L = 1.51$ (Saiz, 2010), we obtain $E[\widehat{\sigma}_{iYL}] \approx -1.12$. Thus, more constrained cities experienced negative shocks to housing supply equivalent to a -1% annualized growth in housing quantities.

As we discussed above, there are a number of potential concerns with this explanation. First, the magnitude of this shock-driven growth in housing quantities is extraordinarily large. If relatively inelastic cities had not had such unfortunate supply shocks, then their growth in housing units would have been *double* the national average *despite* their low supply elasticity. Under this interpretation, it is unfortunate negative supply shocks, *not a low supply elasticity*, that is accounting for low unit growth in inelastic cities. Similarly, the supply shocks in less constrained cities are equivalent to the *average growth* in housing quantities across the entire sample, as well as the average within the sample of less constrained cities (see Table 1 in our paper). Therefore, these estimates imply that exogenous shifts in housing supply, not high elasticities, were responsible for *all* of the realized growth in housing quantities in elastic cities on average. Even if we thought the average elasticity in the less-constrained group was much smaller, say 2.5, it would still imply supply shocks equivalent to 50% of the realized growth in housing quantities. In fact, we would need to assume the elasticity is about 1, over 30% lower than the average estimated elasticity in the set of *more* constrained cities, in order for the intercept term to be consistent with estimated elasticities. These implied supply shocks are simply too large to be credible. Setting aside these particular magnitudes, the central issue is that this intercept term requires differential supply shocks because there is no correlation between the elasticity measures and quantities. This is a fact that is fundamentally difficult to reconcile with differential supply elasticities in these groups of cities.

Second, these housing supply shocks *must* have the opposite correlation with supply elasticities as the correlation of supply shocks and elasticities necessary to explain the interaction results that are the emphasis of our paper. That is, supply shocks must be more positively correlated with income growth in inelastic cities in order for the interaction term to be identical across cities. But here it must be the case that supply shocks uncorrelated with income growth (because it is conditioned out) are positively correlated with elasticities. It is unclear what economic mechanism would generate these patterns and, to the best of our knowledge, none has been proposed. Finally, it is important to point out that the standard argument is not that more elastic cities experience more positive productivity shocks to construction, but that their supply function is, over the long run, more elastic so that house price growth is accompanied by lots of growth in units. Thus, the intercept terms, because they point to supply shocks, are actually additional evidence against the standard view that variation in housing supply elasticities explain variation in housing market dynamics.

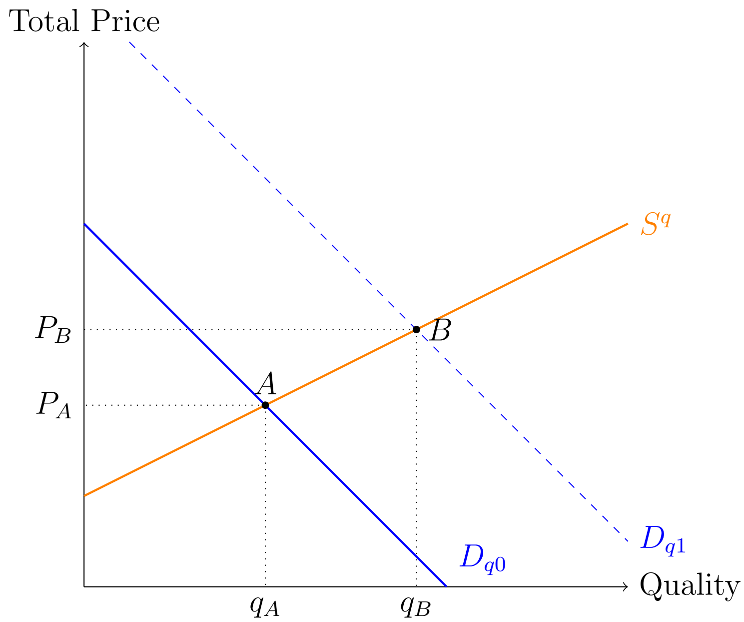
4.2 Alternative Explanation

Instead of relying on implausible, ad hoc shifts in supply curves, we think the simple extension to our standard framework in Section 2.2, which is also proposed by Furth (p. 6) as a critique of our empirical approach in his comment, provides a plausible explanation of the intercept term. Recall that this framework introduces a distinction between the number of units u and the quality of those units q. Changes in income are assumed to not affect the demand for units (consistent with our empirical estimates in Table III) while changes in the population only affect the number of units demanded.

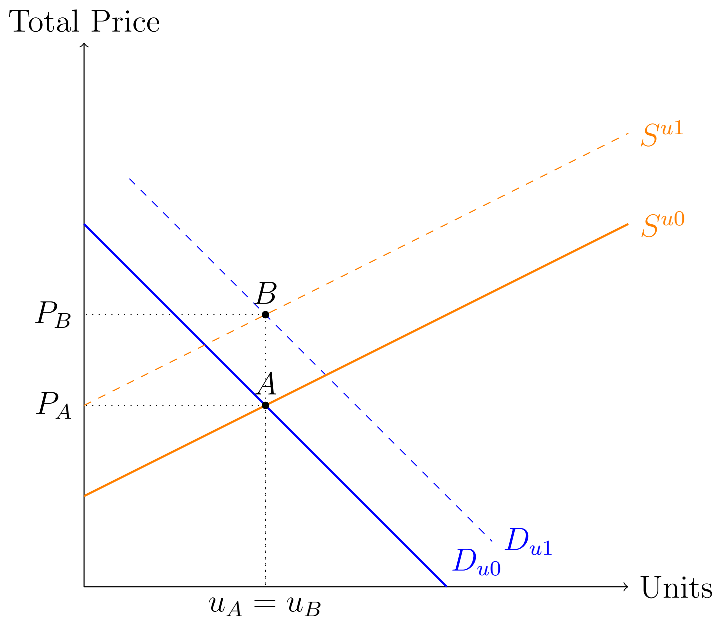
What is necessary to generate the intercept term, which is differential growth in house prices not accompanied by differential growth in housing units, in this extended framework? The key requirement is that price indexes, even quality-adjusted price indexes, cannot perfectly adjust prices for changes in either physical or amenity quality *or* changes in the valuation of amenities. Then this framework will generate an intercept term whenever there are changes in the demand *for quality* that are correlated with measured constraints. This would be consistent with the arguments in Davidoff (2013) and Davidoff (2016), where features thought to make supply inelastic, like oceans or mountains, are also amenities attractive to high-income households or with Diamond (2016), where cities with rising labor demand for educated workers also feature endogenous amenities.

We illustrate what happens if supply elasticities are identical across cities and there is an increase in the demand for quality in Figure I. The shift in the demand for quality will increase the price and quantity of quality, but it will have no effect on the demand for units, and so it will not affect the price of units *holding quality fixed* or the number of units. But, if we draw the equilibrium in units using the total price (not adjusted for changes in quality), then it will appear *as if* there is a vertical shift in the equilibrium, with prices increasing but no change in the number of units. So if there is some residual change in demand (that is, shifts in demand that are uncorrelated with observable changes in total income or its components) that is positively correlated with measures of constraints, then the intercept term will easily appear in a way that is consistent with our empirical results. For example if rich people prefer living in coastal areas, and then rich people become relatively richer, then the price of living in coastal areas (the price of quality) will increase but there may be little or no change in the demand for the number of units. Put another way, if the number of rich people has not changed, just their purchasing power, then the demand for the number of units in areas preferred by the rich has not changed, even though the price will increase.

This argument is consistent with (1) basic facts about how house prices are measured, (2) with our empirical estimates of how growth in per capita income is related to prices and units, and (3) with existing arguments about amenities and cities with "inelastic" housing supply (Davidoff, 2016; Diamond, 2016). Therefore, we conclude that the intercept is not evidence of differential supply elasticities, and may even be additional evidence of the primary role of demand in driving variation in prices across housing markets.



A. Market for Quality



B. Market for Units

FIGURE I
Intercept Effect Due to Imperfect Quality Measurement

5 Empirical Scope

Furth argues that we should be restricting our empirical focus to only the largest metro areas that appear to be very constrained according to the existing measures. This argument seems to rest on an implicit assumption that housing supply elasticities should mean different things depending on the relative wealth or size of the metro area. This would be inconsistent with the methodology of Saiz (2010) and Baum-Snow and Han (2024), who explicitly estimate a consistent and theoretically well-defined concept, the housing supply elasticity, across the entire range of areas that we use in our application. Similarly, the regulatory index from Gyourko, Saiz and Summers (2008) and the land share of value estimates from Davis, Larson, Oliner and Shui (2021) are not accompanied by caveats that these measures should only be compared within narrow ranges or that they are only meaningful within a certain set of geographies. Instead all of these papers provide a single number (sometimes several numbers) meant to index the relative constraints on housing supply across the entire sample of geographies in their respective applications. Of course, demand conditions are not the same across these very different geographies and that is a challenge for empirical evaluations of housing supply elasticities. But that is exactly what our empirical approach is designed to address. So by using the full range of data and by explicitly incorporating differences in demand conditions, our paper should be able to recover any meaningful differences in the behavior of prices and quantities that is correlated with these constraint measures. We do not recover any meaningful differences.

However, despite there not being, to our knowledge, any clear theoretical reasons why housing supply elasticities should behave differently in different kinds of metro geographies, it is certainly possible. This is why we provide quartile specifications, where we allocate metro areas into quartiles of the measured constraints. This allows us to flexibly check if there are important differences in the behavior of prices or quantities that appear only when comparing, for example, the most constrained regions to the least constrained (4th quartile to the 1st quartile) or the most constrained to the second-most constrained (4th quartile compared to the 3rd quartile).

We reproduce these tables for all of the sample periods below and the results are overwhelmingly negative regardless of how the comparisons are being made. Sometimes the effects on prices is the opposite of what is expected (Table IX panel B or Table X panel B) or the relationship changes depending on the sample window (Table V panel B compared to Table VII panel B). Even in some cases when there might be evidence of less house price growth, this is almost never accompanied by evidence of more growth in housing quantities, which is what the standard model suggests. Similarly, our results when splitting the sample by population are essentially identical to the results using the entire sample. These results do not suggest that there is some region of the data where the standard view is borne out. Instead, these measures do not seem to be correlated with differential growth in prices or quantities.

Finally, it may be the case that housing supply constraints behave differently in the superstar cities relative to other large non-superstar cities, but these cities are also different in many other respects. Los Angeles, San Francisco, Boston, and New York, all very expensive cities, are also all hubs of global superstar industries (entertainment, tech, biotech, and finance respectively) and that fact almost certainly has effects on the local housing markets. For example, our results show that growth in per capita income is strongly correlated with price growth and almost completely uncorrelated with growth in population or housing quantities (see Table I and Table III).[12] To the extent that some people in these cities are simply becoming very rich, then the fact that they have lots of house price growth and little growth in housing quantities may have nothing to do with housing supply constraints and simply reflects the high productivity of these industries.

As an example to illustrate this point, from 2000 to 2020 real house prices in San Francisco grew annually by about 2.4%, compared to 1% for Houston. This puts SF in the 90th percentile and Houston a bit below the median of the distribution of house price growth across MSAs. However, real per capita income in SF grew annually by 2.2% (the 99th percentile!), while Houston's real per capita income grew by just 0.83% annually (slightly above the 10th percentile). In both cases, house price growth was just a bit more than per capita income growth. Our estimates suggest per capita income growth translates into house prices a bit more than one-for-one, so these differences in house prices are *exactly* what one would expect!

But broadly speaking, restricting the sample to make comparisons between a very small set of cities, such as the superstars and the other non-superstar big cities, necessarily runs the risk of attributing *any* difference between these cities to one's prior causal factor of interest. This is why we believe it is important and valid to use the entire available sample along with an appropriate framework for analysis to adjudicate the importance of housing supply constraints.

6 Interpretation of Results

We broadly agree with Furth's general thrust that zoning reform may be desirable for reasons other than its potential effects on prices or quantities. Here we just want to clarify a few points with respect to Furth's alternative interpretations.

[12] Again, this holds regardless of the measured constraint.

- “Regulatory reform may lower prices in ways that do not involve the supply elasticity.”
  - This may be possible, but it would be useful to specify a mechanism. The basic claim that regulatory constraints significantly affect the marginal cost (supply curve slope) of building housing across areas is not apparent in our results, so it would need to be some mechanism unrelated to the marginal cost.
- “Regulatory reform may create opportunities for lower-cost types of housing, such as townhouses. That would change the composition of the housing stock without changing the price per quality-adjusted square foot.”
  - First, our results examine overall quantity (number of units) and population, so if regulatory or geographic differences allowed more and smaller units then we should see differences in the number of units or in population. Since we do not see these differences we are skeptical that this effect would be large, but perhaps a more narrow measure of that specific constraint is necessary. Second, it is unclear if being able to buy small quantities of an expensive item adequately reflects what the term “affordable” means and the gains from regulatory reform that advocates expect.
- “Housing supply elasticities could be equal because most metro areas are similarly regulated.”
  - This is possible, but it is not consistent with what the prevailing estimates in the literature suggest. So if it is true that these metro areas all have the same housing supply elasticity it implies something is wrong with the methodologies and/or frameworks being employed and it also calls into question the empirical justification for thinking that regulatory constraints will have an important effect on house prices or quantities. This interpretation would also be consistent with most regulations across metro areas being essentially non-binding when it comes to the long-run supply curve. While Glaeser and Gyourko (2025) argue that housing supply is now tight everywhere, our results point to similar supply responses even from 1980 to 2000 and Pendall, Lo and Wegmann (2022) argue that zoning constraints have generally relaxed in high-growth metro areas. But if we do not know where regulations are tight or loose, then it brings into question why we should believe that changing regulations will making things abundantly cheap.
- “The true urban growth model could have both stock and flow features, as in DiPasquale and Wheaton (1994), such that supply growth responds to price levels as

well as price changes, either of which might be inflated by regulation."

- The model in DiPasquale and Wheaton (1994) is designed to capture the dynamics of housing supply adjustments in the short and long run. Critically, in their model the long-run housing supply function is identical to that coming from the standard local labor market models where total housing stock is equal to population (see p.8, second paragraph), and where population is pinned down in the standard way (see our model in the first section). Thus, in the 20- or 40-year differences that we examine, their model should have identical implications as the framework we present in our paper.
- However, we do agree that alternative frameworks could lead to different behavior in housing markets. For example, models with pricing power Watson and Ziv (2021), dynamic models Titman (1985); Lange and Teulings (2024), or a high degree of substitution between land and capital Ahlfeldt and McMillen (2018); Combes, Duranton and Gobillon (2021) can give very different implications for both the price and quantity of housing.

7 Conclusion

Dog shoots man: Simple and robust comparisons across cities show that measured differences in the supply elasticity do not explain house price growth and quantity growth across cities. Furth (2025) critiques our result on four main points: (1) our measure of total income growth is a function of the city's supply elasticity; (2) differences in supply elasticities matter through the "indicator" variable; (3) we should focus on a small set of large cities; and (4) our results do not call for a re-evaluation of the consensus that regulatory constraints are important. We show that: (1) total income growth is a valid measure of demand; (2) the intercept cannot plausibly capture differences in supply elasticity; (3) we already report results in smaller subsets that point to the same conclusion; and (4) we believe that the emphasis on regulatory constraints should be commensurate with the evidence, which is lacking. Our response therefore reinforces the conclusion in Louie et al. (2025a) that supply constraints do not explain house price and quantity growth across cities.

Bibliography

Ahlfeldt, Gabriel M and Daniel P McMillen, "Tall buildings and land values: Height and construction cost elasticities in Chicago, 1870–2010," *Review of Economics and Statistics*, 2018, *100* (5), 861–875.

Angrist, Joshua D and Alan B Krueger, "Instrumental variables and the search for identification: From supply and demand to natural experiments," *Journal of Economic perspectives*, 2001, *15* (4), 69–85.

Baum-Snow, Nathaniel and Lu Han, "The microgeography of housing supply," *Journal of Political Economy*, 2024, *132* (6), 1897–1946.

Billings, Stephen B, "Hedonic amenity valuation and housing renovations," *Real Estate Economics*, 2015, *43* (3), 652–682.

Combes, Pierre-Philippe, Gilles Duranton, and Laurent Gobillon, "The production function for housing: Evidence from France," *Journal of Political Economy*, 2021, *129* (10), 2766–2816.

Davidoff, Thomas, "Supply Elasticity and the Housing Cycle of the 2000s," *Real Estate Economics*, 2013, *41* (4), 793–813.

_ , "Supply Constraints Are Not Valid Instrumental Variables for Home Prices Because They Are Correlated With Many Demand Factors," *Critical Finance Review*, 2016, *5* (2), 177–206.

Davis, Morris A and François Ortalo-Magné, "Household expenditures, wages, rents," *Review of Economic Dynamics*, 2011, *14* (2), 248–261.

_ , William D Larson, Stephen D Oliner, and Jessica Shui, "The price of residential land for counties, ZIP codes, and census tracts in the United States," *Journal of Monetary Economics*, 2021, *118*, 413–431.

Diamond, Rebecca, "The determinants and welfare implications of US workers' diverging location choices by skill: 1980–2000," *American economic review*, 2016, *106* (3), 479–524.

DiPasquale, Denise and William C Wheaton, "Housing market dynamics and the future of housing prices," *Journal of urban economics*, 1994, *35* (1), 1–27.

Furth, Salim, "Response to Louie, Mondragon, Wieland," Technical Report 2025.

Glaeser, Edward L and Joseph Gyourko, "America's Housing Supply Problem: The Closing of the Suburban Frontier?," Technical Report, National Bureau of Economic Research 2025.

Goolsbee, Austan and Chad Syverson, "The strange and awful path of productivity in the US construction sector," Technical Report, National Bureau of Economic Research 2023.

Gyourko, Joseph, Albert Saiz, and Anita Summers, "A new measure of the local regulatory environment for housing markets: The Wharton Residential Land Use Regulatory Index," *Urban studies*, 2008, *45* (3), 693–729.

Harding, John P, Stuart S Rosenthal, and Clemon F Sirmans, "Depreciation of housing capital, maintenance, and house price inflation: Estimates from a repeat sales model," *Journal of urban Economics*, 2007, *61* (2), 193–217.

Hoffer, Eric, "The passionate state of mind, and other aphorisms," 1955.

Lange, Rutger-Jan and Coen N Teulings, "Irreversible investment under predictable growth: Why land stays vacant when housing demand is booming," *Journal of Economic Theory*, 2024, *215*, 105776.

Louie, Schuyler, John A Mondragon, and Johannes Wieland, "Supply constraints do not explain house price and quantity growth across us cities," Technical Report, National Bureau of Economic Research 2025.

_ , John Mondragon, and Johannes Wieland, "Group-Specific Bias in IV Estimates of Housing Supply Elasticity," 2025.

Pendall, Rolf, Lydia Lo, and Jake Wegmann, "Shifts toward the extremes: Zoning change in major US Metropolitan areas from 2003 to 2019," *Journal of the American Planning Association*, 2022, *88* (1), 55–66.

Saiz, Albert, "The geographic determinants of housing supply," *The Quarterly Journal of Economics*, 2010, *125* (3), 1253–1296.

Sveikauskas, Leo, Samuel Rowe, and James D Mildenberger, "Measuring productivity growth in construction," *Monthly Lab. Rev.*, 2018, *141*, 1.

Titman, Sheridan, "Urban land prices under uncertainty," *The American Economic Review*, 1985, *75* (3), 505–514.

Watson, C Luke and Oren Ziv, "Is the Rent Too High? Land Ownership and Monopoly Power," 2021.

8 Tables

TABLE I
House Price Growth (2000-2020)

Panel A. Total Income Growth				
Less Constrained × Income Growth	-0.004	0.052	-0.097	-0.053
	(0.120)	(0.111)	(0.119)	(0.113)
Income Growth	0.553***	0.589***	0.607***	0.619***
	(0.098)	(0.078)	(0.094)	(0.089)
Less Constrained	-0.868***	-0.438*	-0.504*	-0.496**
	(0.262)	(0.237)	(0.262)	(0.246)
R2	0.48	0.34	0.42	0.37
Number of Observations	268	308	268	306
Panel B. Per Capita Income Growth				
Less Constrained × Per Capita Income Growth	0.158	-0.162	-0.218	-0.222
	(0.253)	(0.248)	(0.268)	(0.232)
Per Capita Income Growth	0.984***	1.284***	1.139***	1.252***
	(0.178)	(0.187)	(0.163)	(0.170)
Less Constrained	-1.120***	-0.263	-0.492	-0.381
	(0.335)	(0.328)	(0.354)	(0.312)
R2	0.41	0.27	0.34	0.32
Number of Observations	268	308	268	306
Panel C. Population Growth (Annualized %)				
Less Constrained × Population Growth	0.061	0.117	-0.001	0.067
	(0.130)	(0.131)	(0.137)	(0.139)
Population Growth	0.460***	0.498***	0.494***	0.483***
	(0.102)	(0.090)	(0.107)	(0.110)
Less Constrained	-0.992***	-0.401**	-0.788***	-0.677***
	(0.158)	(0.158)	(0.168)	(0.166)
R2	0.38	0.20	0.32	0.24
Number of Observations	268	308	268	306

This table reports estimates of house price growth regressed on total income growth (panel A), per capita income growth (panel B), or population growth (panel C) and an indicator for an MSA having an above-median constraint measure (less constrained), and the interaction of the indicator with the respective growth measure. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.

TABLE II

Median Home Value Growth (2000-2020)

Panel A. Total Income Growth

Less Constrained × Income Growth	0.047	-0.089	-0.101	0.068
	(0.120)	(0.119)	(0.121)	(0.124)
Income Growth	0.577***	0.715***	0.663***	0.603***
	(0.104)	(0.094)	(0.099)	(0.099)
Less Constrained	-0.674***	-0.112	-0.205	-0.500*
	(0.254)	(0.244)	(0.258)	(0.262)
R2	0.47	0.41	0.43	0.38
Number of Observations	267	309	267	307

Panel B. Per Capita Income Growth

Less Constrained × Per Capita Income Growth	0.057	-0.266	-0.388	0.002
	(0.257)	(0.277)	(0.263)	(0.265)
Per Capita Income Growth	1.010***	1.298***	1.199***	1.103***
	(0.198)	(0.222)	(0.214)	(0.207)
Less Constrained	-0.728**	-0.110	-0.022	-0.424
	(0.335)	(0.352)	(0.353)	(0.341)
R2	0.32	0.26	0.28	0.25
Number of Observations	267	309	267	307

Panel C. Population Growth (Annualized %)

Less Constrained × Population Growth	0.176	-0.061	0.024	0.183
	(0.132)	(0.124)	(0.132)	(0.143)
Population Growth	0.502***	0.709***	0.580***	0.533***
	(0.110)	(0.092)	(0.105)	(0.117)
Less Constrained	-0.798***	-0.217	-0.533***	-0.533***
	(0.154)	(0.149)	(0.161)	(0.165)
R2	0.36	0.28	0.31	0.25
Number of Observations	267	309	267	307

This table reports estimates of house price growth regressed on total income growth (panel A), per capita income growth (panel B), or population growth (panel C) and an indicator for an MSA having an above-median constraint measure (less constrained), and the interaction of the indicator with the respective growth measure. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.

TABLE III

House Quantity Growth and Per Capita Income Growth (2000-2020)

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Housing Quantities Growth (Annualized %)				
Less Constrained × Per Capita Income Growth	0.308	-0.030	0.189	0.110
	(0.226)	(0.193)	(0.232)	(0.187)
Per Capita Income Growth	0.093	0.309**	0.140	0.212
	(0.183)	(0.148)	(0.152)	(0.137)
Less Constrained	-0.459	-0.084	-0.333	-0.207
	(0.283)	(0.244)	(0.285)	(0.240)
R2	0.03	0.04	0.03	0.03
Number of Observations	269	310	269	308
Panel B. Population Growth (Annualized %)				
Less Constrained × Per Capita Income Growth	0.335	-0.015	0.131	0.175
	(0.249)	(0.211)	(0.265)	(0.207)
Per Capita Income Growth	0.070	0.312**	0.151	0.173
	(0.202)	(0.152)	(0.162)	(0.147)
Less Constrained	-0.572*	-0.168	-0.343	-0.311
	(0.316)	(0.273)	(0.327)	(0.270)
R2	0.03	0.04	0.03	0.03
Number of Observations	269	310	269	308
Panel C. Change in Average Rooms per Person				
Less Constrained × Per Capita Income Growth	0.079	-0.000	0.024	0.002
	(0.050)	(0.045)	(0.052)	(0.046)
Per Capita Income Growth	-0.096***	-0.058*	-0.063**	-0.039
	(0.028)	(0.034)	(0.030)	(0.033)
Less Constrained	-0.034	0.086	0.057	0.063
	(0.063)	(0.058)	(0.063)	(0.058)
R2	0.07	0.08	0.09	0.05
Number of Observations	267	309	267	307

This table reports estimates of house quantity growth (panel A) and population growth (panel B), and the change in average rooms per person (panel C) regressed on per capita income growth, an indicator for an MSA having an above-median constraint measure (less constrained), and the interaction of the two. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index from Gyourko et al. (2008), and column 4 uses the land share of value from Davis et al. (2021). See the text for more details.

TABLE IV

House Quantity Growth and Population Growth (2000-2020)

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Housing Quantities Growth (Annualized %)				
Less Constrained × Population Growth	0.033	-0.019	0.031	-0.008
	(0.025)	(0.024)	(0.027)	(0.025)
Population Growth	0.840***	0.876***	0.838***	0.867***
	(0.017)	(0.019)	(0.021)	(0.020)
Less Constrained	0.025	0.057***	0.022	0.018
	(0.023)	(0.022)	(0.024)	(0.024)
R2	0.95	0.95	0.95	0.94
Number of Observations	269	310	269	308
Panel B. Change in Average Rooms per Person				
Less Constrained × Population Growth	-0.006	0.005	-0.002	-0.024
	(0.022)	(0.021)	(0.021)	(0.021)
Population Growth	-0.046***	-0.047***	-0.045***	-0.032**
	(0.015)	(0.013)	(0.015)	(0.015)
Less Constrained	0.064**	0.072***	0.086***	0.083***
	(0.025)	(0.023)	(0.024)	(0.024)
R2	0.09	0.10	0.12	0.08
Number of Observations	267	309	267	307

This table reports estimates of house quantity growth (panel A) and the change in average rooms per person (panel B) regressed on population growth, an indicator for an MSA having an above-median constraint measure (less constrained), and the interaction of the two. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index from Gyourko et al. (2008), and column 4 uses the land share of value from Davis et al. (2021). See the text for more details.

TABLE V

House Price Growth (2000-2020): Quartiles

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Real House Price Growth (Annualized %)				
Qtl 2 Constraint	-0.468	-0.544	-0.690*	-0.552
	(0.439)	(0.336)	(0.372)	(0.392)
Qtl 3 Constraint	-1.093***	-0.864**	-1.019***	-0.840**
	(0.367)	(0.339)	(0.352)	(0.394)
Qtl 4 Constraint	-1.185***	-0.566	-0.767**	-0.633*
	(0.400)	(0.388)	(0.364)	(0.358)
Qtl 2 Constraint × Income Growth	0.008	0.029	0.085	-0.015
	(0.195)	(0.159)	(0.165)	(0.184)
Qtl 3 Constraint × Income Growth	0.078	0.161	0.096	-0.016
	(0.159)	(0.165)	(0.165)	(0.178)
Qtl 4 Constraint × Income Growth	-0.058	-0.020	-0.191	-0.152
	(0.174)	(0.175)	(0.164)	(0.171)
Income Growth	0.516***	0.572***	0.532***	0.633***
	(0.135)	(0.130)	(0.127)	(0.140)
R2	0.52	0.37	0.47	0.41
Number of Observations	268	308	268	306
Panel B. Real Median Home Value Growth (Annualized %)				
Qtl 2 Constraint	-0.417	-0.491	-0.705*	-0.456
	(0.466)	(0.419)	(0.394)	(0.439)
Qtl 3 Constraint	-1.069**	-0.619	-0.645*	-0.516
	(0.414)	(0.404)	(0.373)	(0.424)
Qtl 4 Constraint	-0.804*	-0.126	-0.602*	-0.889**
	(0.409)	(0.397)	(0.346)	(0.396)
Qtl 2 Constraint × Income Growth	-0.010	0.023	0.059	0.048
	(0.213)	(0.196)	(0.178)	(0.199)
Qtl 3 Constraint × Income Growth	0.143	0.081	0.024	0.008
	(0.178)	(0.190)	(0.177)	(0.187)
Qtl 4 Constraint × Income Growth	-0.014	-0.220	-0.127	0.167
	(0.180)	(0.187)	(0.167)	(0.183)
Income Growth	0.554***	0.701***	0.600***	0.585***
	(0.159)	(0.167)	(0.140)	(0.156)
R2	0.49	0.45	0.48	0.40
Number of Observations	267	309	267	307

This table reports estimates of house price growth (panel A) and median home value growth (panel B) regressed on total income growth, quartiles of the constraint measure, and the interaction of income growth with each quartile. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.

TABLE VI

House Quantity Growth (2000-2020): Quartiles

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Housing Quantity Growth (Annualized %)				
Qtl 2 Constraint	-0.031	-0.025	-0.053	-0.138
	(0.140)	(0.116)	(0.156)	(0.120)
Qtl 3 Constraint	-0.008	0.035	-0.188	0.074
	(0.130)	(0.141)	(0.168)	(0.111)
Qtl 4 Constraint	0.067	-0.068	-0.193	-0.112
	(0.108)	(0.107)	(0.152)	(0.152)
Qtl 2 Constraint × Income Growth	0.050	0.034	0.073	0.168***
	(0.070)	(0.060)	(0.075)	(0.058)
Qtl 3 Constraint × Income Growth	0.067	0.002	0.160*	0.033
	(0.065)	(0.076)	(0.087)	(0.054)
Qtl 4 Constraint × Income Growth	0.014	0.006	0.156**	0.088
	(0.052)	(0.056)	(0.075)	(0.089)
Income Growth	0.624***	0.617***	0.549***	0.552***
	(0.038)	(0.038)	(0.066)	(0.038)
R2	0.80	0.78	0.80	0.79
Number of Observations	269	310	269	308
Panel B. Population Growth (Annualized %)				
Qtl 2 Constraint	-0.115	-0.099	-0.043	-0.179
	(0.169)	(0.130)	(0.169)	(0.139)
Qtl 3 Constraint	-0.089	-0.111	-0.197	-0.016
	(0.141)	(0.150)	(0.170)	(0.114)
Qtl 4 Constraint	0.068	-0.173	-0.158	-0.150
	(0.133)	(0.115)	(0.164)	(0.156)
Qtl 2 Constraint × Income Growth	0.101	0.046	0.050	0.195***
	(0.084)	(0.067)	(0.080)	(0.067)
Qtl 3 Constraint × Income Growth	0.086	0.032	0.134	0.074
	(0.068)	(0.080)	(0.087)	(0.054)
Qtl 4 Constraint × Income Growth	-0.011	0.021	0.110	0.098
	(0.065)	(0.057)	(0.080)	(0.089)
Income Growth	0.715***	0.692***	0.676***	0.619***
	(0.051)	(0.042)	(0.065)	(0.042)
R2	0.82	0.80	0.82	0.81
Number of Observations	269	310	269	308
Panel C. Change in Average Rooms per Person				
Qtl 2 Constraint	0.069	0.153***	0.194***	-0.020
	(0.052)	(0.053)	(0.062)	(0.055)
Qtl 3 Constraint	0.070	0.168***	0.207***	0.107*
	(0.057)	(0.055)	(0.067)	(0.055)
Qtl 4 Constraint	0.065	0.134**	0.180***	0.044
	(0.061)	(0.061)	(0.065)	(0.056)
Qtl 2 Constraint × Income Growth	-0.000	-0.039	-0.079***	0.043*
	(0.022)	(0.025)	(0.027)	(0.024)
Qtl 3 Constraint × Income Growth	0.013	-0.023	-0.057*	-0.010
	(0.026)	(0.025)	(0.030)	(0.023)
Qtl 4 Constraint × Income Growth	0.009	-0.013	-0.036	0.036
	(0.028)	(0.028)	(0.030)	(0.025)
Income Growth	-0.050***	-0.022	0.007	-0.051***
	(0.017)	(0.020)	(0.024)	(0.017)
R2	0.13	0.14	0.15	0.12
Number of Observations	267	309	267	307

This table reports estimates of house quantity growth (panel A) and population growth (panel B), and the change in average rooms per person (panel C) regressed on total income growth, quartiles of the constraint measure, and the interaction of income growth with each quartile. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.

TABLE VII
House Price Growth (1980-2020): Quartiles

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Real House Price Growth (Annualized %)				
Qtl 2 Constraint	-0.614	-0.689*	-0.693	-0.963**
	(0.441)	(0.401)	(0.420)	(0.419)
Qtl 3 Constraint	-0.712*	-1.196***	-0.945**	-0.755*
	(0.413)	(0.417)	(0.430)	(0.419)
Qtl 4 Constraint	-1.180***	-0.938**	-0.943**	-0.613
	(0.402)	(0.408)	(0.449)	(0.432)
Qtl 2 Constraint × Income Growth	0.048	0.077	0.055	0.066
	(0.145)	(0.142)	(0.149)	(0.150)
Qtl 3 Constraint × Income Growth	-0.031	0.268*	0.066	-0.018
	(0.138)	(0.151)	(0.152)	(0.144)
Qtl 4 Constraint × Income Growth	0.018	0.145	-0.060	-0.198
	(0.141)	(0.148)	(0.167)	(0.160)
Income Growth	0.131	0.129	0.144	0.220*
	(0.112)	(0.128)	(0.134)	(0.126)
R2	0.29	0.18	0.27	0.28
Number of Observations	268	308	268	306
Panel B. Real Median Home Value Growth (Annualized %)				
Qtl 2 Constraint	-0.627*	-0.609*	-0.455	-0.664*
	(0.372)	(0.329)	(0.339)	(0.370)
Qtl 3 Constraint	-0.932***	-1.170***	-0.691**	-0.626*
	(0.357)	(0.306)	(0.326)	(0.378)
Qtl 4 Constraint	-1.143***	-0.722**	-1.081***	-0.798**
	(0.354)	(0.296)	(0.321)	(0.370)
Qtl 2 Constraint × Income Growth	0.078	0.079	0.027	0.075
	(0.124)	(0.117)	(0.122)	(0.129)
Qtl 3 Constraint × Income Growth	0.128	0.296***	0.075	0.006
	(0.117)	(0.110)	(0.117)	(0.132)
Qtl 4 Constraint × Income Growth	0.152	0.097	0.169	0.041
	(0.123)	(0.110)	(0.120)	(0.137)
Income Growth	0.189*	0.215**	0.230**	0.260**
	(0.107)	(0.095)	(0.103)	(0.118)
R2	0.46	0.39	0.43	0.41
Number of Observations	267	309	267	307

This table reports estimates of house price growth (panel A) and median home value growth (panel B) regressed on total income growth, quartiles of the constraint measure, and the interaction of income growth with each quartile. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.

TABLE VIII
House Quantity Growth (1980-2020): Quartiles

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Housing Quantity Growth (Annualized %)				
Qtl 2 Constraint	0.123	0.318*	0.364**	-0.022
	(0.159)	(0.163)	(0.161)	(0.120)
Qtl 3 Constraint	0.254*	0.329**	0.356**	0.123
	(0.141)	(0.158)	(0.162)	(0.133)
Qtl 4 Constraint	0.275*	0.281*	0.264*	-0.126
	(0.147)	(0.167)	(0.155)	(0.136)
Qtl 2 Constraint × Income Growth	0.019	-0.039	-0.088	0.105**
	(0.062)	(0.065)	(0.063)	(0.045)
Qtl 3 Constraint × Income Growth	-0.004	-0.028	-0.059	0.057
	(0.053)	(0.064)	(0.065)	(0.053)
Qtl 4 Constraint × Income Growth	-0.025	-0.016	-0.010	0.163***
	(0.060)	(0.068)	(0.062)	(0.059)
Income Growth	0.741***	0.753***	0.783***	0.658***
	(0.049)	(0.058)	(0.054)	(0.040)
R2	0.89	0.88	0.89	0.89
Number of Observations	268	309	268	307
Panel B. Population Growth (Annualized %)				
Qtl 2 Constraint	0.050	0.308*	0.219	-0.039
	(0.178)	(0.161)	(0.168)	(0.116)
Qtl 3 Constraint	0.115	0.291**	0.178	0.078
	(0.160)	(0.144)	(0.165)	(0.132)
Qtl 4 Constraint	0.299*	0.263*	0.188	-0.283**
	(0.166)	(0.151)	(0.154)	(0.130)
Qtl 2 Constraint × Income Growth	0.026	-0.066	-0.071	0.101**
	(0.070)	(0.066)	(0.066)	(0.044)
Qtl 3 Constraint × Income Growth	0.002	-0.077	-0.051	0.061
	(0.061)	(0.060)	(0.067)	(0.052)
Qtl 4 Constraint × Income Growth	-0.079	-0.084	-0.061	0.184***
	(0.067)	(0.062)	(0.062)	(0.057)
Income Growth	0.853***	0.892***	0.885***	0.752***
	(0.056)	(0.052)	(0.052)	(0.035)
R2	0.91	0.90	0.90	0.91
Number of Observations	269	310	269	308
Panel C. Change in Average Rooms per Person				
Qtl 2 Constraint	0.101	0.180	0.525***	0.059
	(0.151)	(0.124)	(0.174)	(0.150)
Qtl 3 Constraint	0.318**	0.148	0.530***	0.152
	(0.148)	(0.119)	(0.175)	(0.168)
Qtl 4 Constraint	0.152	0.092	0.473***	0.269*
	(0.123)	(0.136)	(0.175)	(0.144)
Qtl 2 Constraint × Income Growth	-0.009	-0.029	-0.151**	0.022
	(0.058)	(0.048)	(0.064)	(0.054)
Qtl 3 Constraint × Income Growth	-0.055	0.027	-0.120*	-0.005
	(0.053)	(0.042)	(0.061)	(0.062)
Qtl 4 Constraint × Income Growth	-0.002	0.024	-0.072	-0.025
	(0.045)	(0.055)	(0.066)	(0.057)
Income Growth	-0.085**	-0.113***	0.011	-0.110**
	(0.034)	(0.035)	(0.057)	(0.045)
R2	0.27	0.31	0.36	0.28
Number of Observations	140	159	140	158

This table reports estimates of house quantity growth (panel A) and population growth (panel B), and the change in average rooms per person (panel C) regressed on total income growth, quartiles of the constraint measure, and the interaction of income growth with each quartile. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.

TABLE IX

House Price Growth (1980-2000): Quartiles

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Real House Price Growth (Annualized %)				
Qtl 2 Constraint	-0.736	-0.933	-0.330	-1.052*
	(0.656)	(0.671)	(0.651)	(0.620)
Qtl 3 Constraint	-0.620	-1.357**	-0.365	-0.412
	(0.632)	(0.662)	(0.659)	(0.614)
Qtl 4 Constraint	-1.176**	-1.080*	-0.652	-0.776
	(0.588)	(0.641)	(0.675)	(0.624)
Qtl 2 Constraint × Income Growth	0.060	0.115	-0.078	0.013
	(0.180)	(0.199)	(0.198)	(0.180)
Qtl 3 Constraint × Income Growth	-0.025	0.239	-0.119	-0.142
	(0.179)	(0.195)	(0.194)	(0.182)
Qtl 4 Constraint × Income Growth	0.057	0.145	-0.106	-0.160
	(0.176)	(0.194)	(0.210)	(0.192)
Income Growth	-0.049	-0.042	0.083	0.115
	(0.139)	(0.175)	(0.172)	(0.155)
R2	0.08	0.06	0.09	0.14
Number of Observations	268	308	268	306
Panel B. Real Median Home Value Growth (Annualized %)				
Qtl 2 Constraint	-0.987**	-0.964**	0.227	-0.890**
	(0.416)	(0.446)	(0.460)	(0.409)
Qtl 3 Constraint	-1.216***	-1.718***	-0.245	-1.226***
	(0.410)	(0.440)	(0.450)	(0.432)
Qtl 4 Constraint	-1.940***	-1.435***	-1.095**	-1.348***
	(0.444)	(0.439)	(0.460)	(0.489)
Qtl 2 Constraint × Income Growth	0.181	0.163	-0.121	0.089
	(0.113)	(0.129)	(0.135)	(0.118)
Qtl 3 Constraint × Income Growth	0.245**	0.410***	-0.033	0.134
	(0.115)	(0.130)	(0.136)	(0.129)
Qtl 4 Constraint × Income Growth	0.452***	0.336**	0.264*	0.189
	(0.137)	(0.134)	(0.141)	(0.175)
Income Growth	0.014	0.019	0.237**	0.120
	(0.095)	(0.109)	(0.115)	(0.101)
R2	0.26	0.24	0.24	0.28
Number of Observations	269	310	269	308

This table reports estimates of house price growth (panel A) and median home value growth (panel B) regressed on total income growth, quartiles of the constraint measure, and the interaction of income growth with each quartile. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.

TABLE X
House Quantity Growth (1980-2000): Quartiles

	(1) Saiz	(2) BS-H	(3) WRLURI	(4) Building
Panel A. Housing Quantity Growth (Annualized %)				
Qtl 2 Constraint	0.405*	0.627**	0.022	0.040
	(0.220)	(0.264)	(0.261)	(0.227)
Qtl 3 Constraint	0.737***	0.810***	0.112	0.142
	(0.206)	(0.264)	(0.256)	(0.228)
Qtl 4 Constraint	0.605**	0.684**	0.041	0.141
	(0.235)	(0.267)	(0.255)	(0.275)
Qtl 2 Constraint × Income Growth	-0.049	-0.078	0.024	0.081
	(0.067)	(0.084)	(0.080)	(0.069)
Qtl 3 Constraint × Income Growth	-0.141**	-0.132	0.014	0.084
	(0.062)	(0.084)	(0.082)	(0.072)
Qtl 4 Constraint × Income Growth	-0.120	-0.057	0.051	0.069
	(0.084)	(0.087)	(0.083)	(0.101)
Income Growth	0.758***	0.750***	0.653***	0.619***
	(0.058)	(0.077)	(0.067)	(0.061)
R2	0.81	0.80	0.80	0.78
Number of Observations	268	309	268	307
Panel B. Population Growth (Annualized %)				
Qtl 2 Constraint	0.437*	0.579**	-0.385	-0.015
	(0.224)	(0.250)	(0.328)	(0.229)
Qtl 3 Constraint	0.641***	0.776***	-0.402	0.252
	(0.210)	(0.241)	(0.326)	(0.241)
Qtl 4 Constraint	0.667***	0.645***	-0.322	-0.093
	(0.225)	(0.247)	(0.312)	(0.275)
Qtl 2 Constraint × Income Growth	-0.105*	-0.103	0.095	0.075
	(0.063)	(0.076)	(0.089)	(0.066)
Qtl 3 Constraint × Income Growth	-0.183***	-0.212***	0.088	0.022
	(0.060)	(0.074)	(0.094)	(0.070)
Qtl 4 Constraint × Income Growth	-0.205***	-0.155**	0.040	0.075
	(0.079)	(0.078)	(0.088)	(0.104)
Income Growth	0.876***	0.875***	0.675***	0.708***
	(0.052)	(0.067)	(0.079)	(0.053)
R2	0.81	0.79	0.81	0.79
Number of Observations	269	310	269	308
Panel C. Change in Average Rooms per Person				
Qtl 2 Constraint	0.023	0.134	0.330***	0.144
	(0.113)	(0.105)	(0.120)	(0.129)
Qtl 3 Constraint	0.153	0.069	0.453***	0.097
	(0.114)	(0.092)	(0.111)	(0.141)
Qtl 4 Constraint	0.204*	0.068	0.318***	0.199
	(0.105)	(0.111)	(0.114)	(0.121)
Qtl 2 Constraint × Income Growth	0.008	-0.029	-0.067**	-0.022
	(0.030)	(0.032)	(0.033)	(0.036)
Qtl 3 Constraint × Income Growth	-0.010	0.002	-0.095***	-0.014
	(0.032)	(0.026)	(0.030)	(0.040)
Qtl 4 Constraint × Income Growth	-0.041	0.004	-0.058*	-0.028
	(0.031)	(0.031)	(0.033)	(0.034)
Income Growth	-0.031	-0.037*	0.024	-0.023
	(0.023)	(0.021)	(0.026)	(0.032)
R2	0.21	0.16	0.29	0.16
Number of Observations	140	159	140	158

This table reports estimates of house quantity growth (panel A) and population growth (panel B), and the change in average rooms per person (panel C) regressed on total income growth, quartiles of the constraint measure, and the interaction of income growth with each quartile. Each column uses a different measure of housing constraints where column 1 uses the elasticity from Saiz (2010), column 2 uses an elasticity from Baum-Snow and Han (2024), column 3 uses the regulation index Gyourko et al. (2008), and column 4 uses the land share of value Davis et al. (2021). See the text for more details.