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DISCUSSION PAPER SERIES

IZA DP No. 15447

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ABSTRACT

The Understated 'Housing Shortage' in the United States*

Following popular discourse, we abuse economic terminology by defining the "housing shortage" in the United States as the difference between the number of homes that would be built in the absence of supply constraints and the actual number of homes. The magnitude of the housing shortage is important to policymakers, who use it to measure the scope of the housing supply problem and the extent to which proposed policies would solve it. However, previous studies understate the housing shortage because they estimate how many more homes would have been built if historical building or household formation trends prevailed today, even though historical trends were also affected by supply constraints. We are the first to use a supply and demand framework to estimate the full housing shortage in the United States. Using county-level data on land shares of home prices, we estimate that the U.S. housing shortage was 20.1 million homes in 2021, 14.1 percent of the national housing stock. Our housing shortage estimate is 4 to 5 times as large as previous estimates, and 13 times as high as the shortage cited by the White House to contextualize the effects of policies intended to close the gap. Consistent with predictions of economic theory, our estimated housing shortage is uniformly low in areas with low regulation but varies in areas with high regulation, since a housing shortage requires both stringent regulations and strong housing demand.

JEL Classification: R31, R38, R52

Keywords: housing, regulation, land use, supply constraints, shortage

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I. Introduction

Economists—and increasingly policymakers—recognize that regulatory barriers to housing development restrict supply, increase home prices, and have negative economic consequences. Local land use regulations such as minimum lot sizes, height restrictions, occupancy limits, parking space requirements, and permitting delays impose costs on the development of housing. When too few homes are built each year and demand grows, prices rise. The extent of the problem and its variation across geographic regions has been quantified by indices of regulatory stringency (Ganong and Shoag 2017; Gyourko et al. 2019), the elevated home prices that result from regulatory barriers (Glaeser and Gyourko 2018), and the resulting shortfall in housing quantities (e.g., Khater et al. 2021; Rosen et al. 2021; Kingsella and MacArthur 2022). The extensive economic consequences of regulatory barriers have also been documented. Excessive regulatory barriers increase home prices (e.g., Quigley and Raphael 2005; Saiz 2010; Albouy and Ehrlich 2018), suppress economic growth (Glaeser and Gyourko 2018; Hsieh and Moretti 2019), impede regional economic convergence (Ganong and Shoag 2017), increase homelessness (Raphael 2010), reduce fertility (Shoag and Russell 2018) and reduce the effectiveness of rental assistance programs (Ericksen and Ross 2015; Corinth and Irvine 2021).

Policymakers, perhaps convinced by the economists, have increasingly recognized the problem of supply constraining regulations, and they have sought to implement policies to address it. Some state legislatures, including California, Utah, Massachusetts, Minnesota, Nebraska, New York, and New Jersey, have passed reforms that begin to loosen obstacles to new housing construction, reduce or eliminate density restrictions, and streamline environmental rules (Karlamangla 2021; Woodruff 2021). At the federal level, the proposed Housing, Opportunity, Mobility, and Equity (HOME) Act attempts to take a more active federal role in relaxing exclusionary zoning and density restrictions by making transportation funding contingent on local deregulatory efforts.[1] President Trump in 2019 signed an executive order "Establishing a White House Council on Eliminating Regulatory Barriers to Affordable Housing" (White House 2019). President Biden in 2022 proposed a "Housing Supply Action Plan" that would, among

[1] "Booker, Clyburn Take Innovative, Two-Pronged Approach to Tackling Affordable Housing Crisis," October 23, 2019, https://www.booker.senate.gov/news/press/booker-clyburn-take-innovative-two-pronged-approach-to-tackling-affordable-housing-crisis.

other provisions, incentivize localities to liberalize zoning and land use policies (White House 2022).

In order to understand whether proposed policies will effectively address the housing supply problem, policymakers require an understanding of its scope. Among the more popular ways for policymakers to characterize the scope of the housing supply problem is via an estimate of the "housing shortage." The housing shortage is intended to express the gap between the number of homes that would exist absent supply constraining regulations, and the number of homes that actually exist. Of course, economists do not typically use the term housing shortage to express the quantity-reducing effects of supply constraints—while prices may be artificially elevated, any buyer can generally purchase a home at the market price. We nonetheless follow popular discourse and abuse economic terminology.

The problem with existing estimates of the housing shortage (aside from the improper terminology) is that they understate the true size of the problem. They build their estimates by extrapolating historical trends in building or household formation, which simply measure the gap between current quantities of new housing and the quantities that would be expected based on historical patterns. This method implicitly assumes that the historical patterns represent the pace of housing construction or household formation that would be consistent with an unconstrained housing market. Because land use regulations have existed since at least the 17th century and in their modern form since the 1900s, the assumption that historical trends represent outcomes in an unrestricted housing market is unlikely to be true.

In this paper, we define a housing shortage in a particular market as the gap between the current number of homes and the number of homes that would exist absent supply constraining regulations. Unlike other studies, we use a supply and demand framework to estimate the housing shortage. Specifically, we use county-level estimates of the land share of home values from Davis et al. (2021), and following others (e.g., Glaeser and Gyourko 2018) we assume that in a market without supply constraints that land shares would fall to about 20 percent of the value of a home. Applying estimates of the price elasticity of demand for housing from the academic literature, we can then quantity the equilibrium quantity of housing in each market absent supply constraints.

We estimate a national housing shortage of 20.1 million homes, 14.1 percent of the U.S. housing stock. The housing shortage is the largest in Hawaii (35 percent), the District of Columbia (35 percent), California (31 percent), and Massachusetts (30 percent). Our national housing shortage estimate is 13 times the 1.5 million estimate cited by the White House to contextualize the scope of its Housing Supply Action Plan, and between 4 and 5 times the shortage cited in previous studies. Thus, proposed policies that set out to address a meaningful share of previous estimates of the housing shortage are likely to fall far short in addressing the full scope of the problem.

We validate the geographic variation in our housing shortage estimates by examining their relationship with the Wharton Residential Land Use Regulation Index, at the metropolitan area level. We find that housing shortage estimates are uniformly low for metropolitan areas with relatively lax regulations, and housing shortage estimates display wide variation in areas with relatively stringent regulation. Among metropolitan areas in the bottom quartile of the Wharton index (i.e., with the least stringent regulations), the difference between the 25th and 75th percentile of the housing shortage (expressed as a percent of the housing stock) is 6.6 percentage points. Among metropolitan areas in the top quartile of the Wharton index (i.e., with the most stringent regulations), the difference between the 25th and 75th percentile of the housing shortage is 17.3 percentage points. These findings are consistent with theoretical predictions: Quantities are constrained only when regulations are stringent and demand is strong enough such that those regulations bind. Thus, stringent regulations are a necessary but not sufficient condition for a large housing shortage.

Our paper contributes to the economic literature that quantifies the housing supply problem in the United States and how it varies geographically—which includes indices of regulatory stringency, elevated prices, and shortfalls in quantities. Our paper is similar in spirit to the Glaeser and Gyourko (2018) "regulatory tax" that estimates the extent to which home prices exceed the cost to produce a home. From this price differential, we ask a follow-up question—how many more homes would be built if this regulatory tax were eliminated? The difference between the present housing stock and the housing stock inclusive of these new homes represents what we colloquially refer to as the "housing shortage."

The paper proceeds as follows. Section II explains the supply and demand framework for characterizing the housing shortage. Section III describes the model and data used to estimate the

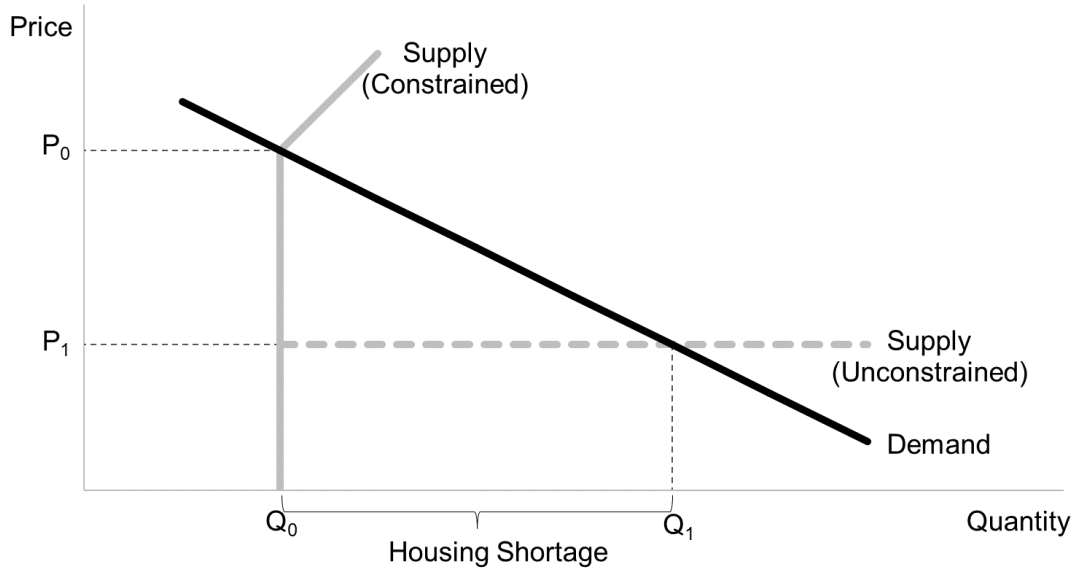
housing shortage. Section IV reports results at the national, state and county levels, and validates geographic variation in estimates at the metropolitan area level using the Wharton Residential Land Use Regulation Index. Section V concludes.

II. Supply and Demand Framework

Unlike previous studies quantifying the housing shortage, we define the term based on fundamentals of the market. While a home buyer can in general find a home to purchase at the market price, the market price can be inflated due to supply constraining regulation. The gap between the market price of housing under current supply constraining regulations and the market price of housing if such regulations were relaxed is what Glaeser and Gyourko (2018) define as a "regulatory tax." Working from this more fundamental understanding of the market, we define the housing shortage in a market as the difference between (i) the number of homes that would be constructed absent supply constraints, and (ii) the actual number of homes in the market.

Figure 1 graphically represents the housing shortage in a market that is supply constrained. Demand (black line) is downward sloping because consumers, including from other areas, are willing to buy more homes when the price falls. The supply curve (solid grey line) is vertical below the current price P_0, since housing is a durable good and so quantity supplied does not fall when prices decline. Supply is upward sloping for higher prices because constraints on building cause the cost of supplying housing to rise with quantity. Without supply constraints, the price of housing would fall to the cost to produce a house, P_1, the sum of the cost of construction, land value, and a normal profit margin. Glaeser and Gyourko (2018) call this the "minimum profitable production cost." Suppliers are willing to provide an unlimited number of homes to the market at price P_1 , the production cost (dashed grey line). The housing shortage is equal to the equilibrium number of homes with unconstrained supply, Q_1, minus the equilibrium number of homes with constrained supply, Q_0.

Figure 1. Diagram of a Housing Shortage in a Market



Note: P_0 and Q_0 are the actual housing price and housing quantity, respectively. P_1 and Q_1 are the housing price and housing quantity in a counterfactual market with unconstrained supply. The difference between the actual and counterfactual housing supply is defined as the housing shortage.

From Figure 1, we see that the housing shortage is largest in markets where demand is more elastic, and where the gap between the existing price, P_0, and the cost to produce housing, P_1, is largest. This gap will be largest when onerous regulations produce a steep supply curve and strong demand bids up prices. Meanwhile, the housing shortage is zero in markets where supply is not the binding constraint on housing development, either because regulations are not restrictive or demand is weak.

III. Model and Data

Using the above supply and demand framework, we estimate the housing shortage in each county in the United States using price elasticity of housing demand estimates from the academic literature, and county-level estimates of the land-share of home values, which we use to estimate the differences between observed market prices and the hypothetical prices absent supply constraints.

We assume that in a housing market without supply constraints, the value of land will comprise about 20 percent of the total value of the home. This assumption follows Glaeser and Gyourko

(2018) who note that an industry rule of thumb is that land values comprise at most 20 percent of the combined total of land values and construction costs in a market with few building restrictions.[2] This assumption is also consistent with research by Davis et al. (2021) who show the relationship between metro-level land-shares and the extent of regulation measured via the Wharton Residential Land Use Regulation Index. They find metro areas with the least stringent regulations have land-shares clustering around 20 percent. Thus, relaxing supply constraints in currently constrained markets can be expected to reduce home prices until land-shares reach 20 percent of the total price of a home.

Letting λ_0 denote the land-share of the home price, we can write the price of a home P_0 as

$$P_0 = \lambda_0 P_0 + (1 - \lambda_0) P_0 \tag{1}$$

where $\lambda_0 P_0$ is the value of the land and $(1 - \lambda_0) P_0$ is the value of the structure.

In a market without restrictions on building, the land-share of the home price should be at its minimum level λ^{min} (i.e., 20 percent), because otherwise, developers incentivized by the opportunity to pursue positive economic profits will build more homes (potentially more densely) until the increased supply reduces home prices to the cost of building a home. We can express the price of a home in a market after restrictions on building housing have been removed, P_1, as

$$P_1 = \lambda^{min} P_1 + (1 - \lambda_0) P_0 \tag{2}$$

The second term $(1 - \lambda_0) P_0$ does not change because the value of the structure does not change. Solving for P_1, we obtain

$$P_1 = \frac{1 - \lambda_0}{1 - \lambda^{min}} P_0 \tag{3}$$

[2] This also applies to the market price of the home, as there is an implied minimum level of entrepreneurial profit required to build a home. In Glaeser and Gyourko (2018) this level was identified as gross margins of approximately 17 percent applied to both land and the structure.

Thus, the higher the initial land-share of the home price, the more the home price will fall when restrictions on building are lifted.

We can also approximate the total number of homes after relaxing restrictions on building housing by applying estimates from the academic literature of the price elasticity of housing demand. Rearranging the elasticity formula, $\epsilon^{\mathrm{D}} = \frac{\%\Delta Q}{\%\Delta P}$, and using equation (3), we obtain the number of new homes built when relaxing restrictions.

$$Q_1 = Q_0 \left[\epsilon^D \left(\frac{1 - \lambda_0}{1 - \lambda^{min}} - 1 \right) + 1 \right] \tag{4}$$

The housing shortage is thus given by

$$Q_1 - Q_0 = Q_0 \epsilon^D \left(\frac{1 - \lambda_0}{1 - \lambda^{min}} - 1 \right) \tag{5}$$

We set the price elasticity of demand for housing, $\epsilon^{\mathrm{D}} = 0.7$, following central estimates from the academic literature. For example, Polinsky and Ellwood (1979) estimate an elasticity of about 0.7, and Albouy et al. (2016) estimate an elasticity of around two thirds. Glaeser et al. (2014), for their own simulations that rely on the relationship between changes in home prices and the housing stock, note that elasticity estimates are typically near or slightly below one. As noted previously, we set $\lambda^{min} = 0.2$ following Glaeser and Gyourko (2018) and Davis et al. (2021).

Because we estimate the housing shortage at the county level, we require county-level estimates of the housing stock Q_0 and land-share λ_0. We obtain estimates of Q_0 from the American Community Survey 2016-2020 five-year pooled sample. We update these 2016-2020 average values to 2021 based on previous growth rates in each county's housing stock and the observed national housing stock in 2021.[3]

[3] We first calculate the difference between (i) the national housing stock in 2021 according to the Census Housing Inventory estimate, and (ii) the aggregate housing stock observed in the 2016-2020 ACS five-year pooled sample. We attribute a share of this total increase in the housing stock to each county. The weight for each county is its

We obtain land-share estimates from Davis et al. (2021), who publish land-share and structure value estimates for various geographic designations for each year from 2012 through 2019. When available, we use the 2019 county-level land-share estimates (which cover 85 percent of the U.S. population). For the counties for which 2019 data are not available, we use their pooled estimates which represent an average over the period 2012-2019 (covering an additional 13 percent of the U.S. population), which we update to 2019 based on state-level increases in land-shares.[4] Land-share values are unavailable for 766 counties, but these counties contain less than 2 percent of the U.S population and are sparsely populated, with only 4.4 people on average per square mile. Finally, we update the 2019 land-share estimates to 2021 based on metropolitan area increases in home prices from 2019 to 2021, after netting out the 16.7 percent increase in U.S. construction prices over this time period.[5]

IV. Results

We estimate an aggregate U.S. housing shortage of 20.1 million homes in 2021, 14.1 percent of the stock of existing homes. As reported in Table 1, our 20.1 million national housing shortage estimate is several times larger than previous estimates, which relied on different definitions of a housing shortage. For example, Kingsella and MacArthur (2022) and Khater et al. (2021) both estimate a shortage of 3.8 million homes, and Rosen et al. (2021) estimate a shortage of 5.5 million homes. The White House reports a housing shortage of just 1.5 million homes. As

compounded annual growth rate of the housing stock based on the 2012-2016 ACS five-year pooled sample and the 2016-2020 ACS five-year pooled sample. U.S. Census Bureau, Housing Inventory Estimate: Total Housing Units in the United States [ETOTALUSQ176N], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/ETOTALUSQ176N, April 28, 2022.

[4] We update the 2012-2019 pooled estimates to 2019 by assuming that the percent increase in the land-share in the county from 2012-2019 until 2019 equals the percent increase in the land-share in the state from 2012-2019 until 2019.

[5] We first calculate the 2021 home value (in dollars) for each county by increasing the 2019 home value by its metropolitan area (using Census Bureau 2022a) percentage change in the Federal Housing Finance Agency's (FHFA) All Transactions House Price Index (HPI) (FHFA 2022). In the case that a county did not fall within a metropolitan area, we applied the state level non-metropolitan area HPI change, following the methodology of NAR (2022). We then calculate the 2021 structure value for each county by increasing the 2019 structure value obtained from Davis et al. (2021) by the 16.7 percent increase in U.S. construction prices as measured by the Price Deflator (Fisher) Index of New Single-Family Houses Under Construction (Census Bureau 2022b). The 2021 land value is equal to the 2021 home value minus the 2021 structure value, which is then expressed as a share of the total 2021 home value. To validate our adjustment, we estimated the national value of housing stock, following the application of the FHFA HPI values to counties, and compared our estimate to the 2021Q4 Z.1 Financial Accounts of the United States from the Federal Reserve. The value of all real estate in Q4 of 2021 as estimated by the Federal Reserve amounted to $75.4 trillion, while our estimate (limited to only residential real estate) amounted to $63.6 trillion. This indicates that the remaining commercial real estate would be worth approximately $12 trillion, which is approximately correct.

described earlier, these estimates rely on extrapolating previous market trends, rather than capturing the entire shortfall in the housing stock due to excessive regulations.

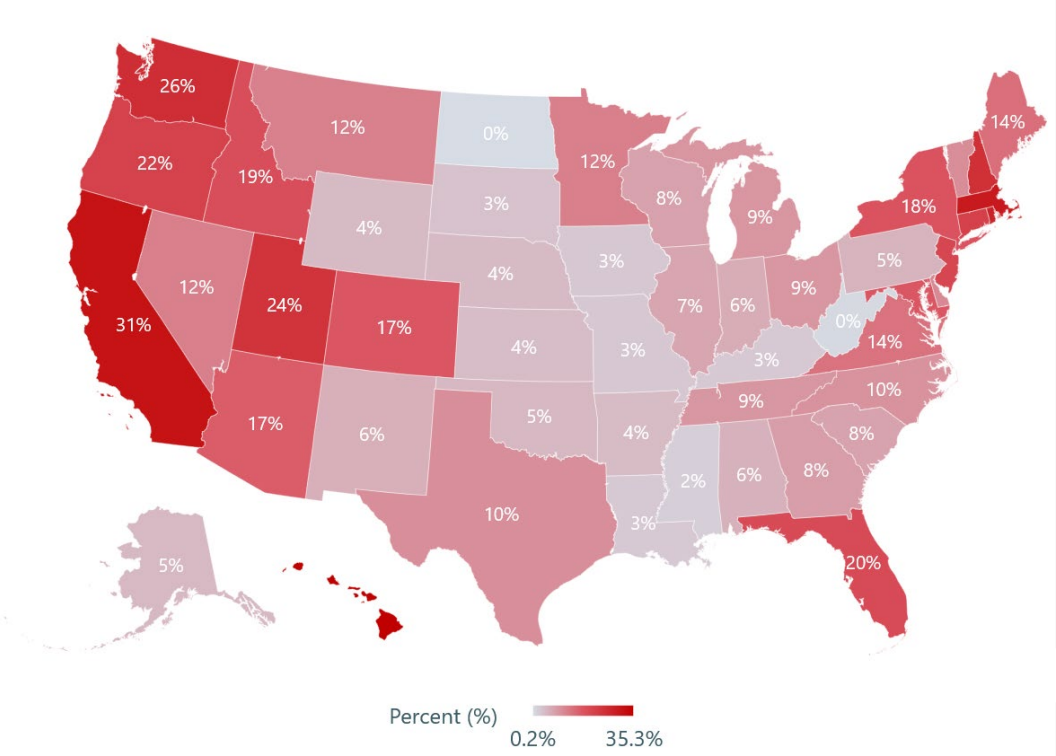
Table 1. Ratio of Housing Shortage Estimate to Housing Shortage Estimates from Previous Studies

Study	Housing Shortage Definition	Estimate Year	Estimate	Estimate Ratio
Corinth and Dante (2022)	Difference between current housing stock and housing stock absent supply constraints	2021	20.1 million	1.0
White House (2022)	N/A	N/A	1.5 million	13.4
Kingsella and MacArthur (2022)	Based on household formation	2019	3.8 million	5.3
Khater et al. (2021)	Based on household formation	2020	3.8 million	5.3
Rosen et al. (2021)	Based on previous building trends	2020	5.5 million	3.7

Note: Estimate ratio is the ratio of the housing shortage estimate from this paper (Corinth and Dante 2022) to the housing shortage estimate from the study in each row. White House (2022) states that its 1.5 million housing shortage estimate is from Parrott and Zandi (2021). The White House notes: "While estimates vary, Moody's Analytics estimates that the shortfall in the housing supply is more than 1.5 million homes nationwide." While Parrott and Zandi (2021) do not appear to directly report this 1.5 million home estimate, they note that the housing supply shortfall is "equal to almost a year of new construction at its current pace." New privately owned housing units completed totaled around 1.3 million each year between 2019 and 2021, according to Census data.

In Figure 2, we report the housing shortage in each state as a share of the state's existing housing stock. The housing shortage is the largest in heavily regulated coastal markets. The states with the largest housing shortages as a share of current housing stock are Hawaii (35 percent), the District of Columbia (35 percent), and California (31 percent). However, some landlocked western states also have large housing shortages, notably Utah (24 percent), Idaho (19 percent), Colorado (17 percent), Arizona (17 percent), and Nevada (12 percent).

Figure 2. Housing Shortage as Percent of Total Housing Stock, By State

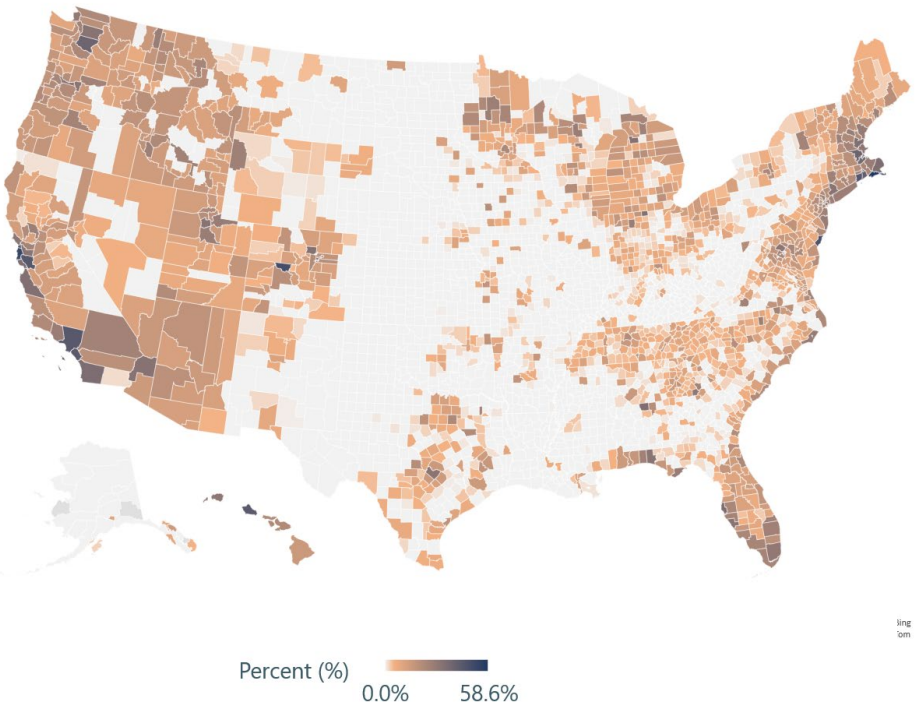


Note: "Housing shortage" defined as difference between the number of homes that would be built in the absence of supply constraints and the actual number of homes. State housing shortages as percent of total housing stock aggregated from county level shortage estimates.
Source: U.S. Census Bureau, Davis et al. (2021), and authors' calculations

In Figure 3, we show housing shortage estimates by county. Unsurprisingly, the housing shortage is greatest in the Northeast, Coastal California, and Hawaii, consistent with higher home prices in these areas. Among counties with a population of at least 200,000 people, the counties with the largest housing shortages are San Mateo County, California (52 percent), Arlington County, Virginia (47 percent), San Francisco County, California (45 percent), and Los Angeles County, California (44 percent). Still, other areas have meaningful housing shortages as well. Of our 3,143 counties, 20 percent, containing 191 million people, have a housing shortage of at least 10 percent of the current housing stock. In addition, 3 percent of all counties, containing 64 million people, have a housing shortage of at least 25 percent. Due to the growth in home prices during the COVID-19 pandemic, the housing shortage is particularly prevalent in the Western, non-coastal region of the United States. Multiple land-locked Western states contain counties with housing shortage of at least 25 percent of their housing stock. For

example, Utah contains 3 counties with a housing shortage of at least 25 percent, and these counties contain 57 percent of the state's population. Colorado also contains 3 counties with a housing shortage of at least 25 percent, and these counties contain 18 percent of the state's population.

Figure 3. Housing Shortage as Percent of Total Housing Stock, By County

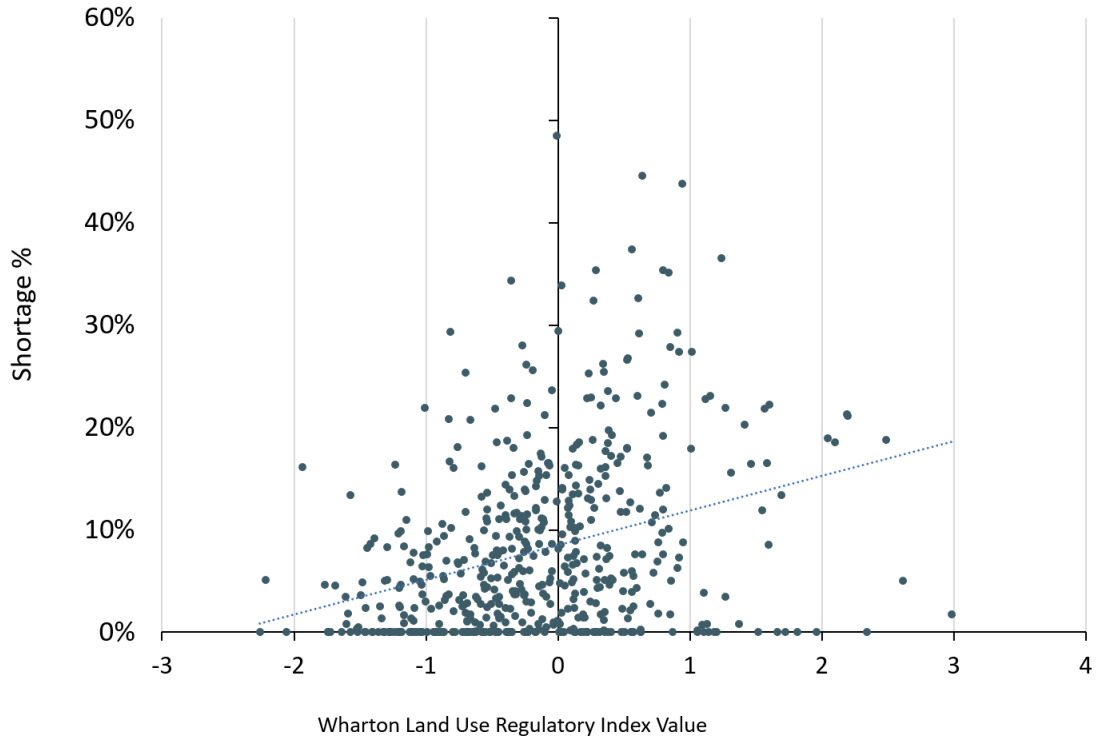


Note: "Housing shortage" defined as difference between the number of homes that would be built in the absence of supply constraints and the actual number of homes. Figure shows county level estimate of housing shortages.
Source: U.S. Census Bureau, Davis et al. (2021), and authors' calculations

As a validation of geographic variation in our housing shortage estimates, Figure 4 plots how metropolitan housing shortages vary with their Wharton Residential Land Use Regulation Index (Gyourko et al. 2019). This index measures the stringency of land use regulations that impede new residential construction, where lower values represent fewer restrictions. We expect less regulated places to have smaller housing shortages. This is what we find. Among metropolitan areas in the bottom quartile of the Wharton index (i.e., with the least stringent regulations), the median housing shortage (expressed as a percent of the housing stock) is 2.4 percent. Among

metropolitan areas on the top quartile of the Wharton index, (i.e., with the most stringent regulations), the median housing shortage is 9.2 percent.

Figure 4: Housing Shortage as Percent of Housing Stock and Wharton Residential Land Use Regulation Index by Metropolitan Area



Note: "Housing shortage" defined as difference between the number of homes that would be built in the absence of supply constraints and the actual number of homes. Housing shortages as percent of total housing stock calculated at the Census Core-Based Statistical Area (CBSA) level by using a CBSA to Federal Information Processing Series (FIPS) County Crosswalk. Wharton Land Use Regulatory Index Values from Gyourko et al. (2019).
Source: NBER, Davis et al. (2021), U.S. Census, Gyourko et al. (2019), and authors' calculations

We also expect more regulated places to have a wider dispersion of housing shortages: If demand is weak, then housing shortages should be small and if demand is strong, then housing shortages should be large. This "fanning-out" pattern is apparent in Figure 4. Among metropolitan areas in the bottom quartile of the Wharton index, the difference between the 25th and 75th percentile of the housing shortage is 6.6 percentage points. Among metropolitan areas in the top quartile of the Wharton index, the difference between the 25th and 75th percentile of the housing shortage is 17.3 percentage points. These findings are consistent with theoretical

predictions: Quantities are constrained only when regulations are stringent and demand is strong enough such that those regulations bind. Thus, stringent regulations are a necessary but not sufficient condition for a large housing shortage.

Notably, the housing shortage is not zero in less regulated places. This is because classification as "lightly regulated," based on a low value of the Wharton land use index, does not imply that a jurisdiction is unregulated or that there is an absence of land use controls that restrict supply within that jurisdiction. The index authors note that even among lightly regulated areas, approval for any project generally must pass through at least two entities (usually councils and commissions) and that almost all of these communities have density restrictions. Ninety-four percent of these communities have minimum lot size requirements, and the average timespan for approval of a project is 3.4 months. Housing supply is restricted almost universally in the United States, indicating that shortages are likely to persist even in some of the least regulated housing markets. Thus, it should not be surprising that some metro areas with low values of the Wharton land use index nonetheless have modest housing shortages.

IV. Conclusion

Restrictions on housing supply have a negative impact on the economy and the wellbeing of American families by driving up the cost of homes in the United States. Rising home prices impose obstacles on family formation, price workers out of labor markets, dampen economic growth, and worsen the problems associated with housing insecurity. In order to address these challenges, policymakers require an accurate understanding the scope of the housing supply problem. Our 20.1 million housing shortage estimate is 4 to 5 times as large as previous estimates, and 13 times the housing shortage estimate relied upon by the White House to assess its 2022 policy proposal to address the housing supply problem. Our results show that the scope of the problem is far larger and more widespread than policymakers currently recognize, and thus, that proposed solutions are likely to fall short of solving the problem.

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Appendix

Appendix Table 1. Housing Shortage by State

State	Housing stock	Housing shortage	Housing shortage as share of housing stock
Alabama	2,325,469	128,405	5.5%
Alaska	326,127	15,440	4.7%
Arizona	3,157,085	524,854	16.6%
Arkansas	1,414,756	61,536	4.3%
California	14,490,486	4,550,097	31.4%
Colorado	2,439,307	424,742	17.4%
Connecticut	1,543,598	336,034	21.8%
Delaware	457,383	49,000	10.7%
District of Columbia	331,500	116,212	35.1%
Florida	9,929,079	1,941,523	19.6%
Georgia	4,484,280	364,666	8.1%
Hawaii	561,510	198,177	35.3%
Idaho	783,002	147,935	18.9%
Illinois	5,426,513	384,336	7.1%
Indiana	2,968,664	186,371	6.3%
Iowa	1,450,405	38,778	2.7%
Kansas	1,308,224	54,494	4.2%
Kentucky	2,033,136	53,110	2.6%
Louisiana	2,133,112	54,403	2.6%
Maine	762,554	108,551	14.2%
Maryland	2,497,802	432,632	17.3%
Massachusetts	2,978,465	886,598	29.8%
Michigan	4,667,018	427,370	9.2%
Minnesota	2,523,007	302,139	12.0%
Mississippi	1,362,833	25,125	1.8%
Missouri	2,862,403	77,813	2.7%
Montana	535,639	63,677	11.9%
Nebraska	871,043	38,425	4.4%
Nevada	1,328,285	159,037	12.0%
New Hampshire	653,684	163,950	25.1%
New Jersey	3,667,351	751,732	20.5%

New Mexico	969,833	57,068	5.9%
New York	8,509,070	1,527,798	18.0%
North Carolina	4,900,312	472,699	9.6%
North Dakota	406,236	645	0.2%
Ohio	5,275,671	479,832	9.1%
Oklahoma	1,780,791	85,115	4.8%
Oregon	1,861,874	400,792	21.5%
Pennsylvania	5,810,894	311,242	5.4%
Rhode Island	474,138	131,634	27.8%
South Carolina	2,433,269	183,053	7.5%
South Dakota	416,180	14,439	3.5%
Tennessee	3,107,876	280,613	9.0%
Texas	11,758,527	1,183,783	10.1%
Utah	1,189,946	291,120	24.5%
Vermont	346,495	35,434	10.2%
Virginia	3,627,244	497,539	13.7%
Washington	3,313,614	847,296	25.6%
West Virginia	901,048	4,350	0.5%
Wisconsin	2,761,578	209,415	7.6%
Wyoming	287,681	12,596	4.4%
United States	**142,406,000**	**20,093,625**	**14.1%**

Note: State housing shortages as percent of total housing stock aggregated from county level shortage estimates. "Housing shortage" defined as difference between the number of homes that would be built in the absence of supply constraints and the actual number of homes. State housing shortages as percent of total housing stock aggregated from county level shortage estimates.
Source: U.S. Census Bureau, Davis et al. (2021), and authors' calculations