Technical Memorandum to Up for Growth's Housing Underproduction in the U.S. report

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This memorandum offers a more detailed explanation of the methodology and assumptions in Housing Underproduction in the U.S. 2022. It refers to the policy descriptions and rationales offered in the report.

Data Sources, Years, and Geographies

The report primarily relies on publicly available data from the Census Bureau that is available and updated annually so that a consistent methodology can be applied for each year of the estimates (dating back to 2012), and for future reports. The main source of data was the Census Bureau Public Use Microdata Samples (PUMS) 1-year samples from 2012 to 2019.

Underproduction is calculated at two geographic scales, metro, and non-metro areas. The report presents results that cover the entire nation, divided into 309 metro regions and 505 non-metro regions. The underlying geographic unit of analysis are census geographies called a Public Use Microdata Area (PUMAs) that contain about 100,000 people. The size of each geography depends on the density of the population. PUMAs generally orient along county boundaries in rural areas, but often are made up of multiple counties. To create metro regions, PUMAs were aggregated that fall entirely inside Core-Based Statistical Areas (CBSAs), which are essentially considered to be metro areas.[1] As a result, the individual metro areas do not exactly match CBSA geographies and are typically smaller than the CBSA geography. The primary reason for this methodological choice is that if any PUMA that falls inside a CBSA was considered part of a metro, almost the entire country would be composed of metro areas, and there wouldn't be any geographic specificity in rural parts of the country.

For non-metro areas of the country, each individual PUMA was analyzed separately, in many cases, these areas are composed of multiple counties.

The housing distribution and neighborhood typologies used in A Better Foundation are calculated at the census tract level, which is an approximation for a neighborhood, typically containing at least 3,000 people.

Data sources and models used to generate for the economic, fiscal, and environmental benefits calculated in the report are listed in later sections of this document.

[1] https://www.census.gov/programs-surveys/metro-micro/about/glossary.html

Calculating Underproduction

Underproduction is calculated at the sub-state level to provide a more accurate reflection of housing markets, which are generally more localized than an entire state. For example, housing may be underproduced in one part of a state but balanced in other parts of a state. In metro areas, the underlying data from all of the individual PUMAs are aggregated in order to represent the conditions across the entire metro region. For example, housing underproduction is not something that can be observed in a particular neighborhood; it is present across an entire geography that constitutes a housing market. Outside of metro areas, underproduction is calculated at the PUMA level, which are the most granular geography where data is available annually.

In this report, if any region within a state underproduced housing, that state is considered to have underproduction. The report does not calculate net underproduction within a state (or nationally). Adding regions that have underproduction together with regions that have adequate housing is not an accurate reflection of the problem because it distorts the issue. A surplus of housing in one housing market does not generally help underproduction in other parts of a state (or the country) which operate as different housing markets.

Calculating underproduction has two components—estimating the demand for housing units and estimating the supply of units available for occupancy.

Figure 1. Housing Underproduction Formula

Step 1: Target Number of Units

The demand for housing can be thought of as a target number of units that need to be built in order to bring the market into long term equilibrium. When this number of housing units is built, the market functions properly, allowing the filtering of units to be more affordable over time, and prices and rents to be in line with incomes in the long run. In order to calculate the number of units each region *should have*, the report adds the total households in the region to an estimate of missing households, then multiples this by a target vacancy rate.

By including an estimate of missing households, this methodology attempts to capture the endogeneity that occurs when households do not form due to the lack of available and affordable housing. Put differently, not building enough housing has a feedback loop that prevents households from forming. That latent market demand contributes to upward price and rent pressure. Effectively missing households are an important symptom of not building enough housing. Examples of missing households are children over 18 still living with their parents or single people living together as roommates at higher levels than has been historically observed at the state level. Data on missing households for each analysis region come from an evaluation of whether headship rates (the percentage of people who head a household) have changed over time for individual age

cohorts. The report compares headship rates in the baseline year of 2000 for all age cohorts between 18 and 45 and compares them to the current underproduction study year. Baseline headship rates were obtained through the 2000 census, then compared to the 1-year PUMS sample in the study year for each age cohort under 45. If an age cohort (typically 5-year increments, except from 35 to 44) had lower headship rates, it is indicative that fewer households were formed. Adding together reduced household formation from individual age cohorts results in the missing households for the study region.

The methodology then sums total existing households and the estimate of missing households to represent the total number of households that under unconstrained market conditions would be seeking housing in each region, were it available and affordable.

Once the number of households in established in each region, the final step is to determine the appropriate vacancy rate to estimate the target number of housing units for that region. The report uses a 5% vacancy factor as the target rate—this effectively represents the structural vacancy rate in unconstrained market conditions. The target vacancy factor was established primarily by calculating a national historical baseline vacancy rate from 1980 to 2000, and then validated by industry stakeholders. In order to calculate the vacancy rate baseline, the national vacancy rate was calculated by tenure annually from 1980 to 2000, then weighted based on the share of households that were owners and renters respectively in each year. The baseline is meant to represent unconstrained market conditions, therefore the 75th percentile of observed vacancy rates was used during this historical reference period.

Taken together, this step calculates how many units each region *should have* to accommodate all its households and a structural vacancy factor that represents housing market conditions that are unconstrained.

Step 2: Estimating the Stock of Housing for Occupancy

Next, the report estimates the total number of units available and suitable for occupancy in each region. This requires eliminating obsolete / uninhabitable units and second and vacation homes from the stock, which are not available for year-round occupancy.

Starting with the total number of housing units in each region, the first step is to remove second and vacation homes. These units are not available for full time occupancy for owners and renters, and therefore overstate the number of units in the market for the purpose of establishing constrained market conditions. For example, in many resort communities, many units are second or vacation homes, which limit the number units available for full times residents.

The next step is to remove units that are obsolete or uninhabitable, which also overstate the stock of housing available for occupancy.[2] Uninhabitable units are defined as units that lack indoor plumbing and complete kitchens—nationally very few occupied units meet these criteria, therefore a further screen is applied to only exclude units meeting these two criteria that are also vacant.

[2] This is true in the short term, it is possible in the long run that investment into these units could rehabilitate them into suitable housing units, which has important policy considerations.

Taken together, this step calculates how many units each region *currently has* to accommodate all its households for year-round occupancy.

Step 3: Calculating Underproduction

Once the target number of units and the number of housing units available for full time occupancy are calculated in each region, the difference between the two represents underproduction. That is to say, regions where the target number of units is less than the stock of housing available for occupancy are experiencing housing underproduction.

Allocating Housing Underproduction

Building off the underproduction findings, the report then explores the economic, fiscal, and environmental benefits of building the underproduced housing units. To do so, the report discusses two potential frameworks – A Better Foundation and More of the Same—from which a counterfactual analysis is conducted. Both build the same number of housing units over the same production period, but differ in location within regions and the building prototypes that are used to build the underproduced units.

More of the Same

More of the Same is an attempt to model the continuation of the status quo. To do so, census data is used to determine the share of development that occurred for each census tract within a region over the past decade. Additionally, the number of housing units by prototype is estimated using census data that catalogues units by the number of units in a structure—essentially if a unit is detached, or if attached, how many units are in the structure. In many locations More of the Same is not possible due to land availability limitations. This is particularly problematic in areas that were recently "greenfields" that were built out over the past decade. For the purpose of the counterfactual, the main goal is to accurately reflect the building trends in a region. If, for example, a region has been largely sprawling with detached development, this approach will capture that, compared to a region that is predominantly experiencing infill high density.

For the counterfactual More of the Same approach, each region's share of recent growth and its density patterns are assumed to apply to the underproduced units in each region.

A Better Foundation

A Better Foundation (ABF) is a policy framework built to optimize the impacts of building new housing to achieve sought after economic, environmental, and fiscal outcomes while applying a racial equity lens. The framework of ABF could be used for any housing policy agenda that concerns new development or adaptive reuse. It is connected to housing underproduction for the purposes of conducting a counterfactual analysis, but is designed to be applied more broadly.

The ABF framework has three steps:

1) Identifying priority locations for new housing at the census tract level,
2) Allocating the amount of housing units in priority locations,
3) Determining the housing mix that is most appropriate for location.

Step 1: Identifying Priority Locations

First, ABF excludes "socially vulnerable" census tracts from the allocation process. Those tracts do not receive any new housing units but are part of the counterfactual More of the Same underproduction modeling process. "Socially vulnerable" areas are defined as the top 20% of census tracts designated as socially vulnerable via the CDC Social Vulnerability Index. This index considers a variety of risk factors, including environmental hazards, health outcomes, and risk of displacement. These tracts are excluded because of these potential risks and the need to do more due diligence depending on the individual factors present in a location. Any new housing in these locations should include mitigation efforts for any of the risk factors identified.

Next, ABF identifies "high-opportunity" census tracts that have any or all of the following characteristics:

A) **Economic mobility.** Census tracts that are in the top 20% of tracts in each state offering economic mobility for low-income households based on data from the Opportunity Atlas from Harvard University's Opportunity Insights lab. There are no calculations associated with this criterion; it is just flagged as yes/no for each census tract.

B) **Access to jobs.** The report highlights those census tracts that have at least two jobs per housing unit, based on data from the Census ACS and the U.S. Bureau of Labor Services. The report calculates this ratio and flags census tracts that have 2.0 or more jobs per housing unit.

C) **Access to infrastructure.** The report highlights those census tracts that are located within one-half mile of high-frequency transit station areas or are within the top 20% of walkable places in a state based on data from the U.S. Environmental Protection Agency (EPA)'s National Walkability Index. Census tracts can meet either of these criteria to be considered to have good access to infrastructure.

To focus on the highest opportunity census tracts, new housing developments are allocated to census tracts based on three tiers or priorities:

Tier 1: meet all three characteristics of economic mobility, access to jobs, and access to existing infrastructure.

Tier 2: meet any two of the three criteria

Tier 3: meet one of the three criteria

Step 2: Allocating the amount of housing units

The appropriate amount of housing to add to a census tract is a function of the priority tier and the existing number of units in that tract. Since tier 1 census tracts have been determined to have adequate infrastructure, access to jobs, and high opportunities, they see the biggest increase in new units, followed by tier 2 and tier 3 census tracts. Under ABF, tier 1 census tracts receive a 40% increase in units over what they have at present. Tier 2 census tracts receive a 35% increase, and tier 3 census tracts receive a 30% increase.

New units are added in preference of tiers, and by the tracts with the lowest densities within each tier. For example, if a region underproduced by 100,000 units, its tier 1 census tracts receive a 40%

increase in units (receiving different unit prototypes based on the existing density as described below). If that allocation does not reach 100,000 units, tier 2 census tracts are increased by 35% (again, receiving different unit prototypes based on the existing density of the census tracts). If that allocation still does not reach 100,000 units, tier 3 census tracts are increased by 30%. If there isn't the need to increase all of the tracts within tier 3 by 30%, the units would be allocated to census tracts in ascending order based on existing housing density (units per acre), starting with the lowest density places.

Step 2: Determining the appropriate housing mix for each area

After identifying where new housing units should be built, the ABF framework identifies the housing mix that each census tract receives based on the existing density of the area. The reason for this step is to acknowledge the existing attributes of a neighborhood, understanding that a neighborhood of detached homes does not have the infrastructure (or, likely, the desire) to support building high rise towers. The idea is to embrace an incremental approach that leverages existing infrastructure in an efficient way. To do so, a variety of algorithmic and heuristic approaches were used to determine a consistent mapping of building prototypes to existing neighborhood density that could be consistently applied across the country. It should be noted that these densities are per gross acre, and therefore are much lower than densities achieved on parcel-specific development projects, as they have allowances for open space, roads, and other non-residential uses.

As Figure 2 demonstrates, census tracts with less than 0.5 units per gross acre (UPA) that are not designated as tier 1 "high opportunity" places, are all assigned as single detached units (see the following section for more detail on individual housing prototypes). This recognizes the development patterns associated with most "greenfield" development.

Census tracts with less than 0.5 UPA that are designated as tier 1 "high opportunity" receive only missing middle units. One of the policy goals of ABF's framework is to put more homes in high-opportunity neighborhoods that are traditionally zoned for single family and that effectively exclude new households (particularly low-income and or minority households) from living there.

Census tracts with existing density between 0.5 and 2.0 UPA receive a mix of 75% missing middle units and 25% medium density units. Census tracts with existing density between 2.0 and 5.0 UPA also receive a 50% / 50% mix of missing middle units and medium density units. Census tracts with existing density between 5.0 and 12.0 UPA receive only medium density units, and census tracts with existing density greater than 12.0 UPA receive only high density units.

Figure 2. A Better Foundation Density Distribution Matrix

Existing Density	Single Detached	Missing Middle	Medium Density	High Density
> 12.0 UPA				100%
5.0 – 12.0 UPA			100%	
2.0 – 5.0 UPA		50%	50%	
0.5 – 2.0 UPA		75%	25%	
< 0.5 UPA (tier 1)		100%		
< 0.5 UPA (not tier 1)	100%			

Housing Prototypes

Housing prototypes used to allocate new housing in the two frameworks include the following:

1) Single-Detached Units (often referred to as single-family homes)
2) Missing Middle: multifamily housing, including a mix of ADUs, duplexes, triplexes, fourplexes, townhomes, or cottage clusters.
3) Medium Density: a range of, typically, all wood construction including row homes, garden style apartments, walk-ups, and elevator-served construction products (at the high-end including podium construction of up to 7 stories).
4) High Density: A mix of high-density prototypes depending on local market conditions. In most places, the high end of the density continuum is likely to be podium construction of up to 7 stories. In high-cost markets, the high-density prototype also includes tower construction using steel and concrete.

Three of the four prototypes – Single-Detached Units, Medium Density units, and High-Density units – were used in the first iteration of the Housing Underproduction in the U.S. report, published in 2018, but have been updated to provide a more narrow definition to allow for a Missing Middle prototype. The Missing Middle housing prototype was added to this report recognizing its growth in housing development in many large cities, and the policy goal imbedded in A Better Foundation to add incremental density to exclusive single family zoned neighborhoods.

Economic and Fiscal Outcomes

After calculating underproduction in each region and allocating housing units to census tracts based on the methods described above, the report uses the Regional Economic Model (REMI) model to estimate the economic and fiscal impacts of the two production frameworks (More of the Same and A Better Foundation). While both frameworks produce the same number of units and use the housing prototypes, they differ in the mix of prototypes used and where units are distributed. The regions in both scenarios are then rolled up to a state level of analysis as input into the REMI model.

REMI is a dynamic economic impact modelling software that uses numerous data inputs to calculate the economic and fiscal impacts of a policy change. In this case, the policy change is large-scale housing development: producing the 3.8 million underproduced housing units over a 20-year buildout period. Results are produced at the national and state levels.

REMI is a structural representation of a regional economy and uses publicly available data to build an economic forecast. Variables can be altered to reflect changes in public policy (e.g., lower taxes, new regulation, or new consumer preferences). The model then simulates the economic impacts of such policy changes and produces a new forecast capturing these effects. By comparing the simulated forecast to the baseline forecast, the economic impacts of the policies modeled can be quantified.

The model has feedback loops to capture the cumulative impacts of development spending, as well as any time-based changes to the structure of the economy, such as migration, induced demand, lower costs, supply chain spending and tax effects, among others. Any change to one sector of the economy will ripple through the others. This is beneficial, as the model is able to capture the relationships between different economic and demographic changes, such as migration, government spending, personal income, etc.

Housing Production

Because the U.S. could not start suddenly producing hundreds of thousands of additional housing units per year, production is gradually increased over a 7-year period to allow the construction industry to scale appropriately. The production curve begins in 2023 and lasts 20 years (see Figure 3). In this model, the U.S. would be producing nearly 265,000 units at peak production. While this doesn't seem like a large increase, this is in addition to the current production of housing at roughly similar levels of expected production over the next 20 years (baseline expectations included in the REMI model). This model would effectively more than double the current production of housing at the peak starting in 2030, then scale back down ending in 2042.

Figure 3. 20-Year Housing Production Schedule