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Abstract

During the past few years many groups have suggested that the United States is experiencing a housing crisis, one marked by a supply deficit and affordability problems. This paper argues for a better understanding of housing availability and the drivers of house price appreciation. It further contributes to the debate in two ways. First, it provides an alternative estimate of housing availability, one that suggests the U.S. housing market has not been in a crisis during the past two decades. Second, to estimate the price response of relaxing regulatory restrictions in a metro area, it provides a robust statistical analysis of zoning changes in Denver in 2010. While there is some evidence supporting a positive effect of rezoning, the findings do not suggest that increased supply will single-handedly fix the supposed housing affordability problem. These results do not imply, in any way, that local governments should refrain from the types of reforms that will reduce regulatory costs and increase construction levels. They do, however, suggest that officials should temper their expectations for exactly how much added construction will slow the growth in home prices. The findings implore the need for more refined research on housing market dynamics—especially on the demand side—to precede policy prescriptions aimed at solving housing-related problems through increased construction.

Introduction and Literature Review

For the past several years, various organizations have called for policies to boost the number of homes built in the United States. These groups regularly characterize the U.S. housing market as facing a shortage, though they typically are referring to a market where the quantity supplied is less than some preferred measure, not a market where the quantity demanded exceeds the quantity supplied at the equilibrium price. Nonetheless, some groups even claim that the U.S. is experiencing both a housing supply and affordability *crisis*.¹ While there seems to be a consensus that this supply deficit has been the primary culprit of the affordability crisis, there is still a vast spread of opinions on exactly how to define the “shortage.” And although these groups deserve credit for trying to quantify this shortage, the range of estimates they’ve produced also varies considerably.

For example, the National Association of Home Builders’ (NAHB) estimated a shortage of 1.5 million homes for 2021, while a study for the National Association of Realtors (NAR) estimated the shortage was 5.5 million.² Freddie Mac, one of the two large housing government

¹ For instance, National Association of Realtors president Leslie Rouda Smith recently stated that “Urgent action is needed to tackle our nation’s housing supply crisis.” National Association of Realtors, “Biden Administration Takes Aim at America’s Housing Shortage,” *Realtor Magazine*, May 16, 2022, <https://www.nar.realtor/magazine/real-estate-news/biden-administration-takes-aim-at-america-s-housing-shortage>. Also see Adewale Maye and Kyle Moore, “The Growing Housing Supply Shortage has Created a Housing Affordability Crisis,” Economic Policy Institute, July 14, 2022, [https://www.zillow.com/research/affordability-housing-shortage-34153/](https://www.epi.org/blog/the-growing-housing-supply-shortage-has-created-a-housing-affordability-crisis/#:~:text=Some%20of%20the%20leading%20factors,in%20certain%20neighborhoods%E2%80%94maintaining%20segregation;Orphe Divounguy, “Affordability Crisis: Housing Shortage Worsened Despite Pandemic Construction Boom,” Zillow, June 18, 2024, <a href=); and Daniel McCue and Sophie Huang, “Estimating the National Housing Shortfall,” January 29, 2024, <https://www.jchs.harvard.edu/blog/estimating-national-housing-shortfall>.

² National Association of Home Builders, “The Size of the Housing Shortage: 2021 Data,” *Eye on Housing*, December 16, 2022, <https://eyeonhousing.org/2022/12/the-size-of-the-housing-shortage-2021-data/>; and, Kenneth T. Rosen et al., “Housing is Critical Infrastructure: Social and Economic Benefits of Building More Housing,” Rosen Consulting Group, June 2021, <https://www.nar.realtor/sites/default/files/documents/Housing-is-Critical-Infrastructure-Social-and-Economic-Benefits-of-Building-More-Housing-6-15-2021.pdf>.

sponsored enterprises (GSEs), estimated the shortage was 3.8 million homes.³ In 2022, the tech-based real estate firm Zillow estimated that “despite a pandemic construction boom, the U.S housing shortage grew to 4.5 million homes,” and said that the shortage was “mainly because of the increase in the nation’s family count and very sluggish construction activity in the decade preceding the pandemic.”⁴

While virtually none of these groups formally estimate the optimal housing supply in a general (or even partial) equilibrium framework, some do construct reasonable statistical models to suggest what the supply of new homes should be compared to current figures. Freddie Mac’s model, for instance, includes household formation rates, current vacancy rates (the share of homeowner inventory that is vacant/for sale), the existing housing stock, and a *target* vacancy rate of 13 percent.⁵ The NAHB, on the other hand, relies on a more parsimonious comparison of the difference between the current vacancy rate and “the ‘natural,’ or long-run average” vacancy rate.⁶ Thus, these two groups essentially assume that the market requires a sort of inventory buffer. While the NAR’s study compares long-term construction trends to current construction, its online “Housing Shortage Tracker” estimates the shortage for major U.S. metro areas by comparing the number of new construction permits issued to “every new job.”⁷

³ Freddie Mac, “Housing Supply: A Growing Deficit,” *Research Note*, May 7, 2021, <https://www.freddiemac.com/research/insight/20210507-housing-supply>.

⁴ Orphe Divounguy, “Affordability Crisis: Housing Shortage Worsened Despite Pandemic Construction Boom,” Zillow, June 18, 2024, <https://www.zillow.com/research/affordability-housing-shortage-34153/>.

⁵ Freddie Mac, “The Housing Supply Shortage: State of the States,” *Insights*, February 27, 2020, <https://www.freddiemac.com/research/insight/20200227-the-housing-supply-shortage>.

⁶ National Association of Home Builders, “The Size of the Housing Shortage: 2021 Data.”

⁷ National Association of Realtors, “Housing Shortage Tracker,” 2024, <https://www.nar.realtor/research-and-statistics/housing-statistics/housing-shortage-tracker>. Separately, the above-mentioned NAR study presents an alternative estimate of the shortage (6.8 million units) with the following calculation: Demand-Supply Gap = Household Formation + Lost Housing Stock – New Completions). Rosen et al., “Housing is Critical Infrastructure,” p. 3.

There is no objectively correct method for making such estimates because they are, by nature, subjective. And while “shortage” models computed with vacancy rates appear to have become a standard way of measuring housing market trends, the lack of a clear answer as to what should be the recommended vacancy rate (and why) makes it difficult to evaluate the estimates these models produce. Still, many groups—and policymakers—use these kinds of estimates to argue that the supply of new construction is insufficient to meet demand. Obviously, using these models in such a way to implement federal policies that boost construction could result in disappointing—or even counterproductive—results.

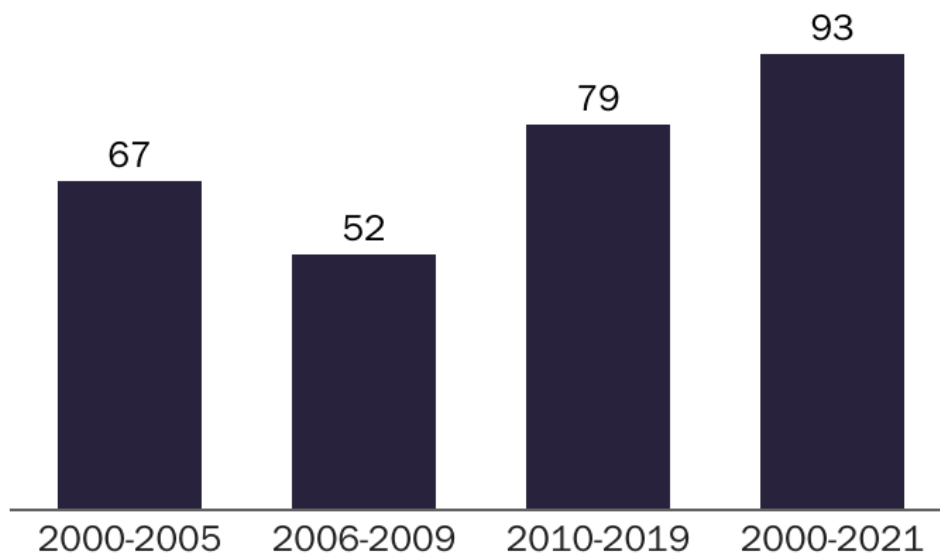
This study does not estimate a formal supply/demand framework, but it does provide an alternative estimate of housing availability that requires no subjective adjustments. It argues that a change in resident population is superior to job creation as a proxy for housing demand, and that vacancy rates represent market inefficiencies.⁸ Consequently, this study outlines how housing units permitted, started, and completed (across different housing types) has trended over time relative to population changes. It provides a basic analysis of historic US-wide time-series data, and a county-level panel analysis to better capture geographic variation.

Based on the evidence that follows, using a simple measure of housing availability spanning 362 US counties from 2000 to 2022, it appears that not only is there no evidence of an appalling housing shortage, but housing availability has been improving in recent years. For instance, housing availability was at its lowest around the 2008 financial crisis when a 100 unit

⁸ It is also possible that vacancy rates exhibit a structural shift as online real estate services have proliferated. That is, rates may now be permanently lower not just due to supply/demand dynamics, but also due to increased uptake of the internet for buying and selling homes, an innovation that allows sellers to reach a greater number of potential buyers more easily. This issue requires more study, but the possibility does complicate evaluating “shortage” models that compare current vacancy rates to long-term vacancy rates.

increase in population was associated with only 52 housing units permitted. This rate increased to approximately 79 units for every 100 residents, after the crisis. Overall, between 2000 and 2021, the average building units permitted per 100-unit change in resident population is approximately 93 housing units, hardly indicative of a major shortage. (See Figure 1.) Put differently, in the full period, U.S. housing construction has kept up with U.S. population increases.

Figure 1
Permits Issued Per 100-unit Increase in Population



More Study of Supply and Demand Factors Needed

While it is impossible to objectively rank the various methods used to quantify the supposed shortage, they all fail to adequately explain an economic shortage relative to the optimal supply. For instance, Freddie Mac states that “The main driver of the housing shortfall

has been the long-term decline in the construction of single family homes.”⁹ But such statements say nothing about what caused the construction decline in the first place, much less whether it was suboptimal from an economic perspective, and the quantitative approaches taken by these groups offer no answers. At the very least, answering such questions about optimal housing supply requires controlling for specific factors driving both supply and demand. However, there is often no substantive discourse on the importance of factors such as changing family sizes, consumer preferences, how the decision to buy fares against the decision to rent, construction changes in single family versus multifamily housing, spatial variation in housing availability, and so on.

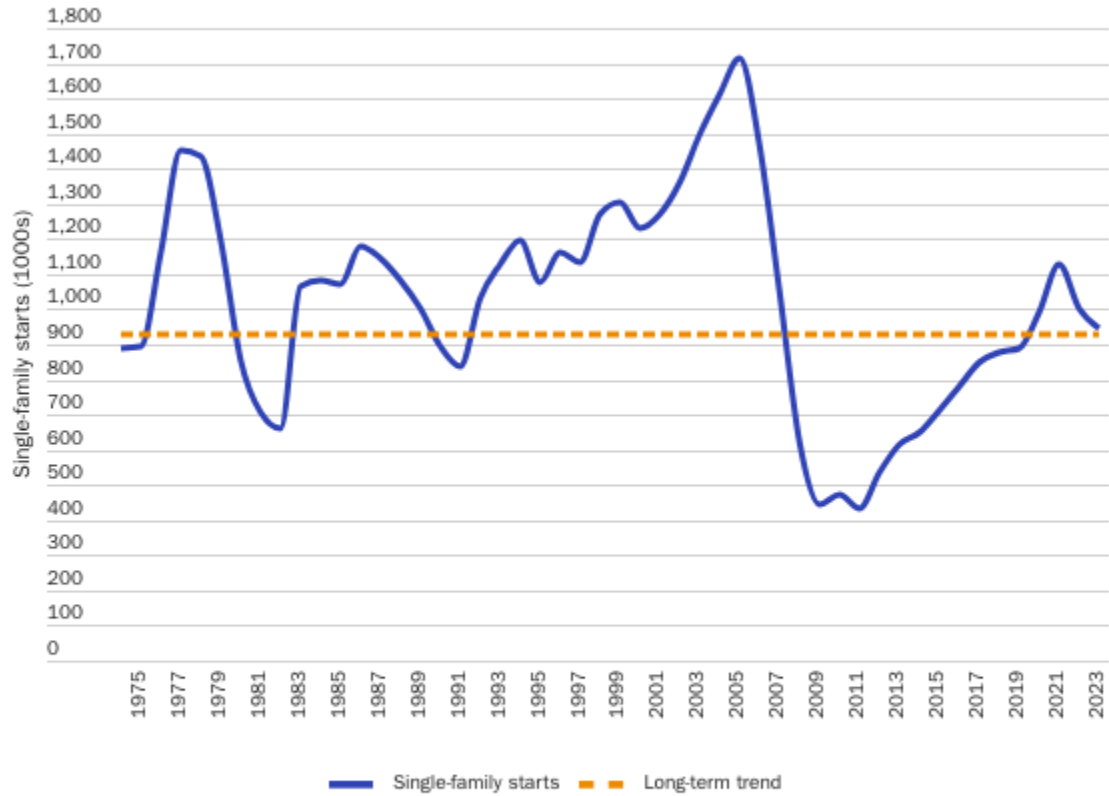
In this study, we provide perspective on *some* of these factors. For instance, the percentage of non-family households has been consistently increasing while household sizes have been falling. Moreover, household sizes have dropped more relative to family sizes, implying that while families have been growing smaller, the number of people living in each house has decreased by a greater magnitude. The data also reveal that vacancy rates prior to the 2008 financial crisis were much lower than the rates in the years immediately following it (see appendix). In terms of building types, construction of detached single family units fell more than attached single family homes.¹⁰ Still, construction of both attached and detached single family homes has recovered from the recession trough and is returning to its long-term trend (see figures 2, 3 and 4).

⁹ Freddie Mac, “Housing Supply: A Growing Deficit.”

¹⁰ Detached single-family units are defined as single-family homes, whereas attached single-family homes are defined as rowhouses and townhouses.

Figure 2

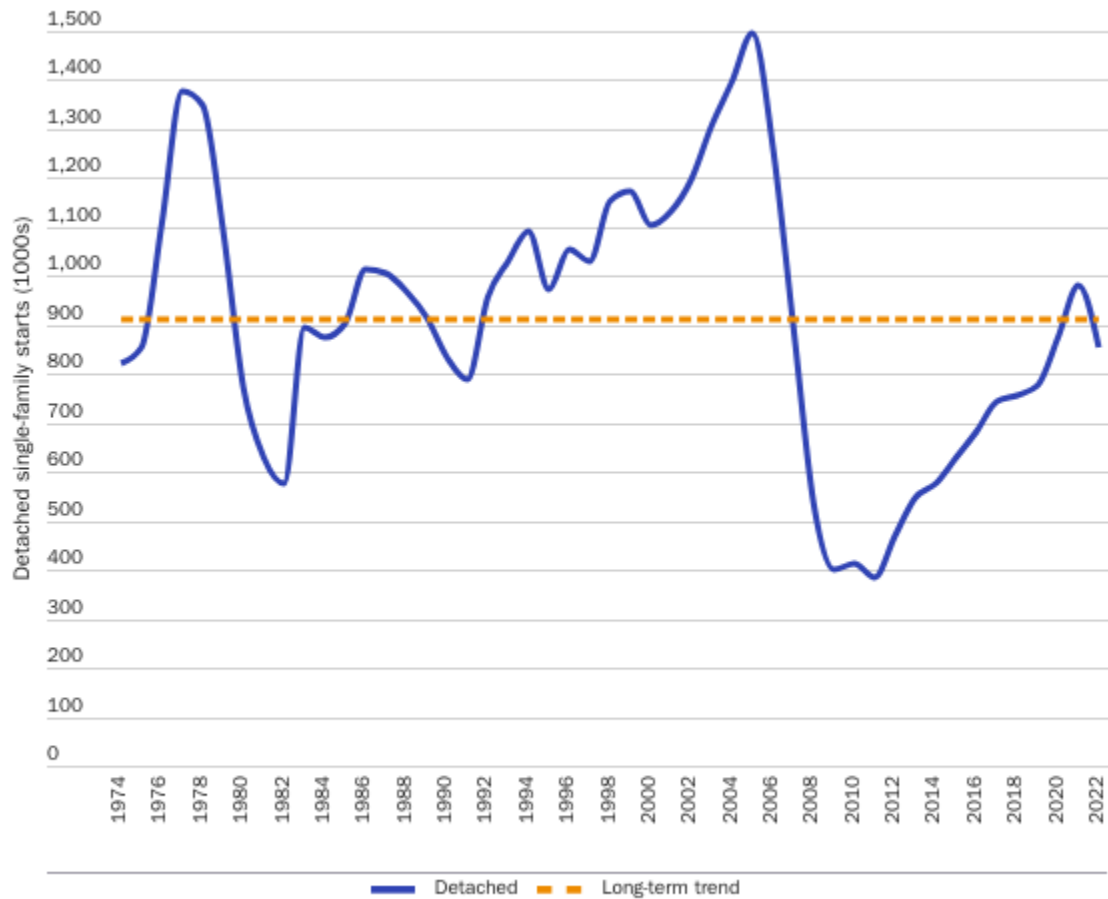
Single-family starts have returned to long-term trend



Source: U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately Owned Housing Starts in the United States, Total One-Family Units [HOUST1FQ], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/HOUST1FQ>, and U.S. Census Bureau, Table Q-1. New Privately Owned Housing Units Started in the United States, by Intent and Design, https://www2.census.gov/programs-surveys/nrc/tables/time-series/historical-nrc/quar_starts_purpose_cust.xls

Figure 3

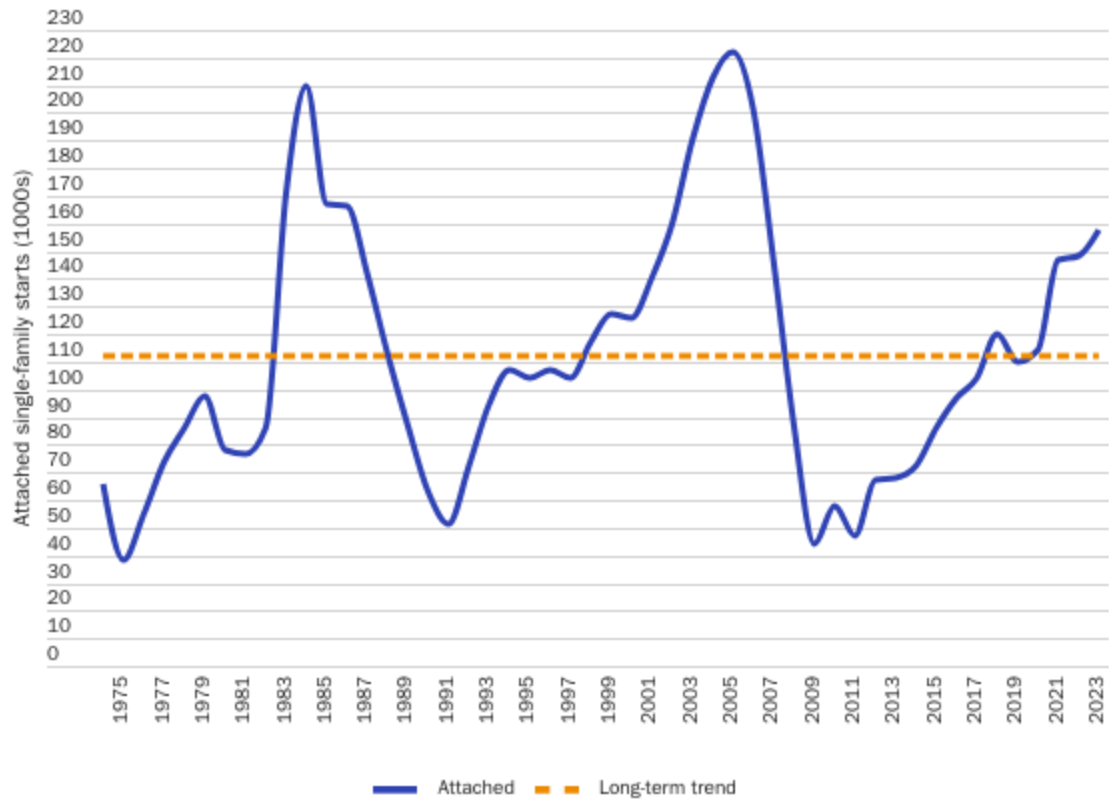
Detached single-family starts have returned to long-term trend



Source: U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately Owned Housing Starts in the United States by Design Type, Detached One-Family Units [HOUSTDTD1FQ], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/HOUSTDTD1FQ>, October 7, 2024.

Figure 4

Attached single-family starts exceed long-term trend



Source: U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately Owned Housing Starts in the United States by Design Type, Attached One-Family Units [HOUSTDTA1FQ], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/HOUSTDTA1FQ>, and U.S. Census Bureau, Table Q-1. New Privately Owned Housing Units Started in the United States, by Intent and Design, https://www2.census.gov/programs-surveys/nrc/tables/time-series/historical-nrc/quar_starts_purpose_cust.xls

Without an adequate understanding of the various demand and supply factors that drive housing market dynamics, policies designed to improve housing affordability could be ineffective or even counterproductive. If, for instance, housing demand factors such as income growth, wealth, and preferences for larger (better equipped) homes, tend to outweigh supply factors, home prices might continue to rise *even* in the face of above-average new home construction. Thus, while many policymakers may relax zoning requirements to boost supply and

help make homes more affordable, as they should, the price responses from such policies could be very disappointing.¹¹

Fortunately, the academic literature reveals a much more complex interplay between housing demand and supply than the groups who focus exclusively on improving affordability through boosting construction, as discussed in detail by Freemark (2023). In fact, several studies show that controlling for demographics and density suggest both housing prices and homeownership may be driven more by demand than supply, (Brookings Report (2002), Glaeser and Ward (2009), Fisher and Gervais (2011)). This finding is reiterated by Anenberg and Ringo's (2022) housing search model that emphasizes the significant role played by housing demand (and its underlying determinants) on the overall housing market dynamics. Still others (Schill (2005) and Glaeser & Gyourko (2018) to name a few) agree that low supply may be causing affordability issues. These studies generally argue that supply restrictions, in the form of land use and/or zoning, are the primary factors causing the *low supply*. We agree that government officials should relax rules and regulations that make building unnecessarily difficult and expensive, but officials should temper their expectations regarding the effects such changes might have on prices. The second part of this paper addresses the relationship between zoning changes and prices by analyzing a case-study in supply-based regulation changes in Denver, Colorado.

Estimating price responses from these kinds of regulatory changes is not always straightforward. For instance, Quigley and Rosenthal (2005) discuss some common issues that arise when studying supply regulation and housing prices. These issues include identification of

¹¹ Zillow, for instance, claims that "The growing housing shortage is the primary reason for the affordability crisis." Divounguy, "Affordability Crisis." Some groups make more subtle claims about affordability. See, for example, Rosen et al., "Housing is Critical Infrastructure," pp. 11-12.

endogeneity between regulation and price (wealthier, more expensive communities may have stronger tastes for regulation), and recognizing the complexity of local policymaking and regulatory behavior (many projects may be implemented simultaneously, some of which may make zoning more restrictive). In this paper, as we study the impact of the rezoning change implemented in 2010 in Denver, we confirm that Denver's rezoning episode does not coincide with any other growth or development projects. Additionally, our primary outcome variable is a Federal Housing Finance Agency (FHFA) House Price Index that considers repeat sales, correcting for well-known biases in price means and medians typically reported.

The data in this paper spans 48 counties in Colorado from 2000 to 2018, with the rezoning occurring in 2010 in Denver. A two-way fixed effects model is employed to isolate the impact of the zoning change in permits and prices, controlling for other geographic and temporal variation. Before rezoning, the average annual home price appreciation in Denver was about 4.53 percent. Controlling for permits issued both in the past year and the year before, rezoning is found to have reduced annual home price appreciation to about 2.6 percent. The presence of rezoning is associated with a significant increase in building permits issued as well, but the findings show that the relationship between an increase in permits and a reduction in house price appreciation is ambiguous. Still, the Denver rezoning presents a unique opportunity to study the effect of an exogenous shock to the number of permits on house price appreciation. It allows us to separate the supply-based outcomes and estimate how much supply singularly may affect affordability, while controlling for some of the demand-variation (those that can be captured by fixed effects). Naturally, we cannot control for all the demand-variation, and the ambiguity in our finding suggests that studying more detailed demand-dynamics might provide a clearer answer.

Our analysis of rezoning contributes to a growing literature studying zoning changes both in the US and abroad (e.g. in Zurich (Buechler & Lutz (2021), Auckland (Greenaway-McGrevy and Phillips (2022), Brisbane (Limb and Murray (2022))). While studies about zoning changes within the US almost unanimously agree that relaxing zoning restrictions leads to higher building permits and supply (although the effect on supply of low-cost housing is mixed), the findings on price-effects are more ambiguous. For instance, a host of studies find that some rezoning efforts have led to *increasing* housing prices. These studies include Angotti (2016) and Liao (2022) analyzing New York upzoning, Freemark (2019) discussing Chicago upzoning, Dong (2021) analyzing rezoning in Portland and Stacy et al. (2023) analyzing a cross-city panel dataset of land use reforms. However, another set of studies finds that zoning changes can reduce price growth, aligning with our finding with respect to Denver. These studies include Anagol, Ferreira & Rexer (2021) studying rezoning in Sao Paolo, a paper that reports rezoning led to a 1.9 percent increase in housing stock and a 0.5 percent reduction in prices, with substantial heterogeneity across neighborhoods. Separately, Buechler & Lutz (2021) analyze rezoning in Zurich and discuss how increased housing production may reduce prices in the region overall due to increased supply, but with limited effect at the city level due to changes in amenities from construction.

Motivation

Real housing prices exhibited an above-normal spike during 2020 and 2021, and many observers have referred to this spike as a housing crisis caused by a shortage in construction of new housing units.¹² However, these so-called shortages typically do not refer to the quantity

¹² A recent Brookings Institute article asks, “What can the next administration do about the US housing shortage?” and argues that “experts broadly agree that the U.S. has millions fewer units of housing than American families need.” Wendy Edelberg, “What Can The Next Administration Do About The US Housing

demanded exceeding the equilibrium quantity at the market price. Moreover, they do not refer to a situation where buyers (or renters) cannot buy (or rent) at a given market price. Instead, these “shortages” typically refer to a supply deficit compared to some preferred measure of supply. Consequently, various groups (and elected officials) use these figures to argue that more building is needed to reduce market prices.

Naturally, the market price of new homes will fall, holding all other factors constant, if supply is increased. Still, not only can many factors change, but housing markets are always somewhat supply-constrained. It takes approximately one year to build a new house, and many of the places that people want to live are already well-developed. Thus, in many geographic locations, because demand factors can outweigh supply factors, an increased supply of homes may not lead to a *decrease* in home prices, even if new supply results in prices rising less rapidly than they would have otherwise.

Regardless, the estimates of these so-called shortages vary widely, both in terms of how they are calculated and in size. Corinth and Dante (2022) estimate that the United States had a housing shortage of 20.1 million homes in 2021, a total representing the number of homes that (according to their methodology) would have been built in the absence of zoning and other regulatory constraints.¹³ Corinth and Dante’s (2022) estimate is something of an outlier in terms of the quantity and in methodology. Unlike the other groups, the key variable in their model is the land share, a variable that they assume will fall to approximately 20 percent without

Shortage?”, Brookings, October 24, 2024, https://www.brookings.edu/articles/what-can-the-next-administration-do-about-the-us-housing-shortage/?utm_campaign=Economic%20Studies%20Bulletin&utm_medium=email&utm_content=331343753&utm_source=hs_email.

¹³ Kevin Corinth and Hugo Dante, “The Understated ‘Housing Shortage’ in the United States,” IZA Discussion Paper No. 15447, July 2022, <https://docs.iza.org/dp15447.pdf>.

regulatory constraints. As alluded to earlier, many of the other estimates of the so-called housing shortage, which range from approximately 1 million to 5 million units, depend on a comparison of current vacancy rates—the number of vacant homes as a share of all housing units—to their long-term average.

Relying on such metrics to call for new construction is problematic for several reasons. First, these metrics do not answer the key question of whether, over the long run, housing construction tends to keep up with population growth, such that people are generally not lacking a place to live. Additionally, these metrics generally do not estimate specific demand factors (income growth, consumer preferences, interest rates, lending policies, etc.) that could still lead to home price increases even in markets with additional construction.¹⁴ Finally, because these metrics ignore equilibrium supply conditions, attempts to make up even the most conservative of these “shortages” could constrain basic supply factors (labor, materials, land, etc.) so much that it leads to higher home prices.

It is likely that claims of a crisis are largely driven by the size of the recent price spike, one that was larger than normal. However, as Figure 5 shows, the recent price spike was followed by an almost perfectly offsetting decline, so much so, that the real median home price is found to be on an overall downward trend since the second quarter of 2022. Additionally, the

¹⁴ It is well documented that federal policies made a concerted effort to increase home mortgage lending at various points during the past century. In the 1950s, for example, the Federal Housing Administration (FHA) began to reduce the downpayment required to take on a home loan through its single-family mortgage program. Eventually, Congress passed the Federal Housing Enterprises Financial Safety and Soundness Act of 1992, a law that required the secretary of the U.S. Department of Housing and Urban Development (HUD) to establish three broad affordable housing goals for Fannie Mae and Freddie Mac, thus expanding their lending support. In 2000, HUD increased those goals. For a history of FHA downpayment requirements see M. Carter McFarland, “FHA Experience with Mortgage Foreclosures and Property Acquisitions,” Federal Housing Administration, January 1963, p. 23, <http://babel.hathitrust.org/cgi/pt?id=mdp.39015008723499>. For a description of the increase in the affordable housing goals see U.S. Department of Housing and Urban Development, “HUD’s Affordable Lending Goals for Fannie Mae and Freddie Mac,” *Issue Brief* No. v, January 2001, <http://www.huduser.org/publications/pdf/gse.pdf>.

recent price spike coincided with major market disruptions related to the COVID-19 pandemic which appears to have changed demand factors in many regional markets, partly due to increased remote employment opportunities. As Figure 6 shows, the spike also coincided with a decline in the U.S. population *and* an increase in new housing units completed. In fact, new units completed have been on an increasing trend since 2011. Thus, while government officials should do all they can to reduce regulatory impediments to building the homes that people want, they should also refrain from trying to meet arbitrary targets with new construction because doing so may worsen affordability.

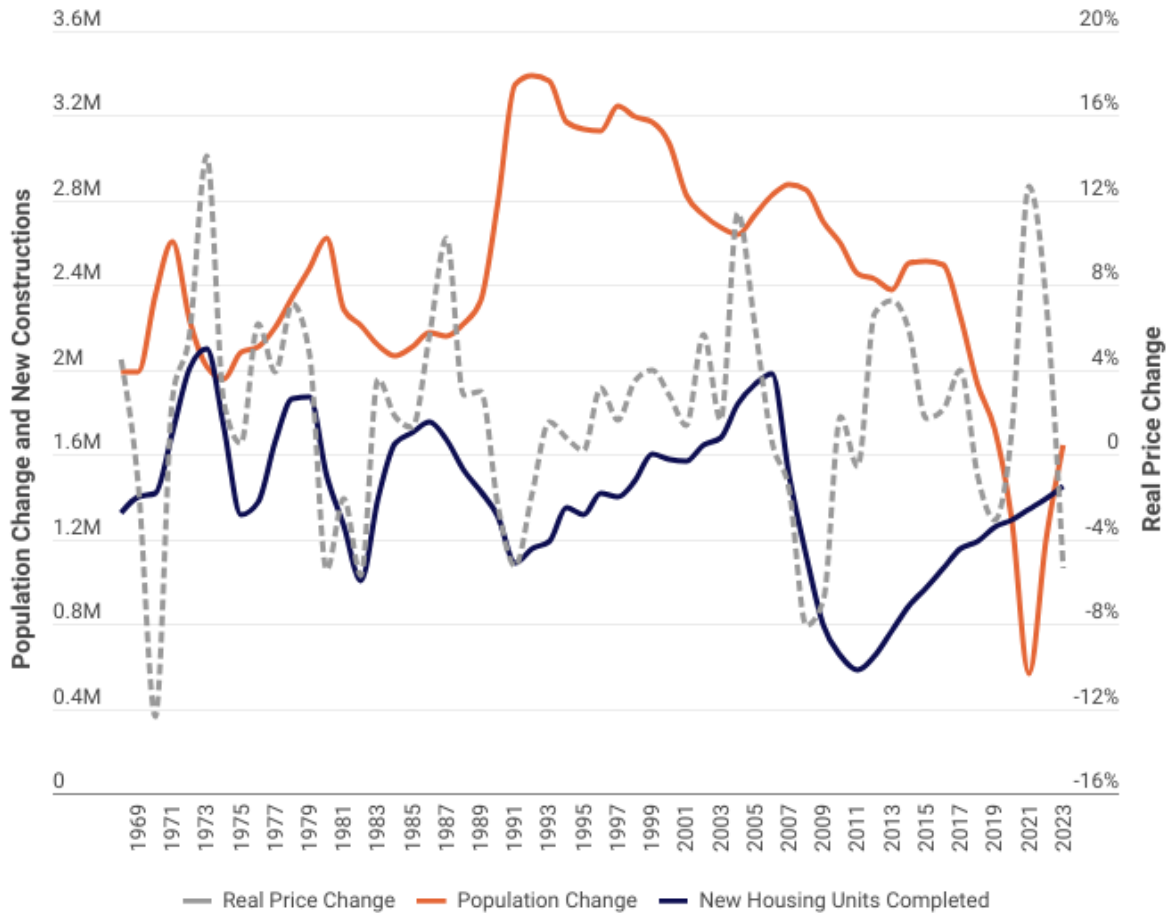
Figure 5

Real Median Home Price Over Time (PCE-adjusted, 2017 Dollars)



U.S. Census Bureau and U.S. Department of Housing and Urban Development, Median Sales Price of Houses Sold for the United States [MSPUS], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/MSPUS>, October 28, 2024, and U.S. Bureau of Economic Analysis, Personal Consumption Expenditures Excluding Food and Energy (Chain-Type Price Index) [PCEPILFE], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/PCEPILFE>, October 28, 2024.

Figure 6
Population Change, New Constructions and Price Change



U.S. Census Bureau and U.S. Department of Housing and Urban Development, Median Sales Price of Houses Sold for the United States [MSPUS], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/MSPUS>, October 28, 2024, and U.S. Bureau of Economic Analysis, Personal Consumption Expenditures Excluding Food and Energy (Chain-Type Price Index) [PCEPILFE], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/PCEPILFE>, October 28, 2024, U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Completed: Total Units [COMPUTNSA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/COMPUTNSA>, October 28, 2024, U.S. Bureau of Economic Analysis, Population [POPTHM], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/POPTHM>, October 28, 2024.

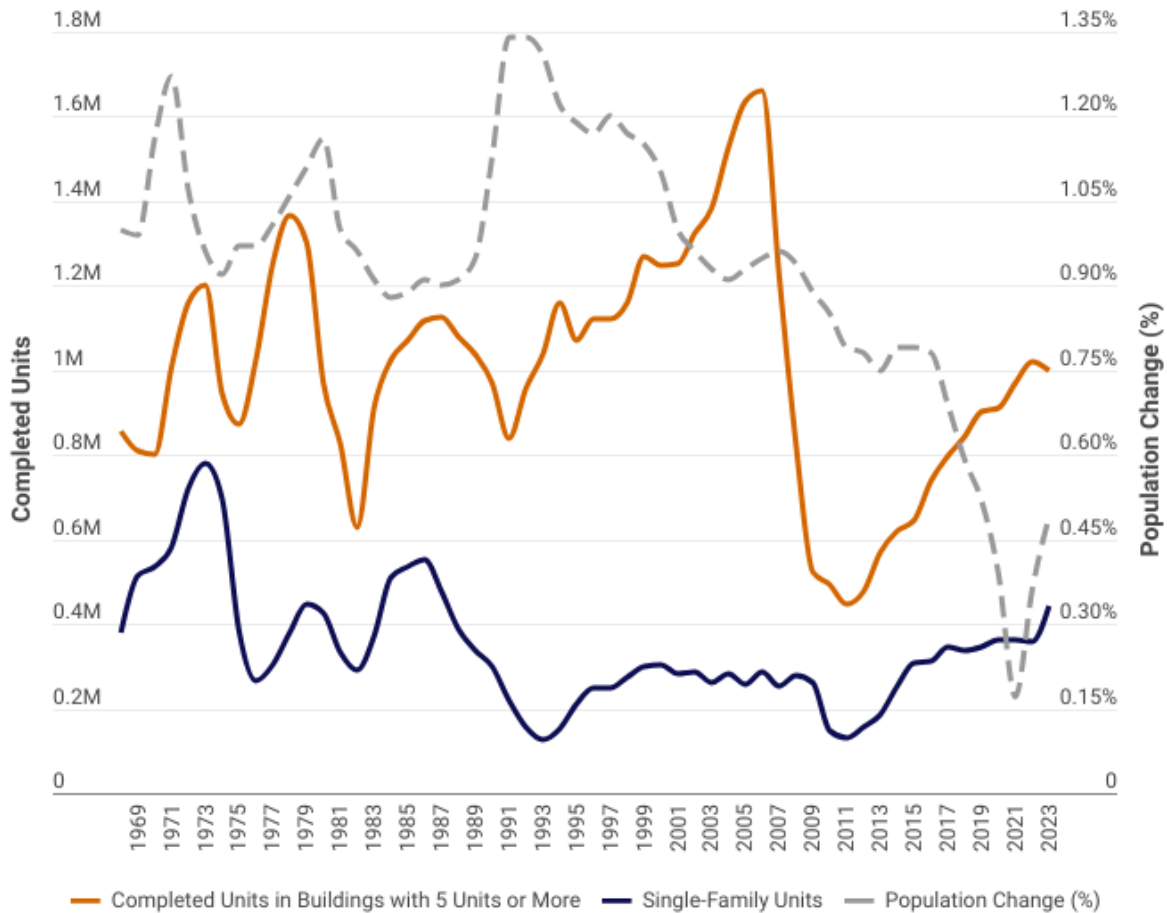
A longer-term look at the data shows that, from 1967 until the 2008 financial crisis, new units completed tended to move very similarly to prices, though with a bit less variation. However, that similarity changed after the 2008 financial crisis. In 2011, new units completed began a steadily increasing trend, but prices exhibited one large spike from 2008 to 2013, followed by a decreasing trend until 2019, and then a sharp spike followed by a reversal in 2021.

Although supply remained on a steadily increasing trend through this period, mortgage rates declined to historic lows, suggesting that the spike in prices was largely demand-driven.

Availability Metric Counters Housing Crisis Story

Rather than focus on an existing metric of the so-called housing shortage, we present more details on housing availability, a concept that says more, by definition, about whether the United States is experiencing a housing crisis. As Figure 6 demonstrated, annual housing units completed followed an upward trend from 1992 to 2005, while the population change was falling, and then declined for several years. Since 2011, however, units completed have been on the rise. Figure 7 presents population changes with units completed in multifamily housing (5+ units per building) and single family, respectively. As Figure 7 shows, construction of both single family units and multifamily units has been increasing.

Figure 7
Completed Units by Type and Population Change



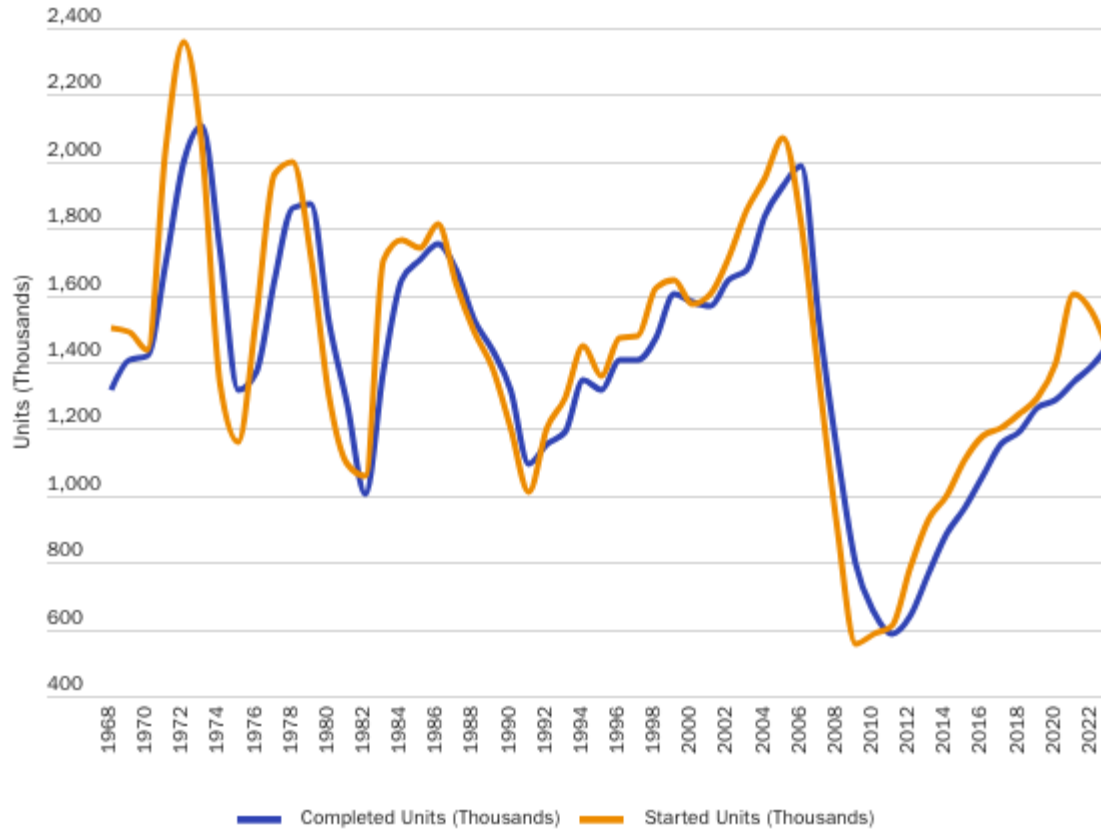
U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Completed: Units in Buildings with 5 Units or More [COMPU5MUSA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/COMPU5MUSA>, November 4, 2024, U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Completed: Single-Family Units [COMPU1USA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/COMPU1USA>, November 4, 2024, October 28, 2024, U.S. Bureau of Economic Analysis, Population [POPTHM], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/POPTHM>, October 28, 2024.

While annual units completed show the supply of housing that is ready for occupancy, many analysts use annual units *started* to proxy housing construction. It is important to note, though, that during the COVID-19 pandemic the housing units completed was not a simple lagged version of housing units started. The two series diverged following the pandemic in 2020, and as of 2023 have converged to their longer-term relationship (see Figures 8 and 9). It is

possible, of course, that the divergence in these two series was driven by delays in construction activity caused by pandemic related Non-Pharmaceutical Interventions (NPIs).

Figure 8

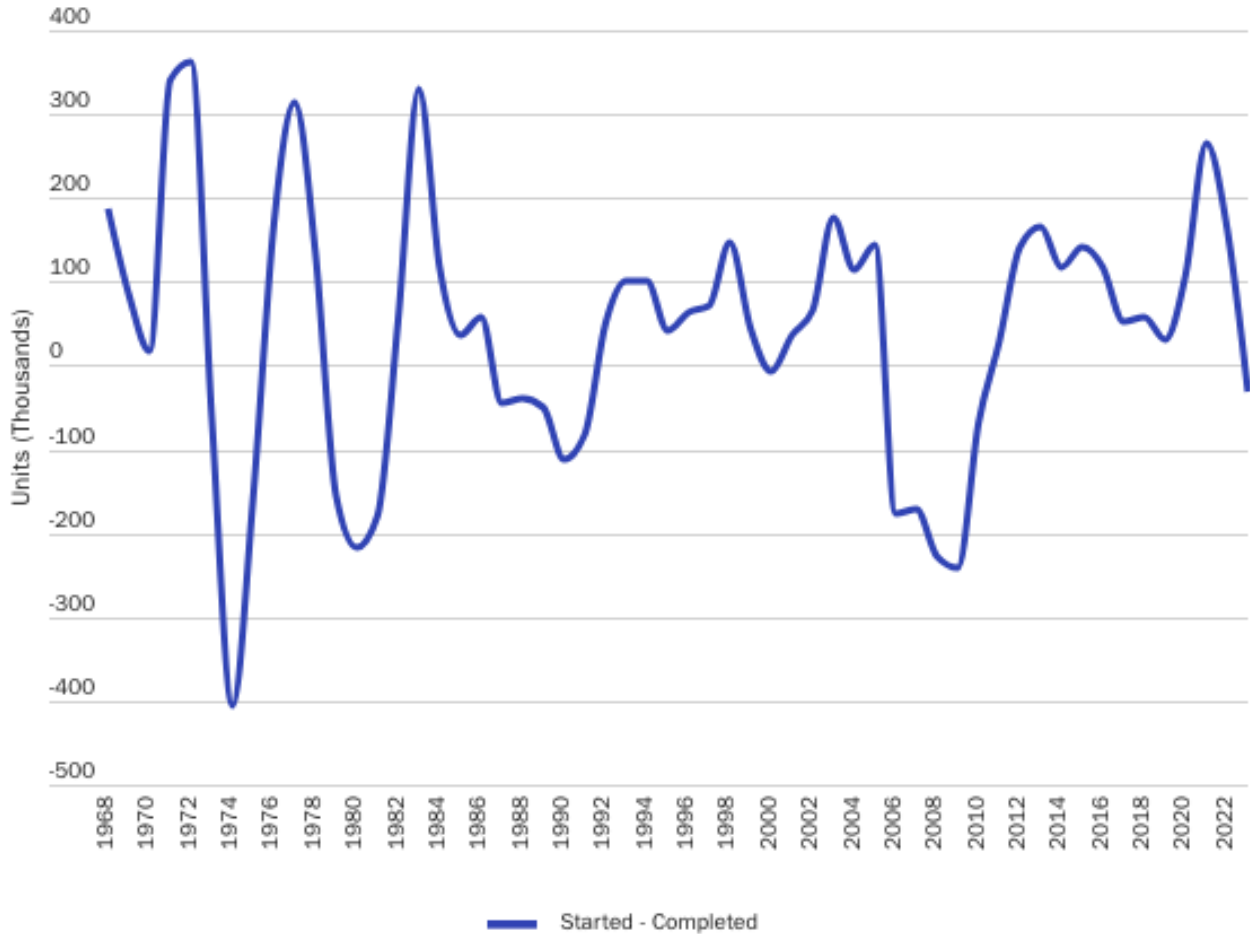
Units Started vs. Completed



Source: U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Completed: Total Units [COMPUTSA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/COMPUTSA>, October 31, 2024, U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Started: Total Units [HOUST], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/HOUST>, October 31, 2024.

Figure 9

Units Started Minus Units Completed



Source: U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Completed: Total Units [COMPUTSA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/COMPUTSA>, October 31, 2024, U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Started: Total Units [HOUST], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/HOUST>, October 31, 2024.

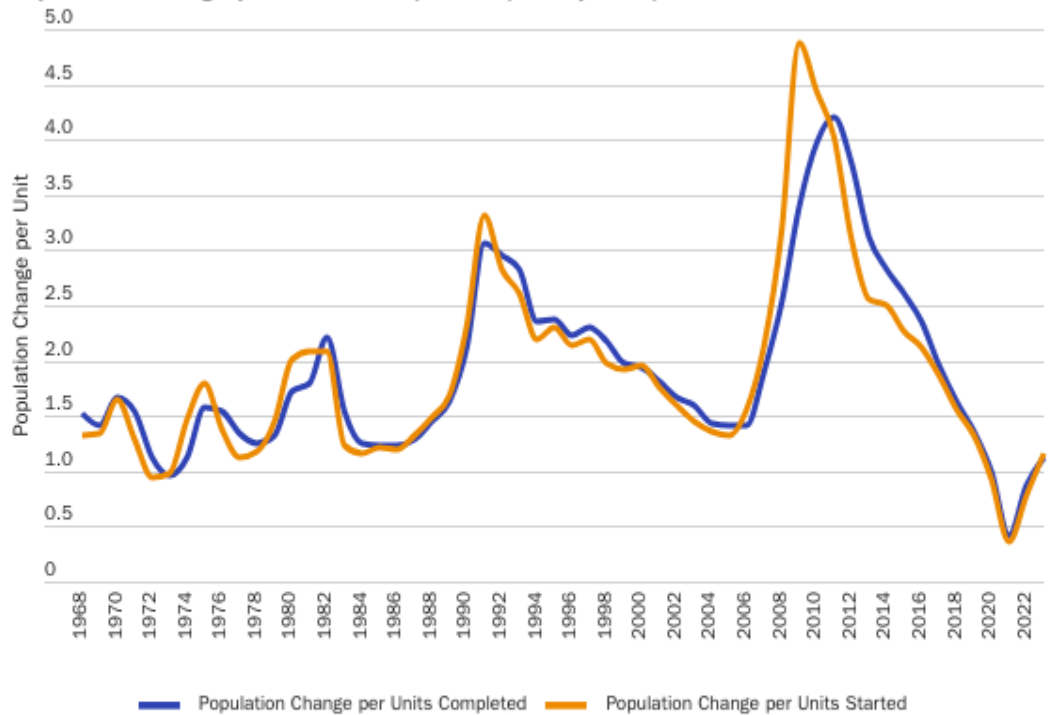
Naturally, it is important to study how units started (or completed) compared to the change in population nationally during the past several decades. Without accounting for how they relate to population changes, the housing starts (or completes) series only shows temporal trends and lacks an objective measure of how construction has fared alongside the “need” for it.

Figure 10 therefore shows the annual change in population divided by the number of units started

(in blue) and the annual change in population divided by the number of units completed (in orange). As either of these ratios decreases, it implies that there is a relatively higher volume of housing being built compared to the demand created by annual population change.

Figure 10

Population Change per New Units (Started/Completed)



Source: U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Completed: Total Units [COMPUTSA], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/COMPUTSA>, October 31, 2024, U.S. Census Bureau and U.S. Department of Housing and Urban Development, New Privately-Owned Housing Units Started: Total Units [HOUST], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/HOUST>, October 31, 2024, <https://fred.stlouisfed.org/series/COMPU1USA>, October 31, 2024, U.S. Bureau of Economic Analysis, Population [POPTHM], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/POPTHM>, October 31, 2024.

As Figure 10 demonstrates, from approximately 2009 to 2018, yearly units completed and started increased with annual population changes (a downward trend in the orange and blue lines for both periods). The population change per units started (or completed) was the highest

following the financial crisis.¹⁵ However, since then, population change relative to building units dropped continuously, to hit an all-time low of 0.35 in 2021, before rising slightly in 2022. The 2021 ratio is symbolic of a lower change in population than housing unit starts (and completes) and the magnitude itself was lower than it was at any point during the past five decades. As such, in the absence of clear evidence showing a shortage in supply, from here on, we refer to our housing supply related metric as a “housing availability” metric, departing from the widely used terminology of “housing shortage.”

Panel Data on Housing Availability Counters Housing Crisis Story

While the national trends in the long time-series graphs are not indicative of any crisis-level decrease in housing supply, it is also important to study similar availability metrics for geographically smaller regions. Of course, since so many aspects of the housing market have changed since the 1970s, it is also important to undertake a more granular analysis on a shorter period. Hence, this section describes a novel analysis of housing availability starting from 2000. It is based on annual housing supply and annual changes in population using a 22-year panel of approximately 362 counties. The county-level data allows a more in-depth analysis that considers housing availability across time, categorized by building types and variation in population density across locations. The supply metric at the county level is measured best (based on data availability) by the building permits issued annually in each county, and hence,

¹⁵ Apart from population change, the change in the number of households may also serve as a proxy for housing demand. However, the aggregate count of households exhibits much more variation than the population series (especially in Census years), owing to both underlying variations and methodological revisions. Figure 14 in the appendix illustrates this variation. Due to this volatility, the ability of individuals (both family and non-family members) to move in and out of households on a regular basis, and the lack of a county-level household count time-series, we use population change here and in the panel analyses shown in the following sections

from here on out, our analyses employ building permits and population changes as the primary variables of interest.

The two major data sources used for this analysis are: (1) county-level annual numeric change in resident total population from the U.S. Census Bureau, Population Division; and (2) Building Permits Survey county-level data on no. of units for which permits are issued in single family and multifamily (2-4 units and 5+ unit) buildings. This data is geographically restrictive and the lack of consistent locations over time limits the sample to a panel of 362 counties. Using these data, we construct an availability ratio, defined as the ratio of resident population change to units permitted (of all building types). While a higher ratio implies a higher number of residents allotted to a single housing unit, alluding to lower housing availability, a lower ratio implies *more* availability.

The ratio can take negative values and positive values corresponding to population reductions and increases in a county, at any point in time. If the annual number of units permitted is 0, a value of 1 is assumed and the ratio takes the value of the population change.¹⁶ Housing availability varies both across time and geographic location, but we first provide a basic overview of how the data looks across time, aggregated over all the available counties.

Table 2 shows the ratio of median population change to median units permitted (of all building types) each year. Among positive values, the ratio can take values less than or greater than 1. A value less than 1 implies that more housing units are permitted annually relative to the population change, suggesting a higher housing availability. A value greater than 1 implies that

¹⁶ Zero permits occur for less than 5 percent of the data and does not materially affect the results; the imputation merely changes the availability ratio to the concurrent population change, implying a very low housing availability (as is shown by the 0 units permitted).

the resident population change is higher than the annual housing units permitted, suggesting a lower housing availability. We use the ratio of median values to help ensure that extremities in large urban areas do not bias the central tendencies. Based on the median ratios, availability has been improving steadily since 2013, with a ratio of less than 1 since 2020. Based on the average ratios, availability has been improving steadily since 2009, with a ratio less than 1 since 2020.

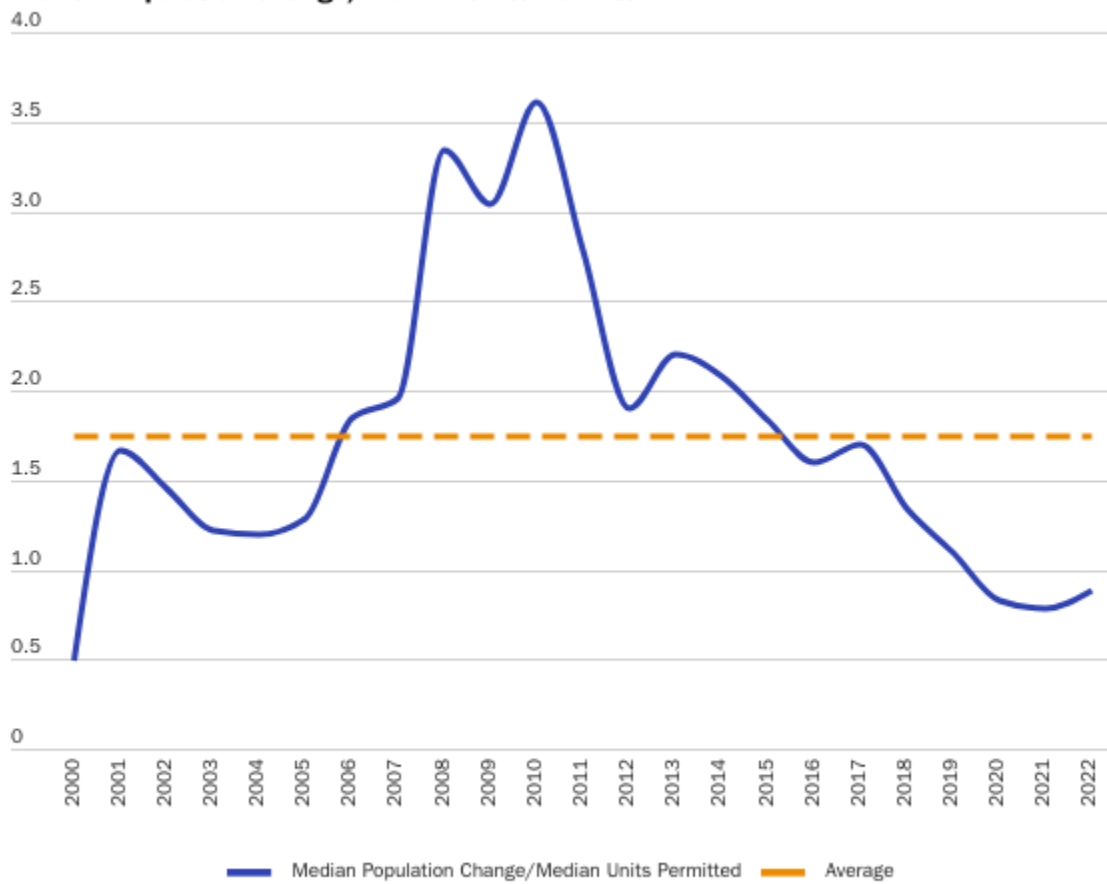
Table 2
Summary Statistics By Year

Year	Avg. Single Family Units Permitted	Avg. Multifamily Units Permitted	Avg. Total Units Permitted	Avg. Pop Change	Median Pop Change	Median Total Units	Average Pop Change/Average Units Permitted	Median Pop Change/Median Units Permitted
2000	1532	625	2157	1195	432	878	0.55	0.49
2001	1585	624	2209	4906	1577	951	2.22	1.66
2002	1687	624	2312	4131	1403	968	1.79	1.45
2003	1847	665	2512	3698	1314	1077	1.47	1.22
2004	1918	694	2612	3840	1272	1066	1.47	1.19
2005	1756	580	2337	3372	921	718	1.44	1.28
2006	1411	600	2011	3123	1116	606	1.55	1.84
2007	973	537	1511	3733	962	490	2.47	1.96
2008	545	433	978	3656	903	270	3.74	3.34
2009	417	150	567	3302	681	224	5.82	3.04
2010	428	174	602	3162	690	191	5.25	3.61
2011	418	235	653	3127	497	179	4.79	2.78
2012	546	404	950	3335	413	217	3.51	1.90
2013	670	495	1165	3181	596	271	2.73	2.20
2014	689	565	1254	3301	594	285	2.63	2.08
2015	755	694	1450	3366	591	323	2.32	1.83
2016	811	602	1413	3136	581	364	2.22	1.60
2017	63	53	1499	2622	625	368	1.75	1.70
2018	926	656	1582	2191	545	406	1.39	1.34
2019	930	714	1644	1949	474	431	1.19	1.10
2020	1058	639	1696	1501	380	460	0.89	0.83
2021	1204	802	2005	-96	447	574	-0.05	0.78
2022	1003	917	1920	1284	432	490	0.67	0.88

Figure 11 reports the ratio of the medians from the above table. This graph shows that housing availability worsened during the financial crisis and was the lowest (corresponding to the highest ratio) immediately following the crisis. Also, while availability slightly worsened in 2022, it has fared better than the average since 2016, with the trend improving almost steadily starting in 2010.

Figure 11

Median Population Change/Median Units Permitted



Note: 2001, 2007-2009 and 2020 are recession years according to NBER.

Source: U.S. Census Bureau Population Division and Building Permits Survey.

Panel Data Regression of Housing Availability Counters Crisis Story

For a more robust study of the associations between annual changes in population and yearly building permits issued, we run multiple regressions. The regression models are listed below with the advantages of each subsequent model explained briefly.

- I. The base model is a simple panel regression with 13 years and 512 counties:

$$PC_{ct} = \alpha + \beta * U_{ct} + \varepsilon_{ct}$$

PC_{ct} = Change in population between year t and year $t-1$ in county $c \forall t = 2010, 2011, \dots, 2022$

U_{ct} = Total units permitted in county c in year t

- II. Then, we add year-fixed effects to base model. The year-fixed effects account for any time-specific changes that happen over the years:

$$PC_{ct} = \alpha + \beta * U_{ct} + \gamma_t + \varepsilon_{ct}$$

γ_t = year dummies

- III. Next, we add state-fixed effects to the second model. The state-fixed effects account for any state-specific changes that happen over the years:

$$PC_{ct} = \alpha + \beta * U_{ct} + \gamma_t + \gamma_s + \varepsilon_{ct}$$

γ_s = state dummies

IV. The following model adds county-fixed effects to base model along with year-fixed effects. The state-fixed effects account for any state-specific changes that happen over the years, while the county-fixed effects are more granular, controlling for county-specific changes over time. This model is known as a two-way fixed effects model owing to the inclusion of fixed effects of the individual unit and time:

$$PC_{ct} = \alpha + \beta * U_{ct} + \gamma_t + \gamma_c + \epsilon_{ct}$$

γ_c = county dummies

Panel Regression Results

The numbers in the tables report the amounts by which changes in population are associated with one additional housing unit permitted to be built. So, the value 0.98 in Column (3) of Table 2 implies that in the full panel, with state and year fixed effects, an additional unit permitted is associated with a 0.98 increase in resident population. This estimate provides a more robust version of the availability metric introduced earlier. It can also be interpreted as a 100-unit increase in resident population being associated with approximately 102 more housing units permitted for construction.

Table 3 shows that within the full sample, adding year-fixed effects increases the magnitude of the association between population-change and units permitted, while adding county fixed effects gets rid of any statistical significance.

Table 3: Full Panel Regression Results

Population Change	(1)	(2)	(3)	(4)
Units Permitted	0.99*** (0.04)	1.10*** (0.04)	0.98*** (0.04)	0.39 (0.30)
Year FE	No	Yes	Yes	Yes
State FE	No	No	Yes	-
County FE	No	No	No	Yes
Adjusted R ²	0.37	0.35	0.37	0.12

Table 4 shows the changing association between population and units permitted across multiple subsamples. Columns (1), (2) and (3) pertains to the pre-pandemic periods, 2000-2005, 2006-2009, and 2010-2019. Column (4) looks at all the years except the most recent year, while Column (5) isolates the relationship for only the most recent year of observation (2022) to enable a comparison of other results to those in the post-pandemic market. In 2022, the value is negative, implying that while population decreased, building permits issued increased at the rate of 100 residents to 185 housing units. The housing availability was at its lowest around the financial crisis when a 100-unit increase in population was associated with only 52 housing units permitted. This rate increased to approximately 79 units for every 100 residents, after the crisis. Overall, between 2000-2021, the average building units permitted per 100-unit change in resident population is approximately 93 housing units.

Table 4: Panel Regression Results for year-based sub-samples

Population Change	2000-2005 (1)	2006-2009 (2)	2010-2019 (3)	2000-2021 (4)	Only 2022 (5)
Units Permitted	1.50*** (0.04)	1.94*** (0.08)	1.26*** (0.05)	1.08*** (0.04)	-0.54*** (0.20)
Year FE	Yes	Yes	Yes	Yes	-
State FE	Yes	Yes	Yes	Yes	Yes
R-squared (Adj. where applicable)	0.53	0.43	0.60	0.45	0.24

Table 5 follows a similar organization to Table 4. The units permitted are subdivided into units in single family, all multifamily buildings, and multifamily buildings with 2-4 units. It appears that while there's significant correlation between population change and units permitted in single family and 2-4-unit multifamily buildings, there's no significant association between population change and units permitted in all multifamily buildings.

Single family units permitted have varied significantly across the pre-pandemic periods. However, in 2022, housing availability in single family buildings was relatively low, with a 100-unit increase in resident population being associated with an increment of 47.6 single family units permitted for construction. Multifamily permits issued in 2-4-unit buildings, however, more than made up for the 2022 deficit in single family housing. For 2-4-unit multifamily buildings, the metric is negative 11.72, implying that each of those housing units permitted is associated with about a 12-unit decrease in resident population during 2022. Put differently, during 2022, a 100-unit decrease in resident population is associated with an 8.5-unit increase in unit permits in 2-4-unit multifamily buildings.

Table 5: Panel Regression Results for year-based and building-based subsamples

Population Change	2000-2005 (1)	2006-2009 (2)	2010-2019 (3)	2000-2021 (4)	Only 2022 (5)
Single family units permitted	1.93*** (0.43)	1.69*** (0.51)	0.92 (0.73)	1.13*** (0.16)	2.10*** (0.25)
Multifamily units permitted in 2-4-unit buildings	-1.81 (4.34)	0.13 (6.36)	-32.37** (15.36)	-1.28 (4.34)	-11.72*** (3.42)
All multifamily units permitted	-0.75 (0.85)	-0.82 (2.02)	-0.78 (0.49)	-0.54 (0.58)	0.00 (0.21)
Year FE	Yes	Yes	Yes	Yes	-
State FE	-	-	-	-	Yes
County FE	Yes	Yes	Yes	Yes	No

Table 6 shows the association between population change and total units permitted in various periods before the pandemic, and in 2022, grouped by locations that have above and below median population density. The availability of housing in countries below median density is slightly worse in 2022 than the entire pre-pandemic era. In 2022, a 100-unit increase in resident population is associated with an approximately 55-unit increase in housing units permitted in low density counties. For high density counties in 2022, the result is statistically insignificant. Historically, housing availability in high density counties has fared better than in low density counties (evidenced by a lower estimate across the 1st row in Table 6, relative to the 2nd row, up until column 4), however there’s no conclusive evidence to say that the same still holds true in 2022. Again, these results are not indicative of a housing crisis in that building is keeping up with population changes, even in higher density areas. Indeed, given this relationship in high-density areas, the results suggest that consumer demand—the choice to live in a high-density area—tends to outweigh supply factors and push prices up.

Table 6: Panel Regression Results for year-based and population-density based sub-samples

Population Change	2000-2005 (1)	2006-2009 (2)	2010-2019 (3)	2000-2021 (4)	Only 2022 (5)
Total units among high pop. density locations	1.22*** (0.08)	1.54*** (0.14)	0.99*** (0.07)	0.82*** (0.06)	-0.11 (0.23)
Total units among low pop. density locations	1.83*** (0.04)	2.01*** (0.05)	2.66*** (0.05)	1.76*** (0.02)	1.82*** (0.11)
Year FE	Yes	Yes	Yes	Yes	Yes
State FE	Yes	Yes	Yes	Yes	Yes

Denver Zoning Change Suggest Price Response Is Muted

The preceding sections of this paper provide evidence that, throughout the past few decades, new housing construction has kept with population growth. The findings in the last section are also consistent with demand outweighing supply in a high-density location, such that

housing price growth may respond mildly to increased home construction. To further investigate such a price response, this section of the paper studies a 2010 rezoning in Denver.

Denver adopted the new zoning code in 2010, replacing an older code, known as Former Chapter 59 (FC59) of the Denver Revised Municipal Code. The new code was adopted by the City and County of Denver on June 21, 2010 and became effective on June 25, 2010.¹⁷ It involves 13 articles defining seven new neighborhood contexts—Suburban, Urban Edge, Urban, General Urban, Urban Center, Downtown, and Special—based on the unique characteristics of a neighborhood, such as existing building types, uses, and street patterns.¹⁸ According to HUD, the code addresses affordability and sustainability by reducing minimum lot sizes, parking requirements for residential developments and increasing opportunities for developing diverse housing types in proximity to transit and employment centers.¹⁹ Using data that spans up to 8 years post the adoption of the new code, this section studies the differential impact of the code change on permits issued and home price appreciation.

To begin, it is important to note some nuances in what has become standard terminology regarding zoning changes. The zoning literature commonly refers to “upzoning” or “downzoning” as a zoning change resulting in an increase or decrease in building, respectively. Zoning codes across US municipalities are very complicated, and code changes may have unintended or unpredictable consequences with respect to the housing supply, so it is often

¹⁷ Denver’s zoning code change is summarized in the official Government website of Denver at <https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directories/Community-Planning-and-Development/Denver-Zoning-Code>

¹⁸ Zone district definitions available at <https://www.denvergov.org/Government/Agencies-Departments-Offices/Agencies-Departments-Offices-Directories/Community-Planning-and-Development/Denver-Zoning-Code/Zone-Descriptions>

¹⁹ As summarized in the U.S. Department of Housing and Urban Development’s online newsletter published on July 2011 available at https://archives.huduser.gov/rbc/archives/newsletter/vol10iss4_2.html

difficult to identify such changes as a true net “upzone” or “downzone.” For example, a zoning change may lead to an increase in single family units but a decrease in multifamily units. Judged by the number of permits, the change may appear to be an “upzoning,” but from the perspective of the change in total units, it would be a “downzoning.”

In the case of Denver’s 2010 zoning code change, with the lack of a clear comparison between the older code and the introduction of the new neighborhood contexts, and given that some properties retained the older zoning, we do not wish to presume the change was an “upzone” or a “downzone.”²⁰ We avoid this post-hoc application of terms and merely use the term “rezoning.”

We run multiple regressions to study the effects of Denver’s 2010 rezoning. Analogous to the two-way fixed effects model used in the preceding section, we now use the following regression specifications to measure the effect on permits and prices, respectively.

1. Impact of rezoning on permits issued:

$$U_{c,t} = \alpha + \beta_1 * R_{c,t} + \Delta P_{c,t} + U_{c,t-1} + U_{c,t-2} + \epsilon_{c,t}$$

Where:

$U_{c,t}$ = Total units permitted in county c in year t

$R_{c,t}$ = Rezoning indicator assuming the value of 1 for Denver between 2010-2018, 0 otherwise

$U_{c,t-1}$ = one-period lag of $U_{c,t}$

$U_{c,t-2}$ = two-period lag of $U_{c,t}$

²⁰ A discussion and further details on areas that did not implement the new code is available at <https://storymaps.arcgis.com/stories/2f00e0f23e8d481d832790ea8eba3a26>

$\Delta P_{c,t}$ = annual population change in county c in year t

2. Impact of rezoning on home-price appreciation:

$$\Delta HP_{c,t} = \alpha + \beta_2 * R_{c,t} + X_{ct} + \Delta HP_{c,t-1} + \Delta HP_{c,t-2} + U_{c,t-1} + U_{c,t-2} + \varepsilon_{c,t}$$

Where,

$\Delta HP_{c,t}$ = Annual change in home price between year t and year $t-1$ in county $c \forall t = 2000, 2011 \dots 2018$

$R_{c,t}$ = Rezoning indicator assuming the value of 1 for Denver between 2010-2018, 0 otherwise

$X_{c,t}$ = vector of contemporaneous controls including vacancy rates, annual population change, and permits issued.

$\Delta HP_{c,t-1}$ = one-period lag of $\Delta HP_{c,t}$

$\Delta HP_{c,t-2}$ = two-period lag of $\Delta HP_{c,t}$

The primary coefficients of interest from the preceding regression specifications are β_1 and β_2 , the coefficients for permits issued and annual change in home price, respectively, for the rezoning treatment across counties and years. (The two-way fixed effects model controls for variation across counties and years, as well as for factors changing across counties and years that may be affecting our outcome variables.) Consequently, a positive β_1 identifies an increase in permits because of rezoning, while a negative coefficient identifies a reduction in permits. Similarly, a positive β_2 identifies an increase in annual home-price-appreciation because of rezoning, while a negative coefficient identifies a reduction in home-price-appreciation.

Table 7: Rezone Effect on Permits

<i>Dependent variable:</i>	
Permits	
rezone	1,427.464*** (216.985)
lag_permits	0.480*** (0.064)
twolag_permits	0.092*** (0.017)
pop_change	0.027 (0.024)
Observations	912
R ²	0.371
Adjusted R ²	0.334
F Statistic	126.815*** (df = 4; 860)
<i>Note:</i>	*p<0.1; **p<0.05; ***p<0.01

Table 7 shows that the Denver rezoning is associated with a statistically significant increase of 1,427 new housing units permitted. For context, the average number of permits issued across all 48 counties in Colorado, from 2000-2018 is approximately 603. Hence, as a percentage of average permits issued, the presence of rezoning led to an increase in permits

approximately 200 percent, confirming that the zoning change did significantly increase housing construction.

	<i>Dependent variable:</i>				
	Annual Change in Home Prices				
	(1)	(2)	(3)	(4)	(5)
lag_annual_change	0.511*** (0.081)	0.512*** (0.082)	0.510*** (0.081)	0.511*** (0.082)	0.516*** (0.083)
twolag_annual_change	0.070 (0.070)	0.071 (0.070)	0.061 (0.072)	0.060 (0.072)	0.062 (0.072)
permits		-0.00005 (0.0002)			-0.0003 (0.0002)
lag_permits			0.0003* (0.0002)	0.0004** (0.0002)	0.0005*** (0.0001)
twolag_permits				-0.0001 (0.0002)	-0.0001 (0.0002)
pop_change	0.0002** (0.0001)	0.0002** (0.0001)	0.0002** (0.0001)	0.0002** (0.0001)	0.0002*** (0.0001)
Vacancy.Rate	-0.512*** (0.081)	-0.511*** (0.080)	-0.531*** (0.084)	-0.525*** (0.085)	-0.527*** (0.085)
rezone	-1.102** (0.507)	-0.969 (0.881)	-1.945** (0.765)	-1.928** (0.767)	-1.512 (0.938)
Observations	912	912	912	912	912
R ²	0.349	0.349	0.350	0.351	0.351
Adjusted R ²	0.310	0.309	0.310	0.310	0.310

Note: *p<0.1; **p<0.05; ***p<0.01

Table 8 shows the effect of rezoning on the annual change in home prices, with negative coefficients across specifications implying a reduction in home-price-appreciation. The first column of results includes controls like concurrent annual population change, vacancy rates, and lagged home price appreciation, but does not include controls for permits (contemporaneous or lagged). These results correspond to the effect of the presence of rezoning on home-price-appreciation, without accounting for change in permits. The second column adds contemporaneous permits, while the 3rd and 4th column include the addition of permits lagged by a year and permits lagged by 2 years, respectively. These results correspond to the impact of rezoning, controlling for the rise in permits issued (with the lagged permits possibly accounting for occupancy, following issuance of new permits). The 5th column provides results including all

the preceding control factors. Of the contemporaneous control variables, population changes and vacancy rates are statistically significant determinants of changes in home-price-appreciation. Meanwhile, increases in population are associated with increased home-price-appreciation, and increases in vacancy rates are associated with reductions in home price appreciation.

Most importantly, the rezone coefficient is statistically significant at the 5 percent level without inclusion of any permits at all, *and* with the inclusion of lagged permits. The results from Column 1 show that the presence of rezoning leads to a 1.102 percent reduction in annual house price appreciation. The average annual house price appreciation for Denver before the rezoning was about 4.53 percent. Hence, without accounting for changes in permits, rezoning appears to have reduced Denver's home price appreciation from 4.53 percent to 3.43 percent. The results in Column 3 indicate that, after controlling for permits issued in the prior year, rezoning is associated with a reduction of Denver's home price appreciation from 4.53 percent to 2.59 percent. This result does not change substantially when accounting for lagged changes in permits from 2 years back (Column 4), instead of one year. The addition of contemporaneous permits (as shown in Columns 2 and 5) renders the rezoning treatment insignificant, possibly suggesting that the time lag between permit-issuance and occupancy plays a pivotal role in home-price-appreciation being impacted by rezoning.

There are two key takeaways to be noted from the preceding results. First, even though rezoning substantially increased permits issued and helped reduce home-price-appreciation, it did not eradicate the increases in home prices altogether. In fact, relative to the very large increase in units permitted post rezoning, the price effect, at best, is a subdued 2 percentage point reduction in annual home-price-appreciation. Secondly, and more importantly, holding every other factor constant, the variation in the coefficient size and significance (comparing the results

across columns) solely originating from the inclusion or exclusion of contemporaneous and lagged permits implies an uncertainty in the role that increased supply played in the reduction of home-price-appreciation.

So, while rezoning did seem to slow the growth in home prices, it is not clear how much of that reduction stemmed from higher construction, raising questions about the general idea of more construction fixing exorbitant increases in house prices. While the models presented above attempt to control for as many of the demand factors as can be captured through fixed effects, we speculate that demand-based outcomes that change across time and space simultaneously, that are difficult to (and hence, not always) account for, might be important and often overlooked driving factors in the pricing story. For instance, housing demand increases with income, and Americans' real income has been increasing for decades.

According to the latest Census data, the share of households earning more than \$100,000 (income figures in real terms) essentially tripled from 1967 to 2023 (from 14 percent to 41 percent), while the share of households earning less than \$35,000 fell from 31 percent to 21 percent, and the share earning between \$35,000 and \$100,000 fell from more than 53 percent to 38 percent (see table 9).²¹

²¹ U.S. Census Bureau, "Income in the United States: 2023," <https://www.census.gov/library/publications/2024/demo/p60-282.html>

Table 9
Americans have gotten richer in real terms

Year	<\$35k	\$35k-100k	>\$100k
1967	31.3	54.5	14.4
2023	21.0	38.1	40.9

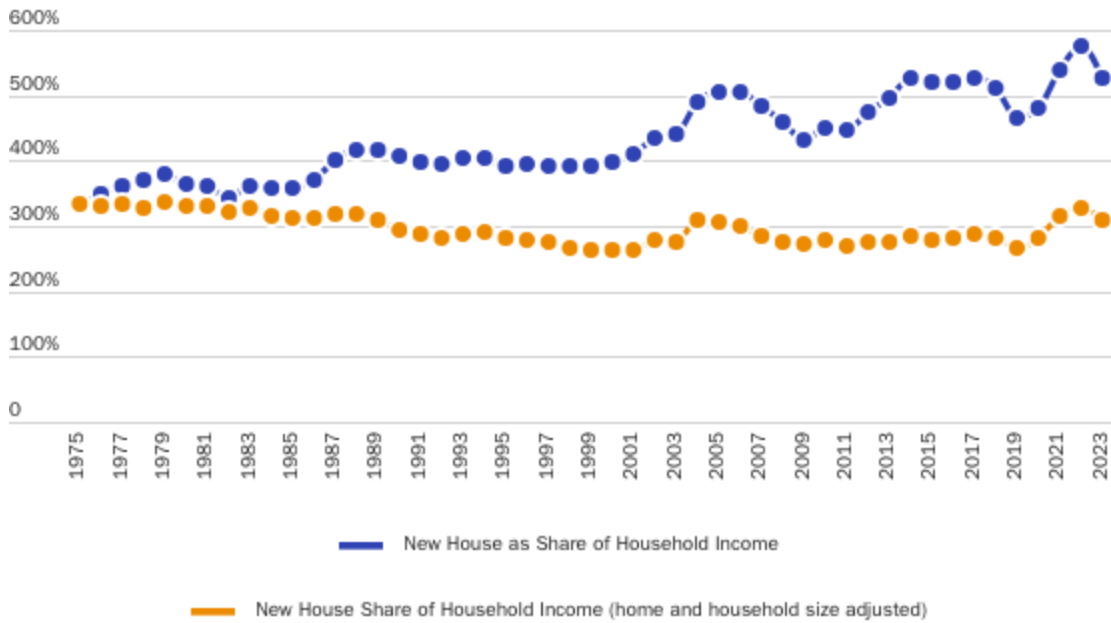
Note: Figures denote percent of households within real median household income range.

Source: U.S. Census Bureau, "Income in the United States: 2023,"
<https://www.census.gov/library/publications/2024/demo/p60-282.html>

Thus, while it does not fit the conventional narrative, it is at least plausible that people have been willing and able to pay higher prices for housing during the past few decades. In fact, as Figure 12 shows, adjusting for home size increases and household size decreases, homes are not more unaffordable—they have become slightly more affordable. Put differently, even though home prices have exhibited an increasing trend, holding both the average home size and household size constant, the share of household income spent on home space per person has been on a slightly decreasing trend since 1975. Thus, while zoning changes reducing house price appreciation (albeit marginally) are helpful for buyers, housing affordability has not been as dire of a crisis as is widely believed, partly owing to widespread real income growth which, on its own, has helped drive prices higher.

Figure 12

Adjusting for home and household size changes, home space has gotten more affordable



New house as a share of income is the median new house price divided by the median household income. Adjusting for home and household size holds constant the mean home and household sizes from 1975 such that the amount of area per householder is constant over time.

Source: Statista, "Average size of floor area in new single-family houses built for sale in the United States from 1975 to 2023," October 4, 2024, and U.S. Census Bureau and U.S. Department of Housing and Urban Development, Median Sales Price for New Houses Sold in the United States [MSPNHSUS], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/MSPNHSUS>, October 4, 2024, and Census Bureau, "Table H-5. Race and Hispanic Origin of Householder—Households by Median and Mean Income: 1967 to 2023," October 4, 2024, and Census Bureau, "Table HH-4. Households by Size: 1960 to Present", October 4, 2024.

Conclusion

This paper addresses some questions related to housing availability and affordability that are not being asked very often. It provides some evidence that the housing shortage “crisis” is not as dire as is widely believed, and it provides a robust statistical analysis of zoning changes in Denver in 2010. In terms of prices, while there’s some evidence here supporting a positive effect of rezoning, the findings suggest that increased supply might not single-handedly make housing drastically more affordable, at least not if reforms are implemented on the scale that they are

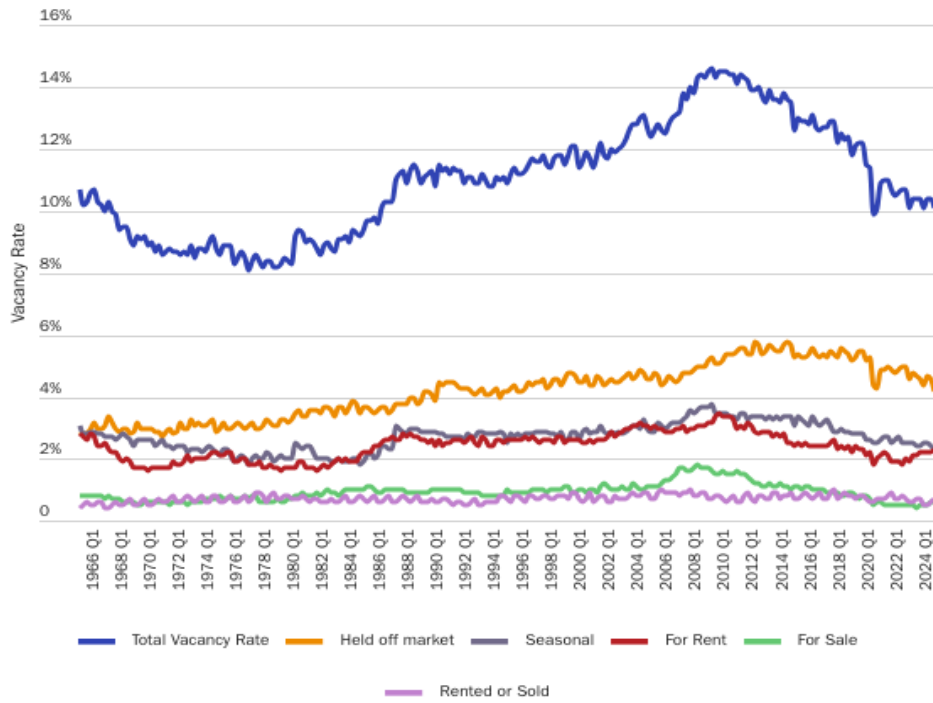
typically implemented. These results do not suggest, in any way, that local governments should refrain from the types of regulatory reforms that lead to higher construction. But they do suggest that people should temper their expectations for how much added construction will slow the growth in home prices.

More broadly, this research demonstrates the critical need for robust analysis of housing markets in a rigorous demand-supply framework that can account for multiple simultaneous factors. Housing markets are generally supply-constrained, and demand-side factors can outweigh supply innovations, leaving prices to rise even in the face of added construction. Few of the analyses of the so-called housing shortage examine these kinds of factors, so the paper argues for a better understanding of housing availability and the drivers of house price appreciation. At the very least, our findings underscore the need for more refined research on housing market dynamics to precede policy prescriptions aimed at solving housing-related issues.

Appendix

Figure 13

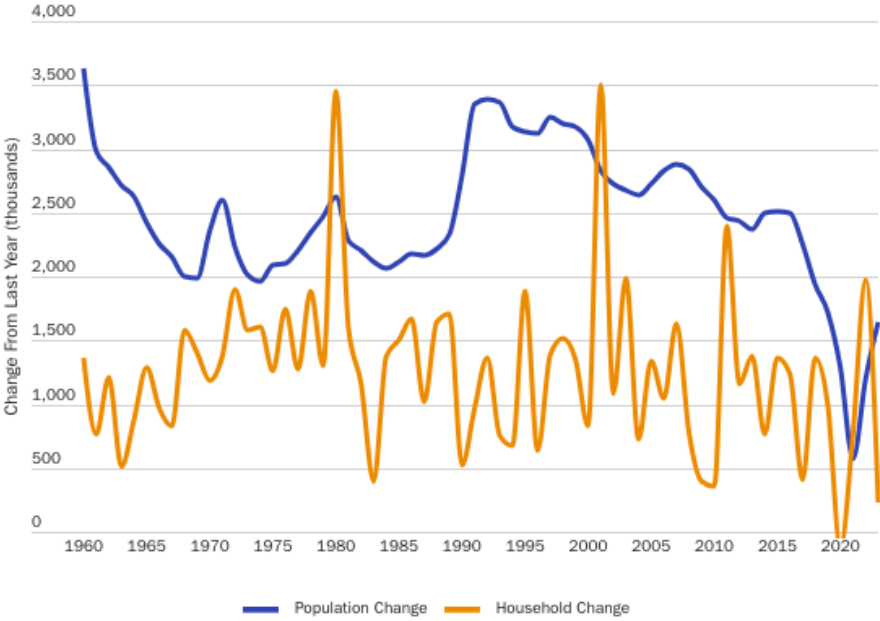
Vacancy Rates over Time



Source: U.S. Census Bureau, Housing Vacancies and Homeownership (CPS/HVS), Table 8, <https://www.census.gov/housing/hvs/data/histtabs.html>

Figure 14

Population Change and Household Change



U.S. Bureau of Economic Analysis, Population [POPTHM], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/POPTHM>, December 4, 2024. U.S. Census Bureau, Total Households [TTLHH], retrieved from FRED, Federal Reserve Bank of St. Louis; <https://fred.stlouisfed.org/series/TTLHH>, December 4, 2024.

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