Executive Summary

Estimating Housing Supply Elasticities for Manhattan from 1870 to 2017[1]

Jason Barr, PhD
Rutgers University-Newark

Wei You, PhD
Peking University

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Introduction

Before the devastation of the COVID-19 pandemic, one of the most pressing problems in large urban areas, like New York City, was that of housing affordability. Given the importance of large cities in the global economy, after the pandemic recedes, places like New York are likely to see a rebound in employment; with these jobs comes an increased demand for housing and likely higher rents and housing prices as well.

A recent body of scholarship within economics has attempted to measure and understand the housing market's supply-side and the degree to which cities across the U.S. might be supply-constrained. Large cities like New York have several characteristics that can reduce their ability to build more housing at a pace that would keep prices from rapidly rising. First, much of New York is surrounded by water; the terrain is not a large featureless plain like midwestern cities; thus, much of the region is land constrained.

Second, building and zoning regulations seek to limit building and population density across neighborhoods to improve the quality of urban life; and third is the scarcity and costs associated with locating and assembling sufficiently large lots to redevelop. These three factors are likely to impact the real estate community's ability to add new housing.

Surprisingly, however, very little work aims to measure and understand the changes in supply responsiveness for New York City over time. Thus, our main contribution in this work is measurement: To better understand the housing supply trajectory within a long-run context. Specifically, our focus is on Manhattan Island (which is nearly coterminous with New York County). We focus on Manhattan for several reasons. First is that Manhattan remains the economic center of the New York Metropolitan region. It has a population of 1.6 million people and is the densest county in the United States. Second, because of Manhattan's historical

[1] We are grateful for our students, Shaojie Wang, Ujjaini Desirazu, and Haochen Zhang who have helped collect and process data.

importance, there is a long "paper trail" of data about the city's real estate history, which allows us to look at a century and a half of its real estate market.[2]

The questions that we bring to this project are first: To what degree is Manhattan Island supply constrained, as we define below. Second, what has been the long-run price of housing? And lastly, what might be driving changes in this supply-ability over time?

In particular, we have created a new data set comprised of two key variables related to housing supply. First, we create a database of nearly all new housing building permits issued in Manhattan from 1870 to 2017. Since comprehensive data on actual building completions is not available, we use these permits to measure housing supply.

Second, we created a database of over 60,000 real estate transactions for every census year from 1870 to 2010 and 2017 for nearly all residential building sales in Manhattan. This allows us to look at the long-run trajectory of housing prices over time and see whether a lack of corresponding supply has driven rising prices. Our focus here is on what economists call the price elasticity of housing supply, which measures how responsive supply changes are in the housing market to price changes.

We find a consistent downward trend in the size of housing elasticity of supply. In the early part of the 20th century, supply was quite responsive to price increases, which then lowered or moderated price growth. Today, we find evidence that the housing market in Manhattan is quite inelastic, which means that the elasticity of supply is less than one—a 1% increase in housing prices is met with a less than a 1% increase in supply. The net effect of this is that housing prices are going to continue to rise in Manhattan when demand for housing renews. Without substantial reforms to promote larger increases in supply, affordability is likely to remain a problem in the future.

The Long Run Real Estate Market

Here we present some graphs that illustrate the nature of the data that we have collected. Figure 1 gives maps of permit locations for four different periods. On the left is permit locations for 1870, the middle-left is the 1920s, the middle-right is the 1960s, and the right is the 2010s. The graphs demonstrate the location of building activity in each period. The 1870s saw growth in the immigrant districts of the Lower East Side and East Harlem. In the 1920s, growth took place on the Upper West Side, along Central Park and Washington Heights, and Inwood. In the 1960s, (re) development took place larger along Third Avenue, likely a result removing the Third Avenue elevated railroad. During the 2010s, development took place on the south and east parts of the island, with less construction on the west side. Note that the boundaries within Manhattan are Community districts, which are our measure of neighborhoods. [3]

[2] Note that Manhattan was the City of New York until 1874 when it annexed western parts of the Bronx. In 1898, the city annexed additional Bronx territory, along with Brooklyn, Queens, and Staten Island, to form what at the time was called "the City of Greater New York," which today is simply New York City.

[3] Community Districts were created to allow neighborhoods some advisory role in neighborhood real estate development and land-use changes. Each district has a community board with authority to review major projects that might require rezonings or special permits.

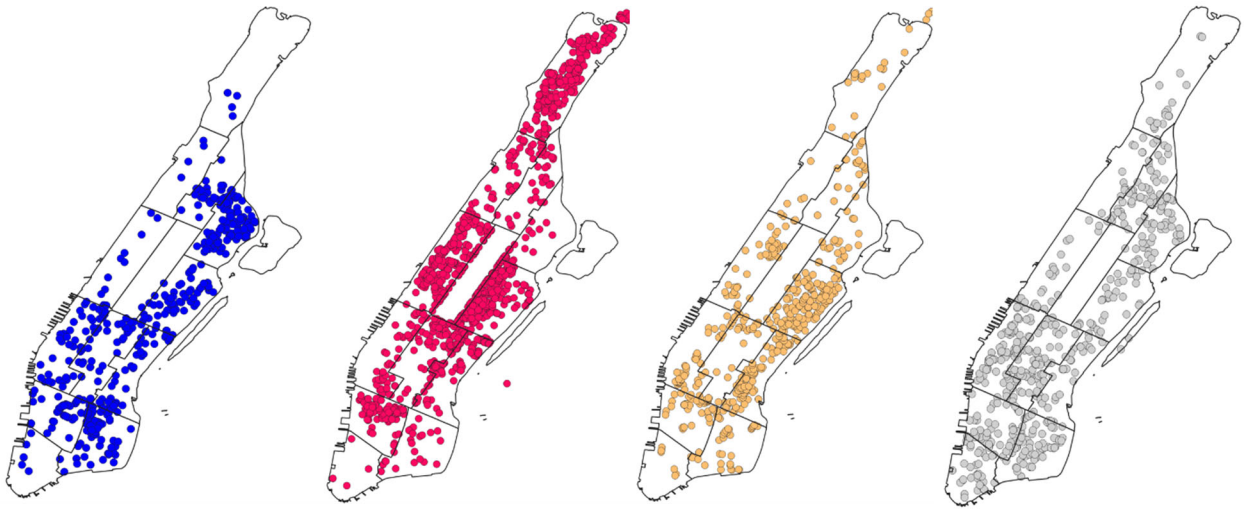


Figure 1: Location of New Building Permits in Four Different Times Periods for Manhattan: From Left: 1870, 1920-29, 1960-69, 2010-2017. Note: Boundaries are Community Districts.

Figure 2 (top) gives the number of permit applications over time (a moving average of three years) for all of Manhattan. We can see a dramatic fall in the number of permit applications over time. The bottom figure is total permit applications by decade for four selected neighborhoods (Lower Manhattan, Lower East Side, Upper West Side, and East Harlem). They also show a drop in each of these neighborhoods over time, with some rebound since the 1980s.

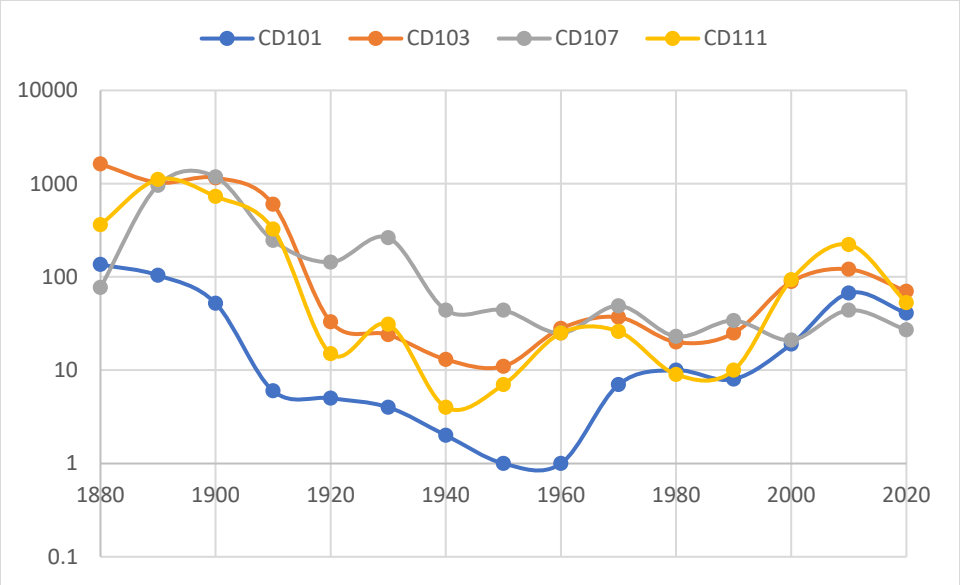
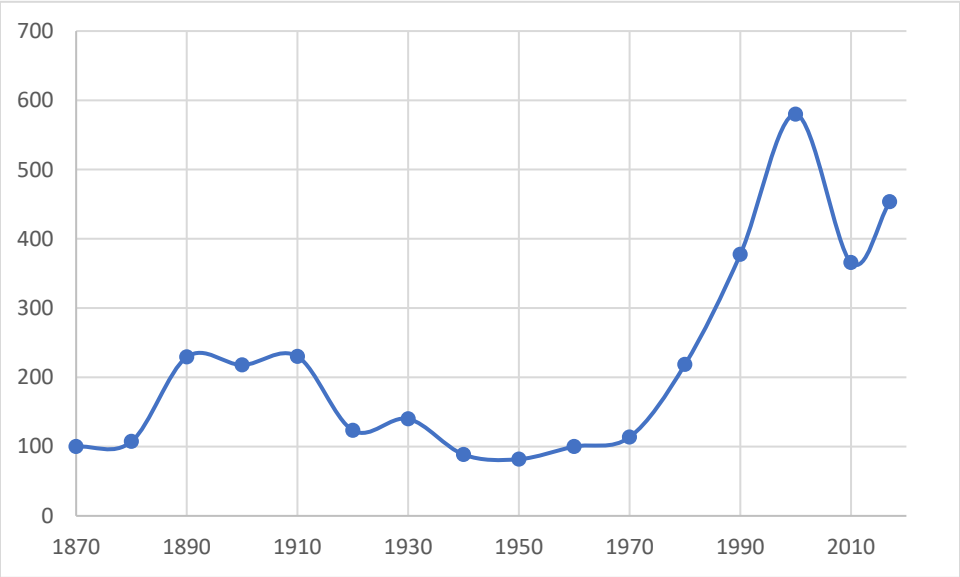


Figure 2: Top: Number of New Residential Building Permits Issued from 1870-2017. Note: Moving average of three years is shown. Bottom: Total number of Permits Issued for 10-Year Periods for Four Selected Neighborhoods (Lower Manhattan (CD101), Lower East Side (CD103), Upper West Side (CD107) and East Harlem (CD111). Note: Log_{10} scale.

Figure 3 (top) gives the long-run price index for all of Manhattan and four selected community districts (Lower Manhattan, Lower East Side, Upper West Side, and East Harlem) on the bottom. The indexes were created from regression analyses. The long-run Manhattan index shows that recent price increases are an anomaly. Prior to that, price changes were cyclical with no long-run trend until 1980, when prices started to shoot up. The neighborhood indexes show similar long-run trends, but different levels of decline and uptick.



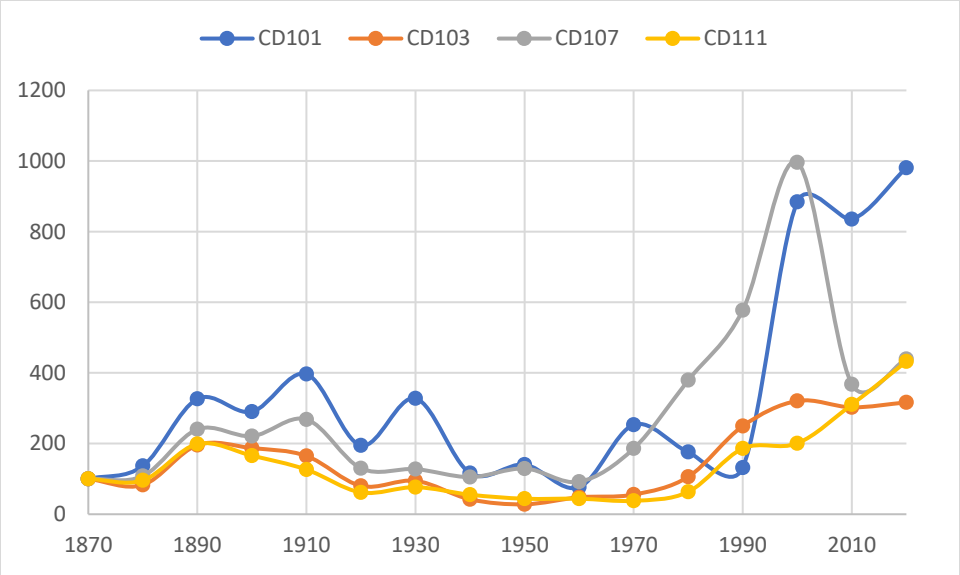


Figure 3: Top: Long Run Real Housing Price Index for Manhattan, 1870-2017 (1870=100). Bottom: Indexes for four neighborhoods: Lower Manhattan (CD101), Lower East Side (CD103), Upper West Side (CD107) and East Harlem (CD111).

The Economics of Supply

Our main objective is to estimate the housing elasticity of supply, which is defined as the percentage change in housing supply (here measured by accepted permit applications) with a one percent increase in housing prices. Of particular concern is estimating the magnitudes of these elasticities over time. We hypothesize that they have been decreasing, and this decrease is responsible, in part, for the rise of prices.

If new housing construction is relatively elastic, then price spikes due to rises in population or income will be followed by a significant increase in housing, leading to a reduction in price growth, and keeping housing relatively affordable over the long run. If elasticity is relatively inelastic, then supply, then housing price increases from the demand side will not be offset price reductions from supply.

The Measurement Problem

As a thought experiment, let us say at the beginning of a year, we observe median housing prices per square foot to be $500. Let us say one year later, we observe prices to be $525. What caused this housing price increase? Assuming that we are observing the same housing stock with the same quality, we have a measurement problem. The price could have come from either an increase in demand, holding supply constant, a decrease in supply, holding demand constant, or movement in both supply and demand. The graphs in Figure 4 illustrated this problem.

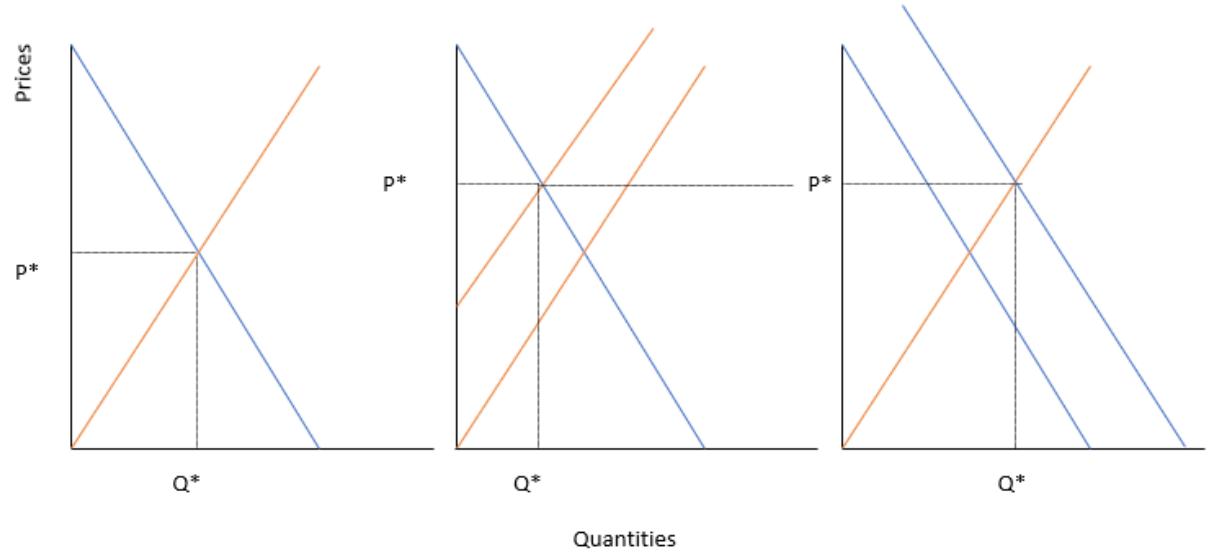


Figure 4: Supply and Demand Example. Graph on left is market at beginning of period. Two graphs at right show that a price rise at end of period can come from either fall in supply or rise in demand (or both). Statistical methods need to be used to disentangle respective changes in supply and demand.

Our goal is to isolate or identify the slope of the supply curve. But to do this means using additional data. If we can map out the price changes due to the demand side, we can properly map out the supply curve. To the end, we use a statistical procedure called Instrumental Variable regression. First, we estimate the price changes that come from the demand side (in this case population increases); this gives us a new measure of prices that are independent of supply. Then we see how those price increases affect supply conditions in the respective years that follow.

Results

In order to perform the statistical analysis, for each decade, we look at permit counts and price changes at each of the 12 Community Districts (CDs) on Manhattan (See Figure 1). Each community district constitutes a large neighborhood. We were able to obtain population data for several but not all years and community districts.

Our statistical analysis thus estimates supply responsiveness (number of permit applications over a 10-year period) as function of real housing prices for each of the Community Districts. Because of the small sample, we estimate average supply elasticities for twenty-year periods (note that for technical reasons related to the data and statistical methods, we begin our analysis in the 1920s). Figure 5 gives our key findings. It shows that in the early part of the 20th century, the average 10-year supply was well-above one, which means that a one percent increases in prices, on average, was met with a more than one percent increase in supply. Over the 20th century, elasticities have consistently fallen. Today, a 1% rise in prices leads to about a 0.5% increase in housing permits, suggesting supply does not keep pace with price increases.

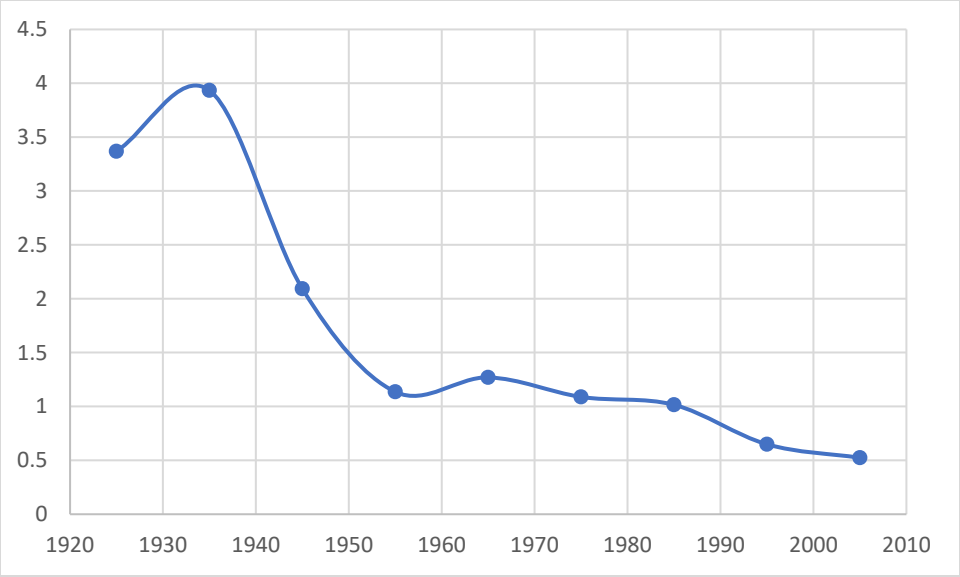


Figure 5: Supply Elasticities. Average decade by decade elasticity of supply estimates for the past century for Manhattan. Note: Each point gives average estimate for two-decace period. Year is mid-point of the period.

What's Driving the Drop in Elasticities over Time?

There are several possible reasons for the decline in supply responsiveness. One reason can be from the increasing difficulty of assembling large lots, given how dense Manhattan has become over the years. Another reason might be due to the rising costs of construction. If construction costs outpace sales prices, then developers would be disincentivized against adding more housing. Another factor is zoning regulations. Starting in 1961, New York regulations limited the floor area ratio (FAR) of each lot, where the FAR is the total allowable floor area divided by the lot size. Across Manhattan, the average allowable FAR under current zoning rules is about 5.3, though it can range from 0.6 to 12 across the borough. As an example, 19th century browstone townhouses have FARs around 3. 1920s, five-story apartment buildings will have an FAR around 4. Modern highrises will have an FAR above 10.

We can shed some light on what is driving low elasticities after 1960 by performing additional statistical tests. For each CD, we obtained the average allowable FAR for residential buildings. We also looked at the elasticity of supply measure with and without time controls, where the time controls can control for both the availability of lots and construction costs.

By comparing regressions with different sets of controls, we can see how the elasticity measure changes. That is to say, we look at how the elasticity measure changes after also controlling for time-related factors and zoning regulations. In short, the results support that zoning and other factors played a role. First, the "raw" elasticity, on average, without controls for 1970 to 2017 is 0.52. When we add year controls, the elasticity goes up to 0.663, and when we also control for allowable FAR levels, the elasticity goes up to 1.158. That is to say, the evidence suggests that high development costs and restrictive zoning combined has the effect of reducing supply elasticity to below one. In other words, once we remove the effect of zoning and other factors,

elasticity goes up, demonstrating that these other variables are important determinants of elasticity.

Conclusion

This project represents the first attempt to measure long-run housing prices in New York City and supply responsiveness by estimating the long-run housing elasticity of supply for Manhattan. We find that in the 21st century, Manhattan is highly unresponsive to price increase; thus, supply growth cannot offset price rises. Our work also shows that the recent run-up in housing prices is a historical anomaly. In the late 19th and early 20th centuries, we see no upward trend, but rather price cycles, which suggest that the real estate community's ability to respond to price changes was relatively easier a century ago, for example.

We find that supply elasticity has constantly fallen from about four to below one over the past century. We estimate that in the last 40 years, zoning and high development costs are in large part responsible for the drop below the 1.0 threshold. To keep housing more affordable, policies need to be designed to relax overly restrictive zoning, especially in residential neighborhoods north of Central Park, and to reduce the cost of building new units.