

Do house price shocks originating in Manhattan spill over to other boroughs of New York City?

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Abstract

This dissertation investigates whether house price shocks originating in Manhattan spill over to the other boroughs of New York City. Using monthly borough-level housing price data from January 2000 to March 2026, a fixed effects panel data model examines the relationship between Manhattan house prices and prices in the Bronx, Brooklyn, Queens, and Staten Island. Unemployment and inflation are included as macroeconomic control variables in an extended specification. The results reveal an approximate three-month lag in spillovers from Manhattan, with the contemporaneous and one-to-two-month relationships losing significance once macroeconomic controls are included. Both unemployment and inflation are statistically significant determinants of borough-level house prices, and model comparison tests indicate the extended model provides a significantly better fit than the baseline specification. Overall, the findings suggest that Manhattan acts as a leading, though delayed, driver within New York City's interconnected housing market, with important policy implications for the NYC government.

AI Statement

I acknowledge the use of generative AI in the drafting and code development in this paper. However, the work reported remains my own.

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1.) INTRODUCTION

1.1.) MOTIVATION

Rapid increases in New York City (NYC) house prices, particularly in Manhattan, have raised concerns regarding housing affordability and potential displacement across the wider metropolitan area. Home to over 8.6 million residents, NYC faces significant housing pressures, making affordability an important policy issue (United States Census Bureau, 2026). If house price increases in Manhattan transmit to other boroughs, affordability pressures may extend beyond the city's core rather than remaining geographically concentrated. Despite a recent slowdown in transaction volumes, prices have remained elevated, with the median Manhattan sales price reaching \$1.285 million in Q1 2026, representing an 8% year-on-year increase (Coldwell Banker Warburg, 2026). This persistence suggests sustained demand pressures within Manhattan's housing market and motivates an investigation into whether these pressures propagate to surrounding boroughs through spatial spillovers.

1.2.) LITERATURE FOUNDATION

Existing literature suggests that housing markets are spatially interdependent, such that shocks in one location may influence prices in neighbouring markets (Case & Shiller, 1989, 1990; Fischer et al., 2018). These spillovers are commonly explained through mechanisms including household relocation in response to affordability constraints, investor substitution across markets, and the diffusion of information regarding local housing conditions. More broadly, housing markets may exhibit lead-lag relationships, where certain submarkets transmit price signals to others over time (Wu and Sharma, 2012; Blatt, Chaudhuri, and Manner 2023)

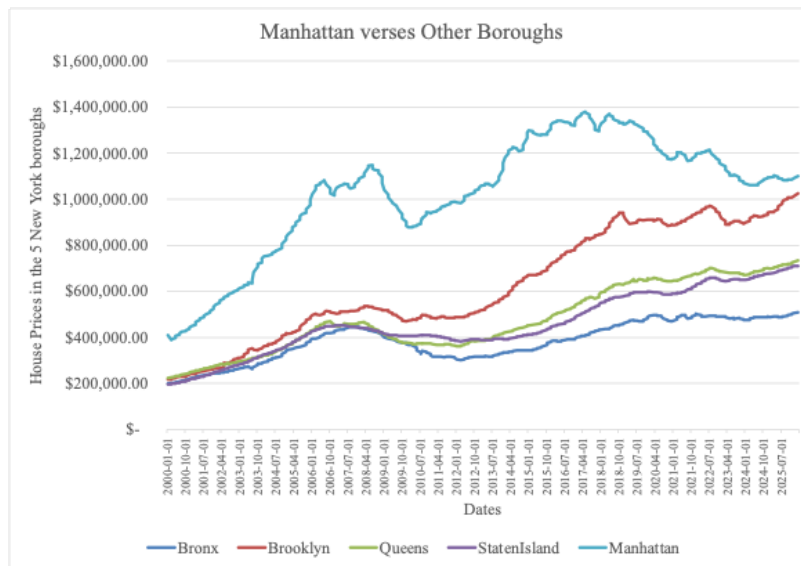


Figure 1.1- New York's 5 main borough house prices from January 2000 until March 2026

1.3.) CONCEPTUAL FRAMEWORK: WHY MANHATTAN LEADS NEW YORK

Within this framework, Manhattan is considered the dominant submarket in NYC due to its high price levels, concentration of economic activity, and sensitivity to macroeconomic conditions. As illustrated in Figure 1.1, Manhattan consistently exhibits both the highest average house prices and the greatest volatility across NYC boroughs, suggesting a potential leadership role in city-wide housing dynamics. This motivates the hypothesis that Manhattan may act as a leading indicator for housing price movements in surrounding boroughs, transmitting shocks through interconnected urban housing markets.

1.4.) RESEARCH GAP

While a substantial body of literature has examined spatial spillovers across regions and metropolitan areas, comparatively less attention has been devoted to intra-city transmission within major urban centres. NYC provides a particularly relevant case for addressing this gap due to its highly integrated yet structurally distinct borough-level

housing markets. Understanding whether price shocks originating in Manhattan propagate to other boroughs is therefore important for assessing the extent of market integration and the spatial reach of affordability pressures.

1.5.) RESEARCH AIM

This dissertation investigates whether house price shocks originating in Manhattan lead to changes in house prices across the other boroughs of New York City. The analysis focuses on the Bronx, Brooklyn, Queens, and Staten Island. Using borough-level housing data alongside macroeconomic control variables, the study examines the extent to which price disturbances in Manhattan propagate across borough boundaries, capturing both the magnitude and short-run dynamics of these spillover effects. A fixed effects model is employed to control for unobserved borough-specific heterogeneity, with current borough-level house prices regressed on lagged Manhattan prices and control variables.

2.) LITERATURE REVIEW

The literature on housing markets consistently identifies two key empirical regularities:

A.) Strong persistence in house prices over time and,

B.) Spatial spillovers between connected housing markets.

Together, these characteristics suggest that housing markets are neither fully independent nor perfectly efficient, and they provide the theoretical foundation for examining whether house price shocks originating in Manhattan influence prices in New York City's other boroughs.

2.1) HOUSE PRICE PERSISTENCE

A substantial body of research documents the existence of house price persistence, whereby past price movements contain information about future price changes. The seminal studies of Case and Shiller (1989, 1990) demonstrate that housing markets exhibit significant autocorrelation, implying that house prices do not adjust instantaneously to new information. Instead, price increases in one period tend to be followed by further increases in subsequent periods, creating momentum in housing returns. This finding contrasts with the predictions of efficient market theory and suggests that housing markets are characterized by frictions, imperfect information, and gradual adjustment processes.

More recent research continues to support this view. Choi, Chudik and Smallwood (2024) emphasize that persistence remains a defining feature of U.S. housing markets, arguing that current house price growth is a useful predictor of future price growth. As they note, periods of strong house price appreciation tend to be followed by further appreciation, indicating that housing market shocks can have lasting effects rather than disappearing

immediately. This interpretation was echoed by Robert Shiller at the AREUEA Policy Forum on November 16, 2022, who remarked that “home prices have a lot of inertia and momentum, which makes housing markets more forecastable than stock markets.” (Choi, Chudik and Smallwood, 2024). The persistence documented throughout the literature implies that shocks originating in one market may influence future prices not only within that market but potentially in connected markets as well which we identify as spatial spillovers.

2.2) SPATIAL DIMENSION OF HOUSING MARKET DYNAMICS

Alongside temporal persistence, researchers have increasingly focused on the spatial dimension of housing market dynamics. Spatial spillovers occur when house price changes in one location affect prices in nearby markets, reflecting the interconnected nature of housing demand and supply. Such spillovers may arise through household mobility, commuting patterns, migration flows, etc. As a result, housing markets often behave as networks rather than isolated geographic units.

A particularly important contribution is provided by Fischer et al. (2018) who examine the extent to which house price shocks spill over across neighboring housing markets. Their findings reveal clear evidence of spatial transmission, but also demonstrate that these effects are highly localized. Specifically, they conclude that spillover effects are strongest among immediately adjacent areas and weaken rapidly as distance increases. As the authors state, “spillover effects only exist in the nearest neighbourhood and die out quickly with increasing distance.” This result suggests that geographical proximity plays a crucial role in determining the strength of housing market linkages and supports the broader view that housing markets exhibit a clear spatial decay pattern. Their evidence

further indicates that local price dynamics cannot be fully understood without accounting for interactions between neighboring markets.

The importance of spatial transmission is also highlighted by Schubert (2021), who investigates how house price shocks propagate across regional housing markets. Schubert finds that housing markets are linked through economic and demographic connections, with the magnitude and speed of spillovers depending on the degree of market integration. Rather than affecting all locations equally, house price shocks spread unevenly across space, reflecting differences in commuting networks, migration patterns, and local economic conditions. The study provides further evidence that housing market outcomes in one location can be influenced by developments elsewhere, reinforcing the idea that regional housing markets should not be analyzed in isolation.

This pattern is not limited to a single national context. For example, Blatt, Chaudhuri, and Manner (2023) document a similar ripple effect in the United Kingdom, where house price increases originating in London propagate outward to surrounding commuter towns and peripheral regions. Their findings provide further evidence that leading urban housing markets can act as transmission centres, influencing neighbouring areas through the diffusion of price shocks.

2.3.) DEBATE IN LITERATURE

Despite broad evidence of house price persistence and spatial spillovers, the literature remains divided regarding the mechanisms underlying these patterns. Some researchers argue that apparent persistence may reflect the gradual adjustment of prices to economic fundamentals rather than true momentum effects (Meen, 1999). Likewise, observed spatial correlations may not necessarily represent direct spillovers but instead arise from common macroeconomic shocks affecting multiple housing markets simultaneously

(Holly, Pesaran and Yamagata, 2011). These critiques highlight the importance of controlling for economic factors such as inflation and labour market conditions when estimating spillover effects. Consequently, this study incorporates controls for unemployment and CPI to isolate the independent effect of Manhattan house price shocks on housing markets in the other boroughs of New York.

2.4.) LITERATURE GAP

While the literature establishes that housing markets exhibit both strong persistence and spatial spillovers that decay with distance, most empirical work focuses on either neighbourhood-level interactions or cross-city dynamics. As a result, relatively little attention has been given to the transmission of house price shocks within large, integrated metropolitan areas.

This is an important limitation because major cities are not homogeneous units but consist of distinct submarkets that are economically and spatially interconnected. Within this context, intra-city spillovers may operate differently from the neighbourhood or inter-city relationships typically studied in the literature.

New York City provides a particularly relevant case for addressing this gap due to the scale and heterogeneity of its housing market. Manhattan occupies a central role within the city's economic and financial structure, yet the extent to which price shocks originating in Manhattan transmit to other boroughs remains underexplored.

By focusing on borough-level dynamics within a single metropolitan area, this study extends the existing literature on spatial housing market spillovers and provides evidence on whether leading submarkets act as transmission channels for housing price movements.

3.) DATA

3.1) DATA: HOUSE PRICES

Monthly house price data were obtained from Zillow (no date) and cover the period from January 2000 to March 2026 for all NYC boroughs. The original dataset was available at the ZIP-code level; therefore, ZIP-code house prices were aggregated into borough-level price indices to construct a balanced panel dataset for the empirical analysis. Borough-level indices were calculated using the median house price across ZIP codes within each borough.

The median was chosen because it is more robust to extreme values and reduces the influence of ultra-expensive ZIP codes, particularly in areas such as Manhattan, thereby providing a more representative measure of borough-wide housing market conditions.

Nevertheless, this aggregation process introduces some limitations. Since the underlying data are recorded at the ZIP-code level, aggregation may mask substantial variation within boroughs and potentially introduce aggregation bias.

Summary statistics: House prices					
	Bronx (N=314)	Brooklyn (N=314)	Queens (N=314)	Staten Island (N=314)	Manhatta n (N=314)
Minimu m	199,403	216,412	223,112	195,203	387,928
Median	388,739	533,979	450,268	427,854	1,073,046

Mean	383,300	627,911	478,810	458,420	1,028,761
Standard Deviation	86201.2 2	240,354.6 8	147,457.0 7	134,787.3 3	255,939.35
Maximum	509,220	1,024,585	732,812	711,159	1,380,120

Table 3.1- Monthly house price summary statistics

Table 3.1 and Figure 1.1 highlight substantial differences in housing market conditions across the five main boroughs of New York City. Manhattan stands out as by far the most expensive borough, with a mean house price of \$1,028,761 and a median of \$1,073,046, figures approximately 2.7 times greater than those of Brooklyn, the next most expensive borough. Most strikingly, Manhattan's average house price exceeds the maximum observed house price in each of the remaining four boroughs, underscoring the profound and persistent price premium that characterises the Manhattan housing market and suggesting that it occupies a dominant position within the broader NYC housing landscape.

A clear borough price hierarchy emerges consistently across all descriptive statistics, Manhattan, followed by Brooklyn, Queens, Staten Island, and the Bronx, a ranking that holds across the minimum, median, mean, and maximum values, pointing to a stable spatial pricing structure that provides a natural motivation for investigating whether price movements originate in Manhattan and propagate outward to the outer boroughs.

Manhattan also displays considerable price volatility, recording the highest standard deviation in absolute terms, which implies that Manhattan house prices respond more

strongly to market shocks and changing economic conditions. Consequently, Manhattan is not only the most expensive borough but also one of the most dynamic, making it a plausible origin of housing market shocks that may spill over into neighbouring boroughs.

The substantial and persistent structural differences in average house prices across boroughs that these statistics reveal further justify the use of a fixed effects panel model, which controls for unobserved borough-specific characteristics that remain relatively constant over time. A pooled OLS specification, by contrast, would fail to account for such heterogeneity and could therefore produce biased and inconsistent estimates.

3.2) DATA: CONTROL VARIABLES

Summary statistics: Control Variables						
	Bronx Unemployment (N=314)	Brooklyn Unemployment (N=314)	Queens Unemployment (N=314)	Staten Island Unemployment (N=314)	Manhattan Unemployment (N=314)	CPI (N=314)
Minimum	4.70	3.30	3.00	3.30	3.10	169.3
Median	7.70	6.20	5.20	5.50	5.10	231.8
Mean	8.94	7.00	6.15	6.35	5.90	234.4
Standard Deviation	3.17	2.52	1.47	1.34	2.55	4.22
Maximum	26.50	21.10	23.40	19.60	16.80	332.4

Table 3.2- Key Economic variables summary statistics

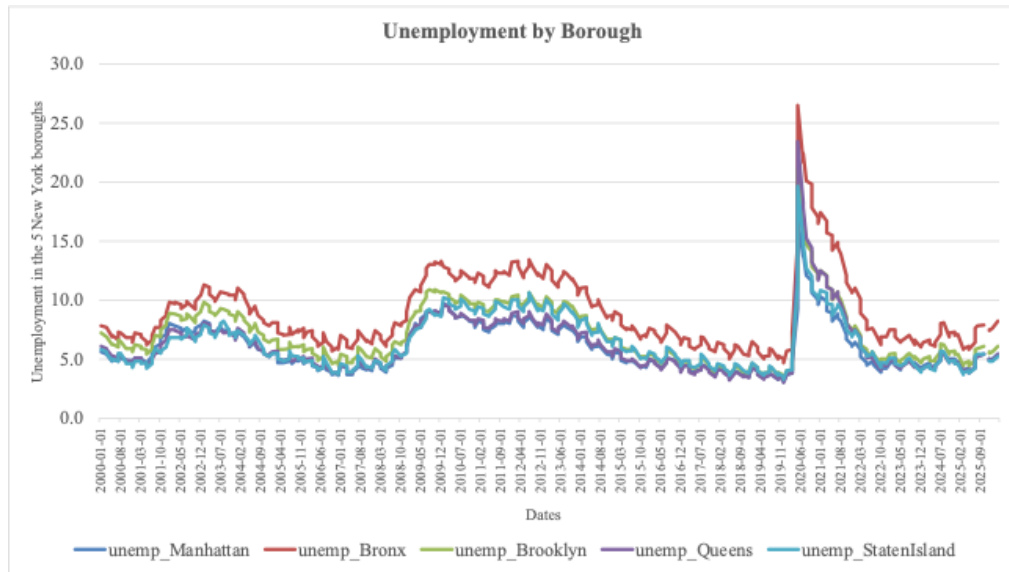


Figure 3.1- Monthly unemployment data

3.2.1) CONTROL VARIABLES: UNEMPLOYMENT

Monthly unemployment data for all boroughs was obtained from the Federal Reserve Bank of St. Louis (FRED), adjusted to cover the sample period from January 2000 to March 2026. The series is expressed in percentage terms and is not seasonally adjusted.

Unemployment rates are incorporated into the model to control for local economic conditions that influence housing demand, given that labour market conditions directly affect household income, borrowing capacity, and consequently the ability to purchase property.

Table 3.2 reveals considerable variation in unemployment across boroughs, with a clear hierarchy emerging: the Bronx records the highest mean unemployment rate of 8.94%, followed by Brooklyn (7.00%), Staten Island (6.35%), Queens (6.15%), and Manhattan (5.90%).

The Bronx also exhibits the greatest dispersion, with a standard deviation of 3.17% and a maximum of 26.50%, the highest recorded across all boroughs. According to the Office of the New York State Comptroller (2021), this heightened volatility may be attributable to the borough's higher concentration of employment in cyclical service-sector industries, such as retail and hospitality, combined with lower average educational attainment relative to other boroughs, making the Bronx labour market particularly sensitive to economic downturns.

This pattern indicates significant labour market heterogeneity across New York City and supports the inclusion of borough-level unemployment controls within the panel specification rather than relying on a single citywide measure.

3.2.1) CONTROL VARIABLES: CONSUMER PRICE INDEX (CPI)

Monthly CPI data, specifically the Consumer Price Index for All Urban Consumers: All Items in U.S. City Average, was also obtained from the Federal Reserve Bank of St. Louis (FRED), indexed to a base period of 1982–1984 = 100 and seasonally adjusted.

The CPI is included to control for broader inflationary pressures affecting the housing market, as rising general price levels may inflate nominal house prices independently of any borough-specific demand dynamics. This distinction is important given that, as Holly, Pesaran and Yamagata (2011) caution, observed spatial correlations across housing markets may not necessarily represent direct spillovers but may instead arise from common macroeconomic shocks affecting multiple markets simultaneously. By accounting for economy-wide price level changes over time, the inclusion of CPI helps isolate Manhattan-specific housing spillover effects from wider macroeconomic influences that would otherwise confound the estimated coefficients.

The descriptive statistics show a mean CPI of 234.4 and a median of 231.8, values that are close in magnitude and indicative of a broadly symmetric distribution over the sample period, while the range from a minimum of 169.3 to a maximum of 332.4 reflects the substantial cumulative inflationary pressures experienced over the full sample window spanning more than two decades.

Taken together, the descriptive statistics for both control variables reinforce the economic heterogeneity that exists across New York City's boroughs and highlight the importance of controlling for both local labour market conditions and aggregate price level movements when estimating cross-borough housing price spillovers, ensuring that the identified effects reflect genuine spatial transmission from Manhattan rather than confounding macroeconomic forces.

Staten Island, Brooklyn, and Manhattan are listed as Richmond, Kings, and New York County respectively on data sites like FRED and Zillow.

4.) METHODOLOGY / DATA ANALYSIS

4.1) ECONOMETRIC METHOD

This study employs a fixed effects panel data model to examine whether house price shocks originating in Manhattan spill over to other New York City boroughs. A fixed effects specification is appropriate because it controls for unobserved borough-specific characteristics that remain relatively constant over time, such as housing stock composition, geographic factors, neighbourhood quality, and long-run income differences. By accounting for these time-invariant characteristics, the model reduces omitted variable bias and focuses on within-borough changes in house prices over time.

The use of fixed effects is well established in the housing literature, with Kuminoff et al. (2010) arguing that they provide an effective way of absorbing spatially correlated omitted variables. However, Anselin and Arribas-Bel (2011) note that fixed effects address spatial heterogeneity rather than true spatial dependence, meaning some spillover effects may remain. Nevertheless, fixed effects provide a suitable framework for isolating the relationship between changes in Manhattan house prices and subsequent changes in prices across the other boroughs while controlling for persistent borough-specific influences.

4.2) DATA CONSTRUCTION

To facilitate panel data analysis, the original dataset was transformed from a wide format into a long format, where each observation represents a borough-date combination. House prices and CPI were log-transformed to reduce skewness, stabilise variance, and allow coefficient estimates to be interpreted as approximate percentage changes. The data were subsequently organised into a balanced panel structure to ensure consistency across boroughs and time periods.

4.3) KEY VARIABLE CONSTRUCTION

The empirical analysis focuses on the four outer boroughs of New York City (Bronx, Brooklyn, Queens, and Staten Island), with Manhattan treated as the source of potential housing market shocks. To capture the transmission of housing market dynamics over time, lagged values of Manhattan house prices were constructed and included as explanatory variables. Specifically, one-period, two-period, and three-period lags were generated to examine whether spillover effects occur immediately or persist over multiple periods.

4.4) MODEL CONSTRUCTION

There were two models created.

Model 1: The Baseline model

This models borough house prices as a function of one lagged Manhattan house price.

The baseline model can be expressed as:

$$\log(P_{i,t}) = \beta_1 \log(\text{Manhattan}_{t-1}) + a_i + \varepsilon_{i,t}$$

Where:

- $\log(P_{i,t})$ represents the log house price in borough i at time t
- B_1 represents the coefficient capturing the effect of lagged Manhattan house prices on outer borough prices
- $\log(\text{Manhattan}_{t-1})$ represents natural logarithm of Manhattan house prices lagged one period
- a_i represents the borough-specific fixed effect, capturing time-invariant unobserved characteristics of each borough

- $\varepsilon_{i,t}$ represents the idiosyncratic error term for borough i at time t

Model 2: The Extended model

This models borough house prices as a function of lagged Manhattan house prices and incorporates additional control variables that may also influence housing market outcomes. As mentioned earlier, borough unemployment and CPI are included to control for local labour market conditions and broader inflation, helping isolate Manhattan-specific spillover effects.

The extended model can be expressed as:

$$\log(P_{i,t}) = \sum_{k=1}^3 \beta_k \log(\text{Manhattan}_{t-k}) + \gamma_1 \text{Unemployment}_{i,t} + \gamma_2 \log(\text{CPI}_t) + a_i + \varepsilon_{i,t}$$

Where:

- β_k represents the coefficient on the k -th lag of Manhattan log house prices
- $U_{i,t}$ represents the unemployment rate in borough i at time t
- CPI_t represents the Consumer Price Index at time t
- $\gamma_1 \gamma_2$ represent the coefficients on the control variables

4.5) MODEL SPECIFICATION

Time fixed effects were not included in the final specification. Since Manhattan lag variables and CPI vary only across time and are common to all boroughs, including time fixed effects would absorb much of the variation required to identify spillover effects. Therefore, the preferred specification retains borough fixed effects while excluding time effects to preserve the variation necessary to estimate the impact of Manhattan housing market shocks on other boroughs.

Finally, robust standard errors clustered at the borough level are employed to address potential heteroskedasticity and serial correlation. This approach was further motivated by evidence of heteroskedasticity identified through the Breusch–Pagan test, ensuring more reliable statistical inference.

5.) RESULTS

5.1) BASELINE MODEL

Fixed Effects Baseline Model Results			
Variable	Coefficient	Std. Error	p-value
Log (Manhattan_lag1)	0.908	(0.0173)	<0.001***
Statistic		Value	
Observations		314	
R ²		0.6901	
Adjusted R ²		0.6891	

Table 3.1: Fixed Effects Baseline Model Results

REGRESSOR ANALYSIS

Log (Manhattan_lag1)

The coefficient on the first Manhattan lag is 0.908, indicating that a 1% increase in Manhattan housing prices is associated with an approximately 0.91% increase in prices across the outer boroughs in the following period. The effect is highly statistically significant ($p < 0.001$). Taken at face value, this near unit coefficient could suggest substantial transmission of Manhattan price movements to the rest of the city, however, as will be seen in the extended model, this baseline relationship is substantially affected by the omission of relevant macroeconomic controls and should therefore be interpreted with caution.

5.2) EXTENDED MODEL

Fixed Effects Extended Model Results			
Variable	Coefficient	Std. Error	p-value
Unemployment	-0.0080	(0.001)	<0.001***
Log CPI	1.0779	(0.0285)	<0.001***
Log (Manhattan_lag1)	-0.4325	(0.5119)	0.257
Log (Manhattan_lag2)	0.0694	(0.9011)	0.850
Log (Manhattan_lag3)	0.7957	(0.4671)	<0.001***
Statistic		Value	
Observations		314	
R ²		0.8692	
Adjusted R ²		0.8684	

Table 3.2- Fixed Effects Extended Model Results

REGRESSORS ANALYSIS

Unemployment

The negative coefficient on unemployment is consistent with economic theory, as higher unemployment reduces household income security and housing demand. The coefficient of -0.0086 suggests that a one percentage-point increase in unemployment is associated with approximately a 0.86% decrease in house prices, holding other factors constant. This highlights the importance of local labour market conditions in shaping housing market outcomes.

Log_CPI

The positive coefficient on CPI suggests that higher inflation is associated with higher house prices across New York City boroughs. The coefficient implies that a 1% increase in CPI is associated with an approximately 1.0779% increase in house prices, holding other factors constant. This result is consistent with the view that housing acts as a real asset and inflation hedge, whereby increases in general price levels are reflected in higher property values.

The significance of both unemployment and CPI demonstrates that local economic conditions and broader macroeconomic factors play an important role in explaining borough-level house price movements.

Log (Manhattan_lag1)

Following the inclusion of unemployment and CPI controls, the coefficient on Manhattan's first lagged house price falls from 0.91 to -0.43 and loses statistical significance ($p = 0.257$). This suggests that the contemporaneous relationship observed in the baseline model was largely capturing broader macroeconomic conditions rather than a genuine spillover effect. Once these factors are accounted for, Manhattan's immediate lagged price no longer exerts an independent influence on house prices in the other boroughs.

Log (Manhattan_lag 2)

The second lagged Manhattan house price variable is also statistically insignificant ($\beta_2 = 0.069$, $p = 0.850$), indicating no detectable spillover effect at this horizon once macroeconomic controls are included. This suggests that any influence of Manhattan house prices on the other boroughs does not operate through a two-month lag.

Log (Manhattan_lag 3)

In contrast, the third lagged Manhattan house price variable is positive and highly statistically significant ($\beta_3 = 0.796$, $p < 0.001$), even after controlling for unemployment and CPI. A 1% increase in Manhattan house prices three months earlier is associated with an approximately 0.80% increase in house prices in the other boroughs. This suggests a lagged spillover effect, with shocks transmitting after around three months, consistent with a gradual adjustment process in housing demand as households relocate in response to affordability constraints. The significance of this longer lag, combined with the insignificance of lag1 and lag 2, suggests that spillover effects are delayed rather than immediate, a pattern obscured in the baseline specification.

5.3 ANALYSIS AND COMPARISON OF BOTH MODELS

Models Fit and Robustness

The models demonstrate strong explanatory power, with an R-squared of 0.690 for the baseline model and 0.869 for the extended model, indicating that roughly 69% and 87% of the variation in house prices is accounted for by the included regressors. Inference is conducted using robust standard errors, guarding against heteroskedasticity as indicated by the BP test, and ensuring that significance tests remain reliable. The fixed effects specification is appropriate given the panel structure of the data, absorbing unobserved time-invariant heterogeneity at the borough level and thereby reducing the risk of omitted variable bias. Crucially, the three-month lagged spillover effect remains statistically significant even after the inclusion of macroeconomic controls, while the insignificance of the first and second lags persists across specifications. This consistency underscores the robustness of the delayed transmission finding and lends confidence that it is not an artefact of any modelling choice.

Wald/F-test

Our hypothesis is that the additional regressors in the extended model are jointly insignificant, rendering the baseline specification the more parsimonious and preferred model.

$$H_0 = \beta_2 = \beta_3 = \gamma_1 = \gamma_2 = 0$$

$$H_1 = \text{At least one of } \beta_2, \beta_3, \gamma_1, \gamma_2 \neq 0$$

Initially, the test was estimated using a heteroskedasticity-consistent cluster-robust covariance matrix (*vcovHC*, clustered by group). This approach is desirable in panel data because it relaxes the assumption of homoskedastic errors and allows for correlation of error terms within each cross-sectional unit over time, leading to more reliable inference when these issues are present.

However, the panel consisted of only four cross-sectional units, meaning there were only four clusters available for estimation. Cluster-robust covariance estimators generally require a much larger number of clusters to perform reliably, and in this case the procedure produced an invalid negative F-statistic, indicating numerical instability and rendering the test uninterpretable. Consequently, a standard Wald test was conducted instead.

The test yielded a statistic of $\chi^2(4) = 1686.1$ with $p < 0.001$, leading to rejection of the null hypothesis that the additional variables are jointly equal to zero. This result indicates that they significantly improve the explanatory power of the model and should therefore be retained in the final specification.

*** indicates statistical significance at the 0.1% level ($p < 0.001$).

6.) RESULTS DISCUSSION AND LIMITATION

6.1) RESULTS DISCUSSION

The main findings suggest that Manhattan functions as a leading indicator of the New York City housing market, with price movements in Manhattan strongly associated with subsequent changes in the other boroughs. However, rather than an immediate effect, the spillover appears to operate with a three-month lag, with the contemporaneous and one-to-two-month lagged relationships losing significance once macroeconomic controls are introduced. This suggests that shocks in Manhattan take time to filter through to the wider city housing market, plausibly reflecting the time required for prospective buyers priced out of Manhattan to adjust their search toward neighbouring boroughs. The results also indicate that part of the co-movement observed in the baseline model was driven by shared macroeconomic conditions, such as unemployment and inflation, rather than purely direct transmission effects from Manhattan itself. The delayed transmission result reaffirms the persistence and spatial spillover dynamics discussed earlier (Case and Shiller, 1989, 1990; Fischer et al., 2018).

6.2.) LIMITATION

Despite insights, the analysis has several limitations. The small cross-sectional dimension, consisting of only four boroughs after excluding Manhattan, restricts variation and reduces the precision and reliability of estimated effects. In particular, the limited number of cross-sectional units also constrains the use of cluster-robust inference, as standard errors based on clustered covariance matrices require a sufficiently large number of clusters to be reliable. There is also the possibility of omitted variable bias, as unobserved factors influencing borough-level housing markets may not be fully captured within the model specification.

The inclusion of multiple lagged explanatory variables raises concerns regarding multicollinearity, which may weaken the interpretability of individual coefficients. In particular, the insignificance of some lag terms may reflect shared variation across lags rather than a true absence of effect. Finally, the study does not employ a fully specified causal identification strategy, meaning the results should be interpreted as statistical associations rather than definitive causal effects.

Taken together, these constraints suggest that the findings provide an informative but partial representation of spillover dynamics in housing prices. Future research using a longer time dimension, or a larger cross-sectional sample would improve the reliability of inference and help further validate the observed significance of the three-month lag structure.

7.) CONCLUSION

7.1.) FINAL FINDINGS

This study examined whether house price shocks originating in Manhattan spill over to the other boroughs of New York City using a fixed effects panel data model. The results provide evidence that Manhattan plays a leading role in the city's housing market, with increases in Manhattan house prices associated with subsequent increases in house prices across the other boroughs, operating with an estimated three-month lag. The findings also indicate that unemployment and inflation are significant determinants of borough-level house prices, suggesting that both local housing market dynamics and broader macroeconomic conditions influence housing outcomes. Furthermore, the extended model was statistically preferred to the restricted specification, highlighting the importance of incorporating relevant economic controls when analysing housing market spillovers. However, only short-run spillover dynamics were captured, and the full temporal transmission process beyond three months remains unexplored.

The results suggest that housing markets within New York City should not be viewed as independent submarkets. Instead, Manhattan appears to act as a leading driver of price movements across the wider city, with spillover effects emerging within a few months. This supports the view that housing affordability challenges in one borough can have consequences that extend beyond its geographic boundaries over time.

7.2) POLICY IMPLICATION

These findings carry important policy implications because they suggest that housing-market shocks in New York City are not confined to the borough in which they originate. The significant response of other boroughs to changes in Manhattan house prices indicates that price pressures may transmit across the wider housing market over time.

Therefore, affordability policies could be considered at a city-wide level rather than focusing solely on Manhattan. Expanding housing supply outside Manhattan through affordable housing mandates and increased residential development could help accommodate demand and reduce pressure on surrounding markets. Auckland's Unitary Plan (2016), which introduced large-scale upzoning and increased housing capacity across multiple submarkets, provides a useful example (Auckland Council, 2024; Greenaway-McGrevy, 2026). Transport investment may also improve access to lower-cost areas, as demonstrated by London's Crossrail (Comber and Arribas-Bel, 2017). However, improved connectivity can increase nearby property values, suggesting that infrastructure investment should be accompanied by housing-supply measures to maximise affordability benefits.

7.3) FUTURE STEPS

Future research could extend this analysis by incorporating formal measures of spatial dependence, such as Moran's I, like Morali and Yilmaz (2022) did in their paper, to assess the extent of spatial autocorrelation in borough house prices. Additional work using neighbourhood-level data and more advanced spatial econometric techniques could also provide further insight into the mechanisms through which housing market shocks propagate throughout New York City.

To conclude, this dissertation adds to the limited literature on intra-city housing market spillovers by examining the transmission of house price shocks from Manhattan to the other boroughs of New York City and highlighting the interconnected nature of urban housing markets.

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