Freddie Mac

Economic & Housing Research **Insight**

SEPTEMBER 2019

Proximity to a Metro Rail Station and Its Impact on Washington, DC Metropolitan House Prices: Amenity or Not?

Location, Location, Location are the three magic words when it comes to real estate. Everyone shops for the "right location" when buying a home, but determining the right location varies tremendously from buyer to buyer.

In metropolitan areas, where the cost of the commute is high, and time is of the essence, metro rail (light rail) provides an easy transport alternative. While proximity to a metro station can reduce commuting cost in terms of time and offer a level of convenience, it also comes with certain drawbacks—factors such as noise, crowded neighborhood streets and parking issues could become a nuisance. Depending on the buyer's preference, proximity to a metro station could either increase or decrease the value of a house. This *Insight* analyzes whether DC Metro Area residents consider proximity to a Metro rail station to be an amenity or not, and how much value such proximity adds to or subtracts from the price of a house.[1]

Washington Metro rail (known as "Metro") began operations in 1976 and serves the District of Columbia, as well as several surrounding jurisdictions in Virginia (Arlington and Fairfax counties, including the independent cities of Alexandria, Fairfax and Falls Church) and Maryland (Montgomery and Price George's counties). Metro is the second-busiest rapid transit system by ridership in the United States. Several studies have analyzed the impact of nearby light rail stations on residential property prices, but only a handful of studies have focused on the DC Metro Area (see Appendix A.1).

Within this *Insight*, we find that proximity to a Metro station in the DC Metro Area increases the prices of nearby houses. Additionally, we find that the closer the house is to the station, the higher the price.[2] In some cases, the premium can be as much as 14% of the price of the house. This means that, when putting up a house for sale, highlighting the details about the proximity to a Metro station in the house listing may make the listing much stronger in terms of price.[3]

1 The DC Metro Area includes the District of Columbia and parts of Virginia and Maryland, along with a small portion of West Virginia. It is also known as the Washington-Arlington-Alexandria, DC-VA-MD-WV Metro Area.
2 We include single-family residences and townhouses in our analysis. Distance to Metro station is the Euclidean distance from the centroid of the property to the nearest Metro station.
3 This result is in line with Lewis-Workman and Brod 1997 research in San Francisco and New York City. See Appendix A.1 for selected literature review.

The value added to house prices, however, does vary. For example, the premium is higher for homes less than $415,000 and lower for more expensive homes. This may be because residents of lower cost homes may rely more heavily on public transportation and, therefore, may place a higher premium on proximity to a Metro station.

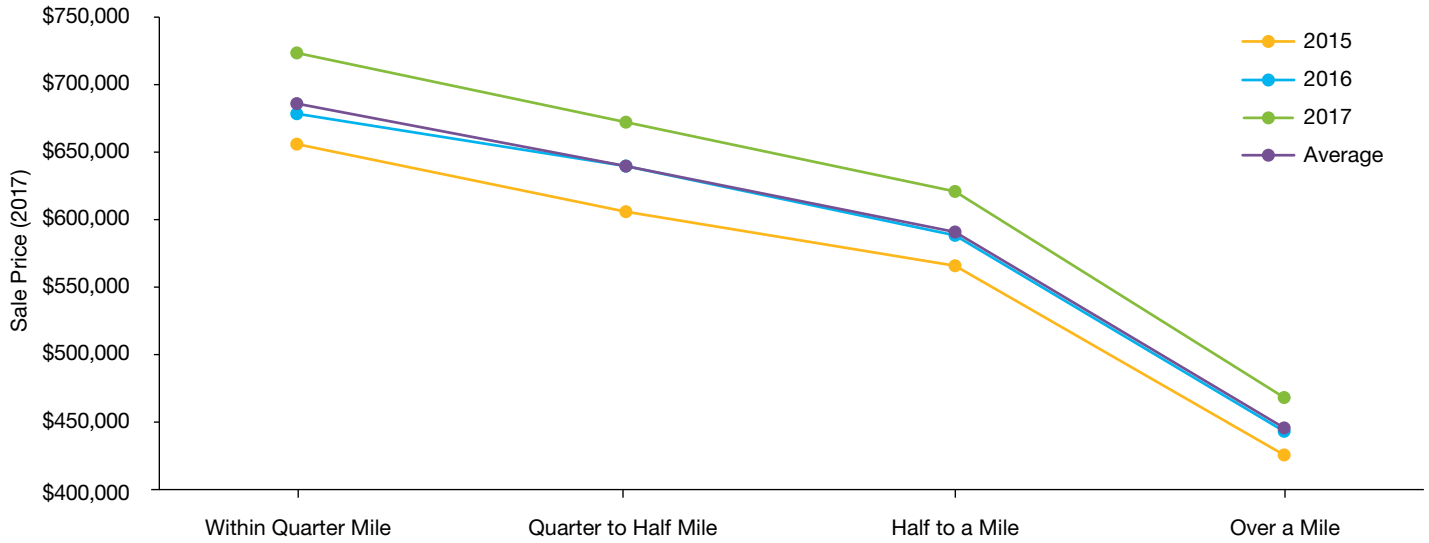
For many homebuyers in the congested DC Metro Area, cutting down on commuting time is of value. The sections that follow describe the questions we considered to tease out the effect of proximity to a Metro station on house prices.

What makes up house prices?

There are several factors to consider when pricing a house. A house's appeal is first and foremost influenced by its location, followed by its structural attributes, including the number of bedrooms, bathrooms, and lot size, as well as amenities such as neighborhood and schools. Between 2015 and 2017 (our study period), houses sold for $467,008 on average in the DC Metro Area. The average distance to the nearest Metro station was 10.4 miles. These houses, on average, had 2 bedrooms, 2 full baths, 1 half-bath, and a lot size of 0.4 acre. Of all the homes sold during our study period, approximately 13% were within a mile of a Metro station, including 1% within one-quarter mile, 3% within one-quarter mile to one-half mile, and 9% within one-half mile to one mile. The rest were located more than one mile from the nearest Metro station. **Exhibit 1** shows how prices vary according to the distance to a Metro station. See Appendix A.2 for other attributes tested.

Exhibit 1

House sales prices relative to their distance to the nearest Metro station ($2017)



Source: Author's calculations based on CoreLogic Sale transaction data.

How much value does proximity to a Metro station add to a typical house?

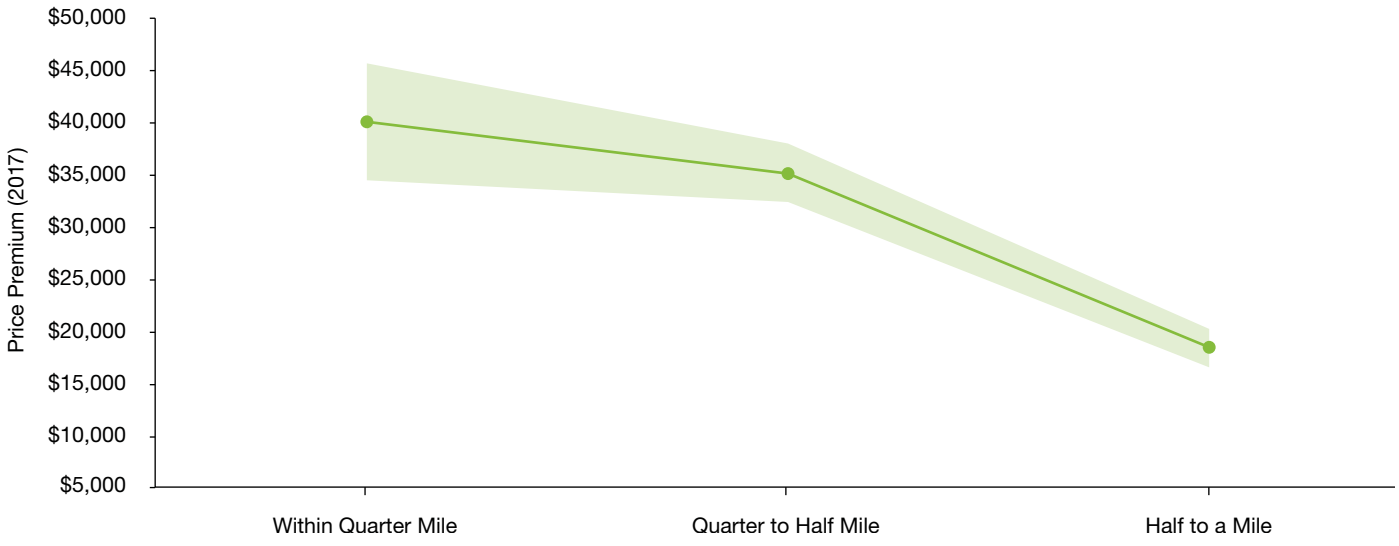
To quantify the value of a nearby Metro station on house prices, we use a hedonic model. This statistical method has been extensively used in previous studies to tease out the impact of a single variable of interest (in our case, proximity to a Metro station) on house prices. Full details of the model can be found in Appendix A.3.

Consistent with most of the previous studies, our results indicate that there is a price premium for houses that are located closer to Metro stations in the DC Metro Area. For example, using small discrete distances, houses within a quarter mile of a Metro station, a reasonable walking distance, sold for 8.6% more than houses over a mile away. Similarly, houses within a quarter mile to a half mile of a Metro station sold for 7.5% more, and houses within a half mile to a mile sold for 3.9% more. Consequently, the price increase for houses one mile away is almost $8,640 and that amount goes up by $1,636 for every 100 feet closer the house is to a Metro station. **Exhibit 2** shows the price premium for a typical house in the DC Metro Area based on proximity to a Metro station.

Exhibit 2

The sales price premium of an average-priced house in the DC Metro area based on distance to a Metro station

The premium is highest within one-quarter mile of a Metro station and drops off after one-half mile.



Source: Author's calculations. Note: The shaded area indicates standard errors.

Is the amount of the house price premium the same for all houses?

The short answer is, no.

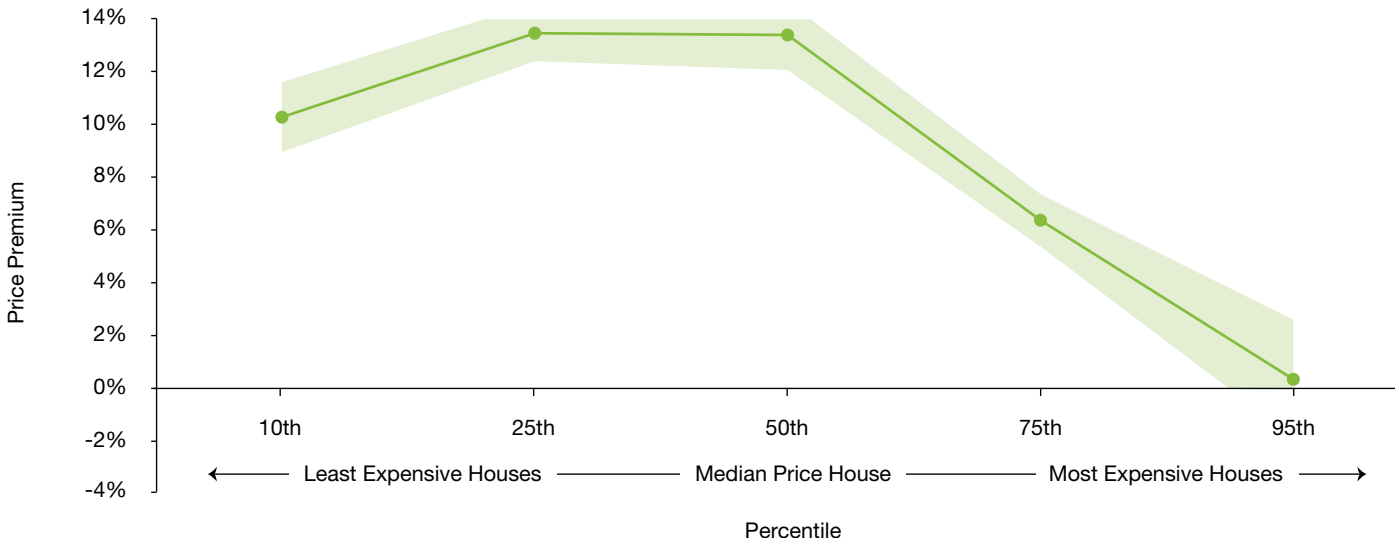
House prices differ significantly across localities and neighborhoods in the DC Metro Area. For example, in our study period, an average house in the Virginia suburb of Reston sold for almost $400,000, but an average house in nearby McLean, Virginia, one of the wealthiest areas in the country, sold for more than double that amount ($958,000). We sorted all the houses in the DC Metro Area from least expensive to most expensive and determined the impact of a nearby Metro station on each price point. This exercise reveals potential differences in the importance of proximity to a Metro station because residents of lower cost houses may depend more on Metro and thus may place more of a premium on proximity to a Metro station while residents of more expensive houses may not.

As expected, our analysis indicates that proximity to a Metro station has the smallest effect on the most expensive houses.[4] In other words, buyers who buy more expensive houses do not value proximity to a Metro station as much as other buyers. **Exhibit 3** presents the price premium

Exhibit 3

House price premium within one-quarter mile of a Metro station distributed by sales prices

The price premium for proximity to a Metro station is higher for lower-priced houses.



Source: Author's calculations. See Appendix A.4.2 for estimates of the quantile regression. Note: The shaded area indicates standard errors.

4 We use quantile regression that allows the effect of the explanatory variables to differ over house prices to determine whether the Metro premium was uniform across all house prices.

within one-quarter mile of a Metro station distributed by house prices. The price premium is the highest in the 25th and 50th percentile of the house prices, where prices range from $310,000 to $415,000. At this house price range, the price premium is around 13-14%, which is equivalent to about $41,000 to $55,000. By comparison, the price premium is insignificant in the 95th percentile of house prices, where prices are over $870,000.

Other notable findings

Other explanatory variables that were included in our analysis, such as structural attributes, show the expected results. For example, an additional full bath, half bath and bedroom add almost 19%, 8% and 4.6%, respectively, to house prices. A corner unit in the DC Metro Area was valued at 10% more than other units. Having a golf course, park or waterfront as a community feature commanded a premium of almost 16.5%, 11% and 40% on house prices, respectively. More notably, in the DC Metro Area, an increase in the property tax rate by $1 per every $1,000 in assessed value (11.33 to 12.34 mills) decreases the price of a house by 2.6%, which means that the tax liability is capitalized into house prices.

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Appendix

Appendix A.1 Literature Review

Table A.1

Selected previous studies on the impact of proximity to a Metro station on house prices

Study	Focus	Results
Kim and Lahr 2014	New Jersey	Prices of houses nearest to Metro stations appreciate at lower than average rates. Prices of houses a little farther appreciate at higher than average rates.
Pan 2012	Houston, TX	In the immediate proximity, a significant negative impact is found, but there is a net positive effect on some residential property values.
Hess and Almeda 2007	Buffalo, NY	Within a one-quarter mile radius of a light rail station, a premium of $1,300–$3,000 is found, or 2% to 5% of the city's median house value.
Dueker and Bianco 1999; Chen, Rufulo, and Dueker 1998	Portland, OR	Median house value increase at an increasing rate closer to the station. The largest price difference ($2,300) occurred between the station and 200 feet away. Beginning at 100 meters from the station, each additional meter decreases the average house price by $32.20.
Lewis-Workman and Brod 1997	San Francisco area and New York City	San Francisco – House prices decline by $1,578 for every 100 feet further from the station. New York City – House prices decline by $2,300 for every 100 feet further from the station.
Landis et al. 1995	San Diego and San Jose, CA	A typical house sells for $272 more in San Diego and $197 more in San Jose for every 100 meters closer to a light rail station.
Grass 1992	Washington, DC	House value increase by 19% in the impact areas in 1970 and 1980. The impact area was defined as one-quarter of a mile from a station, a reasonable walking distance.

Appendix A.2 Data

Table A.2.1

Data sources

Data Sources	Comments
CoreLogic Public Records House sales data	Single-family houses sold between 2015 and 2017: 87,000 observations; sale prices restricted between $10,000 and $10 million; lot area restricted to 10 acres; bedrooms restricted to less than or equal to 10.
opendata.dc.gov Metro station GIS data	Used to determine the distance from a property to the nearest Metro entrance. Data created as a part of DC Geographic Information System (DC GIS); used Analysis tool in Arc GIS.
U.S. Census Bureau School district data and highway data	Unified school districts for all the District of Columbia, Maryland, Virginia, and West Virginia downloaded separately and merged to the DC Metro Area using Arc GIS. Used Analysis tool in Arc GIS to determine the distance from a property to the nearest highway.
Federal Emergency Management Agency (FEMA) Flood zone data	Used spatial join in Arc GIS to identify whether a property falls within a flood zone.

Table A.2.2

Summary statistics

Variable	Description	Mean
Sale price	Average Sale price of properties in 2017 dollars	$467,008
Metro_dist	Distance to the nearest Metro station in miles	10.4 mi.
Metro_Quarter-mile	Dummy = 1 if a property within one-quarter mile from the nearest Metro station; otherwise, dummy = 0	0.9%
Metro_qtrtohalf	Dummy = 1 if a property is between one-quarter and one-half mile from the nearest Metro station; otherwise dummy = 0	3.1%
Metro_halftoamile	Dummy = 1 if a property is between one-half mile and one mile from the nearest Metro station; otherwise, dummy = 0	8.8%
Metro_overamile	Dummy = 1 if a property is more than one mile away from the nearest Metro station; otherwise, dummy = 0	87.2%
Hwy_dist	Distance to the nearest highway in miles	4.0 mi.
Cbd_dist	Distance to the central business district	21.5 mi.
Tax rate (mills)	Property tax/Sale price, *1000	11.33 mills
fullbath	Number of full baths	2.4
halfbath	Number of half baths	0.8
bdrms	Number of bedrooms	1.9
lot_sqft	Lot size in sq. ft	17,982 sq.ft.
Stories	Number of stories	1.0
Pool	Dummy = 1 if pool is present; otherwise, dummy = 0	3.1%
built_yr	Year the property was built	1980
brick_wall	Dummy = 1 if the property has a brick wall; otherwise, dummy = 0	18.2%
Fireplace	Dummy = 1 if the property has a fireplace; otherwise, dummy = 0	69.6%
Condition: Good/ Very Good/Excellent	Dummy = 1 if the property condition is good, very good, or excellent; otherwise, dummy = 0	8.7%
Corner unit	Dummy = 1 if the property is a corner unit; otherwise, dummy = 0	1.7%
Site feature -Golf	Dummy = 1 if the property has a golf course in the community; otherwise, dummy = 0	0.3%
Site feature -Park	Dummy = 1 if the property has a park in the community; otherwise, dummy = 0	0.7%
Site feature -Waterfront	Dummy = 1 if the property is waterfront; otherwise, dummy = 0	0.3%
Floodplain_100yr	Dummy = 1 if the property is in the 100-year floodplain; otherwise, dummy=0	0.9%

Appendix A.3 Methods

We use a hedonic model focusing on properties sold between 2015 and 2018 in the DC Metro Area.

Dependent variable (P) – Sale Price of the Property;

and $P = f(S, L, R, M)$

$$\log(P_{it}) = \beta_o + \sum_{j=1}^{J} \beta_j S_{ij} + \sum_{k=1}^{K} \beta_k L_{ik} + \sum_{l=1}^{L} \beta_l R_{il} + \beta_m \ln\left(M\right)_i + \Upsilon_i + \delta_t + \varepsilon_{it}$$

$$\log\left(P_{it}\right) = \beta_o + \sum_{j=1}^{J} \beta_j S_{ij} + \sum_{k=1}^{K} \beta_k L_{ik} + \sum_{l=1}^{L} \beta_l R_{il} + \sum_{m=1}^{M} \beta_m M_{im} + \Upsilon_i + \delta_t + \varepsilon_{it}$$

- **S**tructural Attributes (# of baths, # of beds, lot size, exterior)
- **L**ocational Attributes (location features such as golf course, parks, waterbody, corner unit, distance to nearest highway)
- **R**isk Attributes (FEMA designated Flood Zones)
- **M**etro (distance to nearest Metro station)
- Υ_i is the school district fixed effect and δ_t is the year fixed effect

Appendix A.4 Results

Table A.4.1

Regression results using discrete distance to a Metro station

Variables	(1) Using Linear Distance	(2) Using Distance Dummies
lnmetro_dist	-0.018***	
	-0.002	
metro_quatermile		0.086***
		-0.012
metro_qtrtohalf		0.075***
		-0.007
metro_hlftoamile		0.039***
		-0.004
lnhwy_dist	0.005***	0.006***
	-0.001	-0.001
lncbd_dist	-0.319***	-0.333***
	-0.005	-0.004
taxrate_mill	-0.026***	-0.026***
	-0.003	-0.003
fullbath	0.190***	0.189***
	-0.001	-0.001
halfbath	0.079***	0.079***
	-0.002	-0.002
bdrms	0.045***	0.046***
	-0.001	-0.001
lot_sqft	0.000***	0.000***
	0	0
lot_sqft_sq	-0.000***	-0.000***
	0	0
stories	-0.025***	-0.025***
	-0.001	-0.001
pool_yes	0.062***	0.063***
	-0.005	-0.005

built_yr	0.002***	0.002***
	0	0
brick_wall	-0.002	-0.002
	-0.003	-0.003
fireplace_yes	0.171***	0.171***
	-0.002	-0.002
cond_goodabove	0.088***	0.087***
	-0.005	-0.005
cornerunit	0.100***	0.101***
	-0.005	-0.005
ftr_golf	0.168***	0.165***
	-0.014	-0.014
ftr_park	0.108***	0.111***
	-0.009	-0.009
ftr_waterfront	0.398***	0.397***
	-0.019	-0.019
fld_plain	-0.003	-0.003
	-0.01	-0.01
School District FEs	Included	Included
Year FEs	Included	Included
Constant	9.960***	9.891***
	-0.205	-0.207
Constant	18.989***	11.435***
	(0.147)	(0.140)
School District FEs	Not Included	Included
Observations	86,989	86,989
R-squared	0.707	0.708

Robust standard errors in parentheses. FE = fixed effects. Omitted category in (2) is over a mile from a Metro station. *** p<0.01, ** p<0.05, * p<0.1

Table A.4.2

Quantile regression results using discrete distance to a Metro station

	House Price Quantiles				
Variables	10th	25th	50th	75th	95th
metro_quatermile	0.062**	0.103***	0.135***	0.134***	0.064***
	-0.025	-0.013	-0.011	-0.013	-0.01
metro_qtrtohalf	0.073***	0.095***	0.109***	0.115***	0.073***
	-0.016	-0.009	-0.008	-0.007	-0.007
metro_hlftoamile	0.047***	0.048***	0.057***	0.063***	0.051***
	-0.007	-0.006	-0.004	-0.005	-0.005
lnhwy_dist	0.010***	0.010***	0.006***	0.004***	0.006***
	-0.002	-0.001	-0.001	-0.001	-0.001
lncbd_dist	-0.274***	-0.270***	-0.278***	-0.299***	-0.344***
	-0.006	-0.005	-0.004	-0.004	-0.005
taxrate_mill	-0.042***	-0.041***	-0.038***	-0.034***	-0.028***
	-0.001	-0.001	-0.001	-0.001	-0.001
Constant	8.623***	8.544***	8.185***	8.146***	8.730***
	-0.2	-0.17	-0.138	-0.131	-0.133
Structural attributes	Included	Included	Included	Included	Included
Year FEs &	Included	Included	Included	Included	Included
School District FEs					
Observations	86,989	86,989	86,989	86,989	86,989

Robust standard errors in parentheses. FE = fixed effects. Omitted category is over a mile from a Metro station.
*** p<0.01, ** p<0.05, * p<0.1

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