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Impact of a light rail extension on residential property values

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ABSTRACT

Previous work has examined a new light-rail line or upgrades to existing rail infrastructure. However, the following is the first examination of the value of an extension of a light-rail line. The analysis relies on repeat sales of houses in Bayonne, New Jersey, where the first sale occurred before the 2008 announcement of a southern extension to the Hudson-Bergen Light Rail to 8th Street in Bayonne, and the second sale occurred after the opening of the station in 2011. Our results show that the 8th Street Station had no statistically significant impact on annual house price appreciation. That is, we find no evidence that properties closer to the station showed more price appreciation than properties further from the station.

1. Introduction

In an attempt to reduce the problems associated with traffic congestion and spur economic development, a series of U.S. cities have built light-rail transit systems.[1] Proponents of these systems contend that the economic development benefits typically follow from improved access of low-income workers to employment opportunities, lower pollution, and higher property values (Garrett, 2004; Hammond, 2013; Vock, 2015). Of course, rapid-transit lines (metro or commuter) provide similar benefits. However, light rail can be constructed at 20% of the cost of a metro line (UITP, n. d.).

While a series of papers examine the benefits of new light-rail lines (e.g., Chatman, Tulach, & Kim, 2012; Kim & Lahr, 2014), there are no evaluations of the economic impact of an extension to an existing light-rail line. Despite this, a series of U.S. cities have either recently built (e.g., Northern New Jersey; Phoenix, AZ) or are constructing extensions of their light-rail system (e.g., Charlotte, NC; Dallas, TX; Minneapolis, MN; Denver, CO; Virginia Beach, VA) (Formby, 2014). Other cities are considering expansions (Trenton, NJ; Seattle, WA) (Hammond, 2013).

Given this interest in expansions to light rail, this paper evaluates the effect of an extension to an existing light-rail line. This assessment of the effect of an extension contributes to the literature in two ways. First, it serves as a check on the robustness of the results of studies that examine the impact of an entire light-rail line. At some point, the returns from an extension to an existing line likely diminish. Second, it allows us to assess whether reductions in travel distance to a station yield benefits when residents already have access to an existing station. When a new station is added, some property owners with access to the existing line experience reduced travel time to the new station. To measure the effect of a new light-rail station, we evaluate the impact of the 2011 extension of the Hudson-Bergen Light Rail (HBLR) line on property values.

The HBLR line is a 20-mile light-rail line that primarily runs parallel to the Hudson River in the northern New Jersey counties of Hudson and Bergen. The HBLR began service in 2000. The line has 24 stations (see Fig. 1), an average weekday ridership of 45,000, and annual ridership of 13.8 million – roughly the median number of

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[1] Light rail is a style of mass transit combining characteristics of trams (streetcars) and trains. They are characterized by primarily street-level "trains" of multiple cars with exclusive right-of-way on their tracks (UITP, n.d.).

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0739-8859/

Fig. 1. Map of the Hudson-Bergen Light Rail service area.

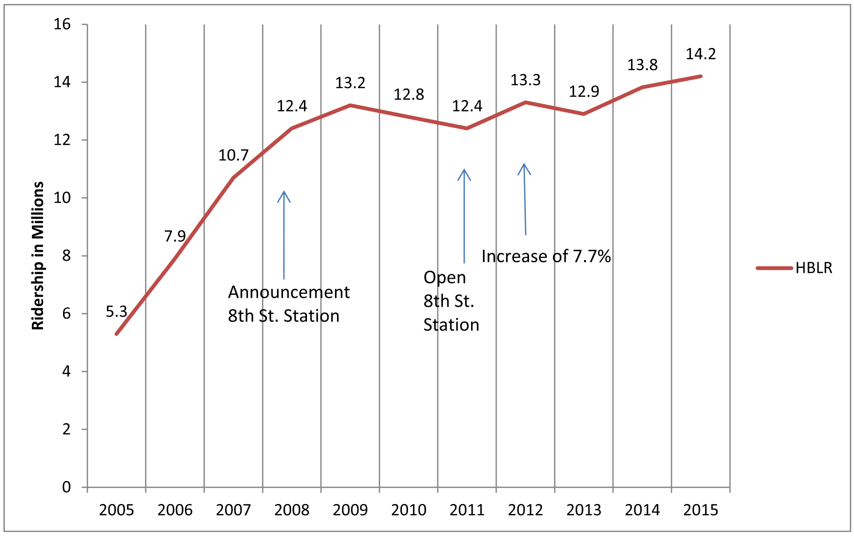

Fig. 2. Annual ridership on the Hudson-Bergen Light Rail.
*Generated from NJT Annual Reports.

trips for all light-rail systems in the United States (American Public Transportation Association, 2015). In 2011, the HBLR was extended from 22nd Street in Bayonne NJ to 8th Street (also in Bayonne). Just prior to the extension, ridership on the HBLR was 12.4 million rides per year. One year after the extension, ridership increased by 900,000 or 7.3% to 13.4 million rides per year. Annual ridership for the HBLR line can be seen in Fig. 2 (NJT, 2012).

We examine the effect on property values as way to gauge the value of the line because a significant literature on urban amenities shows the value of enhanced transport opportunities will be capitalized into property values (i.e., hedonic pricing). To accurately assess the impact of the extension to the HBLR, we will compare pre-station-announcement and post-station-opening real sale prices of the same houses (repeat-sales) for homes near the 8th Street Station extension. To develop the framework that follows, we examine previous work on repeat sales.

2. Literature review

Bartholomew and Ewing (2011) review hedonic pricing studies that analyze revealed-preference (RP) for new transit developments. They find that there is a primarily positive effect on housing prices with the addition of new transit options. The evidence for this point is best shown in a meta-data analysis of the effect of transit developments on real estate prices by Debrezion, Pels, and Rietveld (2007). Of 73 previous studies of hedonic pricing effects of transit, they found 52 focused on residential housing prices. The overall effect for residential properties was a 1.9% increase in housing prices for every 250 m increase in proximity to the station with an average effect of 6.2% for houses within a quarter of a mile from the station.

Bartholomew and Ewing (2011) report that: 1) the type of rail (including frequency, length, location, and local traffic patterns) has a large impact on housing prices; 2) distance to the central business district (CBD) has a negative relationship with the effect of transit lines on property value (i.e., the closer to the CBD the greater the positive effect of a new transit system on property value); 3) there can be a “disamenity” effect because of negative externalities of train stations (additional noise, pollution, and/or crime reduces property values), but the effect is smallest for light rail; and 4) the greater the density of development, the greater the positive impact of the rail line.

Two recent studies examine light rail in New Jersey (Chatman et al., 2012; Kim & Lahr, 2014). Kim and Lahr (2014) analyze the effect of the HBLR using a hedonic model with residential repeat-sales over the period 1991–2009. Consequently, their analysis does not include the 8th Street Station (which opened in 2011). Kim and Lahr set out to measure consumer valuations over the HBLR by analyzing houses that sold prior to the announcement of the line, and comparing them to sales (inflation adjusted) after the opening of the line. In addition to the basic repeat-sales methodology, Kim and Lahr included independent variables for aerial distance (as the crow-flies) and network distance (using the streets) using a gradient approach for the network distance variable. The analyses also included a series of socio-demographic variable to control for differences across northern New Jersey cities.

They found that, over the entire line, house prices next to a station showed 18.4 percentage points of additional annual appreciation (relative to locations more than ¼ mile from the line) with the effect decreasing by one percentage point for every 50 feet further from the station. For the 22nd Street Station in Bayonne (the end of the line at the time), properties at the station showed 17 percentage points of additional annual appreciation (relative to locations more than ¼ mile from the line) and the rate of appreciation declined by 2 percentage points for every 1% increase in distance from the station.

Chatman et al. (2012) examine the economic effect of the opening of the River Line – a light-rail line that runs from Camden, NJ to Trenton, NJ. Like Kim and Lahr (2014), the model used a repeat sales method with the logged ratio of the most recent sale price divided by the oldest sale price as the dependent variable. The model included a series of distance variables to account for the spatial relationships that would be of interest in determining price appreciation affects (i.e., closest commuter rail, bus station, highway, and major CBDs). This study differs from Kim and Lahr (2014) in that it runs separate regressions by house size and income level. Additionally, the study analyzed distance from whistle-blowing points to test whether there was a negative effect associated River Line noise.

Surprisingly, the analysis concluded that there was a negative effect associated with the River Line in the five-mile radius around new stations (a range far greater than many other studies.) However, the analysis included sales in 112 municipalities along the entire length of the 34-mile line and many of these municipalities had fairly low population densities.

They found that while low-income areas and smaller houses near the new stations did benefit from the line, properties farther away from the station faced a decline in housing value. Chatman et al. (2012) characterized this as transference of value from properties further from the station to properties nearer the stations. Interestingly, the net change in value was negative as the decrease in value for houses slightly exceeded the corresponding increase. The measured increase occurred after the rail was operational. During the construction phase, proximity to the line was associated with negative externalities of construction (i.e. noise, material delivery, additional traffic). The authors surmise that residents expected the line to increase traffic and crime which in turn contributed to the lower property values once ground was broken for the line.

A separate set of papers examine the effects of “upgrades” to an existing rail system and find more consistent positive effects on property prices. Grimes and Young (2013) research the property price appreciation attributable to upgrades on Auckland's urban passenger rail “Western Line” in 2005. These upgrades included “double tracking of the rail line from the CBD through to the western outskirts of Auckland's urban area (allowing more frequent train service), station redevelopment, and related urban renewal projects.”

Grimes and Young focused on appreciation due to the announcement of the upgrade. They assumed rational homeowners who would immediately recognize the value of the transit upgrade and used a quadratic regression with distance and distance squared as the only two independent variables. The analysis shows a positive effect from the upgrades with the magnitude of the effect increasing as the distance to the station decreased. However, some of the stations show a negative effect at very close proximity to the station. While there are obvious differences between this study and an extension on the River Line (passenger vs. light rail; full line upgrade vs. extension; Auckland vs. New Jersey), this study does support the view that changes to a rail line can add value.

Similarly, Baum-Snow and Kahn (2000) examined five cities (Atlanta, Boston, Chicago, Portland, and Washington) that upgraded their urban rail systems. They measured changes in census tract median rental rates from 1980 to 1990 as a function of changes in distance to transit over the same period and found that a decrease in transit distance from 3 km to 1 km would increase housing values by about $5,000 and rents by about $19 per month.

Indeed, adding transit options may increase the value of the existing transit options. Kim, Ulfarsson, and Hennessy (2007) find that if there is direct bus service to a light rail station, it increases ridership on the light rail and on the bus system. Additionally, Kim et al. analyzed patterns of pedestrian activity around light rail stations. While the industry standard average walking distance from light rail station is about 0.25 miles, the average walking distance was 760 m, or 0.47 miles for the St. Louis MetroLink. This suggests that property at a greater distance from the station will still have the potential to see price appreciation. Finally, this study found that park-and-ride lots can increase ridership if the line is in an area where car density is already high.

3. Hudson-Bergen Light Rail background

The idea for the HBLR line originated in 1984 as part of a smart growth plan to decrease traffic congestion while enhancing transit options in northern New Jersey. The $2.2 billion line links cities along the Hudson River waterfront in Hudson and Bergen Counties – stretching 20 miles with 24 stations from Bayonne to North Bergen through seven municipalities (see again, Fig. 1). The line is operated through a public-private partnership by New Jersey Transit (NJT) and Washington Group International as a “proof-of-payment” (ticketing is enforced by spot checks rather than a formalized ticket-checking process) line with a one-way ticket priced at $2.25 and a monthly pass at $70 (NJT, n. d.). The HBLR line was designed as the first ever design-build-operate-maintain (DBOM) system in the nation, which means that NJT provided the funding for the line, but Washington Group is responsible for DBOM (this aligns incentives so both parties work towards long-term viability for the project) (NJT, n. d.).

Fig. 2 shows annual ridership for 2005 to 2015. The Bayonne section of the line is of particular interest for us because of our examination of the 8th Street extension. Bayonne used to be home to a port, refineries, and significant rail yards, but since World War II these industrial areas have closed or significantly decreased activity; the closing of a naval terminal in 1995 exacerbated the downward trend. At the southern tip of the Hudson County peninsula, Bayonne is relatively isolated and as such had lower-quality transit options into New York City prior to the HBLR line.

4. Methodology and data

To investigate whether extending the southern terminus of the HBLR line to 8th Street in Bayonne had an effect on property appreciation, we used a repeat-sales methodology. Following the repeat-sales method used in Kim and Lahr (2014), Chatman, et al. (2012), and Grimes and Young (2013), we examined houses in Bayonne that had been sold once before the announcement of the 8th Street extension on April 18th, 2008 and again after the station opened on January 1st, 2011. In this manner, we hope to capture the revealed preferences of consumers for the light-rail extension while controlling for other factors that might influence house prices. The interim period between announcement and opening is excluded from the analysis because the actual construction of the line affects properties differently (construction nuisances are not constant for all properties). This may affect the conditions of the natural experiment we want to observe.

The data for the repeat sales analysis was generated from an Open Public Records Search System (OPRS) managed by New Jersey's Monmouth County. The initial search of transactions brought in over 14,000 housing sales that took place between November 2000 and September 2015. November 2000 was chosen as the initial date to match the window of time used in the earlier repeat-sales analyses (at least 5 years and up to 8) and because the database did not include earlier sales transactions. Similarly, September 2015 was the most recent data published. The data do not include any specifics on the houses themselves; it includes only transaction date, assessed value, and sale price. Each transaction was coded by the address and lot number – this way we had a unique identifier for each property even if they were apartments at the same address (i.e. Apartment A at Lot 1 and Apartment B at Lot 2 at 123 Main St. were counted as unique properties).

We then separated the data into pre-announcement, construction, and post-opening groups. All transactions with sale prices of less than $15,000 were dropped from the analysis. We dropped these transactions because they were not arms-length transactions. That is, the home was sold at a discount that did not reflect the market value of the property (e.g., a parent sells a home to a child for $1). Additionally, observations with missing prices or incomplete addresses were deleted from the data set. After these edits, we had 4417 pre-announcement house sales, 1108 construction-stage sales, and 2006 properties that were sold after the 8th Street Station opened.

Next, we matched the transactions to find the houses that had sold at least once prior to the announcement and at least once after the opening of the station (repeat-sales). From this analysis, we

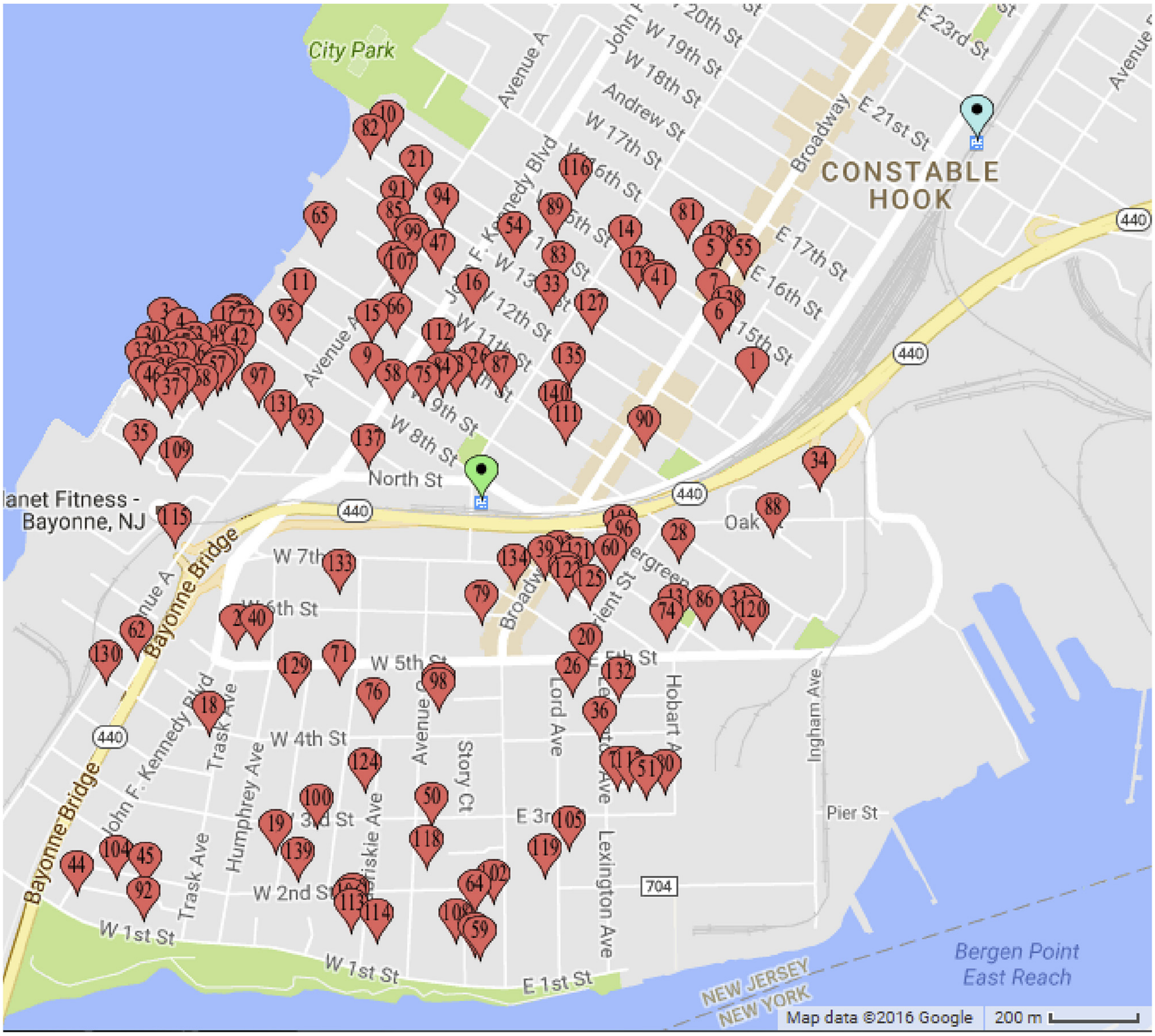

Fig. 3. Map of Repeat-Sales with the 8th Street Station marked in green, and the 22nd Street Station marked in blue. (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)
*Generated from https://www.mapcustomizer.com/map/RepeatSalesMap.

found 463 properties that had repeat-sales. The repeat-sales covered all of Bayonne, NJ. To measure the effect of the new station, we then identified the houses for which the new 8th Street Station would be the closest rail station (if there was another rail station closer, then the effect of a new station would be negligible). We were left with 149 repeat sales. Of these 149, we dropped nine observations.

Of the nine, three data points were for apartment buildings, which we dismissed because they reflect commercial deals rather than residential sales; one was a short sale, one was an industrial complex (again a commercial deal with more valuation considerations then a residential sale), one was a for an entire city block (the redevelopment of the land undermined the validity of a repeat-sales analysis), one was for a lot that could not be found on Zillow.com or Google Maps, and one had a second sale price that was only 46% of assessed value while the initial sale was for 176% of assessed value (the median was 215% of assessed value). The last property was excluded because the second sale price was $20,000 or only 18% of assessed value. On this basis, we concluded that the sale was not an arms-length transaction.

This left us with 140 repeat-sales to use for our analysis. Fig. 3 shows a map of our observations (the 8th Street Station has the green marker and the 22nd Street Station has the blue marker).[2] We then mapped the distance for each house from the 8th Street Station and the next closest station, the 22nd Street Station, as well as the distance to the closest bus line. We calculated the distance to the light rail stations in both minutes and tenths of miles using the fastest walking route that Google Maps suggested. Distance to the closest bus line was calculated as a straight line path to the bus route because the exact location of the nearest bus stop could not be identified since buses in Bayonne have intermediate stops between the stops listed on the official schedule.

To measure how much the new rail station increased transit accessibility, we created an "Improvement" variable by finding the difference between the distance to the 22nd Street Station and the

[2] https://www.mapcustomizer.com/map/RepeatSalesMap.

8th Street Station for each property. The dataset generated from the OPRS Database contained dates and prices for each sale; we used these sale prices (deflated for inflation using the BLS NY/NJ CPI_U for housing with 1982–84 as the base year) to calculate annual percent change. Consequently, our dependent variable (*Annualized Price Change*) is:

[(inflation adjusted price in year T)/(inflation adjusted price in year t)] $^{[1/(T-t)]}$.

Our model does not include any variables for house characteristics. We do not need to include such controls because a repeat-sales analysis compares a house against itself, so comparisons are only made between identical properties. Additionally, we did not include any municipal characteristics because all of our observations are in the same town; the analysis can be thought of as a natural experiment where the methodology eliminates the need for fixed effects or other control variables.

However, we include three controls to capture the effect of changes in general economic conditions over time. First, we include a variable that measures the time between first and second sale for each property in the data set (*Time Between Sales*). Second, we include a set of dummies for quarter of sale for both the first and second sales. Third, we include a set of year dummies for both the first and second sale. However, the year dummies were highly correlated with the time between sales. Finally, we include a control for the inflation-adjusted initial sale price. We include initial sale price because lower-priced houses may show more percentage appreciation than higher-priced houses. Thus, we estimate:

(1) $\textit{Annualized Price Change}_i = \alpha + \beta_1 \textit{ Distance to } 8\text{th } St_i + \beta_2 \textit{ Improvement}_i + \beta_3 \textit{ Initial Sale Price}_i + \beta_4 \textit{ Time Between Sales}_i + \delta_{jt} Q_{ijt} + \tau_{jt} Y_{ijt} + e_i$

where *i* indexes the observation (a twice-sold house), *Q* represents a dummy variable for quarter of transaction, *Y* represents a dummy for year of transaction, *j* indexes first and second sale, and *t* indexes time (quarter or year). Finally, we estimate the equation using the natural log of *Distance to* 8th *St*, *Initial Sale Price,* and *Time Between Sales*. We use the natural log of *Distance to* 8th *St* to capture any non-linear relationships. However, linear specifications of distance produce similar results. We do not estimate *Improvement* using natural logs as the variable includes some zero values.

5. Results

Table 1 below shows the summary statistics for our independent variables (*Distance to* 8th *St* (in minutes), *Improvement* (in minutes), *Time Between Sales* (in years), *Initial Sale Price* (in 1982–84 dollars), and our dependent variable (*Annualized Price Change*). The properties in our data set ranged from 3 to 19 min away from the 8th Street Station, while *Improvement* ranged from 0 to 18 min. The average distance to the 8th Street Station was 9 min and 15 s, while the average *Improvement* was 13 min and 43 s. *Time Between Sales* ranged from 4.14 years to 13.04 years and was 8.63 years on average. *Initial Sale Price* ranged from $39,473 to $707,092 and was $333,904 on average.

For *Annualized Price Change*, a value of one implies that after adjusting for inflation the price of a property did not change. In our dataset, annualized price change has an average value of 0.959. This implies that the average house lost 4.1% of its value each year between the first and second sales. This reflects that the pre-announcement housing sales were prior to the Great Recession and the housing market collapse, while the second sale is after the collapse. At the extremes of our dataset, there was a house that lost 16.8% of its value each year and one that gained 14.1% each year.

Using the variables described above, we estimate the impact of the 8th Street light-rail station on property values using both ordinary least squares with robust standard errors (OLS), a spatial error model that corrects for spatial autocorrelation, and robust regression (screening using Cook distance to remove outliers and then doing Huber and biweight iterations in sequence). It is important to note that due to the design of the robust regression procedure, the R-squared of the model is not reliable so therefore is not reported. Our results are summarized below in Table 2.

In Table 2, we report six specifications. In each specification, we regress *Annualized Price Change* on *Ln_Distance to* 8th *St* and *Improvement.* The first column reports an OLS regression with robust standard errors that regresses *Annualized Price Change* on *Ln_Distance to* 8th *St*, *Improvement*, and *Ln_Time Between Sales* . The second column repeats the column 1 specification and adds dummies for the quarter of sale for both the first sale and the second sale. The third column drops the control for time between sales and adds dummies for the year of sale for both the first sale and the second sale to the column 2 specification (the two measures are highly correlated). The fourth column adds a control for initial sale price to the column 3 specification. The fifth column repeats the column 4 specification using the robust regression procedure described above. The final column repeats the specification of column 4 and corrects for spatial autocorrelation using a spatial error model.

Because of the nature of our data, spatial autocorrelation may be present. Consequently, we test for spatial autocorrelation using both spatial error (i.e., residuals are influenced by neighbors) and spatial lag (i.e., the dependent variable is influenced by neighbors) tests. None of the tests offer much support for the claim that spatial autocorrelation is present (Spatial error tests: Moran's $I = 1.504$, $p = 0.133$; Robust Lagrange multiplier $= 1.05$, $p = 0.306$ and Spatial lag test: Robust Lagrange multiplier $= 0.919$, $p = 0.338$). Still, one might argue that $p = 0.133$ is not a terribly strong basis for concluding that spatial autocorrelation is not present. We therefore include a specification that corrects for spatial autocorrelation in Table 2. We include only the spatial error model as the spatial lag model produces nearly the same results.

The first row in Table 2 reports estimates on our variable of interest (*Ln_Distance to* 8th *St*). The estimates of *Ln_Distance to* 8th

Table 1
Means and standard deviations.

	Mean	Standard deviation	Minimum	Maximum
Annualized Price Change[a]	0.959	0.0492	0.832	1.14
Distance to 8th St[b]	9.25	3.2	3	19
Improvement[c]	13.72	4.63	0	18
Time Between Sales[d]	8.63	1.96	4.14	13.04
Initial Sale Price[e]	333,904	118,054	39,473	707,092

[a] Annualized Price Change is the change in house price measured by [(inflation adjusted price in year T)/(inflation adjusted price in year t)] $^{[1/(T-t)]}$.
[b] Distance to 8th St is the distance measured as minutes to walk to the 8th Street Station from property i using the suggested Google Map directions.
[c] Improvement is the distance to the 22nd Street Station minus the distance to the 8th Street Station for each observation (measured in minutes).
[d] Time Between Sales is the elapsed time, measured in years, between the first and second sales of property i.
[e] Initial Sale Price is the inflation adjusted price on the first sale for property i (1982-84 CPI-U adjusted dollars, housing component).

Table 2
Regression results on annualized price change.

	1 Annualized price change	2 Annualized price change	3 Annualized price change	4 Annualized price change	5 Annualized price change	6 Annualized price change
Ln_Distance to 8th St	−0.018[a] (0.0095)	−0.021[b] (0.0092)	−0.015[a] (0.0080)	−0.0065 (0.0085)	−0.0093 (0.0088)	−0.0063 (0.0092)
Improvement	−0.000059 (0.00082)	0.0000059 (0.00081)	0.000035 (0.00094)	0.000042 (0.00092)	−0.00022 (0.00072)	−0.00015 (0.00081)
Time Between Sales	0.011[c] (0.0017)	0.012[c] (0.0017)				
Initial Sale Price				−0.00015[c] (0.000046)	−0.00012[c] (0.000032)	−0.00015[c] (0.000033)
Constant	0.90[c] (0.028)	0.91[c] (0.029)	1.02[c] (0.025)	1.03[c] (0.022)	1.04[c] (0.026)	1.04[c] (0.027)
Dummies for Sale Quarter	No	Yes	Yes	Yes	Yes	Yes
Dummies for Sale Year	No	No	Yes	Yes	Yes	Yes
Robust Regression	No	No	No	No	Yes	No
Spatial Correction	No	No	No	No	No	Yes
R-Squared	0.24	0.29	0.37	0.46		0.46
Observations	140	140	140	140	140	140

Robust standard errors in parentheses for column 1 through 4. Standard errors in parentheses for column 5.
Ln_Distance to 8th Street is the natural log of Distance to 8th St for property i.
[a] significant at the 0.1 level.
[b] significant at the 0.05 level.
[c] significant at the 0.01 level.

St for the first two columns suggest that a 1% increase in distance from the station is associated with a 1.8 to 2.1 percentage-point reduction in *Annualized Price Change* ($p = 0.07$ and $p = 0.02$, respectively). The linear specification of the distance variable implies that a one-minute increase in walking distance to the light rail station is associated with a 0.20 to 0.23 percentage-point decrease in *Annualized Price Change* ($p = 0.07$ and $p = 0.04$, respectively, not reported). In column 3, we add dummies for year of sale (and drop *Time Between Sales*). As a consequence, the magnitude of the estimated effect of *Ln_Distance to* 8th *St* on *Annualized Price Change* drops modestly; a 1% increase in distance from the station is associated with a 1.5 percentage-point reduction in *Annualized Price Change* ($p = 0.06$).

In column 4, adding a control for initial sale price causes the estimated effect of *Ln_Distance to* 8th *St* on *Annualized Price Change* to shrink dramatically; a 1% increase in distance from the station is associated with a 0.65 percentage-point reduction in *Annualized Price Change* and the estimate loses statistical significance. The column 5 estimates (robust regression) are nearly the same for the distance variable (*Ln_Distance to* 8th *St*) as the column 4 estimates and suggest that the insignificant result reported in column 4 is not the result of outliers. The column 6 estimates show that correcting for spatial autocorrelation does not alter this conclusion. A 1% increase in distance from the station is associated with a 0.63 percentage-point reduction in *Annualized Price Change*. However, the effect (once again) is not statistically significant.

Taken together, these results suggest that distance from the station (*Ln_Distance to* 8th *St*) does not produce as-if random assignment of housing units. Rather, *Ln_Distance to* 8th *St* and *Initial Sale Price* are positively correlated ($r = 0.22$, $p = 0.009$) and lower first-sale prices produce more annual price appreciation. The correlation of distance to the 8th Street Station and the *Initial Sale Price* is somewhat lower ($r = 0.17$, $p = 0.05$), but the same result obtains for the estimated effect of distance (rather than the natural log of distance) on *Annualized Price Change*.

By contrast, *Initial Sale Price* and *Time Between Sales* were significant in each specification. The estimates imply that a one thousand dollar increase in initial sale price is associated with a 0.012 to 0.015 percentage-point increase in *Annualized Price Change*. The estimates for *Time Between Sales* imply that a one-year increase in the time between the first and second sales is associated with about a 1 percentage-point increase in *Annualized Price Change*. *Improvement* was not statistically significant in any specification.

We also investigated distance to the nearest bus line. However, neither of the local bus lines that traverse Bayonne experienced service or route changes during our study period. This implies that access to the bus line would already have been internalized in the price of the houses.

6. Conclusion

We examine the effect of an extension to a light-rail line on property appreciation by comparing pre-station-announcement and post-station-opening real sale prices of the same houses (repeat-sales) for homes near the new extension. The analysis serves as a check on the robustness of the results of studies that examine the impact of an entire light-rail line. Additions to an existing line may yield diminishing returns.

The results reported here contrast with those reported in Kim and Lahr (2014). Kim and Lahr analyze the effect of the Hudson-Bergen Light-Rail (HBLR) Line on property values using residential repeat-sales over the period 1991–2009. In 2009, the terminus of the line was the 22nd Street Station. In 2011, the line was extended by one station to 8th Street. Consequently, Kim and Lahr did not analyze the impact of the 8th Street Station.

Kim and Lahr (2014) find that both the 22nd Street Station and indeed the entire HBLR line caused statistically significant increases in house prices. Over the entire line, house prices next to a station showed 18.4 percentage points of additional annual appreciation (relative to locations more than ¼ mile from the line) with the effect decreasing by one percentage point for every 50 feet further from the station. For the 22nd Street Station in Bayonne (the end of the line at the time), properties at the station showed 17 percentage points of additional annual appreciation (relative to locations more than ¼ mile from the line) and the rate of appreciation declined by 2 percentage points for every 1% increase in distance from the station.

Our evaluation of the impact of the 8th Street Station finds no evidence that the 8th Street Station raised the annual rate of property appreciation for properties close to the station (relative to properties further from the station). This failure to find an effect from the light rail station may follow from diminishing returns; light-rail stations further from the CBD likely yield smaller returns than stations closer to the CBD. Distances further from the CBD have lower densities and therefore the cost of parking and driving a car is lower. Thus, strong evidence of property appreciation for portions of the line near the Central Business District (CBD) is no guarantee that extensions to the line further from the CBD will yield similar appreciation.

However, the weak returns to the light rail station may also be a result of factors that uniquely affect the 8th Street Station. Bayonne is isolated on a peninsula surrounded by Newark Bay to the west and the Upper New York Bay to the east. Access to Interstate 78 that crosses Newark Bay is 8 miles north of the 8th Street Station. While the Bayonne Bridge is only about a mile south of the station, the bridge goes to Staten Island. This isolation may raise the value of car ownership. Finally, zoning restrictions may prevent conversions to uses that make better use of the land. This inability to convert land may prevent prices from rising following the opening of the new light rail station.

Consequently, policymakers should consider issues of distance to the CBD, access to the station, and zoning around the station in deciding whether to extend existing light rail lines. Of course, the study does not examine any reductions in externalities like traffic congestion or pollution that likely follow from expansions of light rail. Taking account of the benefits of such reductions may ultimately produce evidence that the benefits of extensions exceed the costs. The evidence presented here simply suggests that it is less likely that the net benefits of extensions to light rail are positive.

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