

Team 10 Literature Review
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Since our initial proposal, we have refined our question to something more specific around housing prices and transportation. In particular, there are known relationships between proximity to public transportation and housing prices in urban areas. In New York, the Second Ave Subway (SAS) opened in January 2017 after nearly 100 years of fits and starts. By using a novel spatial model (a difference-in-difference model) used to analyze similar developments, we want to understand housing trends near SAS. In particular, we wonder to what extent did anticipated improvements around this long-running project increase property values before the substantive effect of new transit took hold.

First, some history and literature from the ground: while not a scholarly paper, StreetEasy's crack team of data scientists can go blow-for-blow in the ring with any academic researchers. In anticipation of the line's opening in November 2016, StreetEasy published some research discussing historical context, examining the changing rental price trends in the neighborhood, and forecasting increasing rent prices - specifically linking those prices to improved commute times, although without any heavy methodology to do so (StreetEasy, 2017). It will be interesting to see how those forecasts have held up now that the line has been open for nine months while running smoothly and not catching on fire. StreetEasy also did a fascinating analysis measuring the relationship between commute times in New York (to 42nd street) and rental price (StreetEasy, 2016). These posts provide insight into the current markets' thinking of how these variables impact prices, specifically for renters. Additionally, they provide strong evidence for anticipated price increases based on the published summary statistics. We look forward to confirming this notion and understanding how sale prices have changed, as well.

Much work has been done regarding the impact of transportation on real estate prices. For the most part, there is a positive relationship between transportation access and housing prices, and many case studies exist demonstrating this relationship. We will highlight some of them and the unique angles they brought to the table.

Probably the most similar study is a paper published this month, which looks at the introduction of Singapore's Circle Line, a new underground subway system, and its effect on

property values. It used many techniques, including a spatial difference-in-difference model, to study these impacts. It looked at anticipated effects as well as aftereffects of pricing as a result of the subway construction. We expect many similarities in this paper and the results we generate, as it looked at many of the temporal effects we hope to tease out and also used a similar model. Indeed, this paper also helps confirm the viability of the difference-in-difference model. This study also showed the impact of the subway on the real estate prices is proved to vary in different stage of construction (Diao,2017). As for SAS, the impact also tend to be different as a supplement and expansion of a mature subway line.

The specific spatial difference-in-difference model we hope to use comes from a 2014 paper which introduced the model and applied it to a specific case in Montreal where two new commuter rail stations were opened (Jean, 2014). This model builds on top of the baseline econometric models that have been historically used, such as the Hedonic Price model mentioned above. This same article goes on to provide a specific case study applying this model to commuter rail patterns in Montreal - another North American city with well-established transit. It is important to note, however, that the Second Avenue line is not specifically a commuter rail (although based on Yorkville's demographics we may expect the line to serve a similar function). Another interesting point of contrast is that the Second Avenue Subway has been a long time coming, whereas according to the authors of this paper the announcement / implementation of new commuter rail in Montreal was done on a timescale short enough to make "anticipation effects" negligible. It will be interesting to see how the spatial DID model applies here and what conclusions we can draw from running this particular analysis.

Historically, we point to several studies showing the relationship between real estate pricing and transportation. Examples of rent hikes after the opening of new public transportation can be found throughout North America, but the density of the city influences the exact effect. When streetcar lines were replaced with a subway line in the late 1970s, several studies looked to the city of Toronto to explain this relationship. D.N. Dewees's study from 1976 concluded that the rise in housing price increased perpendicular to the subway entrances, but not all the way along the line. It also showed the housing price increases diminished $\frac{1}{3}$ mile (walking distance) from the station. Vladimir Bajic's study on the same subway introduction showed that the

savings from commuting costs were factored into the price of housing along the new line, and that the rent increases impacted the housing stock close to the new stations, but not along the line in its entirety (Bajic, 1983). These studies are interesting to keep in mind as a baseline for the relationship between new transit options and housing. It's impossible to generalize their findings in the case of the Second Avenue Subway, however, because of density of other transit options.

Another interesting case study, closer to home, came from Washington, DC. In 1980 Damm studied the anticipated effects of the system, and in the 90s Grass studied the effects of the system's development. Damm studied the anticipated effects of development across a variety of real estate types, to the end of supporting some sort of "value capture" policy - in use in various municipalities, most notably Hong Kong, today (Kembrey, 2017). What's interesting about D.C.'s system is that it was developed entirely in the 1960's/70's - before that, there was no subway network, and then there was. Damm found that prices for retail real-estate jumped more immediately than residential real-estate prices, indicating elasticity in that market (Damm, 1980). This will be an interesting question for us to investigate as well. Grass looked at residential values and found a positive increase in prices after the fact. It will be interesting for us to look at the elasticities of various markets and the time it takes those markets to respond to changes in infrastructure (Grass, 1992).

Another case from London gives us great inspiration about how to distinguish between changes in house prices caused directly by the new subway site and changes with economic growth and decline (Gibbons, 2005). Comparing the implied value of travel time savings (VTTS) they conclude that households value rail access reflected in about 1.5% on price and that these valuations are large compared to the valuations of other local amenities.

Many other similar studies exist - we'll highlight two more which illustrate specific points. The first came from Athens, Greece - researchers looked at the relationship between already-existing transportation and housing prices. It found a positive relationship, but did note that the *type* of transit matters. Proximity to heavy rail and airports, for example, decreases prices (Efthymiou, 2013). In our case, we do not worry about these effects - now that construction is complete, the Second Avenue Subway does not create any excess noise at the street level.

Finally, through the case of Beijing, we believe that the impact of different urban subway stations on housing price is different. The article constructed a traffic substitution index by using private transport and subway traffic, and shows that the lower the alternative to the subway is, the greater the impact of the subway on house prices is (Xu, 2015). Through the comparison of private traffic restrictions on the implementation of the policy, the article obtained housing price premium produced by subway station. And because of the difference in the degree of convenience between private transport and public transport in different cities, the resulting housing price premium would become unique.

Thinking about these relationships in a broader context, there have been several studies that assess which transportation projects are “best” for New York City. Joseph Berechman and Robert Paaswell in particular examined the Second Avenue Subway amongst other capital transportation projects using a cost-benefit analysis of indirect economic development benefits of the line’s expansion, as well as transportation benefits, and environmental factors (Berechman, 2015). This analysis may be particularly useful because it ranks the Second Avenue Subway with contemporary projects such as the Seven Train expansion and the Fulton Transit Center. Although this article was written over ten years before the project’s completion, it discusses the project as one that’s “extremely problematic” based on the capital cost, construction effects on everyday life in such a dense area, and due to the disproportionate amount of public attention it’s received. This is interesting for us to fold into our analysis: does the project’s long and unusual lifespan make its influence on housing cost deviate from the usual pattern that public transportation has on housing patterns?

Even more broadly, the Economic Policy Institute published a report discussing externalities that haven’t been captured in current discussion around infrastructure projects (Bivens, 2017). It mentions that regional and national “spillover effects” aren’t included in the current discussion - perhaps the Second Avenue Subway has created some regional benefit by virtue of increasing access to, for example, East Harlem’s sanitation garage or the nearby Metropolitan Hospital. It also mentions Climate Change - perhaps Yorkville residents are now taking fewer cab trips as a result of having a train steps away. Last, it mentions job creation - perhaps less of a concern in Yorkville, though maybe the construction jobs associated with large

infrastructure projects such as the SAS provide a pathway to the middle class for the less educated. By measuring real estate values, we look at one piece of this puzzle, but many others remain to be explored.

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