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The competitiveness of the telecommunications industry in New York City

White Paper

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Contents

Abstract

The New York City Department of Information Technology and Telecommunications (DoITT) is interested to understand whether the current telecommunication industry regulations are effective towards generating a competitive industry environment that can provide cheap and reliable internet access to all New Yorkers. We analyzed the current internet infrastructure coverage data and overlaid it with pricing and socio-economic data to determine the relationships and policy changes that can lead to the desired state.

Executive Summary

A market analysis of the NYC broadband market established that the sector is dominated by a few large companies that collectively serve all census blocks, but not individually. This is consistent with the characteristics of an industry characterized by fixed costs, such as infrastructure. Furthermore, there are geographically contiguous clusters of census blocks that show similar levels of infrastructural provision, pricing, and internet access. This suggests that the spatial configuration of networks and other factors play a part in accounting for the patterns observed.

Despite changes in the number of Internet Service Providers (ISPs), household wired broadband subscription rates have remained relatively stable. The introduction of new ISP into an area has the potential to further fragment the consumer market, driving down profit margins and any benefits to consumers. Furthermore**,** regression results show that regardless of the

number of providers found in a Census block, the rates of broadband subscription correlated positively with income levels, and negatively with the number of ISPs.

This implies that policy options associated with increasing the number of competitors are likely to be detrimental in the long-run. Further, some of these options, such as building a publicly-owned network, might not be feasible given the size of NYC. The FCC presently has a Lifeline program which defrays the cost of a subscription for low-income families. However, neither is it publicized nor is the sum offered significant enough to offset the cost of a broadband subscription. It is therefore proposed that the NYC government further subsidize broadband subscriptions for low-income families to fill the gap between those who have access to a broadband ISP but cannot afford the service on top of publicizing and ensuring greater utilization of the existing FCC Lifeline program.

Introduction

As an internet subscription becomes an increasingly vital component to participate in the economy and our broader society, it is vital to ensure that every member of society has access to an online connection. However, for activities necessitating a steady, fast connection, such as remote working and learning, accessibility is contingent on having broadband internet access. The NYC Internet Master Plan (The New York City Mayor's Office of the Chief Technology Officer [NYC CTO], 2020) states that a reliable broadband internet connection is increasingly becoming crucial to NYC's long-term economic vitality and societal wellbeing.

Moreover, the Federal Communications Commission (FCC) defines a wired home broadband service as an "Internet access connection providing speeds of at least 25Mbps download and

3Mbps upload." (Talbot, Hessekiel, & Kehl, 2018, p.4) This usually takes the form of a cable or fiber network with the latter being capable of higher speeds and bandwidth (US Congressional Research Service, 2019). However, it is a fact well known that not all New Yorkers have broadband internet access either by choice, or by circumstance (NYC CTO, 2020). This suggests that the present policy framework surrounding the broadband internet market is unable to ensure universal access in NYC.

This White Paper will elaborate on the present situation confronting NYC, the reasons behind this digital divide, and provide policy options to narrow the digital divide between New Yorkers.

Problem Statement

In an increasingly digitized world, a fast and stable internet subscription is fast becoming essential for economic advancement. However, many of New York City's residents lack a home broadband internet service. As a result, we are interested in discovering if there is an optimal number of ISPs for the New York City market that can improve Internet accessibility in terms of coverage area, household adoption rates, and affordability for all New Yorkers.

Analysis of NYC's Broadband Internet Connectivity

Unevenness in Digital Access

The existing unevenness in broadband affordability and availability in NYC is a microcosm of social inequality and ineffectiveness of competition and regulation of the telecommunications industry. In total, approximately 18% of New Yorkers do not have any high-speed internet connection (NYC CTO, 2020). However, they are not evenly spread out across the city. There

are a few Neighborhood Tabulation Areas (NTAs) such as Williamsburg, Borough Park, Lower East Side, and Belmont with extremely low household broadband adoption rates. Additionally, even among residents with wired home broadband service perceive their service as extremely costly (Talbot *et al.,* 2018).

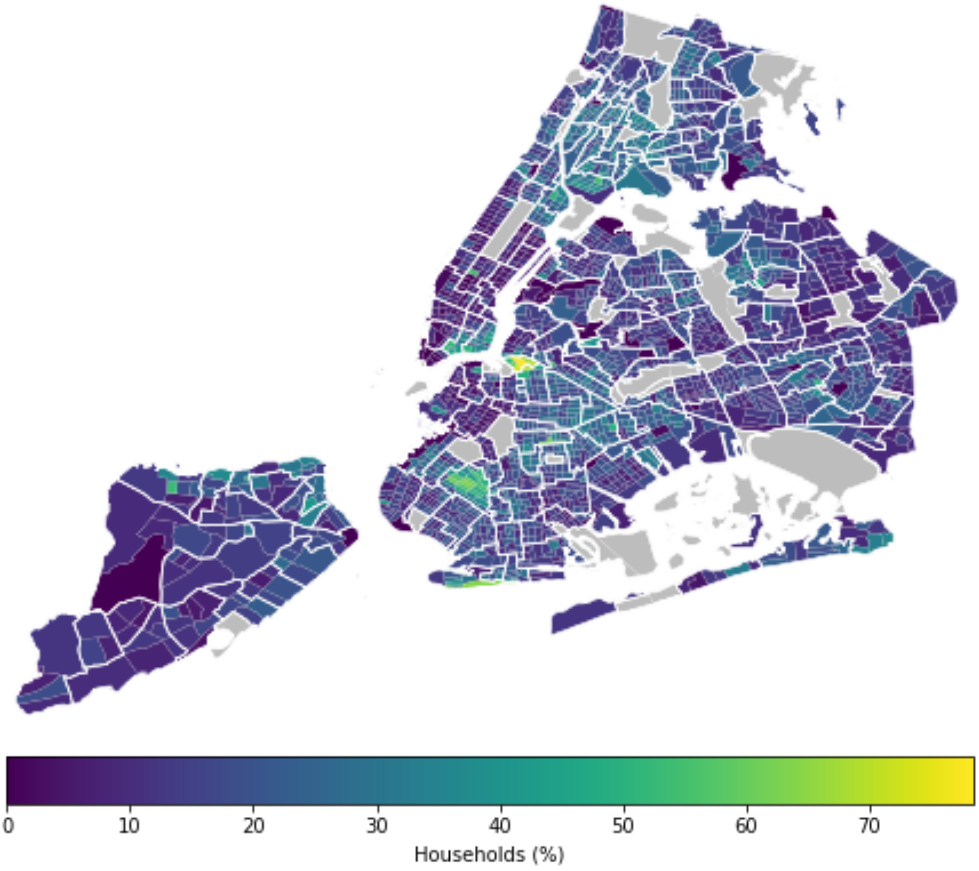

Figure 1: Geographical distribution of households in each census tract and NTA without a broadband subscription in 2018

An Oligopolistic Market

The shortcomings in access and pricing are commonly attributed to the lack of competition between service providers because the industry is effectively a spatially segmented oligopoly (Brake and Atkinson, 2019). The Herfindahl-Hirschman Index (HHI), a common measure of firm-market concentration used by the Department of Justice, was used to estimate the

concentration level of the broadband market in New York City. The HHI was calculated by taking the sum of the square of each firm's market share. It takes into account the relative size distribution of the firms. The number will increase when more companies emerge in a market or the disparity in size between those firms decreases. However, it fails to assess the complexities of various markets in a more accurate way. In NYC, the Index score for the telecoms industry is 3096, above the 2500 threshold for an oligopolistic market, following the guidance of the U.S. Department of Justice & FTC. ISP pricing and plan data scraped and provided by DoITT further supports Brake and Atkinson's argument of spatial segmentation (2019). Among the main ISPs in New York City, Altice covers the Bronx and East Brooklyn, Charter serves the rest of NYC, and Verizon is available across NYC. This can be attributed to the existing franchise agreements between the City and ISPs (NYC CTO, 2020).

To further the hypothesis of spatial segmentation, the degree to which contiguous spatial units reflected similar values, and whether said observed patterns were randomized outcomes was calculated. This is also known as spatial autocorrelation. At the scale of census tracts, internet service infrastructure displays strong signs of spatial autocorrelation. There are clusters of spatially contiguous census tracts that share similar levels of infrastructural provision in terms of price and the number of ISPs that is beyond randomness as explained in Table 1.

Not Sig:	Statistically insignificant traces of spatial autocorrelation among contiguous census tracts
High-High:	Census tract with above-average value bounded by tracts with equally above-average values
Low-High:	Census tract with below-average value bounded by tracts with above-average values
Low-Low:	Census tract with below-average value bounded by tracts with equally below-average values
High-Low:	Census tract with above-average value bounded by tracts with below-average values

Table 1: Interpretation of spatial autocorrelation maps

It is more likely than not that these spatial patterns seen in Figures 2 and 3 are not randomized outcomes. The broad swathes of contiguous census tracts that are similarly clustered together imply that there are network effects at a scale greater than census tracts.

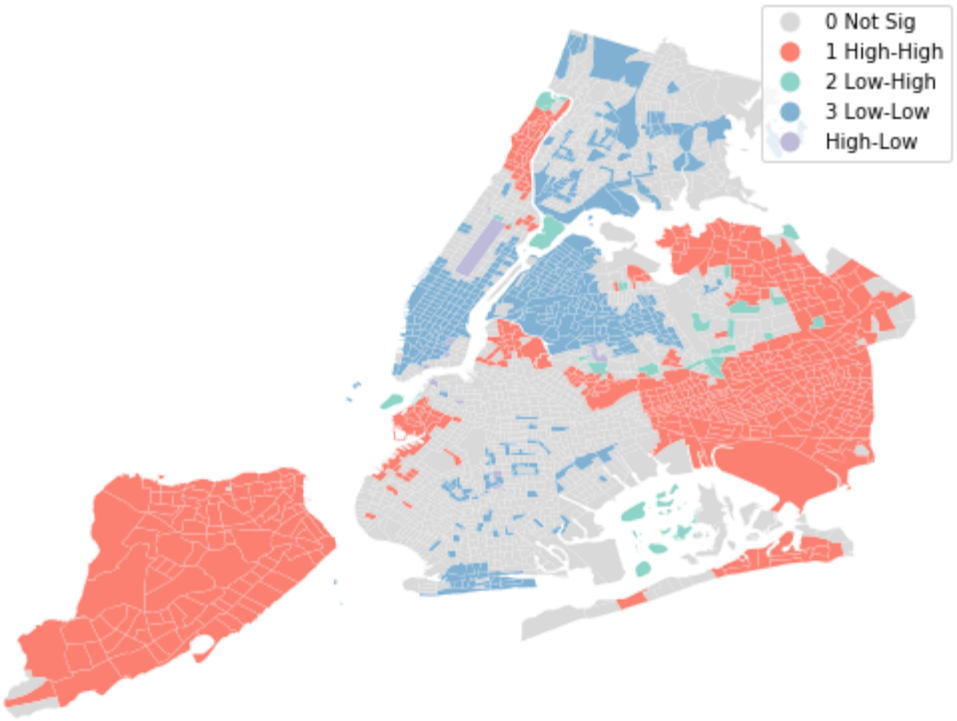

Figure 2: Spatial autocorrelation map for contiguous household broadband subscription price clusters

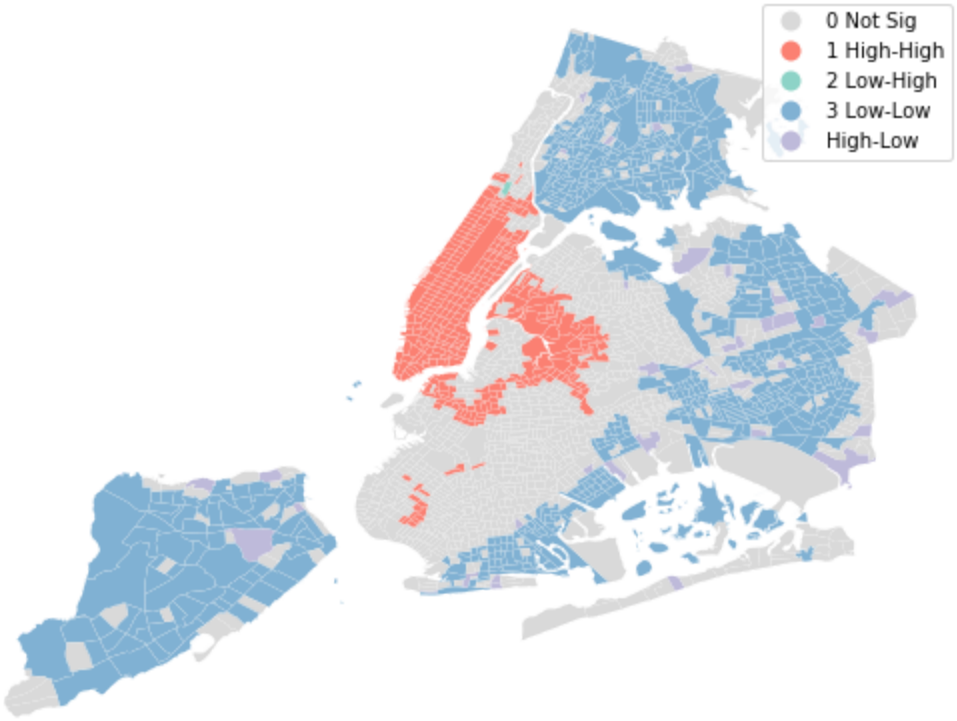

Figure 3: Spatial autocorrelation map of contiguous clusters based on the number of ISPs

Consumer Sensitivity towards ISPs

ISPs declare their level of service provision to the FCC using the Form 477. Using this data, nearly all of NYC Census Blocks have at least one provider of broadband-speed Internet access delivered through cable or fiber infrastructure. About 80% of blocks have access to two or more distinct ISPs for their broadband service. For any service in excess of 1 Gbps, only around 7% of all Census blocks have access to any ISP that offers those speeds. The number of ISPs in Manhattan increased between 2017 and 2018, but Brooklyn saw a decrease over the same time period. However, changes in the number of ISPs in each census tract appear to have very little impact on the rate of household broadband subscription. Subscription rates were fairly stable in the face of pricing strategies and changes in the number of ISPs in NTAs. This is borne out in Figure 3 below where the X and Y axes reflect the changes in number of ISPs and proportion change in the wired broadband subscription rate. Each point represents a census tract.

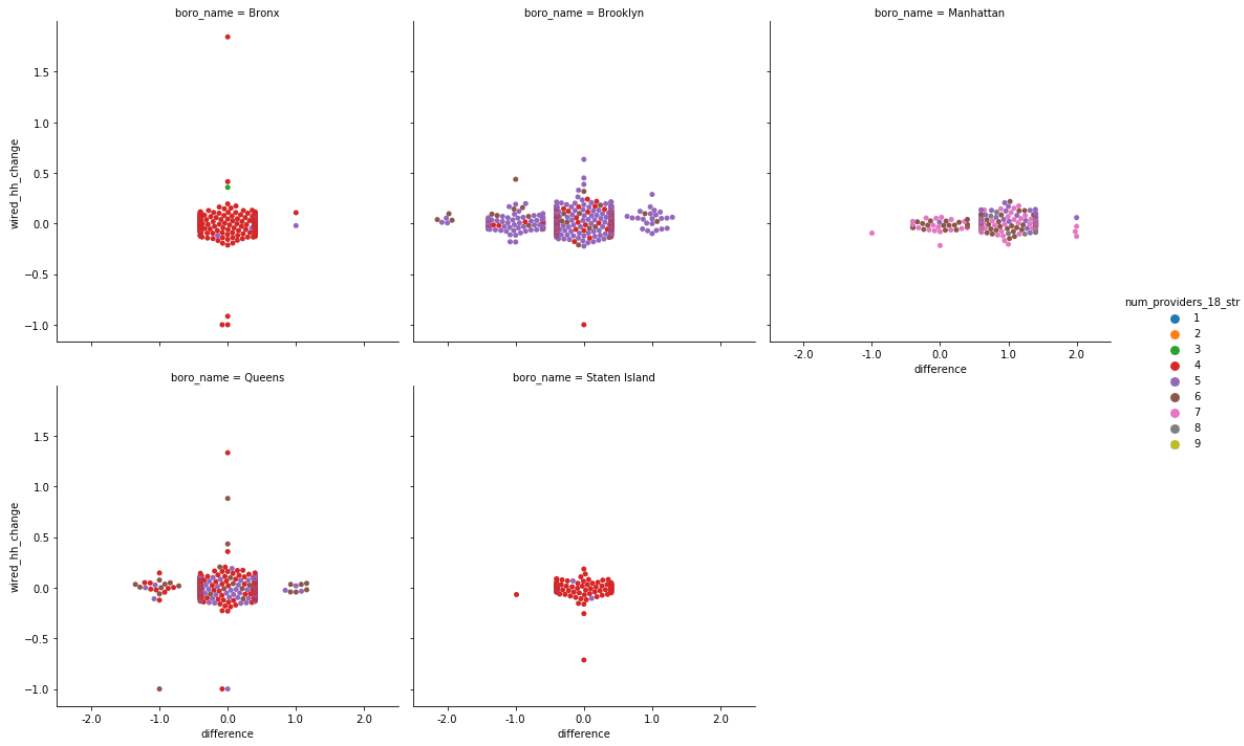

Figure 4:Swarm plot of changes in ISPs and household wired broadband subscription rate by borough

Furthermore, in considering the sensitivity of internet subscriptions to the number of providers available, it appears that around 17% of census tracts in NYC registered below-average rates of household broadband subscription despite having an above average number of ISPs, grouped by borough, present in their census tract. This is likely to be an undercount as there are many census tracts in Manhattan with commercial-only ISPs that do not serve residential accounts. This would have skewed the average number of ISPs upwards. Interestingly, many of these census tracts are those on the Lower East Side, South Williamsburg, and Sunset Park, which have low rates of broadband subscription to begin with. This suggests that broadband subscription rates might not be particularly sensitive to the availability of ISPs.

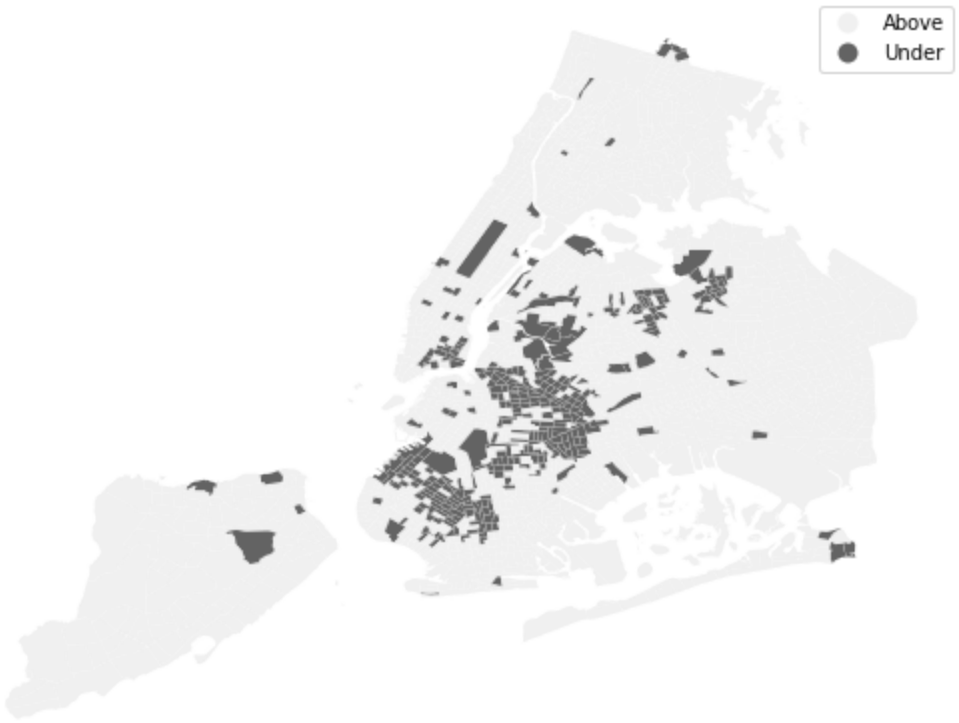

Figure 5: Census tracts with below-average rate of household broadband subscriptions but above-average number of ISPs

Demand for Broadband Access

The customer base of ISPs include businesses as well. Given that Manhattan is dominated by census tracts with below-average plan prices and above-average number of ISPs as compared to other boroughs, it was hypothesized that Manhattan's heightened connectivity could be due to its commercial nature. KMeans clustering was performed on the estimated number of business and household accounts in each NTA. This algorithm searches for an ideal number of clusters within the dataset, and segments the observations into groups based on a latent structure within the data. The results suggest that clusters with a higher business to residential accounts ratio are associated with above average ISP counts. The converse is true for NTAs that are more residential in nature. This is not entirely unexpected as there are ISPs that

specifically cater to businesses and do not serve residential accounts. Unsurprisingly, these clusters tend to be found in Manhattan.

A proxy for the connectivity of New York City is the demand and supply of ISPs in NYC. Potential factors affecting broadband prices on both demand and supply side were identified. On the demand side, the number of providers and other demographics, including income, age and race, were considered as independent variables. On the supply side, the only variable was the number of providers. Unsurprisingly, the number of providers was significant in the regression results of both demand and supply. On the demand-side, census tracts where high income people who earn more than US$200,000 a year live and with multiple races tend to have a more expensive broadband service price. Further, the percentage of people with no internet is a significant variable which has a positive impact on the pricing of broadband. In other words, the price of broadband tends to be higher in those places where more people lack access to the internet.

As shown in Figure 4 below, demand for the number of ISPs is relatively more price-elastic than the supply curve, which means the change of the number of providers may not lead to a significant decrease in the consumer's expectation of broadband price. The intersection of these two curves is considered as an equilibrium of the broadband market. The optimal number of providers is around 5. The equilibrium price ranges from US$69.1 to US$89 per line per month.

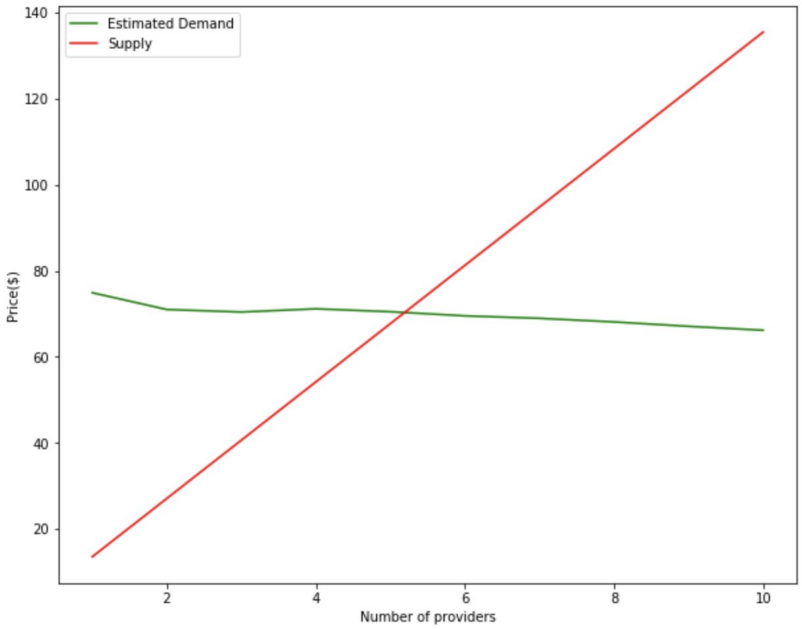

Figure 5: Demand curve and supply curve of broadband services

A second indicator of connectivity is the percentage of households with a home-based wired broadband subscription. Universal access means 100% of households can access high-speed broadband internet from their homes. Presently, it is around 65%. Given the high degree of spatial autocorrelation, the effect of the spatial configuration of each census tract's independent variables, and their cumulative effects on each census tract's household subscription rate should be considered. Furthermore, since each borough displays different degrees of spatial autocorrelation associated with the franchise agreements in force, it cannot be assumed that the dependent variable is uniform across space. In other words, spatial heterogeneity must be considered when measuring the impact of demographic, racial, and infrastructural variables on household subscription rates. (Drukker, Egger & Prucha, 2010; Deng, 2018)

This was done by introducing a spatially-lagged term in a regression model that allows the coefficients to vary by boroughs, while accounting for the aforementioned feedback loops and

variable auto-correlations. Much like the aforementioned regression results of the supply and demand of ISPs, income levels were significant variables. Census tracts with wealthier residents are associated with higher subscription rates. More interestingly, the number of ISPs was negatively correlated with subscription rates. This might imply that in the long-run, an increase in the number of ISPs can result in market fragmentation that reduces subscription rates.

Recommendations

Municipal Broadband Networks

To increase the number of broadband providers, cities can construct their own fiber broadband networks to act as a public ISP. (Talbot *et al.*, 2018) Examples of cities that have done this successfully include Chattanooga, TN and Santa Monica, CA. (Lampland and Mitchell, 2014). Talbot *et al.* (2018) argue that a majority of these cities were able to offer faster broadband connectivity at lower prices, forcing incumbents such as Spectrum to improve their services to compete effectively. What remains unclear is whether these public options were able to raise household broadband subscription rates. However, the sample size of this study was small, given the limited number of community-owned fiber networks around the country. Plus, these networks serve communities with less than a million residents; it is unclear whether large metropolises such as NYC will be able to replicate and scale up effectively, while providing the funding required to maintain the infrastructure in the long-run.

More ISPs

Brake and Atkinson (2019) argues that the instinctive solution to improve internet coverage is greater competition by increasing the number of ISPs through favorable regulations. However, greater competition does not necessarily result in lower prices and maximum consumer benefit.

As more ISPs enter a market, the customer pool further fragments across more providers, making it difficult to financially support a broadband network infrastructure. As a result, only an oligopolistic market structure with a few big firms can achieve economies of scale and thrive, whereas smaller companies require subsidies to stay afloat.

Furthermore, data from the past few years have shown that changes in the number of ISPs in either direction have not significantly altered household broadband subscription rates. Our regression shows that the number of ISPs and household subscription rates are negatively correlated. Increasing the number of ISPs is associated with a decrease in household wired broadband subscription rates. This reflects Brake and Atkinson's (2019) argument that more entrants may instead lead to greater market fragmentation and reduction in consumer welfare and economic efficiency. In the long-run, this can result in a number of outcomes such as higher prices or lags in investing in and adopting new technologies by ISPs.

Broadband Access Subsidy

If the government maintains that universal access to broadband is a desirable outcome, then public intervention should focus on helping all New Yorkers become potential customers who are able to pay for such services. Our analyses have revealed that income levels are significant variables affecting household broadband subscription rates. Siangjaeo (2016) found that a price subsidy for lower-income residents in Minnesota was most effective at improving broadband adoption rates. A subsidy to help pay for a broadband subscription would help connect those folks who cited price as an impediment to get a better or any internet service (Horrigan, 2009), this would specifically help areas where internet infrastructure may be underutilized. However, this subsidy should not be limited to wired connections, as Lee (2017) found that people of

lower income preferred and prioritized a wireless internet service over wired broadband service. Besides, the less elastic demand curve also suggests people may be inactive to the increase of internet providers unless they can afford one. A means-tested program designed to reduce the out-of-pocket cost for broadband internet access can increase the pool of potential customers across the city. This will shift responsibility for network maintenance, upgrades, and service to ISPs even as they compete for a broadened customer base.

At the federal level, the FCC already has a program called Lifeline which provides up to $9.25 a month to eligible households who earn up to 135% of the federal poverty line. Given the lack of publicity, it is unclear if households are aware of such a scheme. Besides, a $9.25 monthly subsidy is insufficient for wired broadband plans that can cost as much as $70 a month. Among the six telecommunication providers in NYC which are authorized to receive Lifeline subsidies, Verizon is the only provider with wired broadband services.

As such, the NYC government can provide a supplementary top-up to low-income families modeled on Singapore's Home Access program which has been in operation since 2014 . This scheme is administered by the national regulator of telecommunication services, the Infocomm Media Development Authority. Families whose monthly incomes are in the bottom decile are eligible to sign up for broadband plans offered by multiple ISPs with up to an 80% subsidy off market prices (Infocomm Media Development Authority, 2020). Consumer choice is maintained as consumers get to pick between ISPs. The prices paid range between 0.3% to 1.3% of monthly household income.

The 2018 ACS survey revealed that 46% of NYC households without an internet subscription, or approximately 231,000 households, earn less than US$20,000 annually. The NYC government can enter into negotiations with ISPs to provide broadband plans to low-income households earning less than US$20,000 annually at wholesale prices below market rates. The government can then administer the subsidies for households that qualify and sign up. Prices can be means-tested and capped at 0.5% to 2% of monthly income. The total cost of such a scheme is dependent on rates negotiated by the government and the total number of households that sign up.

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Appendix

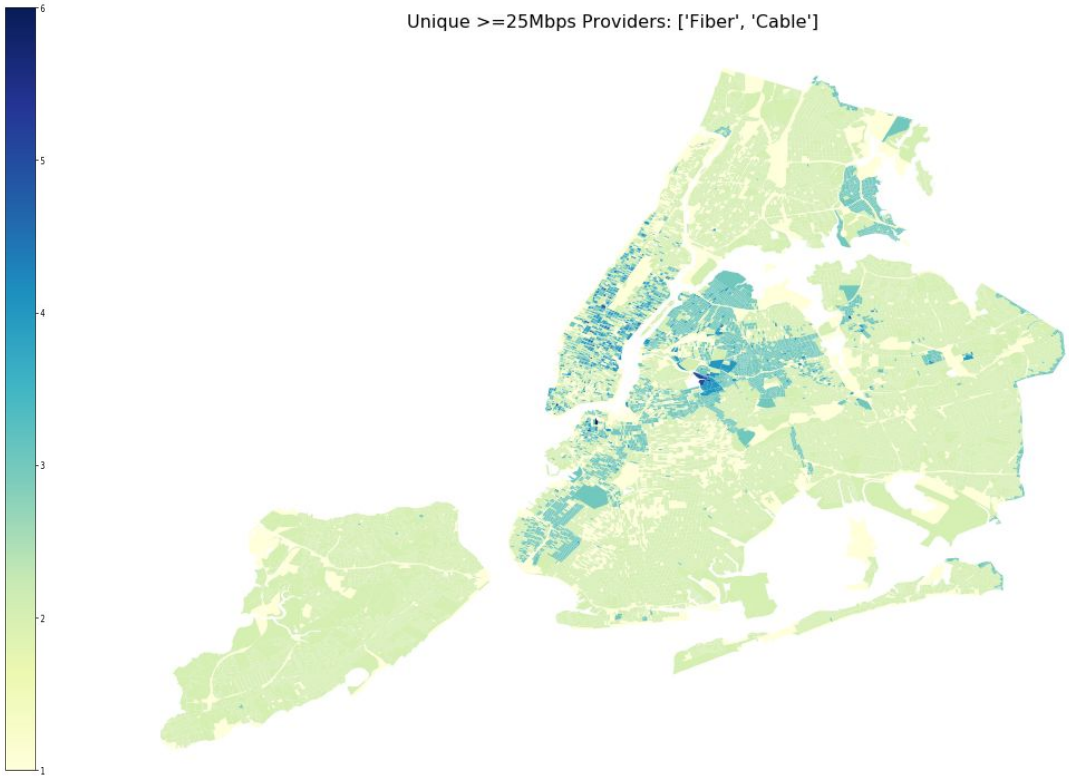

Figure 6: Number of providers per census block offering fiber/cable connections in excess of 25mbps

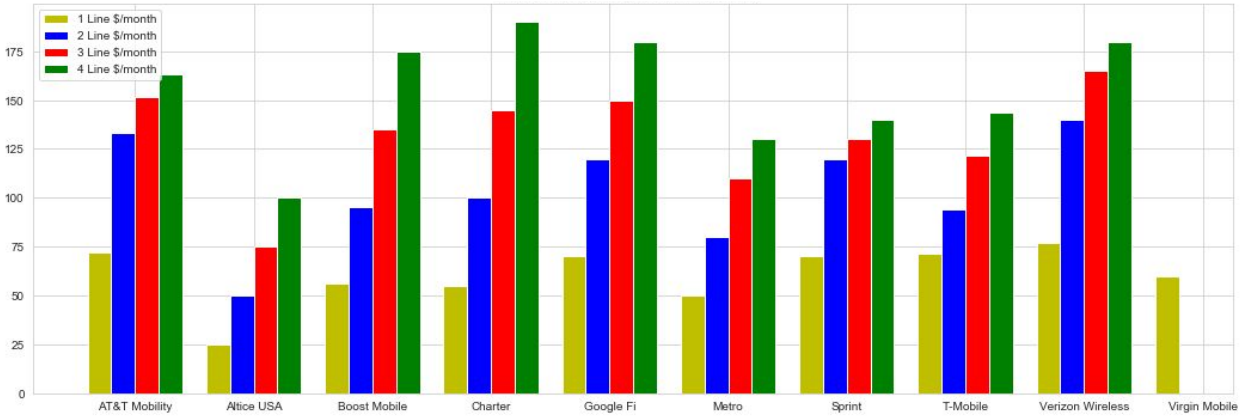

Figure 7: Mobile broadband subscriber plan cost

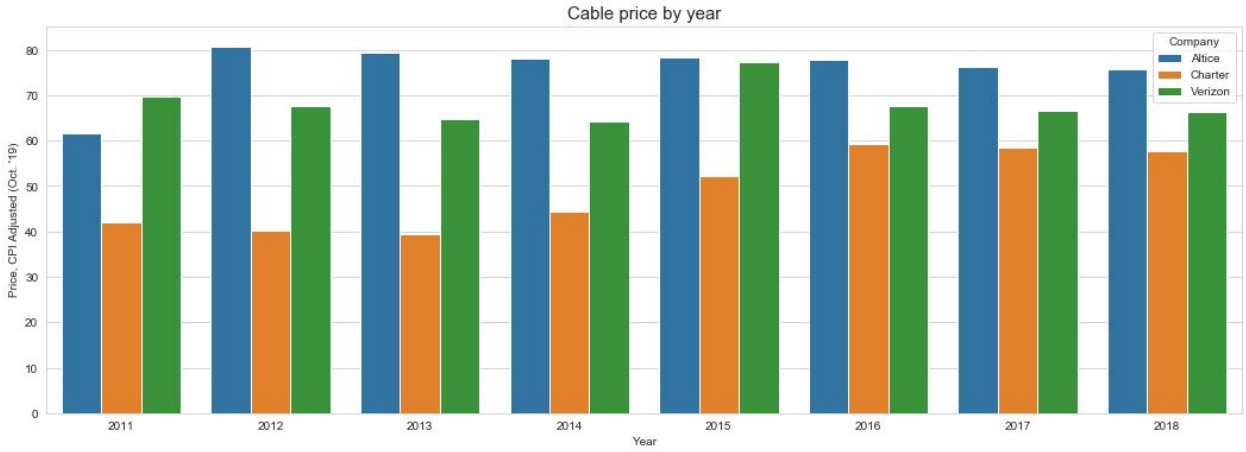

Figure 8: Cable plan pricing over the years

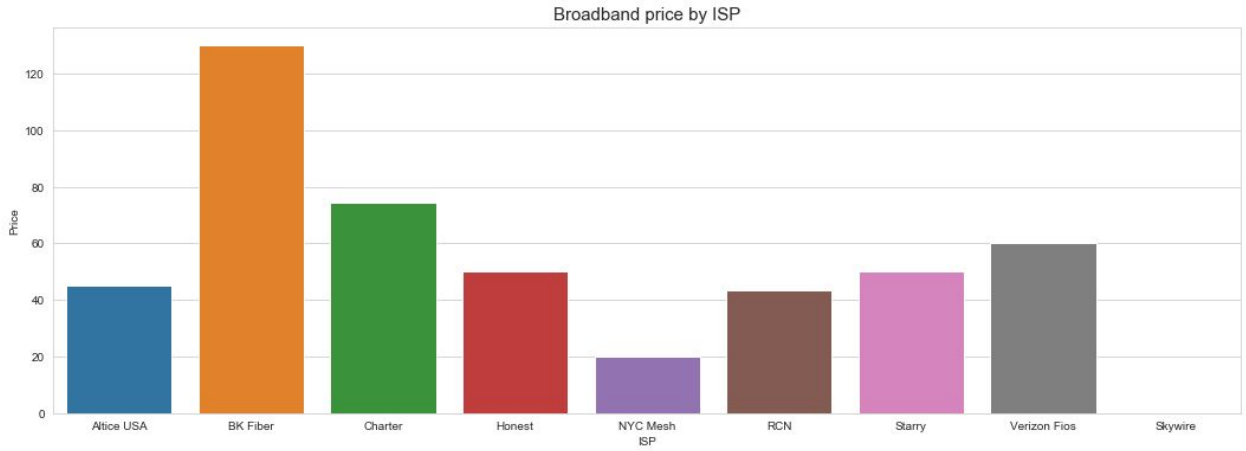

Figure 9: Residential broadband price plans by ISP

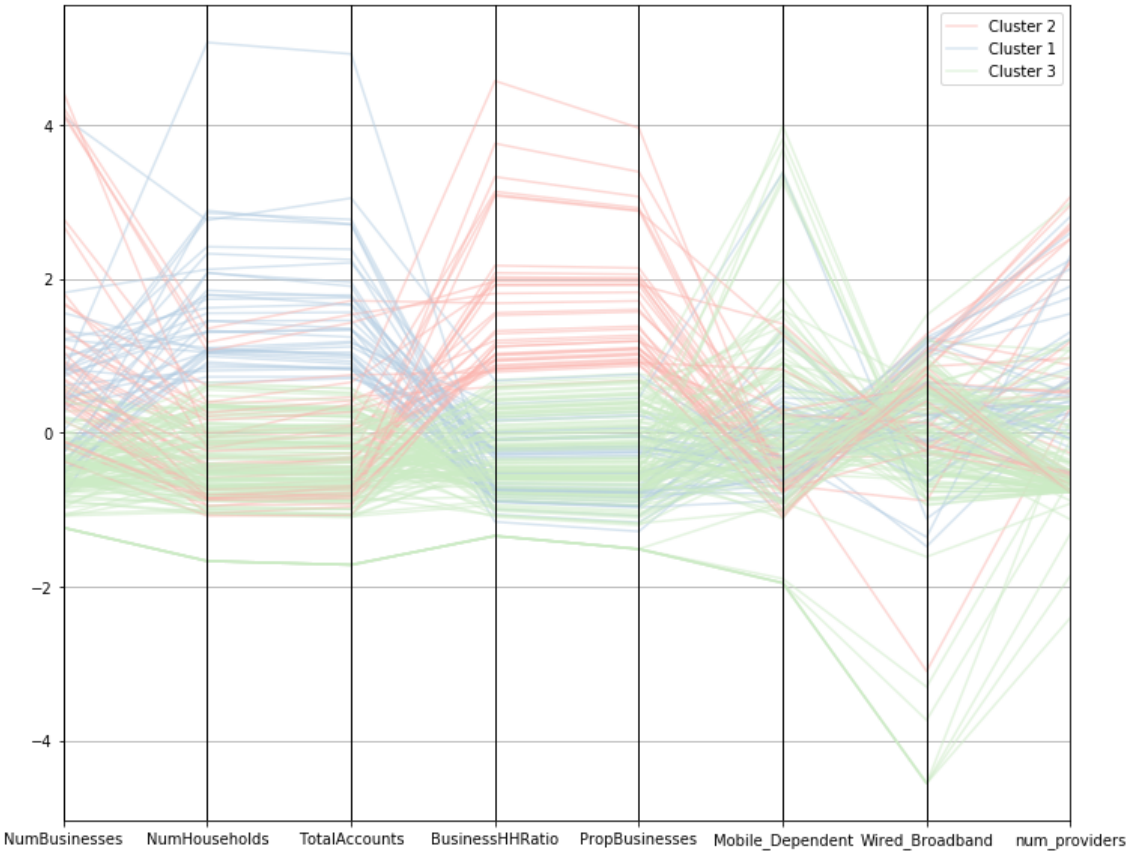

Figure 10:Parallel coordinates plot of KMeans clustering based on business patterns