DOES SUBWAY STATION PROXIMITY SPUR RESIDENTIAL DEVELOPMENT?

ANALYZING THE IMPACT OF THE SHEPPARD SUBWAY LINE ON HOUSING DEVELOPMENT IN THE CITY OF TORONTO.

by

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Does subway station proximity spur residential development?

Analyzing the impact of the Sheppard Subway Line on housing development in the City of Toronto.

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Abstract

This study examines the pace and scale of residential development within a 1-kilometer radius of subway stations along the Sheppard Subway line within the City of Toronto during the years 1991-2016. The dataset used for this study was obtained from Statistics Canada that contained data on the number of housing units per dissemination area within a 1-kilometer radius of a subway station in addition to several variables used for analysis. The difference-in-differences method was used, findings indicated insignificant results meaning the Sheppard Subway Line did not spur residential development at a rate faster than the one observed for the Sheppard West corridor. This was further proved by examining the pace of development during the pre-treated and post-treated period amongst both the treated and control groups, findings indicated that both groups received similar amounts of residential growth, such that the difference in residential construction between the two corridors was statistically insignificant.

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Chapter 1: Introduction

This section examines the research background, the research question and describes the study area and the framework for the thesis.

1.1. Background of Research

Transit oriented development, commonly referred to as "TOD" is a popular intervention in large cities globally. Its use is more pronounced in North America and Europe (Brown, 2010). While there are many academic studies examining its implications and importance, currently there is no universal standardized definition. Qviström & Bengtsson (2015); Freeman & Schuetz (2017); Renne, Hamidi & Tolford (2016) and Duncan (2009) define transit-oriented development as the provision of higher density, mixed-use, walkable development which is located near a rapid transit station. Often, TOD is presented as a solution to various urban challenges, such as urban sprawl, traffic congestion and infrastructure costs. By creating dense, walkable communities near public transit, the need for driving and energy consumption is greatly reduced. In many large urban centers, TOD has been an effective solution for maximizing the potential return on investment for existing and future transit infrastructure projects, such as in Copenhagen, Denmark (Dabermstein, 2016). Additionally, limited research has examined the impact of rail transit on housing development within the Canadian context. Housing development can be defined as a structured real estate development of residential buildings which range from single-family, multi-family, apartments, townhouses or condominiums. Popular throughout North America and the United Kingdom, they are often areas of high-density, low-impact residences of single-family detached homes, and often allow for separate ownership of each housing unit ("Definition of HOUSING DEVELOPMENT," n.d.). This study contributes to the limited literature examining the effects of rail transit on housing development by focusing explicitly on residential units located within a 1-kilometer radius from rail transit which will be explained further throughout this thesis.

Qviström & Bengtsson (2015); Cervero (1998) and Grant (2002) suggest that 'TOD' was coined by Thocamas Lowry during the late 1890's in Minnesota. As the population started rapidly increasing after World War I, the Metropolitan area of Minnesota started to grow. However, without a complex transit system, urban growth was limited to the few miles individuals could walk by foot. Transit options started with horse cars, which quickly became electric streetcars. From here, most large metropolitan cities primarily within North America and Europe moved to electric streetcars as the main mode of public commuting to the city for services and amenities as Forter (1998) and Moss (2016) describe. Land outside the city became more affordable and the suburbs began to develop with the earliest houses being built alongside the streetcar lines. Soon after, shops, grocery stores and other services were developed near rail transit to accommodate the growing population. Today, many large cities across the world use the concept of transit-oriented development in which the creation of transit lines throughout the city is used to guide real estate development (Bartholomew & Ewing, 2011; Porter, 1998; Fertner, 2013; Searle et.al, 2014; Van Lierrop et.al, 2017; Jones & Ley, 2016).

Previous research has found that land located within close proximity to a transit station has resulted in a substantial increase in land development and increase in land costs, as compared to land located further away transit. The closer a development is to public transit, the pricier it becomes, as transit station proximity is a highly desirable attribute. On average, land located within half a mile from a transit station is 20% higher in price as compared to those not within transit proximity; land within a ¾ mile increases by 15% and land located within 1-mile from a transit station increases by 10%, holding all else constant (Zhang, M & Wang, L. 2013). The research objective of this study is to understand if construction development near transit stations along the Sheppard east subway line happened at a faster and more intense rate as compared to development which occurred on the west side of Sheppard where the transit extension did not occur between the years of 1991-2016. This research examines whether there is a causal link between transit stations and land development, specifically within the City of Toronto. A lot of development would happen regardless due to numerous factors such as educational institutions, employment resources and other services and amenities. However, the researcher is interested in examining how much of the development would occur from the Sheppard subway line; holding all else constant.

1.2. Research Question Statement

Following on from the background and objective of this study, the purpose of this thesis is to investigate the effects of the Sheppard East subway extension on land use development, by answering the following questions:

- Has land development along the Sheppard Subway corridor increased after the subway line started operations in 2002? If so by how much?
- What is the difference in the pace of residential development along Sheppard East when compared with the Sheppard West corridor where the subway extension was not introduced?

1.3. Study Area Introduction

The City of Toronto is the most populated city in Canada with a population of approximately 2.7 million as of 2017 (Government of Canada, 2017). The Sheppard Subway Line opened in November 2002 by the Toronto Transit Commission (TTC) and is Toronto's shortest subway line that connects to the existing Yong Subway Line at Sheppard – Yonge station. The extension is estimated to have cost the city approximately $922 million (2002 dollars) to build (Saxe, et.al, 2016). The line is located in North York, along Sheppard Avenue East, running east from Yonge Street to Don Mills Road. The subway line is situated approximately 25 kilometres from the downtown core, which is equivalent to a 30-minute subway ride (Bow, 2017); and consists of many services and amenities within the area such as the Yonge-Sheppard Shopping Center, restaurants, retail shops and healthcare centers (Saxe, et.al, 2016). Additionally, the subway line is 5.5 kilometres long, consisting of five subway stations namely Sheppard East, Bayview, Bessarion, Leslie and Don Mills (Figure 1).

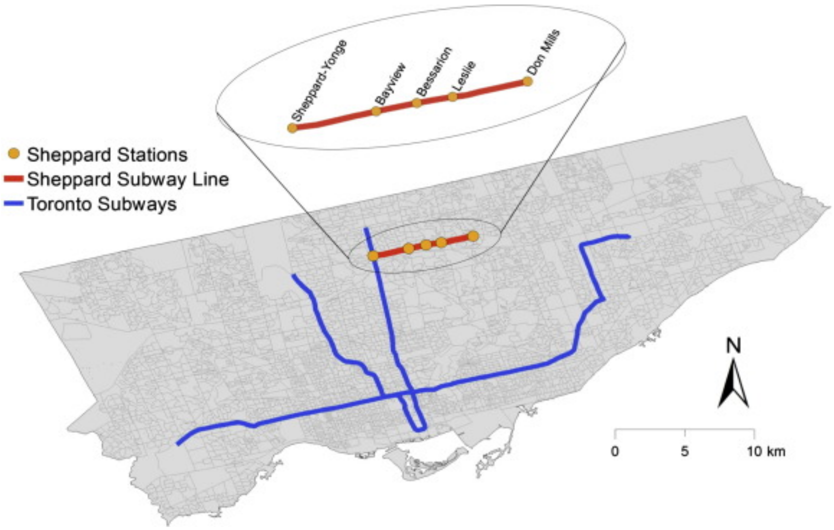


Figure 1-1: Image of subway lines within the City of Toronto, with specific focus on the Sheppard subway line. Source: Saxe et. al (2016)

1.4. History of the Sheppard Subway Line

In 1985, the Toronto Transit Commission issued *Network 2011*, which was a transportation plan for Metro Toronto that included a suggested subway line along Sheppard Avenue between Yonge Street to Victoria Park Avenue (Levy, 2015). The Sheppard Subway Line was part of a strategy to increase connectivity throughout the city. *Network 2011* was approved in 1986 by the Council of Metro Toronto with a total cost of $2.7 billion. However, in 1995 the provincial government reduced the length of the Sheppard Subway Line by moving the eastern end from Victoria Park Avenue to Don Mills Road, to decrease capital costs (Haider & Donaldson, 2016).

The provincial government amalgamated Metro Toronto's constituent municipalities in 1998 to create a single-tier municipality known today as the City of Toronto. Mel Lastman, the first mayor for the City of Toronto played a key role in ensuring the subway line was constructed as promised. In 2002 the subway extension opened in which critics have claimed the Sheppard Line significantly lacks ridership relative to the other two subway lines. Since the beginning, the four eastbound stations have attracted an average daily ridership of 50,000; while the Bloor-Danforth line has nearly 510,000 transit riders daily; and Yonge-University 720,340 (Toronto Transit Commission, 2016). Many claim the subway extension is too short and is only a viable option for those who live within the neighbourhood. Currently, there are several proposals put forward to the City Council to extend the Sheppard Subway Line to Scarborough Town Center, however no agreement has been reached as many transportation experts believe the subway line is too expensive to extend (Ferguson, 2018). Table 1-1 provides a breakdown of the timeline for the subway extension (Haider & Donaldson, n.d.).

Table 1-1: Public transit development timeline for the Sheppard East corridor

Year	Developments
1960s–1970s	With increasing sustained population growth and political opposition to constructing highways, calls for more public transit options gain traction and lead to formalized plans by the 1980s.
1985	TTC delivers *Network 2011* Transit Plan to Metro Toronto ($2.7 billion project including Downtown Relief Line, Eglinton West, and $1 billion for Sheppard Subway extending to Victoria Park).
1986	Metro Council approves *Network 2011* plan (Province to pay 75% of cost).
1990	Provincial government announces $6.2 billion *Let's Move* Transit Plan for the GTA, adding new components to *Network 2011*. Sheppard Subway deprioritized because of high cost projections.
1992	Sheppard Subway Environmental Assessment published as part of *Let's Move* initiative.
1993	Provincial government announces new *Transit Plan: Rapid Transit Expansion Program*. Sheppard Subway is included and made a priority along with Eglinton West.
1994	Groundbreaking for Sheppard Subway takes place.
1995	Construction of Sheppard Subway continues, but other transit projects are cancelled.
1996	Sheppard Subway shortened to Don Mills.
2002	Construction completed at approximately $1 billion (5.4-km of track).
2007	Transit City plan released – LRT proposed for Sheppard East.
2010	Mayor Rob Ford announces scrapping Transit City Plan.*

Source: (Haider & Donaldson, n.d.)

1.5. Framework of the Thesis

Given the objective of this thesis, following the introduction, the paper is organized as follows: chapter two introduces the theoretical background of the study through an in-depth literature review process; chapter three introduces the methodology and research design; chapter four provides the data analysis and results through descriptive statistics; chapter 5 provides the empirical evidence through econometric models and provide a discussion based on learnings and findings. Lastly, based on the research in previous chapters; chapter six summarizes the research findings and proposes recommendations and future research.

Chapter 2: Literature Review

The impact of higher order rail on land development will be addressed in section 2.1, while the impact of higher order rail on land development within the City of Toronto will be addressed in section 2.2. Section 2.3 will address the insignificant effects of rail transit on land development. Section 2.4 will examine the impact of higher order rail on property values, while section 2.5 will examine the negative effects of heavy rail on price premiums. I will then examine the emerging concept of gentrification and 'youthification' in large urban cores in section 2.6 and lastly, section 2.7 will briefly analyze previous policies which have encouraged land development near rail transit.

2.1. Introduction

In the past decade, there have been numerous studies examining the implications of transit stations such as light rail transit (LRT), subway, and bus stops on land use development. Previous studies have found that the construction of a new subway station leads to positive and significant impacts on both urban land use and property values within its served areas, as it improves accessibility and increases the diverse range of developments for citizens (Zhao & Shen, 2018). However, there remains limited literature focusing on subway stations and land use development, specifically in the Canadian context. The purpose of this literature review is to help us understand the implications rail transit has on land development; specifically housing within a 1-kilometer buffer from a transit station.

2.2. Impact of higher order rail on land development

Previous studies have indicated that the construction of a new subway line is associated with positive and substantial impacts on urban land development and property values surrounding its served areas. Properties near subway stations accumulate greater benefits than property located near light rail transit (LRT) due to the faster speed, frequent trains and greater geographical coverage associated with heavy rail (Debrezion et. al, 2007; Higgens &

Kanaroglou, 2017; Raskin, 2010 and Billings, 2011). Using parcel level data from 2000 to 2010, Bhattacharjee & Goetz (2016) analyzed the change in the amount of various types of land use; such as commercial, industrial, mixed-use, single-family and multi-family residential which occurred within the metropolitan area of Denver. Results indicated a conspicuous amount of land use change; specifically, commercial and multi-family land use drastically increased within a 1-kilomer radius of a subway station in comparison to areas located further away, similar to the findings of Duncan (2008) who analyzed land use changes in San Diego California between 1997-2001 after the extension of the San Diego trolley. Findings from Duncan (2008) showed that townhouses and condominiums drastically increased within a 1-kilometer radius from a station after the extension.

Ratner and Goetz (2013) examined the magnitude of urban land use changes within half a mile of the existing or planned transit stations in Denver, Colorado from 1997-2010. Results indicated that urban rail transit (URT) and the emphasis on transit-oriented development have contributed to an increase in the average density of the Denver urbanized area. Additionally, Pan & Zhang (2008) examined land use changes associated with rail transit in Shanghai in which results indicate that higher intensity development occurred in areas near stations through a comparison of two buffer zones (0-200 meters and 200-500 meters) around rail transit stations, which are similar to the findings of Lund (2006); Cao & Porter (2016); and Nilsson & Delmelle (2018). Zhao & Shen (2018) used a consolidated multinomial logit (MNL) and land use allocation model to quantify the impacts of the urban rail transit system on urban land use in Wuhan, China. The authors utilized data from 2000-2010 to analyze the change building and land floor area in three rail transit serviced areas: existing, proposed and non-served areas. Results indicated that residential and commercial development within a half-mile radius from all stations increased significantly. Specifically, the City of Wuhan had seen a drastic increase in high-rise apartment and condominium development, in addition to several building permit approvals. However, industrial land surrounding the stations significantly decreased during the time period, due to a shift in land use.

As cities are rapidly growing in size, there has been an increase in construction of light rail systems mostly due to the lower construction and maintenance cost in comparison to heavy rail as Lund (2006); Rosen & Walks (2014) and Dong (2016) claim. In Minneapolis the Hiawatha Line has attracted 6.7 million square feet of new development from 2003 to 2009, in which most new development that has been constructed was residential, such as single-family and condominium developments (Hurst & West, 2014). The authors obtained property level information to estimate the effects of the introduction of the METRO Blue Line, on land use development; which was Minnesota's first investment in light rail transit. Additionally, using the difference in difference estimation technique the authors measured detailed changes on land use before and after the implementation of the light rail. Findings conclude that industrial properties closer to LRT were converted into various residential uses during construction, in addition to 'big box' commercial lots being converted to single-family residential and condominium units; attracting the younger generation.

Additionally, Dong (2016) argues that there has been limited studies examining the effects of rail transit investment on residential development in suburban neighborhoods. The author used systematic longitudinal analysis on housing development in quarter mile catchment areas around 57 suburban rail stations in Portland, Oregon from 2004-2014 to understand growth related development due to the enactment of the LRT. During this time, the City of Portland enacted an overlay zone called the light rail transit station zone. This encouraged a mix of residential, commercial and employment opportunities near the light rail stations and prohibited car-oriented facilities. Additionally, vehicle repair uses, and car dealerships were prohibited within 500 feet of the light rail transit and commercial parking was prohibited within 200 feet of a stations. Results indicated that rail stations in suburban Portland experienced a vast amount of residential development within a quarter mile catchment area from 2004-2014. Housing inventory increased by approximately 40% within the catchment areas during the 11-year study period. This was significantly faster than the regional average of 18%, which was similar to the findings of Diao et. al (2017). The authors examined the opening of the new Circle Line in Singapore to test the effects of rail transit on housing values. Results indicated that house prices increased by approximately 15% within a 600-meter radius from a transit station after the opening of the line.

Calvo et.al (2013) analyzed the expansion of both lines 1 and 10 of the Madrid subway system by examining land use and population change within a 600-meter radius from each station over an 11-year period from 2000-2011. Both subway lines were extended in an attempt to provide new residential areas for citizens served by sustainable transportation. Line 1 comprised of 24-kilomteres of rail transit which starts from the northern region of Madrid, passing through the city center and continuing to the southern outer region of Madrid, with a 6 new subway stations being added, totally 33 stations. Additionally, line 10 comprised of 36-kilomters of rail transit, starting from the surrounding City of San Sebastián, passing through the city center and ending in the surrounding City of Alcorcón, with 10 new subway stations added, totally 31 stations along the line. The results obtained from the study were compared with contrast areas to evaluate the impact of both lines 1 and 10 on urban land use and population growth. Two criteria were taken into consideration to select these areas: first the areas had to have similar characteristics such as land use, population and built form. Secondly, they had to be areas that did not have urban rail stations. However, due to the Madrid subway lines being quite long two contrast areas were selected for each line in which the authors calculated an average from the data obtained.

Results from Calvo et.al (2013) indicated that there has been a 30.3% increase in population around the new stations, compared to a 7% increase in population along pre-existing stations. Population growth was found to be higher within a 600-meter radius of new stations in comparison to similar areas which have not been equipped with a subway. Additionally, the average population growth around new stations within a 600-meter radius along Line 10 was 23.7 %, compared to a 6% increase in population growth near existing stations and a 10.8 % increase in contrast areas where there is no urban rail. Similar to Line 1, population growth in new urban developments equipped with a subway is higher than in areas without a subway. Regarding land use, for both subway lines the greatest amount of development was seen to occur near transit stations located in the outer areas of Madrid, while stations located near the Madrid city center and surrounding cities was much lower as pre-existing development already existed. Although Calvo et. al focused primarily on population change due to rail transit; these findings are important as they signify that population and urbanization settlement is more significant around new rail transit than in contrast areas without rail transit; illustrating rail transits ability to attract population and residential development within its served corridors.

2.3. Impact of higher order rail on land development within Toronto

At a more local approach, there has been various studies examining the implications transit stations have on land development within Canada, such as Barton & Gibson (2016); Fetner (2013) and Guthrie & Fan (2016). Hess & Sorrenson (2015) examined Toronto's population growth within 30-year cohorts from 1940-1970, and 1971-2001, as the region has been undergoing rapid urban development with several questions being raised regarding the long-term impacts of transit stations and its influence on urban growth and land development. This research builds upon previous research in which Millward and Bunting (2008) analyzed Toronto's density patterns by using local autocorrelation to analyze urban growth clusters within Toronto from 1970-2001. Results from the findings indicate that suburban clusters do exist within Toronto. Over time, large families have become more prevalent in suburban counterparts of the city such as the Don Mills and East York neighbourhoods due to the limited housing options within the downtown core (Figure 2-1).

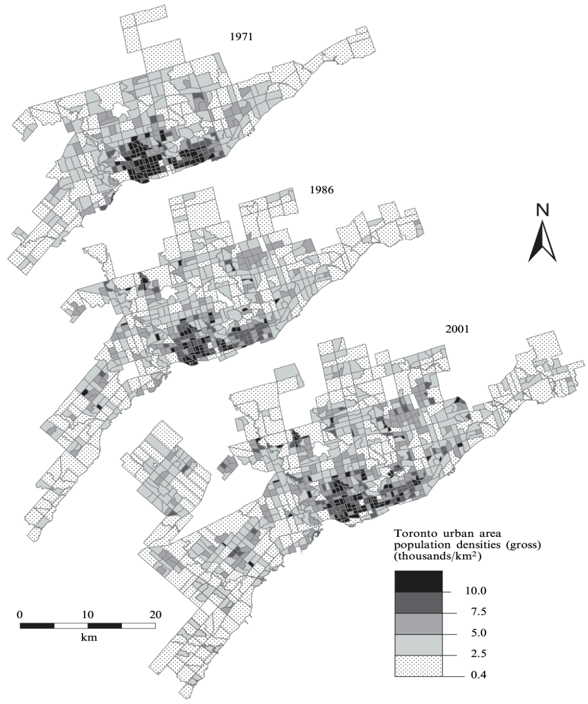


Figure 2-1: Gross population density patterns from 1971-2001 for the metropolitan Toronto area. This image portrays the expansion of density patterns, which have spread throughout the GTA (for census tracts with more than 400 inhabitants/km^2) Source: Millward & Bunting, 2008

2.4. Insignificant effects of rail transit on land development

However, some authors have found insignificant and negative effects of station proximity on land use development, which is important to recognize such as Moos (2016); Zheng et.al (2016); and Kahn (2007). Liu, Deng & Vine (2015) studied changes in residential and retail employment density around new subway stations which opened in New Jersey, between 1990-2010. Results indicated that there was no significance in both residential and retail growth; however certain neighbourhoods along the subway line experienced a significant increase in crime, such as drug use and robberies. Additionally, a study conducted in Los Angeles, California examined the implications of transit on land use patterns within a ½ mile radius from the station. Results indicated that there was not a strong correlation between transit effects on land use development and employment and population densities within a 20-year time period (LA Metro, 2012). A similar approach was used by Cevero & Landis (1997) which the authors examined change in development patterns over time in their study of the BART rail system in the San Francisco Bay Area. The authors predicted the likelihood of vacant land development close to BART stations by comparing matched pairs of BART stations and nearby freeway interchanges in the Freemont and Richmond corridors. The variables that were found to predict development contained proximity to the BART station, levels of land use mix and amount of developable land. Additionally, the authors used existing land use densities and neighbourhood locations as control variables; however, a drawback of the research was the authors did not control for the impact of land use policies. Vacant land development within a 1-kilometer proximity of BART stations did increase, however most BART stations did not appear to have had a momentous effect on development patterns.

Guerra (2014) analyzed the impact of the Metro Line B on land use development which was one of the first suburban high-capacity transit investments in Mexico City. The line was constructed in aim to provide residents living in the suburbs easy access to the downtown core and to various services and amenities, in addition to reducing traffic congestion and improving air quality. The subway opened in 2000 and expanded metro coverage into the densely populated and rapidly growing suburban municipality in Ecatepec. The author compared travel behavior and land use measures at six geographic scales, including a 1-kilometer catchment area, between two time periods which are six years before and seven years after the transit line opened. Results indicated that on average, during the weekday in 2007, residents in the suburb of Ecatepec generated 65,000 more trips to the downtown core than in 1994, which was before the transit line opened. Additionally, in regard to land use, results indicated that there was significant growth around station catchment areas within a 1-kilometer radius from a station, with approximately 9,787 new housing developments constructed after the line opened, between the study period of 2000-2010. However, results indicated that the Metro Line B had an insignificant effect on commercial development within Mexico City. Guerra (2014) indicated that the land use impacts of Line B are significantly different from frequently observed North American cities where new transit investments have stimulated downtown commercial development.

Additionally, Kolko et al (2011) analyzed changes in employment density near transit stations which opened in California between 1992-2006. Similar to Cevero & Landis (1997), the author established matched pairs of station areas and non-station areas. The authors selected comparison areas based on the following: proximity to central business district, proximity to older rail stations, similarities in land use density, and proximity to highways. Kolko et al (2011) also controlled for national economic trends which had the potential to affect employment growth in Los Angeles. Results concluded that there was no increase in employment growth around stations after the station opened. These two studies emphasize the numerous factors that affect densification in urban areas. These studies also highlight the challenge of demonstrating that transit investments affect land development patterns. Amounts of vacant land, proximity to other types of infrastructure and services and pre-existing land use patters all play a role in affecting development patterns. Additionally, local policies and city policies also play a vital role in densification in urban areas.

2.5. Impact of higher order rail on property values

Studies examining the effects of rail transit on property values has been the most prominent body of literature, in comparison to rail transit impacts on land use development (Dong, H. 2016; Liu et.al. 2016; Knight & Trygg. 1977; Hurst & West. 2014; Duncan, 2011; Hess & Almedia; 2006; Diao et. al. 2017; Lee & Sohn, 2013; and Cao & Nelson. 2016). According to

Jones & Levy (2016), transit-oriented development has gained significant popularity within Canada. During 2000-2012 the number of commuters who relied on public transit has increased by 25%. Population forecasts suggest that demographics in Canada are changing regarding the strong desire of individuals wanting to live within close proximity to transit stations. A report published by the Federal Transit Commission estimates the demand for transit accessible housing will double to 15 million households by the year 2025 (Dawkins & Moeckel, 2016). Empirical evidence from Dawkins & Moeckel (2016), Nelson & Skaburskis and Fertner (2013) shows that proximity to public transits is embedded into the price of land and housing.

Billings (2011), compared housing prices in corridors that were considered but rejected for light rail transit to those within 1-2 kilometers of light rail transit stations; results indicated there was a significant price increase for condominium and single-family homes, however there were no significant effect for commercial property values similar to the findings of McMillen & McDonald (2004). A meta-analysis of 57 studies by Debrezion et. al (2007) suggests that for every 250 meters a residential property is closer to a subway station, the price premium increases by 2.4%; however, the authors failed to indicate the type of residential development generating the price premium (single-family, condominium, multi-family, apartment).

Sun et. al (2015) examined how property values reacted to a 400-km city-wide subway expansion in Beijing, China from 2005-2011. The authors conducted an instrumental variable regression and found that the capitalization of subway proximity in home value is significantly weaker where the land supply is more elastic. Additionally, proximities to the central business district, school and subway station resulted in significant price premiums. However, the study found that proximity to the nearest park, had a negative value on price premiums which could potentially be due to the noise and various other nuisances brought by nearby transit facilities. An interesting study by Raskin (2010) examined the effect of Bogota's Trasmilenio system on residential property values within a 10-minute walking distance from a station, between 2000-2004. The analysis focused on the differentiation of the 0-5-minute walk (immediate proximity) and the 5-10-minute walk. Results indicated that properties in the immediate proximity had value premiums of 9% in comparison to properties located within a 5-10-minute walking distance.

Hess and Almedia (2006) accessed the impact of proximity to light rail transit stations on residential values in Buffalo, New York where the light rail transit system has been in service for 20-years, between 1980-2000. Results indicated that an average single-family house located within a 1-kilometer radius from a station is worth between $900-$2310 more than the average home located further away. Additionally, analysis of controlling factors suggests that three variables (number of bathrooms, size of parcel and location on the east side of Buffalo) are more influential than rail proximity and various other factors in predicting property value. Duncan (2011) examined how the light rail system in San Diego affected condominium unit sales, based on rail proximity between 1997-2001. The data included 3,374 sales of individual condo units during the study period. Results indicated that a condo located in a highly desirable pedestrian environment near a transit system had a significantly higher value than a condo in a similar neighborhood not located near a station. Concluding remarks indicated that station proximity becomes more valuable as the level of commercial activity within its vicinity increases. Results of the study are similar to Duncan's (2008) research which found a higher price premium for condominium developments within a 1-kilometer radius from a station as compared to a single-family home within San Francesco, California. The premium associated with proximity to a rail station is estimated to be 17% for the average condominium, compared to a 6% increase for the average single-family unit.

Bajic (1983) studied the extent of property value impact on the Toronto Spadina Line and concluded commute time saving contributed the most to home value premiums. So et.al (1997) examined the implementation of a new transit line on house prices in Hong Kong between 1980-1990. Results indicated that the accessibility to transport is an important determinant in house prices, specifically properties located within less than a mile of a transit station. Additionally, Weinstein and Clower (1999) examined the effect of the Dallas Area Rapid Transit (DART) on surrounding property values, in Dallas, Texas. Results indicated that property prices located within a quarter mile from the DART light rail system increased 25% after implementation. Furthermore, Immergluck (2009) found that single-family houses located within quarter mile radius of the Atlanta Beltline sold at approximately 15-30% higher in comparison to similar properties located further away, in the southern portion of the Beltline district where income and property values were significantly lower than the city average.

Grass (1992) examined the relationship between public transit investment and property values within several neighborhoods in Washington, D.C in order to determine the significance of public investment in heavy rail transit on residential property values. Using a hedonic price equation results included a significant relationship between the opening of a new heavy rail transit station on residential property values within a 500-meter catchment area from each station. However, results also indicated that the opening of a transit station had a negative impact on industrial developments similar to the findings of Riley (2001) who examined the effects of the Jubilee Line extension in London, United Kingdom. Lastly, Syabri (2011) analyzed the effects of the Serpong and Dukuh Atas station extension on housing prices within the Jakarta Metropolitan Area. The extension was done in an attempt to redistribute population and economic activity away from the core metropolitan area of Jakarta, as part of the government’s decentralization policy. Using spatial hedonic price analysis results indicated that rail stations within a 500-meter to 1-kilometer radius from the stations have a positive effect on residential property values, implying a declining price gradient as one moves further away from a station. On average, residential units located within less than a kilometer away from a station received a 20% increase in value. Results from the study also indicated that transit extension within suburban counterparts can lead to the development of inner-city suburbs. As with the case of Indonesia, three new towns were developed as part of the government's decentralization policy which are: Bintaro, Tangergan and Depok city.

2.6. Negative effects of heavy rail on price premiums

Although, we have discussed several studies which have found positive implications of transit systems on land development and price premiums, it is important to be cognizant that not all studies have seen positive results. A handful of studies have found insignificant effects of capitalization (Gatzlaff & Smith, 1993; Landis et.al, 1995; Bae et.al, 2003) while some found negative effects (Lin et.al, 2018; Cohen & Brown, 2017 and Grimes & Young, 2013) due to increased crime rates, noise and congestion associated with nearby transit facilities. Lin et. al (2018) examined the impacts of the city's first LRT on three types of land use development: industrial, commercial and residential within the City of Dongguan, China's largest industrial city. Results indicated that land located within a ½ mile radius from each station experienced a significant impact on commercial and residential development. However industrial development significantly decreased in addition to existing development relocating from the downtown corridor due to increasing land costs and zoning regulation changes. This had a negative effect on the manufacturing industry within the city as many manufacturing firms relocated within other cities in China due to cheaper land costs.

Anderson et al. (2010) analyzed the opening of the high-speed rail (HSR) in Taiwan in 2007 on price premiums, during the study period of 2000-2008. The total length of

Taiwan's HSR line is 345-kilomters which connects seven metropolitan areas of Taiwan to the urban core. The City of Taiwan created the HSR line in attempts to further increase the existing population density which in turn would reduce the per capital cost of a given infrastructure investment. Additionally, the HSR drastically reduced travel times along Taiwan's west coast to the urban core from approximately 50-minutes by car to 19-minutes using the HSR, with a total of 70 departures a day with connections to all major cities. Using the hedonic price model, results indicated that there have been insignificant effects of HSR accessibility on residential property prices. The authors signify that the expensive fares in combination with the inaccessible location of HSR stations are the reason for the insignificant effect. For example, daily fares for a week between Tainan and Taichung would cost NT$23,900 (US $775) per month which is approximately 70% of the median monthly wage in Taiwan.

Forouhar (2016) analyzed the introduction of Tehran's metro rail system (TMRS) on price premiums between 2005-2015 using two versions of trend analysis: linear trend line and polynomial trend line estimators in addition to the difference in difference method. Results indicated a significant negative effect on the sale value of residential properties in the northern areas of Tehran. Housing prices located within a half kilometer radius from a station decreased by 41% after the opening of the line, in addition to the control properties decreasing by 9% during the same time period. Results also indicated that properties located in the southern areas of Tehran experienced a 36% increase in house prices located within half a mile from the station after the opening of the line. The authors signify the importance of investing for regenerating low-income and run-down neighborhoods in Tehran. Due to the northern areas of the city comprising of many gang-related crimes, high-unemployment and inappropriate land-use management the implementation of the rail system further decreased price premiums.

It is important to recognize that accessibility can be provided by other modes of transport. Sun et. al (2015) and Voith (1993) signify that highway accessibility is an important competitor to rail accessibility. "The presence of other facilities that increase accessibility such as highways, sewer services and other facilities influence the impact area in the same fashion." Therefore, the benefits of these facilities and services are also capitalized into property values (Damm et. al 1980). Thus, to single out the effect of railway accessibility, other competing modes of accessibility need to be considered.

2.7. Gentrification and 'Youthification'

2.7.1. Gentrification

Aside from the positive aspects transit systems bring to land use development, gentrification is a common urban issue associated with the implementation of transit systems. Gentrification can be defined as, "the process of repairing and rebuilding homes and businesses in a deteriorating area (such as an urban neighbourhood) accompanied by an influx of middle-class or affluent people and that often results in the displacement or earlier, usually poorer residents" ("Definition of GENTRIFICATION," n.d.). For a neighborhood to have undergone gentrification, it must have been considered 'gentrificable': meaning it must have been considered to be in poverty or working class, prior to their being a market change in socio-economic status. Additionally, rents and house values tend to increase faster than the city as a whole (Freeman, 2005; Hammel & Wylyl, 1996; Kahn, 2007).

Academic and professional literature has examined gentrification associated with subway systems, such as Jones & Levy, 2016; Reynolds, 2012; Zheng & Kahn, 2012. For instance, Cavers & Patterson (2015) examined the relationship between the implementation of urban rapid transit and gentrification within Canada's largest cities (Toronto, Montreal and Vancouver). The authors identified census tracts that could potentially be considered gentrifiable, and those that have undergone gentrification within a 1-kilometer buffer from a station between 2000-2010. Results showed a statistically significant and positive relationship between exposure to urban rail transit stations and the likelihood that census tracts have undergone gentrification in Toronto and Montreal, however there was no significance found within Vancouver. Additionally, Jones & Levy (2016) analyzed the implementation of the rapid transit line within the City of Vancouver from 1970-2000; which stretched from East Vancouver through Burnaby, Westminster and Surrey. Using exploratory spatial data analysis results indicated that after the implementation of the rapid transit line, Surrey one of Vancouver's lowest income neighborhoods with 23% of the population living under the poverty line, experienced immense gentrification which further displaced low-income individuals into suburban neighborhoods. As development along the transit corridor occurred, housing became increasingly expensive with the amount of affordable housing units decreasing at a profound rate, similar to the findings of Kahn (2007) in Boston, Massachusetts, where the implementation of a new 'Park and Ride' subway station negatively decreased housing prices within its periphery.

2.7.2. Youthification

The benefits associated with transit-oriented development (TOD), specifically residential is said to be extremely attractive to the younger generation, specifically working-class professionals (Cevero et. al. 2004; Dittmar et.al. 2004; Nilsson & Delmelle. 2018; Dong, 2016) within the age of the 'consumer city' as Glaser et. al (2001) claims. Moss (2016) studied the importance of age in delineating spaces, within the City of Vancouver. The author found that there has been an increasing association of 'youthification' which is an increasing association of higher-density living within the urban core that aren't designed for households with children. The authors claim that higher density areas remain young over time as young adults move into neighborhoods where there are already young people living. This is often due to many shopping, nightlife and education facilities within the area. The concept of youthification has been found in various literature such as Barton & Gibbons (2016) who analyzed demographic characteristics within downtown Montreal and found similar results of a younger population within the downtown periphery of the city.

Additionally, many previous studies have examined the concept of "condo-ism" in large urban cities like Toronto such as Higgins & Kanaroglou (2016); Moss (2016) and Nahlik & Chester (2014). The emerging theme of condo-ism is a fairly new concept, which is referred to as the immense presence of condos dominating urban cores, specifically alongside transit nodes. A very interesting finding is that of Rosen & Walks (2014) in which the authors examine the development of the spatial dynamic of condo growth within Toronto, over the course of 40-years. The authors geo-coded their findings in which results indicated that there are several clusters of condo growth within the city, primarily located along the Yonge-University subway line and waterfront; which has grown to be attractive locations for high density condo developments (Figure 2-2). Additionally, the authors also found that the average condo size has significantly decreased, making it challenging for large families to reside within transit corridors. Similar to Higgens & Kanaroglou (2016) who analyzed the correlation between land development and transit stations, the authors found that condo developments have been the most prevalent type of land development within a 1-kilometer proximity from transit station corridors.

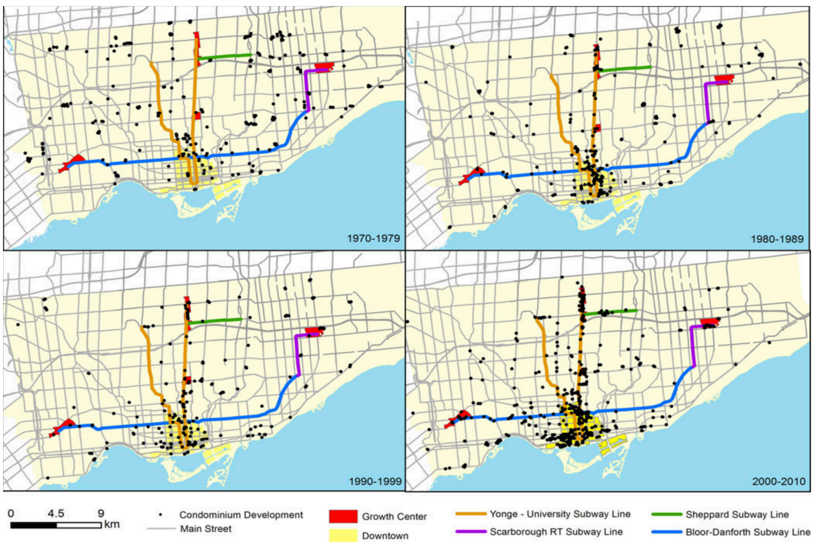


Figure 2-2: City of Toronto condominium construction near rail transit (1970-2010). Source: Rosen & Walks (2014)

Table 2-1: Condominium development within the City of Toronto, 1970-2010

	(New) City of Toronto*				Downtown (including Waterfront)			
Construction period	Total new units	New condo units	New condo projects	Condos' share of total new units	New condo units	New condo projects	Share of total city new condo units	Share of total new city units
1970–1979	146,705	38,829	274	26.5%	2,336	25	6.0%	1.6%
1980–1989	86,054	35,344	259	41.1%	10,514	82	29.7%	12.2%
1990–1999	79,276	27,902	224	35.2%	7,405	62	26.5%	9.3%
2000–2010	126,658	97,631	554	77.1%	38,364	193	39.3%	30.3%
Total	438,693	199,706	1,311	45.5%	58,619	362	29.4%	13.4%

Source: Rosen & Walks (2014)

2.8. Policies Encouraging Development

There have been various forms of public sector plans, policies and initiatives which play an active role in attracting new development around rail transit. For example, when the Hiawartha Line was approved for construction by the City of Minneapolis, the city developed several station area and neighborhood plans to encourage development around the area. Additionally, in Denver, Colorado the city had geared land use around the FastTrack rail line which opened in 2010 by constructing transit-oriented development zones within a 500-meter radius near each station which provided developers with lenient zoning requirements. Lastly, in Charlotte, North Carolina the city had encouraged development alongside the Blue Line, a decade before the line had opened in 2007; which enabled several growth clusters near stations (TCRP, 2004).

2.9. Summary

As we have seen from the literature review, such as studies conducted by (Zheng et,al, 2016; Rosen & Walks, 2015; Billings, 2011; Barton & Gibbons, 2016) the implementation of subway stations has led to the intensification of land use within a 500-meter to 1-kilometer radius from the station. We can then formulate a theory that the construction of a new subway station results in more intensification of land use, due to the accessibility premiums. Therefore, pertaining to this study, one would not expect equal or comparable construction along the Sheppard East side in comparison to the Sheppard West side, which did not receive the subway extension; due to subway stations being the catalyst for development.

In summary, there remains limited literature examining the implications of rail transit on land development; specifically, within the Toronto context. However, there has been a vast amount of studies examining the implementation of rail transit on price premiums within the Canadian, North-American and international context. Additionally, the reported studies have shown mixed results on the effects of rail transit on land use development. As Kahn (2007) indicated, it is important to not use a ‘one size fits all concept’ in other words an in-depth analysis of rail transit on land use development within the City of Toronto needs to be carried out as area context varies.

Chapter 3: Methodology

In this chapter I will analyze the study area boundaries, in addition to the services and amenities within both catchment areas of Sheppard Avenue East and the comparison group of Sheppard Avenue West in section 3.1; 3.2 and 3.3. In addition, section 3.4 will analyze the study hypothesis and section 3.5 which will analyze the research methods deployed. Lastly, section 3.6 will examine how the data was collected.

3.1. Study Area Selection

The City of Toronto lags behind many other world class cities such as New York, Chicago and Beijing; in transit infrastructure. For example, New York City boasts of a complex transit system, serving residents all throughout the city and comprises of 472 subway stations and 27 subway lines (Nguyen, 2018). The City of Toronto has only 75 subway stations and three subway and one Light Rail Transit (LRT) lines namely, Yonge-University, Bloor-Danforth, Scarborough LRT, and the Sheppard line ("Toronto Subway | The Canadian Encyclopedia," n.d.) (Figure 3-1).

The Sheppard Subway Line is selected as the study area for two main reasons. The first reason is the limited research examining rail transit's impact on land development within the City of Toronto; specifically, alongside the Sheppard East corridor as it is a fairly new subway extension. Previous literature examining the impact of rail stations on land development assumes that land development occurs after the new transit stations are established. However, I am interested in determining whether the new development would have been realized irrespective of the transit station being built._The existing research on the Sheppard line has examined the greenhouse gas impacts of the Sheppard line (Saxe et.al, 2016) as well as studies examining the subway ridership and maintenance costs associated with the underused line (TTC Subway, 2017).

The second reason is due to the Sheppard East subway extension being the most recent transit line that has been constructed within the City of Toronto. I am interested in examining how the introduction of a new subway line impacts land use development. Additionally, the pace and scale of development will be analyzed in comparison to the Sheppard Avenue West corridor, consisting of similar characteristics with the only difference being the subway extension did not occur. In addition, Sheppard Avenue West was selected as the comparable group due to its similar nature in regard to Sheppard Avenue East in terms of average rooms within each housing unit, the number of housing units constructed each year and the number of owned and rented units (Appendix A).

Figure 3-1: City of Toronto subway lines. Source: Toronto Transit Commission (2017)

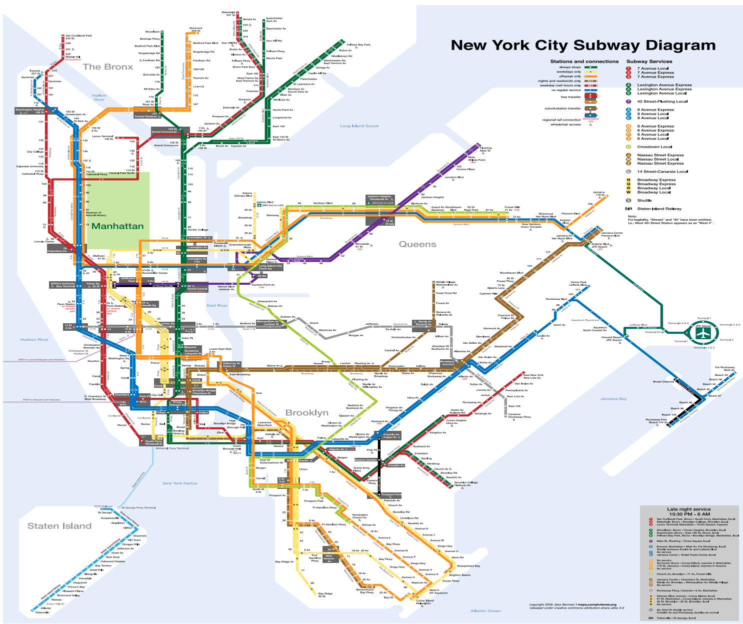


Figure 3-2: New York City subway lines in comparison to the City of Toronto shown above
Source: ("New York Subway Diagram," 2018.)

3.2. Surrounding area of Sheppard East and Sheppard West

It is important to have a clear understanding of the area context for both Sheppard Avenue East (treatment group) and Sheppard Avenue West (control group) as pre-existing services and amenities within the area limit the amount of developable land. The boundaries of the whole study area run west-east from Finch Avenue West and Allen Road to Wilson Avenue East and the Don Valley Parkway and east-west from Don Valley Parkway to Finch Avenue East and Don Valley Parkway to York Mills (Figure 3-3).

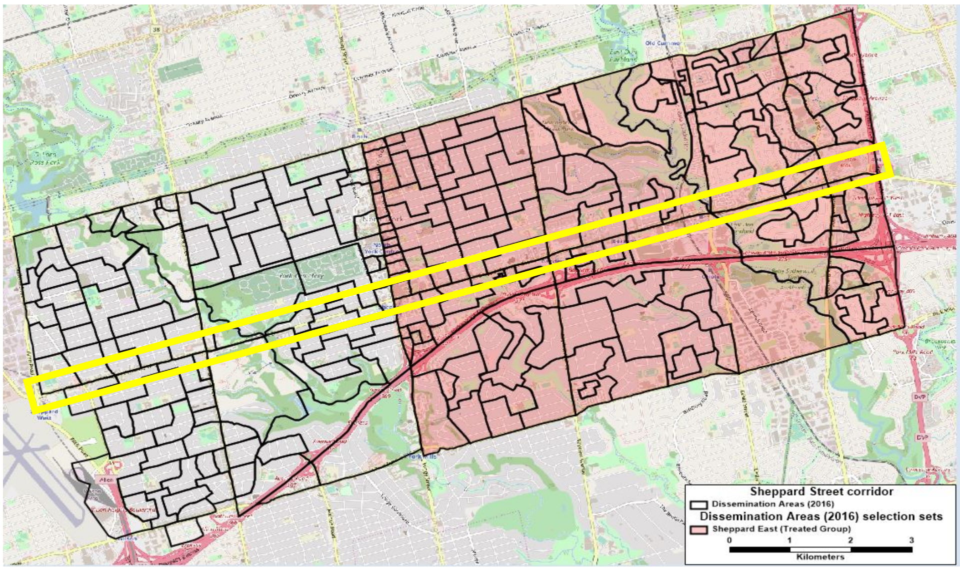


Figure 3-3: Study area, highlighting both the Sheppard Avenue West and Sheppard Avenue East study area; within a 1-kilometer radius from Sheppard Avenue East (treated group) and west (control group). (Source: Statistics Canada, 2016)

3.2.1. Sheppard Avenue East

Regarding the east side of Sheppard Avenue where the subway extension did occur, the study area consists of 24.5 kilometers, which is significantly larger in size than Sheppard Avenue West, as highlighted in red (Figure 3-3). The boundaries of the Sheppard Avenue East study area run east-west from Yonge Street and Finch Avenue East to Don Valley Parkway and Finch running south to Don Valley Parkway and York Mills and York Mills to Finch Avenue East. The area boundaries are within a 1-kilometer radius from the Sheppard Subway extension and exists of many services and amenities such as Bayview Village shopping center, Fairview Mall, the East Don Parkland, Betty Sutherland Park, North York

General Hospital, Highway 401, the Don Valley Parkway and lastly line 3, the Sheppard Subway extension, consisting of 5 subway stations which are: Sheppard-Yonge, Bayview, Bessarion, Leslie and Don Mills subway stations, as previously mentioned.

3.2.2. Bayview Village Shopping Center

Bayview Village Shopping center is located at the northeast intersection of Bayview Avenue and Sheppard Avenue West, in the neighborhood of Bayview Village and community of Willowdale. Opening in 1963, it is one of Toronto's most upscale retail mall consisting of 440,000 square feet with over 110 retail stores including Gap, Mendocino and Swarovski (Figure 3-4). Instead of the traditional mall food court, Bayview Village features numerous restaurants along the western corridor of the mall, called 'restaurant land' consisting of high-end restaurants such as Oliver & Bonnacini Café Grill, Parcheggio and Kabuki Japanese ("Bayview Village Shops," n.d.) (Figure 4-3). As of June 2017, the mall was named one of Canada's most productive malls in terms of sales per square foot by the Retail Council of Canada's shopping center study ("Mall Profile," 2017).

Figure 3-4: Bayview Village Shopping center. Source ("Mall Profile: Bayview Village Shopping Center" 2017)

Figure 3-5: 'Restaurant lane' in Bayview Village with numerous restaurants located in the western corridor of the mall, including many with patios at the front. Source ("Mall Profile: Bayview Village Shopping Center" 2017).

3.2.3. Fairview Mall

Fairview Mall, the other amenity within the Sheppard East catchment area is located at the northeast intersection of Don Mills Road and Sheppard Avenue West. Opening in 1970 the retail mall consists of 860,000 square feet with over 170 stores including American Eagle, Tommy Hilfiger and the Apple Store. Additionally, numerous restaurants, grocery shops and a movie theater are located within the mall. Currently there are various proposals put forward to renovate and extend the mall, however no official plan has been finalized ("CF Fairview Mall | Mall Map | CF Malls," n.d.).

3.2.4. East Don Parkland and Betty Sutherland Trail

The other amenity located within the Sheppard Avenue East catchment area is the East Don Parkland. The parkland is a 10.9-kilometer trail located at Leslie Street and Steeles Avenue to Leslie Street and Sheppard Avenue East. The trail is part of a chain of parks following the Don River with several ravines and greenspace making it a picturesque scenery for hiking, walking and biking (Figure 3-6). Additionally, the trail consists of a paved pathway, making it stroller and wheelchair accessible and is approximately a 2 ½ hour walk long. Opening year-round, there are numerous events throughout the year within the East Don Parkland such as the annual walk for Scleroderma, community picnics during summer months and Halloween and Christmas festivities for children and adults ("East Don River Trail | Ontario Trails Council," n.d.) (Figure 3-7). Additionally, Betty Sutherland Trail follows the East Don River from Sheppard Avenue East to Duncan Mill Road. The trail is 1.85 kilometers long and is situated in 104 acres of green land ("Betty Sutherland Trail - Henry Farm Community Interest Association," n.d.). Similar to the East Don Parkland, the trail is used heavily for walking, hiking and biking year-round.

Figure 3-6: Trail of East Don Parkland. Source:("Mishy's Corner of the World," n.d.)

Figure 3-7: Ravine of East Don Parkland. Source: ("Hiking the GTA", n.d.)

3.2.5. North York General Hospital

North York General Hospital is one of Canada's leading academic hospitals which is affiliated with the University of Toronto Faculty of Medicine. The hospital is located at 4001 Leslie Street near the intersection of Leslie Street and Sheppard Avenue East, which is approximately a 5-minute walking distance from Leslie Station on the Sheppard Subway Line. The hospital provides key services such as: cancer care, emergency care, family and community medicine, pediatric care, diagnostic imaging, mental health and various surgeries. With 410 acute care beds and 192 long term care beds servicing patients, the hospital is known for its spectacular patient care ("North York General Hospital - About Us," n.d.).

3.2.6. Highway 401 and the Don Valley Expressway

Highway 401 and the Don Valley expressway are both located within the Sheppard East catchment area. Highway 401 runs through the whole catchment area at Yonge Street and Highway 401. The highway is one of the busiest highways in North America and one of the widest in the world. Stretching from Windsor, Ontario to the west to the Quebec boarder to the east; the highway is 828 kilometers in length (514 miles), and has an average daily travel rate of 500,000 vehicles per day (Canada Alive, 2014). Furthermore, the Don Valley expressway, commonly referred to as the DVP' is a municipal expressway within the City of Toronto. The DVP runs through the Don Valley river and connects the Gardiner expressway located in downtown Toronto to Highway 401 ("Get Toronto Moving Transportation Plan History - Don Valley Parkway," 2015).

3.3. Sheppard Avenue West

Additionally, the west side of Sheppard Avenue otherwise referred to as the control group for the purpose of this study is significantly smaller in size in comparison to Sheppard Avenue East, consisting of 16.2 square kilometers, as outlined in black (Figure 3-3). The boundaries of the area run east-west from Yonge Street and Finch Avenue West to Finch Avenue West and Allen Road to Allen Road and Wilson Avenue to Wilson Avenue and Yonge Street. The area boundaries are within a 1-kilometer radius from Sheppard Avenue West, the control group and exist of many services and amenities such as: West Don Parkland, Earl Bales Park, York Cemetery and Funeral Home, the Don Valley Golf Course and lastly Highway 401 running through the catchment area.

3.3.1. West Don Parkland

Located at the intersection of Bathurst Street and Finch Avenue West, the West Don Parkland, similar to the East Don Parkland is a public trail consisting of 57 acres. The parkland is open year-round and is used by many for walking, biking and running. Additionally, the Forest Valley Outdoor Education Center is located within the parkland which is one of ten outdoor education centers within the Toronto District School Board (TDSB) designated to provide learning experiences to students and staff on natural and urban environments within the City of Toronto. Each year, approximately 15,000 students and teachers within the Greater Toronto Area visit the learning center to strengthen their connection to the natural world that exists within Toronto's urban environment ("Forest Valley Outdoor Education Center" n.d.).

3.3.2. Earl Bales Park

The other amenity located within the catchment area is Earl Bales Park, which is a large public park located at the intersection of Bathurst Street and Sheppard Avenue West. The park is 127 acres (51 hectares) and consists of an off-leash dog area, two playgrounds, a splash pad for children, memorials, picnic sites and a large paved trail for walking and bicycling (Figure 3-8). Additionally, the park has one of the two ski and snowboard centers facilitated by the City of Toronto referred to as the 'North York Ski Center' or 'Ear Bales Ski & Snowboard Center' which offers a variety of programs for children and adults in the winter months (Earl Bales Ski & Snowboard Center, 2017) (Figure 3-9).

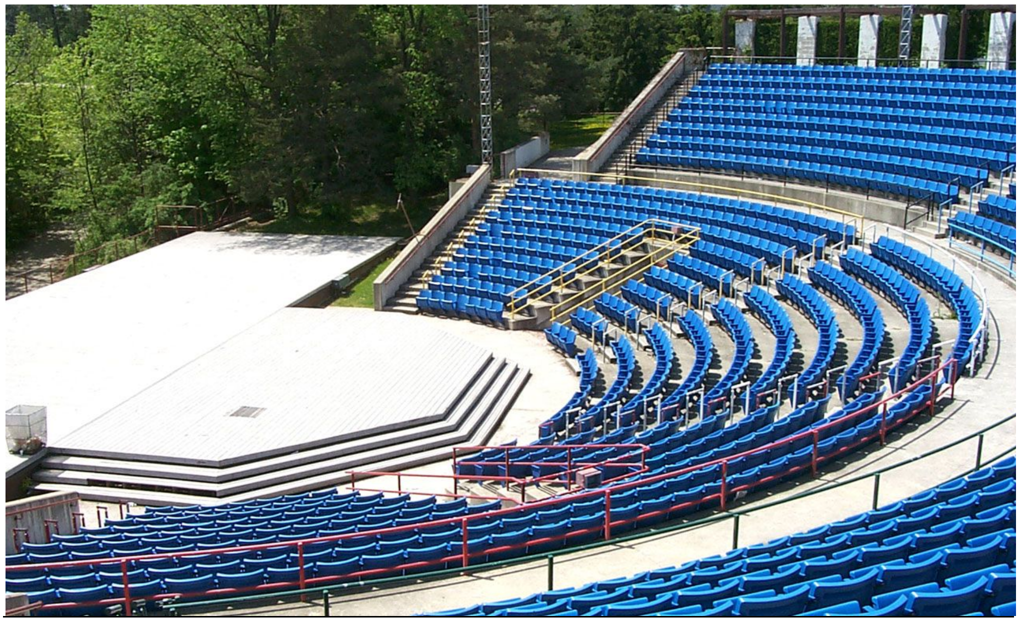


Figure 3-8: Outdoor amphitheater at Earl Bales Park. Source: (Earl Bales Ski & Snowboard Center, 2017).

Figure 3-9: Ski Hills at Earl Bales Park. Source: (Earl Bales Ski & Snowboard Center, 2017).

3.3.3. York Cemetery and Funeral Home

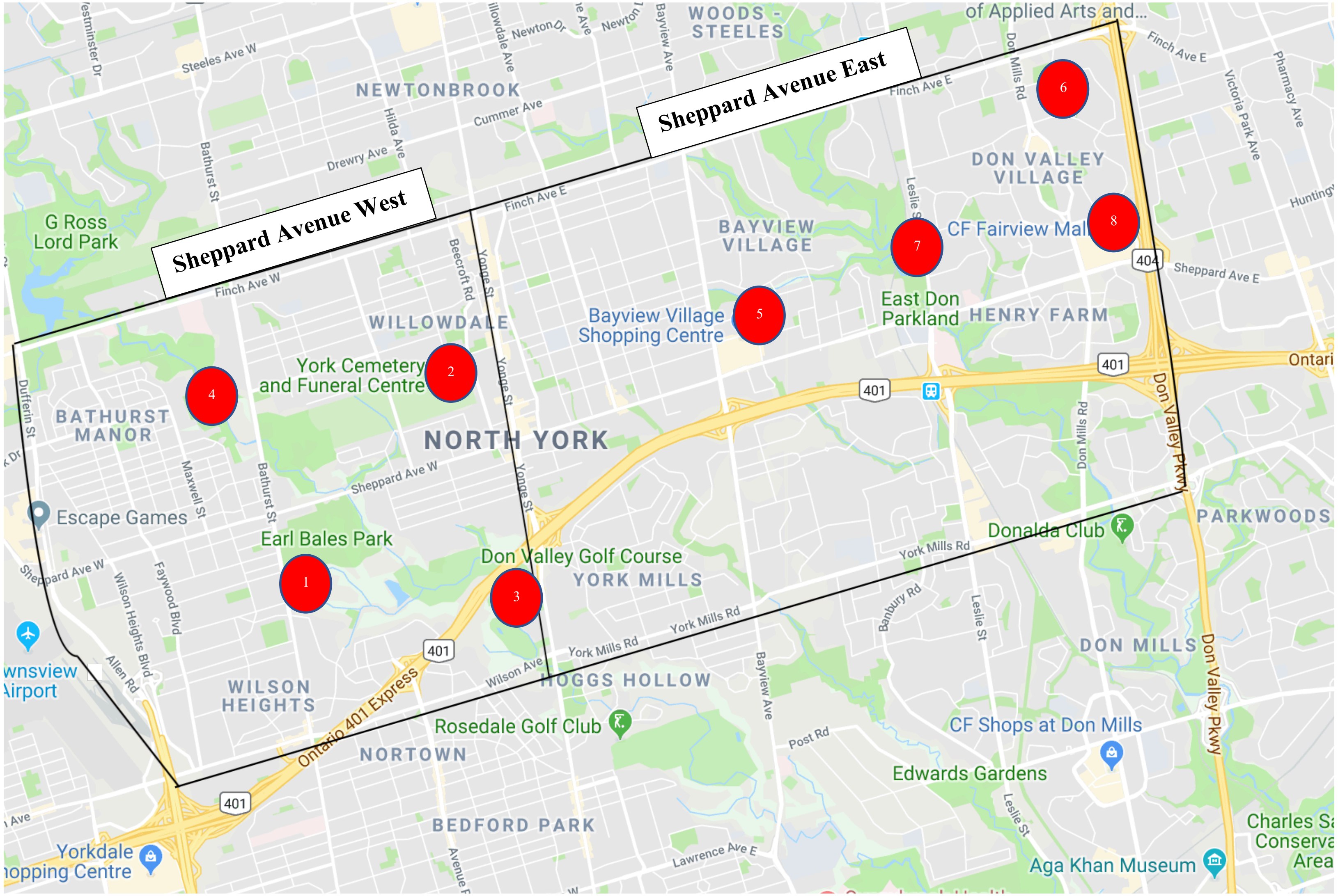
The York Cemetery and Funeral Home is located at 160 Beecroft Road at the intersection of Beecroft Road and Park Home Avenue. It is one of the numerous funeral homes located within the City of Toronto providing services such as visitation, funeral, memorial, cremation and reception services. The center includes a chapel with a 200-person gathering area, in addition to visitation and reception rooms able to accommodate a maximum of 75 guests. The cemetery sits on a spacious 172-acre (70 hectare) parcel of land, situated within the heart of North York ("York Cemetery and Funeral Center", n.d).

3.3.4. Don Valley Golf Course

Located at 4200 Yonge Street at the intersection of Wilson Avenue and Yonge Street, the Don Valley Golf Course is one of the five golf courses located within the City of Toronto. Sitting on a 97-acre parcel of land, it is known for its picturesque landscape and traditional variety of holes (Figure 3-10). The golf course includes private lessons for both children and adults, a pro-shop, two restaurants and 142 parking slots; making it convenient for golfers ("Don Valley Golf Course - Toronto, ON, Canada | Swing By Swing," n.d.).

Figure 3-10: Don Valley Golf Course. Source:("A Par-fect Golf Experience In The Don Valley - Urbaneer - Toronto Real Estate, Condos, Homes," n.d.).

Visual depiction of the services and amenities within the study area



Legend

1: Earl Bales Park

2: York Cemetery and Funeral Home

3: Don Valley Golf Course

4: West Don Parkland

5: Bayview Village Shopping Center

6: North York General Hospital

7: East Don Parkland

8: Fairview Mall Shopping Center

Figure 3-11: Visual depiction of services and amenities within the Sheppard east and west study area. Source: Google Maps, 2016

3.4. Study Hypothesis

Regarding the relationship between transit nodes and land development during the years of 1991-2016, the following assumptions are made:

- Land closest to transit nodes sold at a higher price and faster rate as compared to land located further away
- Condominium developments were the most prevalent along transit corridors as compared to single family houses
- Land alongside the Sheppard East corridor, where the subway station was built developed at a faster and more intense rate as compared to the Sheppard west corridor where the subway extension did not occur

Figure 3-12: North-West corner of Sheppard Avenue West and Yonge Street. Source: Google Maps, 2019

Figure 3-13: North-East corner of Sheppard Avenue East and Yonge Street. Source: Google Maps, 2019

Figure 3-14: North-West corner of Sheppard Avenue East and Bayview Avenue. Source: Google Maps, 2019

3.5. Empirical Method

The method used for analysis is the difference in difference statistical technique, often referred to as 'double difference' or 'DID'; which has become an increasingly popular way to estimate causal relationships and is used heavily in econometrics and quantitative research (Callaway & Ana, 2018). Essentially, the method resolves the problem of missing data by measuring outcomes and covariates for both participants and non-participants in pre-intervention and post-intervention periods (Khander et.al, 2009). Difference in difference compares both the treatment and comparison group in regard to outcome changes over time relative to the outcomes observed for a pre-intervention baseline. For example, Diao et.al, 2017 conducted a similar study using the DID method, however instead of focusing on land development the authors focused on housing prices by examining the impact of rail transit on housing prices within the treatment and non-treatment area. Using the new Circle Line extension in Singapore as an experiment to test the effect of urban rail transit networks on house values, the authors estimated a spatial difference in difference model for spatial autocorrelation in housing price changes in the two zones of before and after the opening of the transit line. Results indicated that the opening of the transit line increased housing values in the treated neighborhoods located within a 600-meter radius from each transit station by approximately 8.6% in comparison to other properties in the untreated neighborhoods. To prevent inaccuracy the authors controlled for heterogeneity in housing attributes, amenities and spatial and temporal fixed effects (Diao et.al, 2017).

The first study using the DID method dates back to the mid 1900's including Obenauer, (1915) and Rose (1952). One of the earliest and most notable studies was by Lester (1946) who studied the effects of wages on employment. The author based his analysis on a survey of firms that had operations in both the southern and northern U.S states. He compared employment levels before and after various minimum wage rises; with groups of firms with low average wages to groups of firms with higher wage levels. Results were indicated that the wage bills of the latter were only mildly affected by the rise in the minimum wage (Lechner, 2011). Another example used widely within post-secondary education is the garbage incinerator effect on house prices (Espinoza, 2010). For example, the price of a home can be affected by several factors such as unemployment rates, interest rates, size and various other macroeconomic factors. Additionally, microeconomic factors also influence house prices such as crime rates, quality of schools, retail shops and subway systems to name a few. A controversial garbage incinerator was built in zone 7 within the Town of North Andover, Massachusetts in which many residents were concerned their house prices would decrease due to close proximity of the undesired use. Using the difference in difference method, Kiel & McClain (1995) estimated the effect the garbage incinerator had on home prices over the course of two years. The regression for the average difference between Massachusetts home prices before and after the incinerator revealed that the incinerator did not have a significant impact on the price of homes within the treatment group.

The main advantage of the DID method is that is reduces the assumption of conditional exogeneity or selection only on observed characteristics. Additionally, the method provides an intuitive way to account for selection on unobserved characteristics (Khander et.al, 2009). However, like many statistical methods there are limitations. One of the main limitations of the method is it may give biased estimates if characteristics of project and control areas are significantly different. Additionally, the method cannot control for unobserved characteristics that may affect outcomes if they differ between pre and post-intervention periods (Khander et.al, 2009). Table 3-1 summarizes the main advantages and disadvantages of the method ("Difference-in-Difference Estimation | Columbia University Mailman School of Public Health," n.d.).

Table 3-1: Advantages and disadvantages of the difference in difference method. Source: ("Difference-in-Difference Estimation | Columbia University Mailman School of Public Health," n.d.)

Advantages	Disadvantages
• Intuitive interpretation • Can obtain causal effect using observational data if assumptions are met • Comparison groups can start at different levels of the outcome (DID focuses on change rather than absolute levels) • Can use either individual or group level data	• Requires baseline data and non-intervention group • Cannot use if intervention allocation determined by baseline outcome • Cannot use if comparison groups have different outcome trend • Cannot use if composition of groups pre/post change are not stable

Additionally, the key assumption required for internal validity of the difference-in-difference estimation technique is the parallel trends assumption which is difficult to fulfill. The assumption requires that in the absence of the treatment, the difference between the 'treatment' and 'control' group is constant over time. However, there is no statistical method used for this assumption, visual inspection is useful when you have observations over many time points. Additionally, it has been concluded that the smaller the time period tested for both the treatment and control, the more likely the assumption is to hold. Violation of the parallel trend's assumption will lead to biased estimation of the causal effect (Columbia University Mailman School of Public Health, 2014).

Figure 3-15 visually displays the parallel trends assumption, pertaining to this research the horizontal axis is time while the vertical axis is housing units. There are two lines, one for the treatment group (Sheppard East) and one for the control group (Sheppard West). The assumption claims that although the levels can be different amongst each group, the trends have to be the same. For example, if Sheppard East increases by 10 housing units, Sheppard West would have to increase by the same amount. Additionally, the two lines don't have to overlap, they only need to have the same trend in which they increase or decrease by the same amount (Columbia University Mailman School of Public Health, 2014).

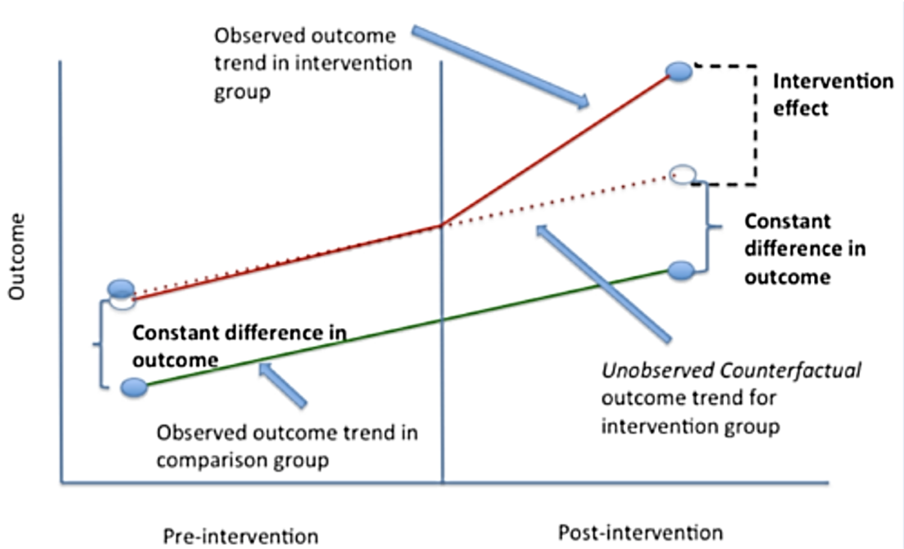


Figure 3-15: Parallel trends assumption example. Source: (Columbia University Mailman School of Public Health, 2014).

3.6. Data Source

The dataset used for this study was obtained from Statistics Canada, which is available from the Ryerson University Data library. Housing data was used for two time periods which are between 1991 – 2001 and 2002 - 2016. The period of 1991-2002 is the pre-treated time period which is before the subway extension occurred. Additionally, 2002-2016 is the post-treated period which is after the subway extension had occurred.

Using the data library, the researcher was able to obtain data regarding the number of housing units per dissemination area within a 1- kilometer radius from a subway station alongside the Sheppard Subway Line between the years of 1991 – 2016 (figure 3-16). The dataset also contained the number of owned and rented houses within each dissemination area, the average bedrooms, the number of houses built each year after the subway line opened, the distance each dissemination area was to the Sheppard-Yonge corridor and the population change between each year; for both the Sheppard East (treated) and Sheppard West (untreated) corridor.

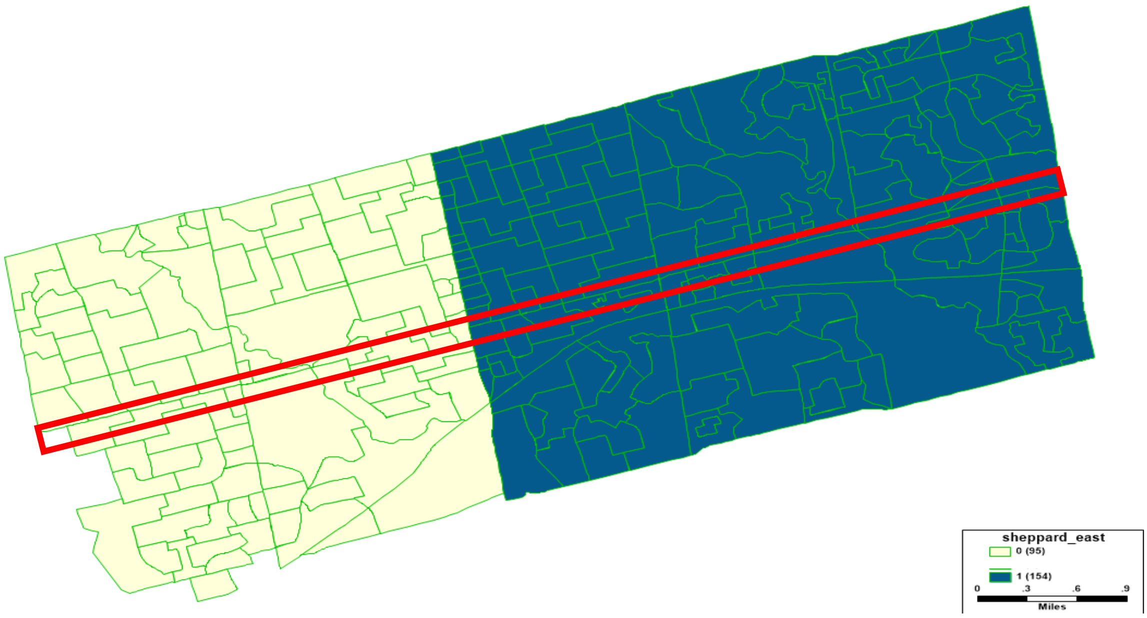


Figure 3-16: Study area, highlighting both the Sheppard West (yellow) and Sheppard East (navy) study boundaries. Source: Statistics Canada, 2016

This thesis focuses on dissemination areas within a 1-kilometer radius from a subway station rather than census tracts primarily due to the size and nature of dissemination areas. Dissemination areas are the smallest geographical areas used in the Canadian census, with a population of approximately 400-700 persons which is equivalent to approximately 250 households ("Dissemination Areas Explained," 2017). In contrast, census tracts are much larger, comprising approximately 2,500-5000 persons and are located in metropolitan areas with a population of at least 50,000 persons (Canada at a Glance, 2018). The researcher was originally going to use census tracts within a 1-kilometer buffer from a transit station, however due to the size of census tracts and short distance between subway stations along the Sheppard subway line, many subway stations were categorized under numerous census tracts; in addition to census tracts capturing property data beyond the scope of a 1- kilometer radius from a station, which is beyond the study boundaries. Therefore, to prevent inaccuracies dissemination areas were used for this study.

3.7. Summary

Various services and amenities exist within the treatment and control study groups, including Earl Bales Park, North York General Hospital and the West Don Parkland to name a few; making the study area a desirable location to many. Additionally, the data for the study came from a direct source, I utilized the difference in difference statistical technique to undertake comprehensive research on the effects of the Sheppard Subway extension on land use development within the City of Toronto between the years of 1991-2016 In summary, data was obtained from Census Canada, which was available through the Ryerson University Data Library, containing information regarding the number of owned and rented houses, average bedrooms, number of houses built each year, and population change between each year for each dissemination area located within a 1- kilometer radius from the transit line.

Chapter 4: Data Analysis and Results

In this chapter I will provide the descriptive statistics by analyzing the variables used for analysis before and after the construction of the Sheppard East subway extension for both the treatment and control study groups in addition to finding correlations between each variable.

4.1. Analysis of Descriptive Statistics

Table 4-1 and 4-2 contains a detailed descriptive statistics of the housing variables used for analysis during the pre-treated (1991-2001) and post-treated (2002-2016) study period within a 1-kilometer radius from Sheppard Avenue. The dataset contains the following variables: total homes by tenure, owned, rented, average rooms within each housing unit, total homes by construction and the average distance to the Sheppard and Yonge corridor, which will be further analyzed in detail below.

Furthermore, before analyzing the descriptive characteristics in further detail, it is important to recognize that the Sheppard Avenue West and Sheppard Avenue East study area are significantly different in size. Sheppard Avenue West as coloured in yellow in figure 3-15 consists of 95 dissemination areas and is 16.3 square kilometers in size while the Sheppard Avenue East study group consists of 154 dissemination areas and is 24.5 square kilometers. The whole study area consists of 249 dissemination areas and is 40.8 square kilometers in size as previously mentioned. Due to the difference in size for both the control and treatment study groups, it can play a vital role in housing characteristics as the treatment group has more land area whilst the comparison group has less.

4.1.1. Owned and Rented Units

The owned variable denotes the number of owned housing units which can be either single-family, multi-family, apartments or condominiums within the study area, during the treatment (Sheppard East) and control (Sheppard West) study group. As we can see from table 4-2, there are currently 31,345 owned housing units within the treatment group which is significantly greater than 15,505 units in the control group. In total there are 46,850 owned units within the study group, whereas 66.9% of units are within Sheppard East in comparison to 33.1% of units in Sheppard West.

Similar to the owned variable, the rented variable denotes the number of rented housing units which can be either single-family, multi-family, apartments or condominiums within the study area. As we can see in table 4-2, there are currently 24,705 rented housing units within the treatment group is greater than 11,065 units in the control group. In total there are 35,770 rented units within the study group, whereas 69% of units are within Sheppard East in comparison to 31% of units in Shepard West. While comparing the similarities between these two variables, there are more owned housing units rather rented units within the study area; however, the results are quite similar. As of 2016, the homeownership rate was 56.7% within the whole sample, more specifically the treatment group had a homeownership rate of 66.9% while the control group's homeownership rate is 33%.

Additionally, figure 4-1 displays a map highlighting the percentage of units that are rented within the study are for the year 2016, which is after the subway extension occurred. As we can see, higher rent clusters exist along Sheppard Avenue in addition to a larger percentage of renters along Yonge Street and Sheppard Avenue, which stretches north to Finch Avenue West. A larger percentage of renters exist along the main streets of the study area, as opposed to areas located further away as majority of apartment and condominium units exist within these areas. Furthermore, a large percentage of rented units are located towards the Don Valley Parkway within the Sheppard Avenue East study area, in addition to the north and south of Highway 401. This is due to the prime attractiveness of house located within close proximity to a highway, expressway and two subway lines, the Yonge-University and Sheppard line. However, as expected, there is a lower percentage of renters located further away the main streets of Sheppard Avenue and Yonge street as majority of the housing stock located further away are comprised of low-density single-family houses which usually signifies home ownership.

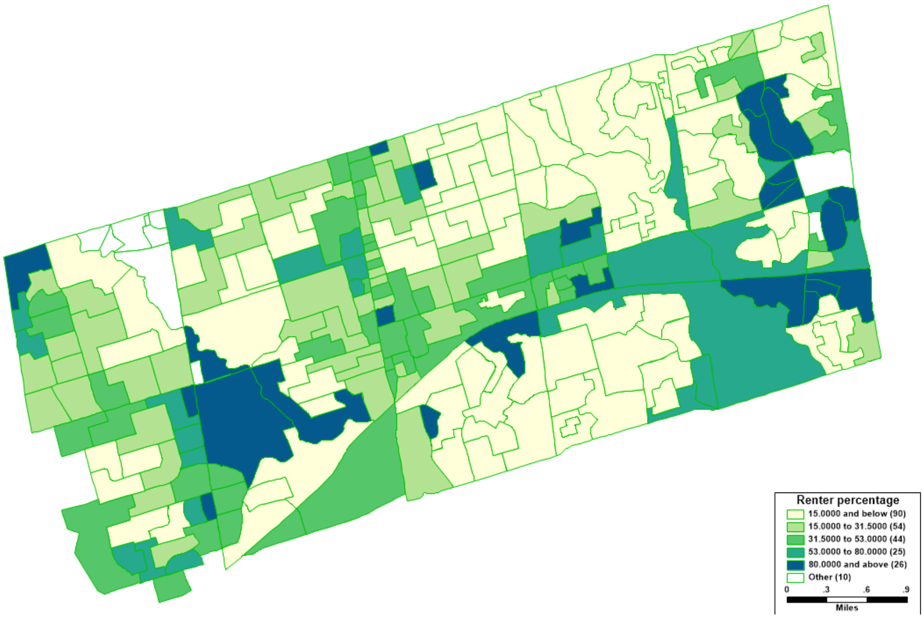


Figure 4-1: Percentage of units that are rented within the study area along Sheppard Avenue (2016). Source: Statistics Canada

4.1.2. Average rooms within each housing unit

The average rooms within each housing unit variable signifies the average number of rooms for both treated and control study areas during the pre-treated and post-treated time period (Table 4-1). The average rooms within the treatment group is 6.05 in comparison to 6.33 for the control group, which is very similar in size. The results indicate that on average, there are approximately 6 rooms in each housing units within the treatment and controlled study group which includes, single-family, multi-family, apartment and condominium houses. According to Statistics Canada, the average number of rooms per dwelling within the Province of Ontario is 6.6, whilst the average for Canada is 6.4 rooms within each housing units ("Table 14.8 Average number of rooms per dwelling, by household size and by province and territory, 2006," n.d.). The standard deviation for the treatment group is 2.28 in comparison to 1.76 for the control group. A lower standard deviation signifies that most of the numbers are similar to the mean in comparison to a higher standard deviation which signifies that the numbers are spread out from the mean. As the standard deviation is lower amongst the control group, this signifies that majority of the housing units within the Sheppard west study group comprise of 6.33 rooms.

Figure 4-2 displays the average rooms within each housing unit during the post-treated period of 2016. The highest average room clusters within the study area exist primarily within the treatment group towards the south of Highway 401 and to the north of Sheppard Avenue East as highlighted in navy, with an average of 9 rooms or more per housing unit. Additionally, higher average room clusters exist towards the north of the study area for both the treatment and control groups with an average of 7.5-9 rooms per housing units, highlighted in dark green. This can be because more single-family houses exist along Finch avenue east and west, which results in more rooms per housing unit.

Along the Sheppard and Yonge corridor and towards the north and south of Yonge Street the average rooms within each housing unit is significantly low, with four rooms or less per housing unit as highlighted in yellow. The primary reason for this is due to Yonge Street comprising of many services and amenities such as restaurants and retail ships rather than housing units.

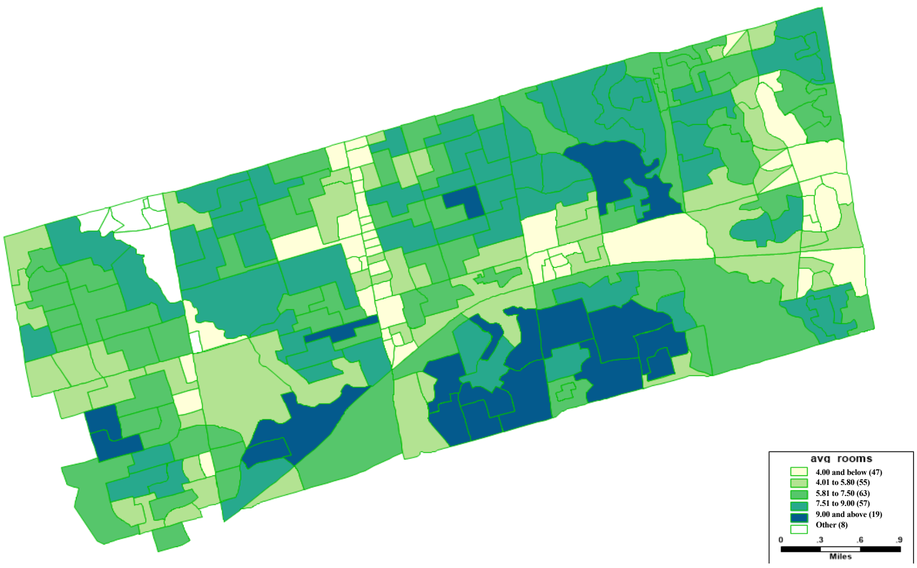


Figure 4-2: average rooms within each housing unit during the post-treated period (2016). Source: Statistics Canada

4.1.3. Total homes by tenure

The total homes by tenure variable denotes the number of housing units which can be either, single-family, multi-family, apartment or condominiums within the study area, that currently exists within the Sheppard study area as of 2016. This is an important variable as it signifies the number of housing units within the treatment and control study group; and can be calculated by adding the number of owned and rented housing units within the study area.

The total homes by tenure within the sample is 82,620 as of 2016. More specifically, the treatment group (Sheppard East) has 56,040 housing units, while the control group (Sheppard West) has 26,575 as of 2016, which includes both the number of owned and rented units. As we can see, the numbers are not evenly dispersed, while 67.8% of the total homes by tenure exists within the treatment group in comparison to 32.2% within the control group. However, as previously mentioned, Sheppard East is a lot larger in size in comparison to Sheppard West, therefore it makes sense for there to be a larger total homes by tenure within the treatment group as there is more developable land in addition to the Sheppard Subway extension, which serves as a major advantage for residents.

4.1.4. Number of housing units built before 1991

The number of housing units built before 1991 variable denotes the number of housing units which existed before the pre-treated time period (1991-2001), in other words housing units which existed along the Sheppard East and Sheppard West corridor. As we can see from table 4-2 there were 44,690 current units before 1991 within the whole study area. More specifically, the treatment group had 28,180 units while the control group had 16,510 units.

4.1.5. Built 1991-2001 (Pre-treated period)

This variable denotes the number of housing units which were constructed during the pre-treated period of 1991-2001 which is before the subway extension had occurred. There were 8,405 additional new units which were constructed in the whole study area. More specifically, 5,885 new units were built within Sheppard East and 2,520 units within Sheppard West (table 4-2).

4.1.6. Built since 2002 (Post-treated)

The built since 2002 denotes the number of housing units which were constructed during the post-treated time period of 2002-2016. As we can see from figure 4-3, there were 29,670 housing units which were constructed during the post-treated time period, with 22,000 units in the treatment group and 7,670 units within the control group. However, we cannot conclude that the spike in housing units during the post-treated period was a result of the accessibility premium provided by the Sheppard Subway Line. There is a possibility that land developers had allocated these locations for new housing construction, regardless of the subway construction.

4.1.7. Population as of 2016

The population as of 2016 variable denotes the total population within the study area as of 2016 within both the treatment and control groups (table 4-2). As we can see, as of 2016 there were 201,635 residents within the whole study area, more specifically 136,940 within Sheppard East and 64,695 within Sheppard West. As expected, there are more residents within the treatment group as 67.9% of the total population of the study area exists within this group in comparison to 32.1% within the control group. Figure 4-3 displays the population density within the study during the post-treated period, while figure 4-4 displays the pre-treated period. As we can see, during the post-treated period the population density further densified along Yonge Street and Sheppard Avenue east and west, in addition to Highway 401.

Population density in the post-treated period (2016).

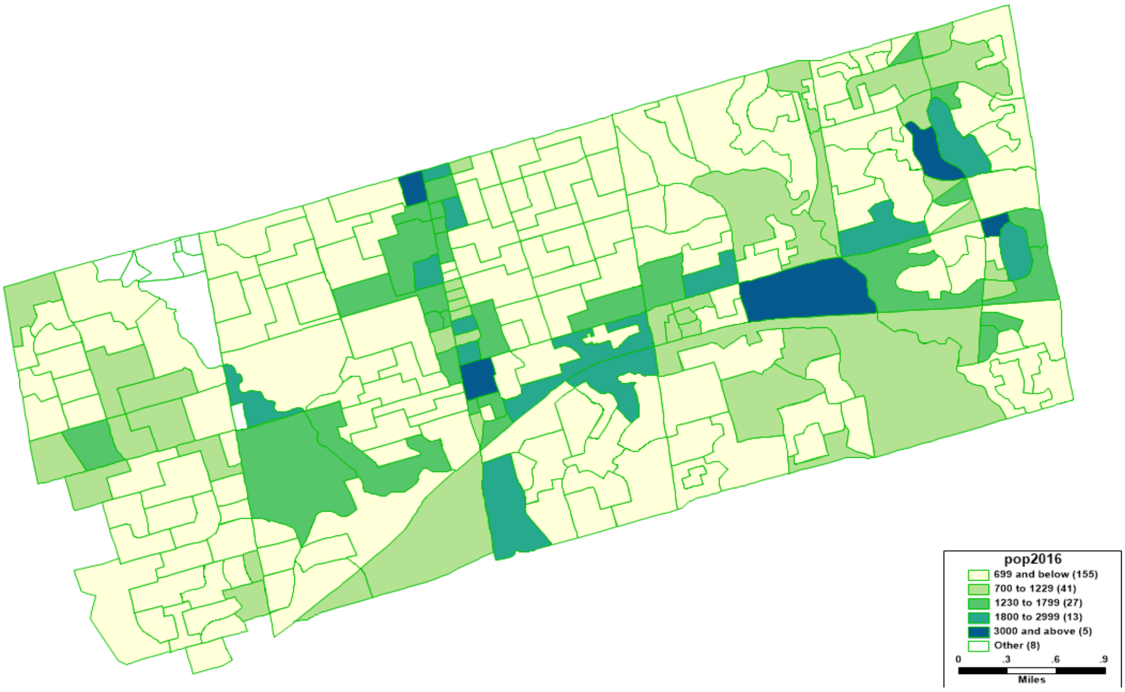


Figure 4-3: Population density of the study area (2016). Source: Statistics Canada

Population density in the pre-treated period (1991).

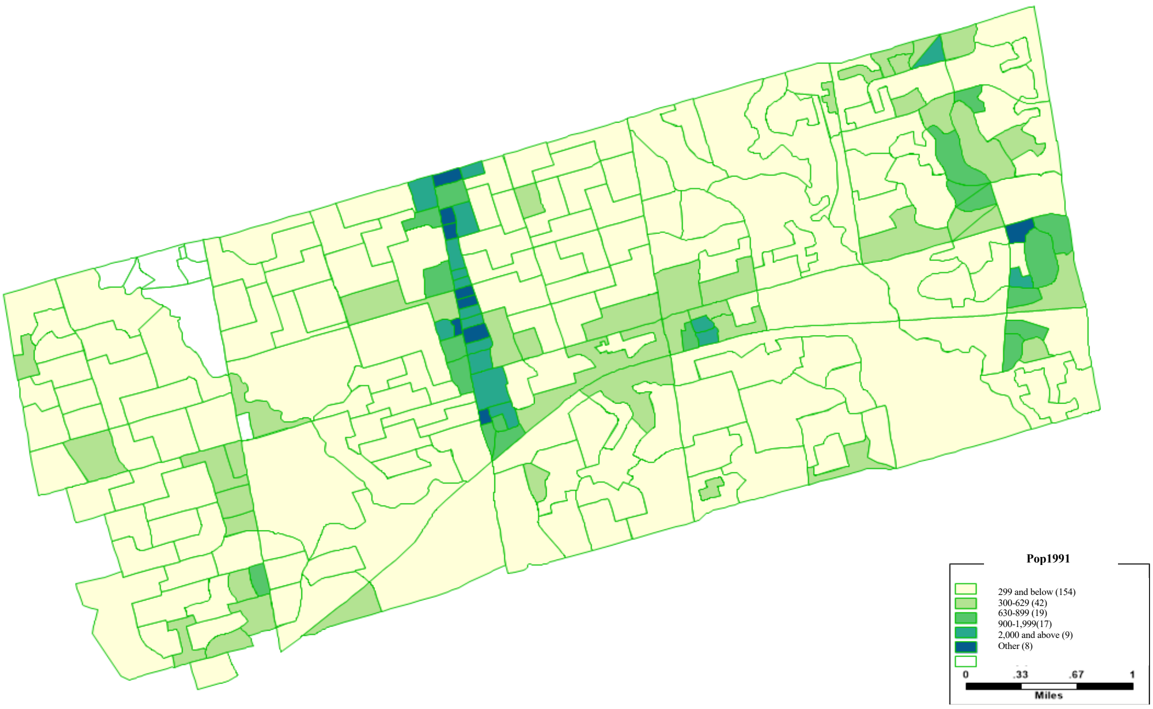


Figure 4-4: Population density of the study area (1991). Source: Statistics Canada

4.1.8. Average distance to the Sheppard and Yonge corridor

The average distance to the Sheppard and Yonge corridor variable signifies the average distance each housing unit is within the treatment and control group to the Sheppard and Yonge corridor (Figure 4-1). The reason this variable was selected is because of the immense popularity of the corridor, which serves as an advantage to individuals living within the study area—specifically, those who use public transportation. The corridor is located near two subway lines which are the Yonge-University line and the Sheppard Subway line, in addition to many services and amenities along Yonge Street such as, restaurants, retail shops, medical offices and a Cineplex movie theater.

The average distance to the Sheppard and Yonge corridor within the treatment group is 3.09-kilometers in comparison to 2.49 for the control group. The results indicate that on average a housing unit located within the Sheppard east study group is 3.09 kilometers away from the Sheppard and Yonge corridor while a housing unit located within the Sheppard west study group is 2.49 kilometers away. The reason the treated group has a larger distance from the Sheppard and Yonge corridor as compared to the control group is because the treated group is 8.2 square kilometers larger, which contains more developable land. Additionally, the standard deviation for the treatment group is 1.79 in comparison to 1.16 for the control group. As previously mentioned, a lower standard deviation signifies that most of the numbers are similar to the mean in comparison to a higher standard deviation which means that the numbers are spread out from the mean. As the standard deviation is lower amongst the control group, this signifies that majority of housing units within the Sheppard West study area are within 2.49 kilometers from the Sheppard and Yonge corridor.

4.2. Descriptive Statistics

Table 4-1: Average rooms and distance to Sheppard and Yonge

	Full Sample		Treatment Group: Sheppard East		Control Group: Sheppard West	
Observation	Mean	St.Dev	Mean	St.Dev	Mean	St.Dev
Average Rooms	6.15	2.11	6.05	2.28	6.33	1.76
Distance to Sheppard and Yonge	2.87	1.61	3.09	1.79	2.49	1.16

Source: Statistics Canada, 2016

Table 4-2: Housing characteristics

	Variables	Full sample	Treatment Group: Sheppard East	Control Group: Sheppard West
	Total Homes by Tenure	82,620	56,050	26,575
	Owned	46,850	31,345	15,505
	Rented	35,770	24,705	11,065
	Built before 1991	44,690	28,180	16,510
Before	Built 1991-2001	8,405	5,885	2,520
After	Built since 2002	29,670	22,000	7,670
	Population 2016	201,635	136,940	64,695

Table 4-1: displays the mean and standard deviation for the two variables: average rooms and distance to Sheppard and Yonge
Table 4-2: displays the descriptive statistics for the full sample, treatment group and control group within a 1-kilometer radius from Sheppard Avenue for the variables: total homes by tenure, owned and rented, sum of before 1991, sum of 1991-2001, sum of since 2002 and sum of population 2016.

Chapter 5: Econometric Models and Evidence

This chapter presents the econometric models estimated in the analysis. Results are presented through charts and tables. I discuss my findings as well in this chapter. Section 5.1 analyzes the rate of housing development in treated (Sheppard East) and control (Sheppard West) groups within the study period, section 5.2 analyzes the difference in difference regression results and lastly section 5.3 discusses the results from the models.

5.1: Rate of Housing Development

Table 5-1 displays the number of housing units before and after the subway extension occurred within the treatment and control study area. It is important to take a deep examination of the results, as we can see there were 34,065 existing housing units within a 1-kilometer buffer along the Sheppard East group before the subway extension was constructed. However, after the subway extension has been built along the Sheppard East group, there have been 22,000 new housing units which have been built; totalling 56,065 units within the treatment group. Regarding Sheppard West where the subway extension did not occur, there were 19,030 existing units within a 1-kilometer buffer along the Sheppard West side before the subway extension occurred. After the subway line has been constructed on the Sheppard East side during the post-treated period there has been 7,670 new units which have been built; totalling 26,700 units within the control area as of 2016.

Table 5-1: Number of housing units before and after the subway extension occurred

	Before 1991	**Pre-intervention (1991-2001)**	**Post-intervention (2002-2016)**	**Grand Total**
Sheppard East	28,180	5,885	22,000	56,065
Sheppard West	16,510	2,520	7,670	26,700

Source: Statistics Canada, 2016

To further examine the pace of housing development, I examined the number of housing units per square kilometer within both the treatment and control study groups during the pre-treated and post-treated time periods to determine the pace of housing development. This was determined by dividing the number of units within both the treatment and control study area by the number of square kilometers in each during the pre-treated and post-treated study period. Regarding the Sheppard East group, there were 1,390 units per square kilometer during the pre-treated time period, which is before the subway extension occurred, while the post-treated period nearly double the number of units with 2,288 units per square kilometer. Regarding Sheppard West, there were 1,167.4 units per square kilometer during the pre-treated time period, while the post-treated time period had 1,630 units per square kilometer. Surprisingly, even though the subway extension did not occur within the Sheppard West group, there was still an increase in housing units per square kilometer during the post-treated time period. Additionally, it is important to examine the population density for the study area, to provide a context for growth within the area. As of 2001, which is before the subway extension occurred within the Sheppard East group, there were 3,589 people per square kilometer; however as of 2016 which is after the subway extension opened in 2002; there were 5,589 people per square kilometre. Regarding Sheppard West, there were 2,193 people per square kilometer as of 2002 which is before the subway extension occurred; however as of 2016 there were 3,969 people per square kilometer. In contrast, a recent study conducted by the Fraser Institute in 2016 indicated that the City of Toronto has 4,457 people per square kilometer. Results indicated that the City of Toronto's density is significantly less than many major Canadian cities such as Montreal with 4,916 people per square kilometer, Vancouver with 5,291 and Canada as a whole with an average of 5,493 people per square kilometer ("Population density in Toronto significantly less compared to other major cities," 2018) (Table 5-3).

Table 5-2: Number of housing units per square kilometer within the treatment and control study group before and after the subway extension occurred

	Before (1991-2001)	**After (2002-2016)**
Sheppard East (24.5 sq. km.)	1,390 units per sq.km.	2,288 units per sq.km.
Sheppard West (16.3 sq.km.)	1,167.4 units per sq.km.	1,630 units per sq.km.

Source: Statistics Canada, 2016

Table 5-3: Population density per square kilometer within the treatment and control study group before and after the subway extension occurred

	Before (1991-2001)	**After (2002-2016)**
Sheppard East (24.5 sq.km.)	3,589 people per sq.km.	5,589 people per sq.km.
Sheppard West (16.3 sq.km.)	2,193 people per sq.km.	3,969 people per sq.km.

Source: Statistics Canada, 2016

Regarding the difference-in-difference technique, I conducted a regression analysis in which the dependent variable used was the number of units built between 1991-2016, while the explanatory variables are time: (if the unit was built before or after the subway line extension) denoted as t; treated (which analyzed the year the development has occurred within a 1-kilometer buffer from a transit station along the Sheppard East corridor only where the subway line was constructed); and lastly the difference in difference which measures the outcomes and covariates for both the participants and non-participants in pre and post-intervention periods denoted as DID. Table 5-4 displays the results generated from the regression analysis.

Table 5-4 shows that there are 598 observations in our sample; half within the pre-treated period and half within the post-treated period. Additionally, there are 249 dissemination areas within the study period of Sheppard East and Sheppard West, specifically

95 dissemination areas within Sheppard West and 154 within Sheppard East. Additionally, the adjusted R-square is used for interpretation which is used when there is more than one x-variable. In the case of the DID conducted in Figure 5-4, the adjusted R-square is 0.048 which indicates that 4.8% of the variation of the y-values around the mean are explained by the dependent variables.

On average dissemination areas in the post-treated period had 59.1 more units than in the pre-treated period. However, after examining the p-value of 0.052 the results indicate it is not statistically significant, therefore we fail to reject the null hypothesis at the 5% level. For a p-value to be statistically significant it has to be less than 0.05, ideally p-values with a numeric value of 0.01 are deemed the most significant.

Additionally, housing units increased by 9.24 units per each dissemination area within the Sheppard East after the opening of the subway extension. However, the p-value is 0.731 which is statistically insignificant, therefore we fail to reject the null hypothesis. Lastly, the difference in difference which is denoted as DID; measures the outcomes and covariates for both participants and non-participants in pre and post-intervention periods. Results from the regression indicates that on average 45.44 additional units were built after the Sheppard Subway opened within the Sheppard East group per dissemination area. However, the p-value is 0.233 which is statistically insignificant; therefore, the null hypothesis states that the estimated coefficient is not significant. In conclusion, findings from the difference in difference regression indicate that the impact of the Sheppard Subway Line did not have a significant effect on housing development.

5.2. Difference in Difference Regression

Table 5-4: Difference in difference results

Regression Statistics	
Multiple R	0.23340837
R Square	0.054479467
Adjusted R Square	0.048545238
Standard Error	200.6870491
Observations	249

ANOVA

	df	*SS*	*MS*	*F*	*Significance F*
Regression	3	1109247.552	369749.184	9.180546395	6.46757E-06
Residual	478	19251589.43	40275.29169		
Total	481	20360836.98			

	Coefficients	*Standard Error*	*t Stat*	*P-value*	*Lower 95%*	*Upper 95%*	*Lower 95.0%*	*Upper 95.0%*
Intercept	28.96551724	21.5159101	1.346237139	0.178864116	-13.31193947	71.24297396	-13.31193947	71.24297396
Time	59.1954023	30.42809187	1.945419468	0.052310389	-0.593950369	118.984755	-0.593950369	118.984755
Treated	9.248768473	26.91583652	0.343618095	0.731284604	-43.63921573	62.13675267	-43.63921573	62.13675267
Difference-in-Difference (DID)	45.44745484	38.06474105	1.193951505	0.233089115	-29.3474497	120.2423594	-29.3474497	120.2423594

5.3. Discussion Based on Research Findings

It is important to take a deep examination of the results generated within sections 5.1 and 5.2 of this chapter. After examining table 5-2 on the development that occurred within the pre and post-treated period; it is easy to conclude that more development had occurred within the Sheppard East group where the subway line was constructed during the post-intervention period. However, we need to examine the context and size of both; Sheppard West is significantly smaller than Sheppard East in comparison. As previously mentioned, Sheppard West is only 16.3 square kilometers, while Sheppard East is 24.5; therefore, it would make sense for more development to occur alongside the east side of Sheppard as there is more land available to be developed.

Moreover, after examining the rate of housing development we see that Sheppard West and Sheppard East have increased by over double the amount of housing units during the post-intervention period which is after the subway extension occurred. Findings from this can conclude that the Sheppard subway extension did not have a direct impact on housing units within the Sheppard East corridor as development was seen within the comparison group of Sheppard West as well. Numerous factors could have contributed to the growth within the area such as services and amenities within the vicinity of the study area including shops, restaurants, Highway 401, the Don Valley Expressway, Bayview Mall, Fairview Mall and of course the extension of the Sheppard Subway Line. However, we cannot conclude that development within a 1-kilometer radius from Sheppard Avenue was merely correlated with the Sheppard Subway Line as the difference-in-difference regression analysis conducted in table 5-4 above is statistically insignificant, therefore we cannot conclude that the Sheppard Subway Line increased housing development within the treated and control study group.

Chapter 6: Conclusion

In this chapter I summarize the major findings of the study in addition to the limitations. Section 6.1 will summarize the research findings; section 6.2 will analyze the study limitations and lastly section 6.3 will determine the contributions of this research in addition to future research opportunities.

6.1. Summary of Findings

Many major ideas have been examined throughout this thesis. The first chapter sets the context of the thesis by examining the research question in addition to introducing the location of the Sheppard Subway Line and history of its development. Chapter two provides an in-depth literature review on transit-oriented development by examining case studies; specifically, within the Toronto, North America and global context. Findings from the research indicated there has been a vast amount of studies examining the implementation of rail transit on price premiums rather land development; many studies have found that housing units located within less than a kilometer away from a station receive approximately a 20% increase in value. However, the reported studies on the impact of rail transit on land development have been mixed. Majority of the literature examined has indicated a positive increase in land development after the implementation of rail transit, specifically subway stations rather bus and light rail. Conversely, some studies have indicated negative effects such as increased crime rates, noise and congestion associated with nearby transit facilities.

The concept of 'youthfication' and 'gentrification' are common themes which have emerged within large Canadian cities after the implementation of rail transit. For example, Moss (2016) found that after the implementation of the rapid transit line in Surrey British Columbia, the city experienced immense gentrification which further displaced low-income individuals, as development along the transit corridor occurred, housing become increasingly expensive and the lack of affordable housing diminished. Additionally, 'condo-ism' has been a common urban theme within the City of Toronto in which there are several clusters of condo growth within the city, primarily along the Yonge - University subway line and waterfront; which has grown to be attractive locations for high density condo developments.

In chapter three, I had provided the empirical method used for analysis in addition to the surrounding services and amenities within the study area. Chapter four provides the descriptive statistics by analyzing the housing characteristics such as total homes by tenure, the amount of owned and rented units, average rooms and the distance each housing unit was to the Sheppard and Yonge corridor during the pre-treated (1991-2001) and post-treated (2002-2016) time periods. Results indicated that the number of owned, rented and housing tenure units increased by more than double for both the treated (Sheppard East) and control (Sheppard West) study groups. The difference-in-difference (DID) statistical technique was then used in chapter five to examine the impact the Sheppard Subway extension had on housing development within both the treated and control study groups during the pre-treated and post-treated time periods. As previously mentioned, the estimation technique resolves the problem of missing data by measuring outcomes and covariates for both participants and non-participants in pre-intervention and post-intervention periods. DID compares both the treatment and comparison group in regard to outcome changes over time relative to the outcome observed for a pre-intervention baseline. Results from the regression reported insignificant results, indicating that the Sheppard Subway line did not have an impact on housing development. Additionally, I have examined the rate of housing development during the pre-treated and post-treated time period amongst the control and treated groups. Results have concluded that the rate of development increased the most amongst the treatment group, however the control group received a considerable amount of growth. More specifically, the treatment group received a 64% increase in housing units while the control group received 40.3% in units from the pre-treated period after the subway extension occurred during the post-treated time period between 2002-2016. Furthermore, the population density per square kilometer during the pre-treated and post-treated time period was also analyzed. Results indicated that after the subway extension occurred, population density increased by nearly double amongst the treatment group within the post-treated period while the control group experienced a 39.6% in population density.

6.2. Study Limitations

Similar to many studies, there exists limitations which are important to acknowledge. One of the main limitations of this study is the explicit focus on housing units within a 1-kilometer radius from Sheppard Avenue as compared to various sorts of land use. As explained within chapter 3.2 there are various services and amenities that exist within the study area boundaries (Sheppard West and Sheppard East) which are classified as commercial, institutional and open space; including North York General Hospital, Bayview Village Shopping Center and Earl Bales Park. Due to this study only examining the change in residential land use, there is a high possibility that various other forms of land use had occurred within the pre-treated and post-treated time periods which was unaccounted.

Additionally, another limitation of this study is the focus on housing units explicitly within a 1-kilometer radius from Sheppard Avenue. Transportation engineering literature claims that 800-meters to a 1-kilometer radius from a transit station is the most accurate way of analyzing land use changes due to transit. A 500-meter radius often does not capture all of the land use changes which have occurred. In contrast, a 2-kilometer radius often stretches too far out of the neighborhood to reap a direct impact of transit stations on land use change. However, to further strengthen this study the focus on housing units within various distances such as a 500-meter, 1.5 kilometer and 2-kilometer radius from Sheppard Avenue can be conducted and compared to our study results to see how much of change occurs. Lastly, the other limitation of this study is the choice of the pre-treated (1991-2001) and post-treated

(2002-2016) time periods. As the Sheppard Subway Line opened in November 2002, there is the possibility that housing development had occurred within the study area before the subway line had officially opened in 2002. Many land developers and residents throughout the City of Toronto were aware of the Sheppard Subway Line being constructed before its opening date as government officials usually make this information available to the media. Therefore, there is the possibility the pre-treated time period of 1991-2001 used for this study had captured housing development which has occurred due to the subway station opening. To mitigate this possibility, for future research the pre-treated time period could be from 1985-1995 for example to alleviate the fuzzy period of capturing potential development due to the subway extension within the pre-treated time period.

6.3. Contributions of Research and Future Research Opportunities

Research examining the impact of transit on land development lags within the City of Toronto, specifically along the Sheppard Subway Line. As mentioned in chapter two, there is limited literature on the topic of rail transit on housing development within the City of Toronto; all present research is focused on the Yonge-University subway line within the City of Toronto, as the Sheppard Subway is fairly new, opening in November 2002. In addition, as the City of Toronto comprises of only 4 subway lines in contrast to many world-class cities within North America such as New York City, Chicago; limited literature on its impact on land development currently exists. I have examined many case studies on the impact of rail transit on land development which have been conducted in many mega cities within Canada; including Vancouver, Calgary and Montreal. However, as Kahn (2007) notes, it’s important not to use a “one size fits all concept” as area context varies.

This study contributes to the limited research examining the impact of rail transit on housing development within the Canadian context, by focusing explicitly on subway stations within a 1-kilometer radius from development within the City of Toronto. Throughout the literature review process, we have seen an over dominating amount of literature focusing on the impact of rail transit on land premiums, however limited literature on land development exists. Another contribution of this research is the is the use of the difference in difference estimation technique used to analyze the impact of the Sheppard Subway on housing development. Most previous studies have used various methods such as spatial autocorrelation and linear regression. The DID method allows us to focus on change over time between treatment and comparison groups by controlling for all other factors.

For future research, the study on the impact of the Sheppard Subway on housing development can be conducted at various distances such as 500-meters, 1-kilometer and 2-klometers during the pre-treated and post-treated time periods to further understand the development patterns along Sheppard Avenue. More variables can be used in analysis such as the specific type of dwellings (semi-detached, row houses, apartments), ethnic background and income levels. By including more variables within the descriptive statistics in addition to various radiuses from Sheppard Avenue, this will allow us to answer the following questions: Do residents with a post-secondary degree reside closer to Sheppard Avenue? Are those of a higher income more likely to reside near the Yonge/Sheppard core?

In addition, the DID technique can be used to analyze the impact of one or more of the GO Transit Light Rail transit lines on housing development within the Greater Toronto Hamilton Area (GTHA) in comparison to the Sheppard Subway Line. As a background, GO Transit is a regional public transit system serving residents within the GTHA by providing bus and light rail to residents. The transit system is owned and operated by Metrolinx, which is a crown agency responsible for managing road and public infrastructure within the Province of Ontario. Currently, GO Transit operates seven rail transit lines which all depart from Toronto's Union Station, designed for serving residents within the GTHA. The seven lines include: Lakeshore West, Lakeshore East, Milton, Kitchener, Barrie, Richmond Hill and Stouffville. This potential future research opportunity will help close the gap of the limited literature examining light rail and subway station proximity on housing development within the City of Toronto and Greater Toronto Hamilton Area.

6.4. Policy Implications

In regard to the policy implications prior to the opening of the Sheppard Subway, the City of Toronto did not implement land use changes. Such changes would facilitate land use intensification near subway stations which could have played a detrimental role in increasing the number of housing units constructed alongside Sheppard Avenue. Within the literature, we have seen many governments throughout various cities amend land use policies near rapid transit systems in an attempt to expediate land use near its proximity (Dittmar et. al, 2014; Levy, E. 2015; Zheng et.al, 2016). As mentioned in the literature review, the government of the Jakarta Metropolitan area had extended the subway line into the suburbs in an attempt to redistribute population and economic activity away from the core metropolitan area as part of the governments decentralization policy. In addition, the government also amended its land use policies to allow for higher-density development to occur within 500-meters from each subway station to encourage growth within the suburbs. As a result, three new towns were developed due to the government's decentralized policy which are: Bintaro, Tangergan and Depok city (Syabi, 2011). Thus, if the City of Toronto had amended its land use intensification policies alongside Sheppard Avenue to encourage growth during the construction of the subway line it would have significantly affected the results of this study.

Appendix

Appendix A: Variable comparison of Sheppard Avenue East and Sheppard Avenue West

Variables	**Shepard E**	**Shepard W**	**SE** Fraction breakdown	**SW** Fraction breakdown
Dissemination areas	95	154		
Population 2016	64695	136940		
Housing tenure (2016)	26595	56015		
Number of owned units (2016)	15505	31345	58%	56%
Number of rented units (2016)	11065	24705	42%	44%
Average rooms (2016)	6.3	6.1		
Housing units constructed before 1960	8290	6025	31	11
Housing units constructed 1961-80	5840	17645	22	31
Housing units constructed 1981-90	2380	4510	9	8
Housing units constructed 1991-2000	2520	5885	9	10
Housing units constructed 2001-05	2470	8040	9	14
Housing units constructed 2006-10	2530	6590	10	12
Housing units constructed 2011-2016	2670	7370	10	13

Appendix A: As we can see, the number of owned and rented units amongst both groups are very similar, in addition to the average rooms and housing units increase during each cohort

Bibliography

A Par-fect Golf Experience In The Don Valley - Urbaneer - Toronto Real Estate, Condos, Homes. (n.d.). Retrieved October 29, 2018, from http://www.urbaneer.com/blog/flemingdon_golf_club

Alive!, C. (2014, January 18). Highway 401. Retrieved October 29, 2018, from https://canadaalive.wordpress.com/2014/01/18/highway-401/

Bae, C. C., Jun, M., & Park, H. (2003). The impact of Seoul's subway line 5 on residential property values. *Transport Policy, 10*(2), 85-94. doi:10.1016/S0967-070X(02)00048-3

Barton, M. S., & Gibbons, J. (2016). A stop too far: How does public transportation concentration influence neighborhood median household income? Urban Studies, 54(2), 538-554. doi:10.1177/0042098015593462

Bayview Village Shops. (n.d.). Retrieved October 28, 2018, from http://www.bayviewvillageshops.com/

Betty Sutherland Trail - Henry Farm Community Interest Association. (n.d.). Retrieved October 30, 2018, from http://www.henryfarm.ca/betty-sutherland-trail

Billings, S. (2011) Estimating the value of a new transit option. *Regional Science and Urban Economics 41 (2011) 525–536*. Doi:10.1016/j.regsciurbeco.2011.03.013

Bhattacharjee, S., & Goetz, A. R. (2016). The rail transit system and land use change in the Denver Metro Region. *Journal of Transport Geography, 54*, 440-450. doi:10.1016/j.jtrangeo.2016.02.004

Cao, X., & Porter-Nelson, D. (2016). Real estate development in anticipation of the green line light rail transit in St. Paul. *Transport Policy,* doi:10.1016/j.tranpol.2016.01.007

Cavers, A., & Patterson, Z. (2015) Urban rapid rail transit and gentrification in Canadian urban centers: a survival analysis approach. *Urban Studies* 52(1), 178-194. Doi:10.1177/0042098014524287

Cervero R, Murphy S, Ferrell C, et al. (2004) Transit-oriented development in the United States: Experiences, challenges, and prospects. (Report No. 102) Washington, DC: Transit Cooperative Research Program

Celik, H. M., & Yankaya, U. (2006). The impact of rail transit investment on the residential property values in developing countries: The case of Izmir subway, Turkey. *Property Management, 24*(4), 369-382. doi:10.1108/02637470610671604

CF Fairview Mall | Mall Map | CF Maills. (n.d.). Retrieved October 31, 2018, from https://www.cfshops.com/fairview-mall/mall-map.html

Changing capitalization of CBD-oriented transportation systems: Evidence from Philadelphia, 1970–1988. *Journal of Urban Economics, 33*, 361–376. doi.org/10.1006/juec.1993.1021

Debrezion, G., Pels, E., & Reitveld, P. (2007). The Impact of Railway Stations on Residential and Commercial Property Value: A Meta-analysis. *Real estate financial economics (35), 161-180*. Doi: 10.1007/s11146-007-9032

Diao, M., Leaonard, D. & Sing, F. (2017). Spatial difference in difference models for impact of new mass rapid transit line on private housing values. *Regional Science and Urban Economics*, 67(64-77). Doi.org/10.1016/j.regsciurbeco.2017.08.006

Definition of GENTRIFICATION. (n.d.). Retrieved October 10, 2018, from https://www.merriam-webster.com/dictionary/gentrification

Definition of Housing development. (n.d). Retrieved April 7, 2018. From https://www.merriam-webster.com/dictionary/housing%20development

Dittmar H, Belzer D and Autler G (2004) The new transit town: best practices in transit-oriented development. Journal of Urban Studies, 55(10), pp-1-18.

Difference-in-Difference Estimation | Columbia University Mailman School of Public Health. (n.d.). Retrieved September 22, 2018, from https://www.mailman.columbia.edu/research/population-health-methods/difference-difference-estimation

Dissemination Areas Explained. (n.d.). Retrieved September 23, 2018, from http://www.cleanlist.ca/newsroom/dissemination-areas-explained/

Dong, H. (2016). If you build rail transit in suburbs, will development come? *Journal of the American Planning Association, 82*(4), 316-326. doi:10.1080/01944363.2016.1215258

Don Valley Golf Course - Toronto, ON, Canada | Swing By Swing. (n.d.). Retrieved October 29, 2018, from http://courses.swingbyswing.com/courses/Canada/ON/Toronto/Don-Valley-Golf-Course/34825

Don Valley Parkway - Images. (n.d.). Retrieved October 29, 2018, from http://www.asphaltplanet.ca/ON/Toronto/DVP_images.htm

Duncan, M. (2008). Comparing Rail Transit Capitalization Benefits for Single-Family and Condominium Units in San Diego, California. *Sage Journals, 87(2). 139-155*. Doi: 10.3141/2067-14

Duncan, M. (2011). The impact of transit-oriented development on housing prices in San Diego, CA. *Urban Studies, 48*(1), 101-127. doi:10.1177/0042098009359958

East Don River Trail | Ontario Trails Council. (n.d.). Retrieved October 28, 2018, from http://www.ontariotrails.on.ca/trails/view/east-don-river-trail

Espinoza, J. J. (2010, August 8). Difference-in-Difference Estimation: Garbage Incinerators and Home Prices. Retrieved October 23, 2018, from https://masterofeconomics.org/2010/08/08/difference-in-difference-estimation-garbage-incinerators-and-home-prices/

Fertner, C. (2013). The Emergence and Consolidation of the Urban-Rural Region: Migration Patterns around Copenhagen 1986-2011. Journal of Economic Geography, 104(3), 322-337. doi:10.1111/tesg.12007

Ferguson, R. (2018, May 09). Doug Ford promises more subways for Toronto. Retrieved September 18, 2018, from https://www.thestar.com/news/queenspark/2018/05/09/doug-ford-promises-more-subways-for-toronto.html

Freeman L (2005) Displacement or succession? Residential mobility in gentrifying neighborhoods. *Urban Affairs Review* 40(4): 463–491. Doi: 10.1177/1078087404273341

Freeman, L., & Schuetz, J. (2017). Producing affordable housing in rising markets: What works? *Cityscape, 19*(1), 217-236. Retrieved from http://ezproxy.lib.ryerson.ca/login?url=https://search-proquest-com.ezproxy.lib.ryerson.ca/docview/1915833245?accountid=13631

Gatzlaff, D., Smith, M., 1993. The impact of the Miami metropolitan on the value of residences station locations. *Land Economics*. 69, 54–66.

Get Toronto Moving Transportation Plan History - Don Valley Parkway. (n.d.). Retrieved October 29, 2018, from http://gettorontomoving.ca/don-valley-parkway.html

Google Maps (2018) Yonge Street and Sheppard Avenue. Retrieved February 26th, 2019 from https://www.google.com/maps/@43.766612,79.3879037,3a,75y,113.62h,91.55t/data=!3m6!1e1!3m4!1sQ82r6BNdD8Z5kEQg6uTiJw!2e0!7i16384!8i8192

Grass RG (1992) The estimation of residential property values around transit station sites in Washington, DC. J Econ Finance 16:139–146

Guthrie, A., & Fan, Y. (2016, October). Developers' Perspectives on Transit-Oriented Development. Transport Policy, 51(1), 103-114. Doi: 10.1016/j.tranpol.2016.04.002

Haider, M., & Donaldson, L. (n.d.). Can Tax Increment Financing Support Transportation Infrastructure Investment?, 39.

Hammel D and Wyly E (1996) A model for identifying gentrified areas with census data. *Urban Geography* 17(3): 248–268

Hess, D., Almedia, T. (2006). Impact of Proximity to Light Rail Rapid Transit on Station-area Property Values in Buffalo, New York. *Urban Studies, 44(4)*, 1041-1068. Doi: 10.1080/00420980701256005

Higgins, C. & Kanaroglou, P. Rapid transit, transit-oriented development, and the contextual sensitivity of land value uplift in Toronto. *Urban Studies, 55(10), 2197-2225*. Doi:10.1177/0042098017712680

Home. (n.d.). Retrieved October 31, 2018, from http://schoolweb.tdsb.on.ca/forestvalley/Home/portalid/1484

Hurst, N. B., & West, S. E. (2014). Public transit and urban redevelopment: The effect of light rail transit on land use in Minneapolis, Minnesota. *Regional Science and Urban Economics, 46*(Complete), 57-72. doi:10.1016/j.regsciurbeco.2014.02.002

Jones, C. & Ley, D. (2016) Transit Oriented Development and Gentrification along Metro Vancouver's low-income sky train corridor. *The Canadian Geographer*, 60(1), 9-22. doi10.1111/cag.12256

Kahn, M. (2007). Gentrification trends in New Transit Oriented communities: Evidence from 14 cities that expand and built rail transit systems*. Journal of Real Estate and Economics,* 35(2), 155-182. Doi: 10.1111/j.1540-6229.2007.00186.x

Knight, R., & Trygg, L. (1977). Evidence of land use impacts of rapid transit systems. *Transportation, 6*(3), 231-247. doi:10.1007/BF00177453

Landis, J., Cervero, R., Guhathukurta, S., Loutzenheiser, D., Zhang, M., 1995. Rail Transit Investments, Real Estate Values, and Land Use Change: A Comparative Analysis of Five California Rail Transit Systems. Institute of Urban and Regional Studies, University of California at Berkeley, Berkeley, CA, 48.

Levy, E.J. (2015). Rapid Transit in Toronto: A Century of Plans, Projects, Politics, and Paralysis. Toronto: BA Consulting Group, Ltd.

Liu, X., Deng, Y & Vine, S. (2016). Residential relocation in response to light rail transit investment: case study of the Hudson–Bergen Light Rail system. *Journal of Modern transportation. 24(2), 139-144*. DOI 10.1007/s40534-016-0100-z

Lund, H. 2006. ''Reasons for Living in a Transit Oriented-Development, and Associated Transit Use.'' *Journal of the American Planning Association* 72 (3): 357–66.

Los Angeles County Metropolitan Transportation Authority (LAMetro), 2012. Quantifying the influence of transit on land use patterns in Los Angeles county. Retrieved Oct. 4, 2016, from http://media.metro.net/projects_studies/sustainability/images/

Lee, J. & Sohn, K (2013). Identifying the Impact on Land Prices of Replacing At-grade or Elevated Railways with Underground Subways in the Seoul Metropolitan Area. *Urban Studies, 44-62*. Doi: 10.1177/0042098013484543

Li, S., Yang, J., Qin, P., & Chonabayashi, S. (2014). Wheels of Fortune: Subway Expansion and Property Values in Beijing. *Journal of Regional Science* , 56(5), 792-813.doi:10.1111/jors.12284

Mall Profile: Bayview Village Shopping Centre [Feature/Photos]. (n.d.). Retrieved October 28, 2018, from https://www.retail-insider.com/retail-insider/2017/6/bayview-village

McMillen and McDonald (2004) Reaction of House Prices to a New Rapid Transit Line: Chicago's Midway Line, 1983–1999. *Real Estate Economics, 464-486*. Doi: 10.1111/j.1080-8620.2004.00099.x

Mishy's Corner of the World: East Don Parklands Trail. (n.d.). Retrieved October 28, 2018, from http://mishylainescorneroftheworld.blogspot.com/2014/06/east-don-parklands-trail.html

Moos, M. (2016). From gentrification to Youthification? The increasing importance of young age in delineating high-density living. *Urban Studies, 53(14), 2903-2920*. Doi: 10.1177/0042098015603292

New York Subway Diagram. (n.d.). Retrieved November 2, 2018, from http://www.columbia.edu/~brennan/subway/

Nilsson, I. & Delmelle, E. Transit investments and neighborhood change: On the likelihood of change. *Journal of Transport Geography*, 66, 167-179. Doi: 10.1016/j.jtrangeo.2017.12.001

North York General Hospital - About Us. (n.d.). Retrieved October 29, 2018, from http://www.nygh.on.ca/Default.aspx?cid=959&lang=1

Obenauer, M. L. (1915). *Effect of minimum-wage determinations in Oregon.July, 1915.* Washington,. Retrieved from http://hdl.handle.net/2027/uc1.32106020105554

Population density in Toronto significantly less compared to other major cities: Fraser Institute - Toronto | Globalnews.ca. (2018, January 9). Retrieved January 2, 2019, from https://globalnews.ca/news/3954609/population-density-in-toronto-fraser-institute/

Qviström, M., & Bengtsson, J. (2015). What kind of transit-oriented development? using planning history to differentiate a model for sustainable development. *European Planning Studies, 23*(12), 2516-2534. doi:10.1080/09654313.2015.1016900

Raskin, R. (2010). Walking accessibility to bus rapid transit: does it affect property values? The case of Bogota, Colombia. *Transport Policy, 17, 72-84*. Doi: org/10.1016/j.tranpol.2009.11.002

Reynolds, M. (2012). A glamorous gentrification: Public art and urban redevelopment in Hollywood, California. *Journal of Urban Design, 17*(1), 101-115. doi:10.1080/13574809.2011.646246

Renne, J. L., Tolford, T., Hamidi, S., & Ewing, R. (2016). The cost and affordability paradox of transit-oriented development: A comparison of housing and transportation costs across transit-oriented development, hybrid and transit-adjacent development station typologies. *Housing Policy Debate, 26*(4-5), 819-834. doi:10.1080/10511482.2016.1193038

Riley D (2001) Taken for a Ride. The Centre for Land Policy Studies, London

Rosen, G., & Walks, A. (2014). Castles in Toronto's sky: Condo-ism as urban transformation. *Journal of Urban Affairs*, 37(3), 289-310. doi:10.1111/juaf.12140

Saxe, S., Cruickshank, H., Miller, E.J., 2016. The Sheppard Subway Line Toronto: changes in residential land use intensity 2001 to 2011. *Transportation Research Board 95th Annual Meeting*

Statistics Canada. 2017. *Toronto [Census metropolitan area], Ontario and Ontario [Province]* (table). *Census Profile*. 2016 Census. Statistics Canada Catalogue no. 98-316-X2016001. Ottawa. Released November 29, 2017. https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/prof/index.cfm?Lang=E (accessed February 26, 2019).

Sun, W., Zheng, S., & Wang, R. (2015). The capitalization of subway access in home value: A repeat-rentals model with supply constraints in Beijing. *Transportation Research Part A, 80*(Complete), 104-115. doi:10.1016/j.tra.2015.07.015

Syabri I (2011) The influence of railway station on residential property values-spatial hedonic approach the case of Serpong's Railway Station. J Teknik Sipil 18(3):291–300

Table 14.8 Average number of rooms per dwelling, by household size and by province and territory, 2006. (n.d.). Retrieved November 4, 2018, from https://www150.statcan.gc.ca/n1/pub/11-402-x/2011000/chap/fam/tbl/tbl08-eng.htm

TCRP, 2004. Transit-oriented development in the United States: experiences, Challenges, and Prospects. 3-35, 119–135, 321–345. http://www.trb.org/Main/Public/Blurbs/ 154989.aspx
Voith, R. (1993).

Toronto Transit Commission. (2016). Toronto Transit Commission subway ridership 2016. Retrieved from https://www.ttc.ca/PDF/Transit_Planning/Subway%20ridership%202016.pdf

Toronto Subway | The Canadian Encyclopedia. (n.d.). Retrieved September 23, 2018, from https://www.thecanadianencyclopedia.ca/en/article/toronto-subway

Zheng, S & Kahn, M. (2012) Does Government Investment in Local Public Goods Spur Gentrification? Evidence from Beijing. Real Estate Economics, 41(1), 1-28. doi: 10.1111/j.1540-6229.2012.00339.x

Zheng, S., Xu, Y., Zhang, X., & Wang, R. (2016). Transit development, consumer amenities and home values: Evidence from Beijing's subway neighborhoods. *Journal of Housing Economics, 33*(Complete), 22-33. doi:10.1016/j.jhe.2016.05.003

Zhao, L., & Shen, L. (2018). The impacts of rail transit on future urban land use development: A case study in Wuhan, china. *Transport Policy,* doi:10.1016/j.tranpol.2018.05.004

Zheng, S., Hu, X., Wang, J., & Wang, R. (2016). Subways near the subway: Rail transit and neighborhood catering businesses in Beijing. *Transport Policy,* doi:10.1016/j.tranpol.2016.