THE EFFECT OF A SUBWAY ON THE
SPATIAL DISTRIBUTION OF POPULATION

By Gordon W. Davies*

INTRODUCTION
The objective of the research described in this paper was to determine the effect of the
original Yonge Street subway line on the spatial distribution of population in
Metropolitan Toronto. The conventional view, that a subway has a substantial
effect on residential density, is based on the observation that large apartment blocks
are often located near the terminals of a subway line.1 This view may be incorrect,
however, because increased space near the subway line is often allocated to commer-
cial uses, parking and other terminal facilities for transit riders, and maintenance
and storage yards for the subway system itself.2

It is important to examine this relationship in order to forecast demand for subway
trips. In calculating expected future mass transit ridership, urban transport plans
typically project the spatial distribution of population and employment on the basis
of past trends, or of the desired form of the area as reflected in other planning
documents. These spatial patterns are then used to calculate mass transit use, given
some assumptions about modal split.3 If, however, residence and employment
densities adjust to the location of the subway line, future mass transit use may be
very different from that predicted in the original plan.4

The effect of a subway on the spatial distribution of population is also of interest
to those who believe that there are important externalities associated with the form
of urban development.5 The popular view is that expressway or road-oriented urban
areas are spatially less concentrated than mass transit-oriented areas. The implicit
comparison we make in this research is between a mass transit system and a road
(rather than expressway) system.

*Assistant Professor of Economics, University of Western Ontario. I thank R. A. L. Carter, E. F.
Haitez, J. R. Melvin, R. S. Woodward, and, especially, Mark Frankena for helpful comments on
earlier versions of this paper. The Research Division of the Metropolitan Toronto Planning Board
provided exact completion dates of all expressway and subway projects, and the Census Division of
Statistics Canada (formerly Dominion Bureau of Statistics) supplied unpublished land areas of all
Census tracts in Metropolitan Toronto in 1966. I acknowledge sole responsibility for the content of
this paper.

1A useful source of facts about the Toronto subway system is Toronto Transit Commission [16].
This booklet includes photographs of substantial residential development near four different subway
terminals [16: 30, 40, 61].

2The Davisville and Greenwood maintenance yards and shops occupy 9·7 and 31·48 acres of land,
respectively [16: 30, 43].

3For an example of this procedure, see Kates, Peat, Marwick [11], [12].

4See M. Frankena [8: 1–5], for this and other criticisms of urban transport plans.

5For a discussion of the potential for using transport infrastructure as an instrument of urban
development, see D. N. Nowlan and N. Nowlan [15: 52–57].
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A proposal for a subway in Toronto was originally formulated in 1910 and recommended again in 1912 and 1942. The present Yonge Street subway was proposed in 1945 and approved by a general municipal vote in January 1946. Construction on the line began in September 1949 and was completed in March 1954. This original line ran from Front Street at Union Station 1200 feet east to Yonge Street and then north to Eglington, for a total length of 4.6 miles6 (see Figure 1). No other subway lines were opened before the 1961 Census. The only expressway at the time of the 1961 Census was an east–west section of approximately 2.5 miles, opened in August 1958. Censuses of 1951, 1956, and 1961 give a substantial number of observations on the distribution of population by Census tracts [5], [6], [7]. We can therefore deduce the effect of the subway by comparing the distribution of population in 1956 and 1961, after the line was opened, with the distribution of population in 1951, before the line was opened.

We find that the subway line was originally constructed through a low density corridor, i.e., that density increased, ceteris paribus, with distance from the corridor through which the line was constructed. The same relationship between density and distance from the corridor is found to exist after the subway was constructed, but the effect is less pronounced in later years: this implies that construction of the subway altered the spatial form of the area. In addition, we find that tracts closer to the subway line normally experienced larger relative increases in population over time than tracts further out; this is consistent with the result described above. This last relationship is found for the periods 1951–56 and 1951–61, but is statistically significant only for the period 1951–61, probably because urban development or redevelopment takes time.

In the next section of the paper we specify two models to test the effect of the subway, and we formulate a number of hypotheses. The following two sections give the sources of data and results, respectively, and the paper concludes with a summary statement of the findings.

HYPOTHESES

We make two sets of tests of the effect of the subway line. For the first set of tests we formulate a model of residential densities and estimate it with cross-section data for 1951, 1956, and 1961. The object of this set of tests is to investigate the relationship between the location of the subway and population density at the time the line was originally constructed. This is important because the relationship between density and proximity to the subway in any subsequent year will be affected by the relationship in the year in which the subway was constructed. By examining the differences in the relationship between density and proximity to the subway in different years we can also deduce the effect that the subway had on densities. For the second set of tests, we formulate a model which explains the relative change in density (or population) by Census tract for 1951–56 and 1951–61 and we thus deduce the effect of the subway line directly.

The relationship between the amount of space (the inverse of density) which a

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Figure 1. Location of subway in Metropolitan Toronto, 1961.

household consumes and distance from the central business district can be derived from the journey-to-work model of residential location if the city is assumed to be topographically uniform and monocentric. In this model, a household with a given income trades off commuting costs represented by distance from the CBD with the amount of space consumed. Households with higher incomes locate further from the CBD and consume more land at lower rents. That is \( \partial (L/P) / \partial d > 0 \) where \( L \) is the amount of land at a given distance from the CBD, \( P \) is population and \( d \) is distance from the CBD. Since density is defined as \( P/L \), this implies \( \partial (P/L) / \partial d < 0 \), i.e., density declines with distance from the CBD.

The spatial distribution of population therefore depends partly on the size distribution of income. Specifically, it has been shown [2], [13] that, under other assumptions, density is a convex function of distance, i.e.,

\[
D = f(d)
\]

where \( f' < 0 \) and \( f'' < 0 \). This function was first estimated by Colin Clark [4] for a number of cities and has since been used extensively by others.\(^8\) Actual density along any given corridor may be uniformly above or below the density implied by this function. To determine whether density at a given distance from the CBD varies systematically with distance from the corridor through which the subway was constructed, we estimate three forms of the function

\[
D = g(d, d_e)
\]

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\(^7\)Two versions of the journey-to-work model are W. Alonso [1] and J. F. Kain [10].

\(^8\)For a survey of the literature on density gradients, see B. J. L. Berry, J. W. Simmons, and R. J. Tennant [3]. Two recent applications are D. Harrison, Jr. and J. F. Kain [9] and J. Yellin [17].
where $ds$ is the distance from the subway line. If $\partial D/\partial ds > 0$, density increases with distance from the subway line, which implies that the line was constructed through a low density corridor. The opposite is implied if $\partial D/\partial ds < 0$.

The reason why we experiment with a variety of functional forms is that there is no theoretical reason to select one form in preference to another, and that the effect of the subway may be sensitive to the particular functional form chosen. One possibility is

$$D = D_0 e^{\alpha d + \beta ds + \varepsilon}. \quad (3)$$

Given $ds$, however, this function implies that the slope of the gradient decreases at a constant rate as distance increases. If actual density is plotted against distance for Toronto, the data reveal a gradient which is, in fact, flatter closer to the centre of the city than at moderate distances. One functional form which gives a density gradient which is flatter near the centre of the city is

$$D = D_0 e^{\alpha d + \beta ds + \varepsilon} \quad (4)$$

which is the equation for a half bell curve when $\alpha < 0$. In natural logs, this is

$$\ln D = \ln D_0 + \alpha d + \beta ds + \varepsilon. \quad (5)$$

which is the first functional form we fit to the data.

The data also reveal a mild "cratering" of the density gradient near the CBD; that is, density first rising with distance and then decreasing. One functional which gives this cratering for appropriate values of the coefficients is

$$D = D_0 e^{\alpha d + \beta d^2 + \gamma ds + \varepsilon}. \quad (6)$$

For $\alpha, \beta < 0$ this function gives monotonically decreasing densities, and for $\alpha > 0$ and $\beta < 0$ it gives rising and then decreasing densities. Taking natural logs we have

$$\ln D = \ln D_0 + \alpha d + \beta d^2 + \gamma ds + \varepsilon. \quad (7)$$

which is the second functional form we fit to the data.

A third possibility is

$$D = D_0 e^{\alpha d + \beta d^2 + \gamma ds + \varepsilon}. \quad (8)$$

This function constrains density at the exact centre of the city to be zero, whereas the previous two do not. The natural log transformation of this is

$$\ln D = \ln D_0 + \alpha d + \beta \ln d + \gamma ds + \varepsilon. \quad (9)$$

which is the final functional form we test.

In the second set of experiments we examine the effect of the subway line on the change in the spatial distribution of population over time. We explain the relative change in population by Census tract by distance from the CBD, tract density in 1951, and distance from the subway line. That is,

$$T = h(d, D_{51}, ds) \quad (10)$$

where $T$ is the relative change in the population of the Census tract from the base year, and $D_{51}$ is Census tract density in 1951.

Given tract densities in the base year and distance from the subway line, the change in population by tract will normally increase with distance from the CBD because, as incomes rise over time, households will choose to locate further from the CBD (if we assume, as is normally done, that accessibility behaves as an inferior

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9This form is suggested by B. E. Newling [14].
good). There are no a priori or theoretical reasons to expect the relationship between the change in density and distance from the CBD to have any particular functional form; but it is reasonable to expect that the first derivative of the change in population with respect to distance from the CBD will eventually become negative as distance increases, because there will be some limit to the distance from the centre of the city at which households moving to the city or moving within the city will choose to live.

Given distance from the CBD and from the subway line, tracts with higher densities in the base year will experience lower relative increases in population, for two reasons. First, tracts with higher densities will have a lower potential for residential development. Second, as incomes rise over time, assuming that space is a normal good, there will be a shift in demand from high density use to low density use. Again, it is reasonable to expect that the inhibiting effect of density on residential development is nonlinear: specifically, that the second derivative of the change in population with respect to density is positive.

Our final hypothesis is that, given distance from the CBD and base-year densities, tracts closer to the subway line will experience a higher relative increase in population because of the savings in travel time resulting from proximity to the subway.

Summarising, for the second set of tests, we estimate the following functional form for 1951–56 and 1951–61:

$$T = \alpha + \beta d^2 + \gamma d^3 + \rho D_{51} + \lambda D_{251} + \delta d s + \epsilon.$$  

(11)

Our hypotheses are $\beta > 0$, $\gamma < 0$, $\rho < 0$, $\lambda > 0$, and $\delta < 0$.

**DATA**

The population by Census tract for the Toronto Census Metropolitan area is given in 1951, 1956, and 1961, and unpublished data on the land areas of the 1966 Census tracts are available from Statistics Canada. Since the boundaries of a large number of tracts are the same in 1951, 1956, 1961, and 1966, we can derive the land area in square miles for most tracts in 1951, 1956, and 1961. A few observations for each of these years are lost because the boundaries of some tracts have changed from Census to Census; most of these tracts are at the periphery of the area. Also, a few other tracts were deleted from the sample in each year. These include the Toronto Island Census tract and tracts in which most or all of the land use was atypical and institutional. For example, tracts containing mainly government buildings, campuses, airports and golf courses were deleted from the sample. We calculate Census tract gross residential density as total tract population divided by the total land area of the tract in square miles.10 There are 205 such observations in 1951, 285 in 1956, and 270 in 1961.

We calculate distance from the CBD as the straight-line distance from the (approximate) centre of the tract to a central point in the down-town area, which is taken to be the intersection of Yonge and King Streets. This variable was calculated

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10 The denominator in gross residential density is total tract land area. Net residential density is defined as tract population divided by the area of land in the tract zoned for residential use.

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in miles from scale maps of the Metropolitan area. Distance from the subway line was calculated as the minimum distance between the subway line and the (approximate) centre of the Census tract. This variable is also expressed in miles.\textsuperscript{11}

In the second set of tests, we use the relative change in gross residential density between 1951 and 1956 and between 1951 and 1961, distance from the CBD, and distance from the subway line. The relative change in density by Census tract is

$$\frac{P_{t+1,t} - P_{t,t}}{A_t}$$

where $P_{t,t}$ is the population of tract $i$ in period $t$ and $A_t$ is the total land area in square miles of tract $i$. This reduces to

$$T_i = \frac{P_{t+1,t} - P_{t,t}}{P_{t,t}}$$

which is the relative change in population by Census tract. There are 208 of these observations common to 1951, 1956, and 1961.\textsuperscript{12} The distance variables for this set of tests are the same as for the first set.

In the next section we consider the results for the two sets of tests.

RESULTS

The three functional forms estimated for each of the years 1951, 1956, and 1961 are:

$$\ln D = \ln D_0 + ad + \beta ds + \varepsilon$$  \hspace{1cm} (5)

$$\ln D = \ln D_0 + ad + \beta d^2 + \gamma ds + \varepsilon$$  \hspace{1cm} (7)

and

$$\ln D = \ln D_0 + ad + \beta ln d + \gamma ds + \varepsilon.$$  \hspace{1cm} (9)

The results for the regression for 1951 using the first functional form are given in line 1 of Table I. All the coefficients are significant at least at the 2.5 per cent significance level, the coefficient on $d^2$ is of the hypothesised sign, and the coefficient on $ds$ is positive, indicating that the subway was constructed through a relatively low density corridor. Comparable regressions for 1956 and 1961 are shown in lines 4 and 7, respectively, of Table I. Again, all the coefficients are highly significant, the coefficient on $d^2$ is of the hypothesised sign, and the coefficient on $ds$ is positive.

Results of regressions using the second functional form are shown for 1951, 1956, and 1961 in lines 2, 5, and 8, respectively, of Table I. All the coefficients in these regressions are significant at least at the one per cent level, except the coefficient on $d^2$ for 1951, which is insignificant. The coefficients on $d$ and $d^2$ are all negative,

\textsuperscript{11}We use distance from the subway line rather than distance from the nearest subway terminal for convenience. Subway terminals are very close together, so little distortion is introduced by this simplification.

\textsuperscript{12}The sample size for this set of tests is 208, as opposed to 205 for 1951 in the first set of tests, because we do not need tract land areas for the second set. There are fewer tracts which have land areas common to 1951 and 1956 (the only year for which land areas are available) than there are tracts which have common boundaries in 1951, 1956, and 1961.
**Table I**


<table>
<thead>
<tr>
<th>Line</th>
<th>Year</th>
<th>Functional Form</th>
<th>Constant</th>
<th>$d$</th>
<th>$d^2$</th>
<th>$ln,d$</th>
<th>$ds$</th>
<th>Number of Observations</th>
<th>$R^2$</th>
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<tbody>
<tr>
<td>1</td>
<td>1951</td>
<td>1</td>
<td>9.954</td>
<td>-0.0318</td>
<td>0.107</td>
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<tr>
<td></td>
<td></td>
<td>(95.864)</td>
<td>10.698</td>
<td>-0.360</td>
<td>-0.00765</td>
<td>0.181</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2</td>
<td>1951</td>
<td>2</td>
<td>(55.498)</td>
<td>(-4.503)</td>
<td>(-1.151)</td>
<td>1.003</td>
<td>0.201</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(55.498)</td>
<td>10.624</td>
<td>-0.699</td>
<td>0.00073</td>
<td>0.201</td>
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<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>1951</td>
<td>3</td>
<td>(83.057)</td>
<td>(-9.770)</td>
<td>(4.649)</td>
<td>(4.480)</td>
<td>205</td>
<td>0.507</td>
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<tr>
<td></td>
<td></td>
<td>(83.057)</td>
<td>9.850</td>
<td>-0.0342</td>
<td>0.125</td>
<td></td>
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<tr>
<td>4</td>
<td>1956</td>
<td>1</td>
<td>(79.350)</td>
<td>(-9.340)</td>
<td>(2.478)</td>
<td>285</td>
<td>0.467</td>
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<tr>
<td></td>
<td></td>
<td>(79.350)</td>
<td>10.285</td>
<td>-0.197</td>
<td>-0.0230</td>
<td>0.176</td>
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<tr>
<td>5</td>
<td>1956</td>
<td>2</td>
<td>(46.131)</td>
<td>(-2.338)</td>
<td>(-3.822)</td>
<td>1.309</td>
<td>0.186</td>
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<td>(46.131)</td>
<td>10.515</td>
<td>-0.771</td>
<td>0.00230</td>
<td>0.186</td>
<td></td>
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<tr>
<td>6</td>
<td>1956</td>
<td>3</td>
<td>(68.166)</td>
<td>(-10.510)</td>
<td>(5.843)</td>
<td>(3.535)</td>
<td>285</td>
<td>0.510</td>
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<td>(68.166)</td>
<td>10.104</td>
<td>-0.0237</td>
<td>0.0583</td>
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<tr>
<td>7</td>
<td>1961</td>
<td>1</td>
<td>(152.471)</td>
<td>(-12.445)</td>
<td>(2.193)</td>
<td>270</td>
<td>0.663</td>
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<td>(152.471)</td>
<td>10.538</td>
<td>-0.189</td>
<td>-0.0129</td>
<td>0.103</td>
<td></td>
<td></td>
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<tr>
<td>8</td>
<td>1961</td>
<td>2</td>
<td>(87.544)</td>
<td>(-4.260)</td>
<td>(-4.104)</td>
<td>(3.707)</td>
<td>270</td>
<td>0.685</td>
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<tr>
<td></td>
<td></td>
<td>(87.544)</td>
<td>10.617</td>
<td>-0.508</td>
<td>0.755</td>
<td>0.107</td>
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<td></td>
</tr>
<tr>
<td>9</td>
<td>1961</td>
<td>3</td>
<td>(111.724)</td>
<td>(-11.924)</td>
<td>(5.044)</td>
<td>(3.894)</td>
<td>270</td>
<td>0.694</td>
<td></td>
</tr>
</tbody>
</table>

(t values in parentheses)
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**Table II**

*Relative Change in Population by Census Tract: 1951–56 and 1951–61*

<table>
<thead>
<tr>
<th>Period</th>
<th>Constant</th>
<th>$d^2$</th>
<th>$d^3$</th>
<th>$D_{51} \cdot 10^3$</th>
<th>$D_{251} \cdot 10^3$</th>
<th>$ds$</th>
<th>Number of Observations</th>
<th>$R^2$</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951–56</td>
<td>2.383</td>
<td>(3.319)</td>
<td>(4.791)</td>
<td>(4.590)</td>
<td>(−0.157)</td>
<td>208</td>
<td>0.360</td>
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</tr>
<tr>
<td>1951–61</td>
<td>1.433</td>
<td>(3.261)</td>
<td>(4.915)</td>
<td>(3.245)</td>
<td>(−2.072)</td>
<td>208</td>
<td>0.329</td>
<td></td>
</tr>
</tbody>
</table>

($t$ values in parentheses)

which implies a monotonically decreasing gradient. The coefficients on $ds$ are again positive and are significant at the 0.005 level.

The results for the third functional form are shown in lines 3, 6, and 9 of Table I. In this case, all the coefficients are significant at least at the 0.005 level. The coefficients on $d$ and the log of $d$ imply that density first rises with distance and then falls. This result is imposed by the functional form which, as noted, constrains density to be zero at the city centre. The coefficients on $ds$ are all positive.

The $R^2$ values for these equations range from 0.403 to 0.694, indicating quite a close fit to the data, particularly in view of the fact that we are using cross-section data with gross residential density as the dependent variable.

On the basis of these results for 1951 we can conclude that the original subway line was constructed through a corridor of relatively low residential density. For the second two functional forms, the coefficient on $ds$ declines in the two subsequent years; for the first functional form it rises slightly from 0.107 in 1951 to 0.125 in 1956 and decreases to 0.0583 in 1961. The implication is that, although the subway was originally constructed through a low density corridor, the effect of the line was to increase densities for tracts near the line in subsequent years, even though the relationship between density and distance from the line remained positive up to seven years after its construction. The results are discussed in more detail in the final section of the paper.

An alternative specification of the subway variable was estimated with the data. The existence of the subway line may cause lower densities for census tracts near to it but higher densities further out, i.e., $\partial D/\partial ds > 0$ for $d < d$ and $\partial D/\partial ds < 0$ for $d > d$. These hypotheses are formulated to take account of the possibility of more land near the subway being used for commercial purposes, with a net positive effect on density for distances beyond this region. The test was made by introducing $ds$ and $d^2$ together in the equations. The combined hypotheses are not supported by the results for any of the functional forms, and the results of these tests do not contradict those given in Table I.

For the next set of tests we regress the relative change in density on a constant, $d^2$, $d^3$, $D_{51}$, $D_{251}$ and $ds$. The results for this regression for 1951–56 and 1951–61 are shown in Table II. The $R^2$ values of these equations are reasonable for cross-section
data, and all the coefficients are of the hypothesised signs and significant at a variety of levels, except for the coefficient on $d_s$, which is insignificant in the first regression. The second regression in Table II shows that tracts nearer the subway line normally experienced higher relative changes in population.

The results for the two sets of tests are therefore consistent and imply that the subway was originally constructed through a low density corridor and that construction of the line in 1954 resulted in higher densities closer to the location of the line, although this effect was significant after seven years but not after two, most likely because development or redevelopment requires time.

**SUMMARY**

In this section we consolidate the results of the tests described above and consider their implications. Table III gives the elasticities of density with respect to distance from the subway for each of the years 1951, 1956, and 1961 for the three functional forms and the elasticity of the relative change in population with respect to distance from the subway for 1951–56 and 1951–61.13

Considering the first set of elasticities, we note that density uniformly increases with distance from the subway. This implies that the subway was located in a corridor which had lower densities than other corridors. This finding is not necessarily in any way criticism of the choice of location for the subway. Residential land use which is of lower than average density may imply commercial land use which is of higher than average density. With subsequent adjustments in the spatial distribution of population and employment, eventual transit ridership may justify locating the subway through a corridor which is initially predominantly commercial.

Although these elasticities are all positive they are, with one exception, smaller in later years. For the first functional form the elasticity increases from 0.107 in 1951 to 0.125 in 1956 and decreases to 0.0583 in 1961. For the second and third functional forms the elasticities decrease by approximately the same relative amount between 1951 and 1956 and between 1956 and 1961. Since the positive relationship between density and distance from the subway is smaller in later years, we can infer, as noted, that the subway exerted a net positive influence on residential location decisions, i.e., that the increased use of land near the subway for commercial purposes, parking and other terminal facilities for transit riders, and maintenance and storage yards for the transit system was more than offset by an increased use of land for residential purposes, or a higher density in residential land use, or both. (An increased use of land both for commercial and for residential purposes is possible if there is undeveloped land available before the subway was constructed.)

Although our estimates of the elasticities vary from 0.107 to 0.201, it is true in all cases that they decline by about 50 per cent between 1951 and 1961. In other words, the results show that construction of the subway line resulted in a percentage increase

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13The elasticity of density with respect to distance from the subway is the same as the coefficient on $d_s$. The elasticity of the relative change in population is calculated at a distance of three miles from the centre of the city and a relative change in population of 0.10, which is typical for tracts between 1.5 and 2.5 miles from the subway.
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TABLE III

Elasticities of Density and Change in Population with respect to Distance from Subway

<table>
<thead>
<tr>
<th>Year</th>
<th>Functional Form</th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
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<tr>
<td>1951</td>
<td>1</td>
<td>0.107</td>
</tr>
<tr>
<td>1956</td>
<td>1</td>
<td>0.125</td>
</tr>
<tr>
<td>1961</td>
<td>1</td>
<td>0.083</td>
</tr>
<tr>
<td>1951</td>
<td>2</td>
<td>0.181</td>
</tr>
<tr>
<td>1956</td>
<td>2</td>
<td>0.176</td>
</tr>
<tr>
<td>1961</td>
<td>2</td>
<td>0.103</td>
</tr>
<tr>
<td>1951</td>
<td>3</td>
<td>0.201</td>
</tr>
<tr>
<td>1956</td>
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<td>0.186</td>
</tr>
<tr>
<td>1961</td>
<td>3</td>
<td>0.107</td>
</tr>
</tbody>
</table>

Relative Change in Population
<table>
<thead>
<tr>
<th>Year</th>
<th></th>
<th>Elasticity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1951–56</td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>1951–61</td>
<td></td>
<td>–</td>
</tr>
</tbody>
</table>

in density for a one per cent decrease in distance from the subway which was only half as great in 1961 as in 1951.

The second set of elasticities allows a better assessment of the magnitude of the effect of the subway on the spatial distribution of population. The elasticity with respect to distance from the subway is —0.113 for the relative change in population between 1951 and 1956 and —3.66 between 1951 and 1961. These results are consistent with the previous ones, since they mean that tracts closer to the subway line experienced relatively larger increases in population than tracts further out. Between 1951 and 1956, the absolute size of the effect (which is not statistically significant) is small, but between 1951 and 1961 it is fairly large. The interpretation is that construction of the line in 1954 resulted in a relative increase in the population of a Census tract which was larger by about 3.7 per cent for each decrease of one per cent in the distance of the tract from the subway line. The fact that the relationship is significant after seven years but not after two is explained by the observation that development or redevelopment of urban land is a protracted process which involves land assembly, possibly rezoning, construction, and the relocation of households and individuals.

A suggested extension of the research described in this paper would be to evaluate the effects of subsequent increases in subway mileage, construction of extensive expressway facilities, and introduction of the Government of Ontario commuter railway. All these changes in transport infrastructure were introduced in Metropolitan Toronto between 1961 and 1971 and probably exerted important influences on the spatial form of the area.
REFERENCES


