THE POST-GENTRIFICATION TRAJECTORIES OF TORONTO CENSUS TRACTS, 1971 TO 2001

By

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ABSTRACT

This thesis characterizes the changes that occur in Toronto neighbourhoods after gentrification takes place, and locates gentrification and ensuing changes within a broader theoretical framework of urban change. The findings show that the changes that occur during gentrification and afterwards are in most ways consistent with the stage model of gentrification. Trends observed during the post-gentrification period are often continuations of gentrification itself. Gentrification as described by the stage model was found to represent the leading edge in several trends at the regional level. Incomes and housing costs increased in central areas relative to peripheral areas between 1971 and 2001. The relative value placed on commuting time may have increased relative to the value placed on housing consumption in location decisions. The density gradient declined despite this, possibly because it is influenced by several factors other than income growth. The findings are relevant to planning policy for two reasons: 1) continuing gentrification may lead to a shortage of affordable housing in central areas; and 2) gentrification may lead to inefficient distributions of density throughout the region resulting in unnecessarily high expenditures on commuting.

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1 Introduction

This thesis characterizes the changes that occur in neighbourhoods after gentrification has taken place (post-gentrification), and locates gentrification within a broader theoretical framework of urban change. Questions that are answered include:

1) What happens after a neighbourhood goes through the gentrification process?
2) How does an already gentrified neighbourhood compare to a gentrifying neighbourhood?
3) Are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process?
4) Do the effects of gentrification dissipate over time, or are they instead part of a lasting regime of change evidenced across a region?

Ley's definition of gentrification is adopted. Neighbourhoods that undergo the fastest increase in social status over a decade are said to have gentrified. Social status is measured by proportion of degree holders and proportion of employment in the quaternary sector.

The stage model describes gentrification in terms of a sequence of events that unfold in a generalized gentrifying neighbourhood. Events have to do with the characteristics and preferences of residents moving into a neighbourhood, the changes they initiate in their surroundings and the associated risk of investment in that neighbourhood. In general, incomes and dwelling values in a neighbourhood increase over time, coinciding with the replacement of initial residents by gentrifiers. Although

specific gentrifying neighbourhoods do not strictly conform to all tenets of the stage model, it is valuable as a guide to the process, providing theoretical standards around which to organize and analyze the data.

2 Theoretical Context

In order to determine if the effects of gentrification dissipate over time or if gentrification is part of a lasting regime of change evidenced across the region, a broad theoretical framework is required. The vehicle for this examination is neo-classical economic theory in the form of the monocentric city model.

The model shows that the slope of the housing price curve is negative and varies positively with the cost of commuting and negatively with the quantity of housing consumed. Thus, the location pattern of residents and the slope of the housing price curve both depend on whether the value of commuting time or housing consumption increase more with income growth (Anas, Arnott & Small 1998).

Mills assumed that increased housing consumption is the dominant result of income growth. This assumption leads to the expectation that income should vary positively with distance from the CBD; income growth should lead to a flattening of the housing price curve; and the density gradient is reduced over time. However, there is debate as to the validity of this assumption. Glaeser et al (2006) found that the effect of increased commute costs dominates the effect of increased consumption of housing in household location decisions. It is possible that demographic changes and other lifestyle changes after 1970 increased the value placed on commuting time relative to the value placed on consumption of housing (Alonso 1982). If it is assumed that the value of commuting time is dominant in location decisions, income will vary negatively with

distance from the CBD; increased income will lead to a steepening of the housing price function; and there will be some upward pressure on the density gradient. However, the density gradient is responsive to factors other than income growth, and is expected to decline regardless of the dominant effect of income growth.

3 Methods

The analysis was conducted using 16 explanatory variables that have roles in two theoretical explanations of gentrification – the stage model and the monocentric city model. Empirical support for these explanations was tested by tracing the variables' absolute and relative change over time.

Data from 1971, 1981, 1991 and 2001 was analyzed at the census tract level. For consistency, 1981 tract boundaries were used in all census years. The inner city was defined as having at least two times the CMA average proportion of pre-1946 dwellings. Gentrifying tracts were defined for 1971-1981 (G70 tracts) and 1981-1991 (G80 tracts) using Ley's method. Elite tracts were defined based on reputation and high income levels that were sustained over time.

1971 values of the explanatory variables and proportional change over the following three decades were found for the G70, G80 and elite tracts, as well as the inner city and the CMA. Multiple regression analysis was used to examine change in individual variables across tract types. Two sets of regressions are presented. The first set is cross-sectional and indicates differentiation of tract sub-groups, given distance. The second set of regressions uses ratios, and indicates significant differentiation in the *rate of change* of a dependent variable in tract sub-groups, holding distance constant. Linear discriminant function analysis was used to look at the effects of all the variables

taken together. Discriminant analysis determines which variables are the best indicators of group identity, and in our case which variables help the most to distinguish between the tracts that gentrified in the 1970s and the other tracts.

4 Analysis

Empirical evidence is compared to theoretical expectations of the stage model of gentrification and the monocentric city model in order to answer four research questions.

Status change and displacement occurred faster in gentrifying areas than in the inner city or the CMA as a whole. These trends were found to continue after gentrification. Changes during gentrification and the period after were consistent with expectations provided by the stage model.

Gentrification as defined by social status change was accompanied by an increase of smaller households, non-family households and 25 to 39 year olds who moved out afterwards. It was also accompanied by the displacement of immigrants, which persisted throughout gentrification and the decades that followed. Average household size decreased across the region during the study period, and smaller households became more concentrated at the city's centre. This raised dwelling values at the centre relative to the periphery. Further, immigrants became less concentrated at the centre during the study period. The region-wide trend of decentralization of immigrants was largely the result of their rapid departure from gentrifying and elite neighbourhoods.

A major change occurred in Toronto's housing price and income profiles between 1971 and 2001. The classic prediction of the monocentric city model accurately depicted the form of the city in 1971 – incomes grew with distance from the CBD. As time went on this prediction became increasingly less accurate as individual incomes in the inner

city and the suburbs equalized. The new income distribution was matched by increases in central relative to suburban housing prices. Changes consistent with the stage model in gentrifying and elite neighbourhoods to the housing price and income increases in the inner city relative to the CMA.

While it was found that there was redevelopment and a move towards more ownership in gentrifying neighbourhoods, as predicted by the stage model, G70 and G80 census tracts did not have a leading role in these changes. In fact, increases in density and ownership were more pronounced outside of the inner city between 1971 and 2001, causing the density profile to flatten while it shifted upwards due to population growth.

5 Conclusions

Gentrification in Toronto between 1971 and 2001 was characterized by faster than average increases in status, incomes, housing costs, displacement and demographic change, an average amount of redevelopment, and declining population density. At the end of gentrification, neighbourhoods were highly differentiated from the rest of the city. The period after gentrification was also characterized by increasing status levels, incomes and housing costs, as well as displacement and redevelopment, although rates of increase were not always greater in gentrifying neighbourhoods than in other areas. Some of the differences resulting from gentrification were found to be expanded afterwards, while others were maintained. Some differences were notably absent. In only one respect did a trend characteristic of gentrification later reverse its course.

The changes during gentrification and afterwards followed the pattern set forth in the stage model. Since similar changes also occurred in the inner city and the region as a whole, consistency with theoretical expectations is best shown by change in gentrifying

tracts *relative* to the rest of the city. Income growth and displacement proceeded faster than average during gentrification and afterwards. Status levels and housing costs grew faster than average during gentrification, but not afterwards. Change in the built environment took place at average rates both during and after gentrification. Demographic change occurred during gentrification and then receded after. Therefore, when relative change is considered, conformity of our findings with the stage model is less precise. Differentiation between gentrified and ungentrified neighbourhoods does not increase in some variables after gentrification. This may be the result of changes consistent with the stage model beginning to occur in other sets of inner city neighbourhoods – the next loci for gentrification.

Observed change in income-distance functions and housing cost-distance functions between 1971 and 2001 lend support to the possibility that traditional assumptions regarding the effect of income on location are invalid. Income growth results in greater commute times and greater consumption of housing. Increased commute time may now dominate the increased consumption of housing in the location decisions of households. This may be the result of important demographic and lifestyle factors that changed the characteristics of the average household after 1970.

It was found that the effects of gentrification did not fade over time, but were instead part of a lasting regime of change evidenced across the region. Gentrification was not influential in urban structural change. Gentrified tracts were part of the same pattern of decentralization as the rest of the city. With regard to the distribution of incomes and housing prices, however, gentrification was found to be representative of a

new pattern. Successive changes occurring in one group of neighbourhoods after another over time led to a steepening of the region-wide income and housing price profiles.

This thesis supports the idea that gentrification will continue throughout the inner city over time. This has policy implications for the distribution of affordable housing within the Toronto CMA. Gentrification may lead to a shortage of affordable housing in areas well-served by public services such as transit. These are often heavily relied upon by low income residents. Extensive gentrification may also have policy implications regarding the efficient distribution of density across the region. Gentrification can lead to entrenched inflections in the density-distance profile, which result in unnecessary commuting expenditures.

CHAPTER 1: INTRODUCTION

Introduction

Few aspects of urban change generate a discourse as intense as that inspired by the process of gentrification. Although gentrification is a highly contentious issue in social, economic and political spheres, our understanding of its impacts is still limited. Consensus on the causes of the process remains equally elusive, perhaps because academics from a variety of backgrounds have studied the phenomenon.

This thesis unravels a small part of the gentrification mystery. It characterizes the changes that occur in neighbourhoods after gentrification (post-gentrification), and locates the process within a broader theoretical framework of urban change. Some questions that are answered include:

1) What happens after a neighbourhood goes through the gentrification process?
2) How does an already gentrified neighbourhood compare to a gentrifying neighbourhood?
3) Are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process?
4) Do the effects of gentrification dissipate over time, or are they instead part of a lasting regime of change evidenced across a region?

To answer these questions, this thesis uses census data to assess gentrification related change at the neighbourhood, inner city and regional levels between 1971 and 2001, in Toronto, Canada.[1]

The remainder of this chapter describes gentrification. It touches upon the debate regarding a universal definition of the process, and provides a thorough description of the stage model. The next chapter discusses the broad theoretical framework within which we place gentrification and ensuing changes. Chapter 3 describes the method used to analyze data, Chapter 4 presents the analysis and findings, and Chapter 5, the conclusions.

Definition of Gentrification

Gentrification has been the subject of considerable academic debate since Ruth Glass coined the term in 1964. Discussion has taken place in economic, geographical and social circles, amongst others. Despite this (or expressly for this reason), consensus on what defines gentrification has not been reached. One of the better definitions allows insight into the numerous issues preventing agreement on a universal definition:

> "Simultaneously a physical, economic, social and cultural phenomenon. Gentrification commonly involves the invasion by middle-class or higher-income groups of previously working-class neighbourhoods or multi-occupied 'twilight areas' and the replacement or displacement of many of the original occupants. It involves the physical renovation or rehabilitation of what was frequently a highly deteriorated housing stock and it's upgrading to meet the requirements of its new owners. In the process, housing in the areas affected, both renovated and unrenovated, undergoes a significant price appreciation. Such a process of neighbourhood transition commonly involves a degree of tenure transformation from renting to owning." (Hamnett, 1991).

[1] Throughout this study, neighbourhoods are operationalized as census tracts, while the "region" refers to the Toronto Census Metropolitan Area (CMA).

Contention regarding the definition revolves around two issues. The first is uncertainty regarding which aspect of the process characterizes "gentrification": the displacement of one social group by another, or renovation and replacement of the physical dwelling stock. The second controversy concerns where gentrification takes place: can it only occur in neighbourhoods with old housing stock and very poor residents or can it occur in any neighbourhood, as long as changes are fast enough?

It is debatable whether the process of upgrading older housing stock can be separated from its sister process of redevelopment within older districts. Most gentrifying districts undergo both renovation and redevelopment (Ley, 1991). However, it may be useful to separate the two processes. Meligrana and Skaburskis (2005) employed this tactic in their examination of the extent, location and profiles of gentrification in Canadian cities between 1981 and 2001. They used a restrictive definition which included the renewal of old housing stock but excluded redevelopment, and focused on the displacement of lower-income households as opposed to social change in general. Ley (1986, 1988, 1991, 1993, 1996) on the other hand used a broader definition of gentrification, simplifying the process to become "an upward movement in the social status of a census tract" (Ley, 1993). Ley calculated a social status indicator for census tracts in each census year by taking the mean of: 1) the proportion of tract population aged 15 and over holding a university degree; and 2) the proportion of the tract's labour force employed in the quaternary sector of administrative, managerial, professional and technical jobs (Ley, 1993). Change in the social status index between census years was used to calculate a gentrification index. The tracts with the highest gentrification indexes were said to have undergone the most gentrification.

This thesis considers gentrification as a broad process of social upgrading. This decision was made for several reasons. Gentrification is the replacement of one social group by another. The physical environment plays a role in attracting gentrifiers and undergoes specific changes as gentrification proceeds, however, it is the replacement of one social group with another upon which all other changes hinge. Renovation and redevelopment are both symptoms of social change and must be considered in unison. To exclude redevelopment from the process would be to study only half of the phenomenon. Further, the same process may occur in tracts with varying status and income levels. This is in keeping with Smith (1996, p. 67), who describes neighbourhood devalorization as a pre-requisite for gentrification, "although the process need not occur fully for gentrification to ensue", and Beauregard (1990, p. 871), who asserts that once the process is begun, it does not necessarily continue until a neighbourhood is totally gentrified.

Causes of Gentrification

The discourse on gentrification does not limit itself to defining the process. The most heated debate has centred around the causes of the process. Opinions became increasingly polarized during the 1980s and 1990s when two explanations garnered most of the attention: the demand side argument, championed by David Ley, and the supply side argument, put forth most forcefully by Neil Smith.

Ley (1981) argues that gentrification is the result of the shift to a post-industrial economy. He associates the process with a corresponding increase in central service sector employment (in the CBD), a decline in central manufacturing, and the preference

of a new middle class for residential locations in the inner city. Thus, it is the consumer's housing choice that leads to gentrification and social change in certain inner city districts.

Smith (1979/96) argues that because capital flows to the highest rate of return, the true explanation of gentrification lies in the movement of capital within urban areas. He maintains that demand side theories take for granted a stock of areas ripe for gentrification. According to Smith, the highest rates of return in North American cities lay in producing housing at the periphery for most of the twentieth century. As capital flowed to the ever more distant edge of the city, many older inner city neighbourhoods went into decline. Smith asserts that the decline was caused by capital devalorization: the flow of capital out of inner city areas to the periphery, where higher returns were available. As capital flowed out of inner city neighbourhoods, the capitalized ground rent declined steadily. Simultaneously, the city's expansion led to an increase in the potential ground rent (at highest and best use) in these same neighbourhoods. Smith argues that gentrification occurs when the gap between capitalized and potential ground rent is wide enough that developers can afford to pay all of the costs of redevelopment[2] and still make a return consistent with new construction in the suburbs. Smith predicts that rent gaps should flow wave-like from the centre of the city; their arrival marked by devalorization, redevelopment following in their wake. Thus, it is the developer's choice to start the gentrification process, for there is money to be made in the renovation, redevelopment and marketing of properties in the neighbourhood.

These opposing explanations of gentrification have gone largely unreconciled, although some attempts to find common ground between the two have been made (Hamnett 1991). Regardless of the diverging views that attempt to explain gentrification,

[2] over and above the costs of green field development at the city's edge

it is generally acknowledged that the process has occurred in numerous cities around the world in the post-war period (Ley 1996; Smith 1996). The next section describes the dominant theoretical formulation of gentrification.

Stage Model of Gentrification

The stage model synthesizes the work of numerous gentrification researchers over the past several decades, and generalizes the process into a predictable sequence of events. It provides the framework to explore the third research question: are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process?

The model describes gentrification as a sequence of stages and defines the process in terms of changes in the type of person moving into the neighbourhood and the risk profile of investment in that neighbourhood. No specific incidence of gentrification is expected to adhere fully to the tenets of the model. After all, gentrification is a "chaotic concept comprising a variety of prior conditions, participants, outcomes and processes" (Beauregard 1990, p. 855). Despite the varied nature of the process due to locational, temporal and other factors, generalizable features still exist (Lees 2003). The stage model is a valuable guide which provides theoretical expectations around which to organize and analyze the data.

This thesis uses a two stage model of gentrification. While descriptions in other academic works sometimes use four or five stages, this can force the arbitrary placement of trends and events into one stage or another, causing the model to lose some of its generality. This reduces the applicability of the model to incidences of gentrification that may occur in radically different geographical and temporal environments.

The Early Stages of Gentrification

In the early stages, gentrification is typified by changing social status, small-scale renovation and the "tidying" of properties in districts that frequently have experienced a certain amount of devalorization (Smith 1979/96). The process begins with an influx of marginal members of the middle class: students, artists and certain professionals who generally have liberal or radical lifestyles and politics (Ley 1991, p. 332). These "pioneer" gentrifiers have low economic capital but high cultural capital which they invest in the building stock, developing sweat equity and effectively exchanging cultural for economic capital (Ley 2003, p. 2540). The presence of pioneer gentrifiers prompts the arrival of specialized retail and service outlets which cater to the middle class. As the image of the neighbourhood develops, it becomes an increasingly desirable destination for leisure visits, as well as a potential location for middle-class movers seeking a new home. A transition has begun which continues indefinitely: movers into the neighbourhood increasingly tend towards greater economic capital and lesser cultural capital (Ley 2003). Incomes begin to increase as gentrifiers displace former residents and dwelling values increase as the reputation of the neighbourhood grows. However, risk-averse households and investment capital generally steer clear of gentrifying neighbourhoods until artists, non-traditional households or other urban pioneers have proven the area's investment potential (Wyly & Hammel 2006, p. 725).

The Late Stages of Gentrification

The arrival and activities of early stage gentrifiers change the social mix, physical environment and reputation of gentrifying neighbourhoods (Ley 1991, p. 332). Over time, those moving into the neighbourhood tend to be increasingly "established" and

more risk averse than their predecessors. Incomes and dwelling values continue to rise, and the social diversity that may have attracted pioneer gentrifiers is less valued, and increasingly so as a result of continued displacement (Ley 1991, p. 332). The neighbourhood has proven its market potential (and perhaps the existence of a rent gap), and de-conversion of housing from rental stock is likely to occur, pushing densities downwards (Ley 1981). Eventually, the neighbourhood is deemed an acceptable risk for investment by developers and investors, following which infill and selective redevelopment may occur (Meligrana & Skaburskis 2005, p. 1572). At the same time, residents of the gentrifying neighbourhood may attempt to inhibit neighbourhood change. This phenomenon, exercised through collective political influence exerted at the municipal level, serves to increase the exclusivity of the neighbourhood (Filion 1991).

Although prima facie it may appear to be so, gentrifiers are not a homogeneous group, and different types of households colonize gentrifying neighbourhoods at different stages of the process (Lees 2003, p. 398). In the late stages of gentrification, pioneer gentrifiers move on to new, more "authentic" locales, the cycle of change that they commenced having led to a loss of aesthetic appeal due to commercialization (Ley 2003, p.2534). They may also be priced out of the neighbourhood as dwelling values continue to rise. Lees identifies very late stage gentrification with the example of districts that gentrified during the 1970s and were re-gentrified in the 1990s by exceptionally wealthy employees of the financial services industry (Lees 2003, p. 398). These re-gentrified neighbourhoods may approach elite neighbourhoods in terms of income and housing values.

Discussion

The stage model sets expectations regarding gentrification in Toronto between 1971 and 2001. It describes changes in a gentrifying neighbourhood in terms of a series of discrete stages, although in reality these stages model a continuous process. Throughout gentrification, the displacement of initial residents (often characterized by low education, high unemployment and a high proportion of immigrants) should be continuous, expanding to include the displacement of early gentrifiers in the latest stages. As displacement progresses, incomes, housing costs and social status (as measured by education and occupation) should rise, and owner occupancy of dwellings is expected to increase. Densities are also expected to increase, but the rate of this growth depends on the interplay between redevelopment and infilling, anti-development attitudes and de-conversion of housing from rental tenure. The continuous nature of the process suggests that the changes associated with gentrification may continue indefinitely in a given neighbourhood.

The rate, extent and exact form of gentrification all depend on many geographical and contextual factors which vary with location and time (Lees 2003, p. 391; Beauregard 1990, p. 871) and may subtly change the functioning of the stage model. For example, the involvement of the state has always been an important factor in urban change – Ley calls it "the most powerful single actor in the construction of the contemporary inner city" (Ley 1991, p. 340). However, this involvement changes with the political climate. During the 1990s, the expansion of neoliberalism led governments to cut interventionist actions such as subsidized housing in favour of free market solutions for urban ailments (Lees 2003; Wyly & Hammel 1999). As a result, gentrification is frequently included as

an aspect of public policy (often as an element of environmentally beneficial planning strategies). Despite the changing nature of gentrification, it is likely that the stage model is still an effective guide: Meligrana and Skaburskis found that "the underlying attributes that make a neighbourhood vulnerable to gentrification have not changed over the past few decades" (2005, p. 1589).

Summary

This thesis explores changes in the post-gentrification period, and seeks to answer several questions: 1) What happens after a neighbourhood goes through the gentrification process? 2) How does an already gentrified neighbourhood compare to a gentrifying neighbourhood? 3) Are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process? 4) Do the effects of gentrification dissipate over time, or are they instead part of a lasting regime of change evidenced across a region?

There is no consensus on the definition or causes of gentrification and as such a clear delineation of this study's approach is required to place it correctly within the context of the literature. Ley's inclusive definition of gentrification as defined by social status change is adopted because using a narrower definition would result in consideration of only some outcomes of a broad and varied process (class change in the inner city). The study is non-partisan with regard to the cause of gentrification: although our results may lend support to one side or the other (demand or supply), making an initial allegiance is unnecessary.

The stage model describes gentrification in terms of a sequence of events that unfold in a generalized gentrifying neighbourhood. Each event has to do with the

characteristics and preferences of residents moving into a neighbourhood, the changes they initiate in their surroundings and/or the associated risk of investment in that neighbourhood. Although specific gentrifying neighbourhoods do not strictly conform to all tenets of the stage model, it is valuable as a guide to the process, providing theoretical expectations around which to organize and simplify the data. The continuous nature of the neighbourhood transformation described in the stage model suggests that changes occurring after gentrification may simply consist of a continuation of the process.

CHAPTER 2: THEORETICAL CONTEXT

Introduction

Gentrification is a cycle of social change in specific parts of our cities. The stage model's description of gentrification guides investigation into the first three research questions, which explore the post-gentrification period. The fourth question asks if the effects of gentrification dissipate over time, or if they are instead part of a lasting regime of change evidenced across a region. To answer this question, we require a broader perspective concerning regional trends in housing, income and urban structure.

A theoretical framework is necessary to investigate change in region-wide trends. An ideal framework allows incorporation of prior findings and evidence, points out future topics of study, and makes verifiable predictions. Neo-classical urban economic theory forms the framework for this thesis. This chapter describes the neo-classical model of residential location and explores its theoretical explanations for gentrification.

The Neo-Classical Model of Residential Location

The neo-classical model of residential location was developed primarily by Alonso (1964), Mills (1972) and Muth (1969). It builds upon the work of many early economists, including Ricardo, Von Thunen, Hurd and Burgess. The model hypothesizes a circular monocentric city on an undifferentiated plain, where all employment is located at the centre point of the Central Business District (CBD). Households located at distance d from the CBD derive utility from consumption of a quantity of housing H(d) and a quantity of a composite good representing all non-land items (z). The price of z is 1. Households also incur an annual transportation cost equal to T(d) which is generally

interpreted as the cost of the daily commute to the CBD. Households have an annual real income of y, which they spend on housing, other goods and transportation. If we start by assuming that all households have the same income and preferences, then at equilibrium all households must attain an equal utility level (u^e). The housing price function describes the maximum amount a household can offer at a given distance from the CBD while still obtaining the equilibrium utility level. The equation for the housing price function is derived as follows. At a given distance from the CBD, a household consumes goods and housing so as to maximize utility subject to their budget constraint. This occurs where the budget line is tangent to the indifference curve:

$$\Delta H(d) / \Delta z(d) = - p_z / p_H(d) \qquad (1)$$

where p_z is the price of z (equal to 1) and $p_H(d)$ is the price of housing at distance d.

When distance is taken into account, the household budget constraint is the following:

$$p_z * z(d) + p_H(d) * H(d) + T(d) = y \qquad (2)$$

Because the budget constraint must be satisfied at all locations, a small change in distance must have effects on $p_H(d)$, H(d), z(d) and T(d) that cancel each other out. Thus,

$$\Delta p_H(d) * H(d) + p_H * \Delta H(d) + p_z * \Delta z(d) + \Delta T(d) = 0 \qquad (3)$$

The cross-product $\Delta p_H(d) * \Delta H(d)$ term is assumed to be very small and is dropped. Re-arranging equation (1) so that the right side is 0 and subtracting it from both sides of equation 3 yields:

$$\Delta p_H(d) / \Delta d = - \Delta T(d) / H(d) \qquad (4)$$

This indicates that the slope of the housing price function is equal to the negative of commuting costs over quantity of housing demanded at distance d. Housing price

declines at a diminishing rate with distance from the centre, because although the decline in price exactly offsets the increased cost of commuting, there is a substitution effect whereby households tend to consume more housing as it gets cheaper, spreading the price savings over more housing. Equation 4 points towards a number of implications for patterns of dwelling value, income and density in urban areas.

Patterns of Location by Income

The monocentric city model is used to derive expectations regarding patterns of location by income. This allows one to determine if income related changes associated with gentrification dissipate over time, or if they are part of a lasting regime of change evidenced across the region. Using the hypothetical situation of undifferentiated consumers of housing across an urban area, Alonso (1964) found that suburban residents demand more housing than inner city residents, and use a lower capital/land ratio than inner city residents at a given utility level (due to the substitution effect). If housing is considered to be a normal good and it is inferred that higher income should therefore result in a greater demand for housing, high income residents are drawn away from the centre in order to occupy greater amounts of housing. This is reflected in equation (4) where an increase in H(d) flattens the housing price curve, making it lower in the centre but higher at the periphery. However, another factor affects location choice by income: the cost of commuting (represented by T(d) and including the time cost of commuting, which increases with income). An increase in T(d) causes the housing price-distance curve to steepen, and draws high income residents to the centre. Thus, the location pattern of residents and the slope of the housing price curve both depend on the relative

increase in the values of commuting time and housing consumption resulting from increased income (Anas, Arnott & Small 1998).

Mills assumed that housing consumption was the dominant factor. Using a model with multiple groups of residents which varied by income, Mills showed that "residences will be ranked by distance from the city centre inversely to their rank by income" assuming that the disutility of a mile of commuting is proportionate to the wage rate; that the factor of proportionality is no greater for high than for low-income workers; and that the income elasticity of demand for housing nearly equals or exceeds 1 (1972, p. 71). This set of assumptions allows the model to explain the predominant pattern of location by income in most North American cities around 1970, which resulted from decades of sustained suburbanization. Based on these assumptions, further increases in income after 1970 would further flatten the housing price-distance curve, entrenching the position of the wealthy at the periphery (assuming income growth of the wealthy matched or exceeded income growth of the less wealthy).

It is important to remember that Mills' prediction regarding residential location by income hinges on the assumption that commuting time is valued at a lower level than housing consumption in the location decision of a household. There is some debate on this issue. If the value placed on commuting time is sufficiently important, higher-income residents would choose to locate more centrally than their lower-income counterparts. Muth is a skeptic: "on a priori grounds alone the effect of income differences upon a household's optimal location cannot be predicted. Empirically, however, it seems likely that increases in income would raise housing expenditures by relatively more than marginal transport costs, so that higher-income CBD workers would

live at greater distances from the city center" (Muth 1969 p. 8). Not everyone agrees: in studying the relative value placed on housing consumption and commute costs (including both the money costs and time costs of commuting), Wheaton (1977) found that the two factors were of similar importance – so much so that "very little confidence can be placed in the original conclusion that greater income will even partially lead to more distant residential locations." (p. 630). Further research by Glaeser et al (2006) found the income elasticity of demand for land to be smaller than 0.5, and inferred that it could not account for the suburbanization of the wealthy. The theory seems indeterminate regarding expectations for the pattern of location by income. This led Wheaton (1977) to reach outside the model by suggesting that the tendency for income to vary positively with distance is the result of negative social externalities in the central city and fiscal advantages of locating in separate suburban municipalities (Wheaton 1977).

A number of demographic and other changes have occurred since 1970 that together increased the value placed on commuting time relative to housing consumption. According to Alonso (1982) these changes would "mold the evolution of urban areas in years to come" and were at least partially responsible for the gentrification of the 1970s (p. 540). Several changes acted to reduce the amount by which housing consumption increases with an increase in income. Average household size declined rapidly and steadily after the war, reducing the quantity of housing demanded. A complementary reduction in the demand for single family dwellings and for owner occupied dwellings (both prevalent in the suburbs) resulted from a decline in traditional nuclear families relative to households with alternative living arrangements. Other changes acted upon the valuation of commuting time. The increased share of women in the workforce

created more dual-income families, effectively doubling commute costs for those households. The continued shift to a post-industrial economy led to an increase in centrally located quaternary sector employment (management, administration and professional jobs). A decline in job security necessitated strategic housing location choices by employees so as to minimize potential future commute costs. A final important change involved social externalities: a reduction in birth rates made the suburbs relatively less attractive since couples without children worry less about the social issues in inner city neighbourhoods (one of the primary appeals of the suburb was as a good place to raise children). Alonso found that all of these factors together "point to the possibility of increasing locational attractiveness of more central locations, in the core city and the older suburbs, where there is an appropriate stock of housing and access to services and probably in many cases locational convenience for the journey to work" (p. 550). Supporting this, Wheaton (1977) found that young, small households had the steepest housing price curve amongst a variety of groups varying by income and demographic factors. The long-standing tendency for income to vary positively with distance from the CBD in North American cities is likely the result of factors outside of the basic monocentric model, such as negative social externalities in the inner city and fiscal benefits of locations in separate suburban municipalities. When demographic and other changes occurring after 1970 are accounted for, the model predicts that Toronto's housing price-distance profile should steepen after 1970, perhaps accounting for income and housing cost increases characteristic of gentrification.

Extending the basic monocentric model to account for changes in transportation technology also allows explanation of gentrification related income increases (LeRoy &

Sonstelie 1983; Glaeser et al 2006). In this model, it is assumed that each time a new innovation is made, use of the resultant technology is very expensive at first, but that costs decline over time. Multiple technologies are available at any given time, allowing different residents the choice of using different technologies. Two income groups are assumed, and in this case, the valuation of commute time is assumed to exceed valuation of housing consumption when pricing forces both income groups to use the same transportation technology. When both groups use the same technology, higher-incomes are drawn to the centre. Higher-income residents move a greater distance from the centre only if the faster commuting technology is priced to be accessible to high-income residents but not to low income residents. Such a model explains both suburbanization (high-income residents move to areas where they do not need to outbid low-income residents, who cannot afford cars to travel to suburbs); and gentrification (the cost of commuting by car decreases to the point where low-income residents can bid against high-income residents for suburban locations). This version of the monocentric model predicts a steepening of the income and housing price profiles after 1970 since automobile commuting became increasingly accessible to lower-income residents and no expensive technological innovation appeared to replace it. These predictions seem to account for observed trends of gentrification in central cities. Of related interest is the observation that poor people continue to live in central areas, to a large extent. This is attributed to the prohibitive costs of automobile ownership, the availability of public transit and the relatively low time cost of commuting of those with low incomes (Glaeser et al 2006). Gentrification of areas well served by public transport has potential

implications for public policy, as the poor may be removed from services they rely on for their well-being.

Another extension of the monocentric city model explains central city income growth by focusing on dwelling age and redevelopment. Brueckner and Rosenthal (2005) developed a dynamic model based on the monocentric city which assumed that cities grow outwards over time and that buildings have a fixed lifespan after which they are redeveloped. As such, the newest buildings in a city will be located on the periphery, until the time the oldest buildings in the centre are replaced. The city continues to grow outwards while the centre is redeveloped, leading to an eventual pattern of dwelling ages in ring-shaped waves. Based on previous studies by Wheaton (1977) and Glaeser et al. (2006), Brueckner and Rosenthal assume that the valuation of commuting time dominates that of housing consumption when incomes increase. They also assume that newer housing provides more services than older housing, thus drawing the rich who demand more housing services. In today's North American cities, dwelling age tends to vary inversely with distance from the centre. Thus, removing the influence of dwelling age on location patterns, the rich live in the centre, and the poor live on the periphery. The study's empirical results were consistent with these theoretical expectations. It found that when the influence of dwelling age is removed, income disparity between inner city and suburbs reduces by up to 50%, especially in larger metropolitan areas. Clearly, dwelling age has a strong effect on residential location choice by income. This version of the monocentric city model implies that neighbourhoods that are the locus of redevelopment and/or new housing construction will be the site of great increases in income. While one

might expect to find most of these neighbourhoods at the periphery, it is possible that gentrifying central neighbourhoods are located at the sites of central city redevelopment.

Urban Structural Change

The monocentric city model permits exploration of changes in urban structure as well as the distribution of incomes and housing prices. The fact that almost all cities have undergone decentralization over the last century or more is touted as one of the strongest empirical regularities relating to urban spatial structure (Anas, Arnott & Small 1999). Observed decentralization can be explained by two inter-dependent theories: the natural evolution of suburbanization (based on the findings of the monocentric city model incorporating Mills' assumptions) and the fiscal-social problems theory of suburbanization (Mieszkowski & Mills 1993).

Decentralization is most often monitored through the observation of density gradients. As originally described by Clark (1951) density functions generally take a negative exponential form:

$$D(d) = Ae^{-\gamma d} \qquad (5)$$

where D(d) is density of population or dwellings at distance d from the CBD and A and γ are positive constants. A represents density at the centre, while γ is the density gradient: the proportional rate at which density falls with distance from the centre. Thus, decentralization is marked by a decline in the density gradient and a flattening in the density function.

The natural evolution theory of suburbanization postulates that during the twentieth century, decentralization has resulted from: 1) a middle class preference for larger single family lots in the suburbs (as opposed to denser multi-family dwellings in

central parts of the city); 2) the durability and heterogeneity of dwellings within an urban region; 3) the falling cost of transportation due to the construction of freeways; and 4) the effects of rising real incomes (Mieszkowski & Mills 1993 p. 137). In this explanation γ relies on the ratio of commuting cost to income, and increased income is expected to reduce the gradient (Clark 1951). It is debatable whether this assumption holds true (Wheaton 1977; Glaeser et al 2006) as demographic and other changes may have increased the value placed on commuting time relative to housing consumption. If this is so, one would expect density functions to flatten more slowly or to steepen over time. However, expression of this effect may lag considerably for two reasons. Firstly, buildings have an average lifetime far longer than the time period for which the monocentric city model's parameters can be expected to remain constant (Anas, Arnott & Smith 1998, p. 1436). The steepening of a density function involves a greater increase in density at the centre than at the periphery. The inertia of a durable building stock would have to be overcome in order for redevelopment at the centre (less the original number of dwelling units) to exceed construction of new dwellings at the fringe. Secondly, inner city neighbourhoods sometimes resist densification through land use controls and political power (Filion 1991; Skaburskis 1989).

Also, γ is influenced by factors other than income and commuting costs. For example, decentralization is often explained by the fiscal and social problems of inner cities: "high taxes, low quality public schools and other government services, racial tensions, crime, congestion and low environmental quality" (Mieszkowski & Mills 1993). This theory proposes that a reinforcing cycle of decline occurs in inner cities: those with higher incomes move to the suburbs to avoid inner city problems. This intensifies the

problems of the inner city and makes suburban locations more attractive, leading to further migration. Mieszkowski & Mills (1993) compared the two explanations of decentralization empirically by examining historical density gradients in a variety of US and international cities. They concluded that both the natural evolution and fiscal-social explanations of decentralization were important.

Thus, we expect Toronto's dwelling density function to have flattened between 1971 and 2001. The value placed on commuting time may have become more important relative to housing consumption in the location decision of residents, leading to pressure for centralization. However, expression of centralization lags due to the durability of the building stock and development controls. Further, decentralization is encouraged by fiscal and social factors.

Summary

Our fourth research question asks if the effects of gentrification dissipate over time, or if they are instead part of a lasting regime of change evidenced across a region. Essentially, the goal is to determine whether changes characteristic of gentrification can be explained within a broad framework of urban change, or if they represent a temporary deviation from established patterns. The vehicle for this examination is neo-classical economic theory, in the form of the monocentric city model.

Formulation of the model shows that the slope of the housing price function is negative and that its magnitude varies positively with the cost of commuting and inversely with quantity of housing consumed. The implications of the model depend on whether the value of commuting time or housing consumption increases more with increases in income. If housing consumption is valued more highly, income varies

positively with distance from the CBD, and increases in income lead to a flattening of the housing price-distance and density-distance curves. However, it is questionable whether housing consumption is valued more highly. Demographic and other changes since 1970 have increased the importance of societal groups that value commuting time more highly. This should result in a steepening of the overall housing price profile for the Toronto CMA which reflects increased demand for central relative to peripheral housing. In this way, the monocentric city model can account for central income and housing cost growth associated with gentrification. The density function may flatten despite the steepening of the housing price curve because of delayed expression of forces encouraging centralization and because of the influence of factors external to the monocentric city model.

CHAPTER 3: METHODS

Introduction

This chapter describes the methods used to analyze Toronto CMA census tract data in the exploration of our four research questions: 1) What happens after a neighbourhood goes through the gentrification process? 2) How does an already gentrified neighbourhood compare to a gentrifying neighbourhood? 3) Are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process? 4) Do the effects of gentrification dissipate over time, or are they instead part of a lasting regime of change evidenced across a region?

Discussion focuses first on the dataset used in the analysis and the scales of study. This is followed by an examination of the various statistical techniques used to analyze the data. The core of the analysis involves a set of regressions for each of 16 explanatory variables. Each set of regressions describes the influence of tract type and distance on a given explanatory variable, and how this influence changed over time.

The Data and the Variables

Analysis of gentrification and the ensuing period was conducted with the aid of 16 explanatory variables identified in the review of the literature on gentrification. The chosen variables have roles in theoretical explanations of the process – the stage model and the monocentric city model. Empirical support for these explanations was tested by tracing the variables' absolute and relative change over time.

The variables were split into four groups: descriptors of status, descriptors of demographics, descriptors of income and housing costs and descriptors of dwelling stock.

The descriptors of status deal with education and occupation. They are important indicators in the stage model, and allow the identification of gentrification using Ley's definition (1996).[3] Descriptors of status are also linked to the monocentric city model in that they are indicators of long term income. The descriptors of demographics describe household size and type, age structure and immigration. Research has indicated that gentrifiers may tend to be young and single and to live in non-traditional household configurations (Meligrana & Skaburskis 2005). It is suspected that immigrants are displaced from some neighbourhoods as gentrifiers move in. Furthermore, household demand characteristics vary demographically, making these variables essential in the interpretation of empirical evidence using the monocentric city model (Alonso 1982). The descriptors of income and housing costs include measurements of average household and individual incomes, average dwelling value and average gross rent. These variables are central to our analysis, and figure largely in the stage model as well as the most important predictions of the monocentric city model (Ley 1991; Mills 1972). The descriptors of dwelling stock describe tenure, dwelling type and density. Various claims have been made regarding the importance of the built environment in gentrification, and tenure change plays a role in the stage model (Meligrana & Skaburskis 2005). Also, density is of primary importance in the study of urban structure and decentralization, one of the major uses of the monocentric city model (Anas, Arnott & Small 1998). All explanatory variables are defined in table 1.

[3] This study defines gentrification in terms of status change over time – see Chapter 1

Table 1: Variable definitions for explanatory variables

Name	Mnemonic	Definition
Proportion with University Degree	*perdegree**	Proportion of population aged 15+ with a university degree.
Proportion without Grade 9	*pedgrd9c**	Proportion of population aged 15+ with less than a grade 9 education.
Proportion Quaternary Workers	*pquaternary**	Proportion of labour force employed at professional, managerial, technical and administrative jobs.
Proportion Unemployed	*punemployed**	Proportion of a census tract's labour force that was unemployed and available for work the week prior to the census.
Average Persons per Household	*hhavgper**	Average number of persons living in a census tract's households.
Proportion Non-Family Households	*phhnonfam**	Proportion of households which do not include an economic family (a group of two or more persons who live in the same dwelling and are related to each other by blood, marriage, common-law or adoption)
Proportion Aged 25 to 39	*prop2539yr**	Proportion of census tract population aged between 25 and 39.
Proportion Immigrants	*pimtotc**	Proportion of census tract population having emigrated to Canada at some point in their lifetime.
Average Household Income	*avghhy**	Total money income received from all sources by all individuals 15 years of age and over in the average household during the year prior to the census year.
Average Individual Income	*avgyy**	Total money income received from all sources averaged across all individuals 15 years of age and over during the year prior to the census year.
Dwelling Value	*dwvalue**	Dollar amount reasonably expected by the owner if the dwelling were to be sold, averaged across households in a given census tract.
Gross Rent	*grrent**	Total annual payments paid by tenant households to secure shelter, averaged across households in a census tract.
Proportion owned	*prowned**	Proportion of a census tract's occupied dwellings owned by some member of the household occupying them.
Proportion SFD	*prsfd**	Proportion of a census tract's occupied dwellings specified as single-detached houses.
Dwelling Density	*dwelldens**	Number of occupied dwellings per area of census tract in square kilometres.
Population Density	*popdens**	Number of persons per area of census tract in square kilometres.

Scales of Analysis

The analysis of 1971, 1981, 1991 and 2001 census data was undertaken at the census tract level.[4] The need for constant geographies over time prompted the selection of the 1981 census tract boundaries for use in all census years. 1991 and 2001 data for tracts that split due to population growth between 1981 and 2001 was usually aggregated by taking the weighted average or the sum.

Particular sub-groups of census tracts were integral to the analysis conducted in this study. Gentrified tracts were defined using Ley's (1986) definition. A social status index variable was calculated for each tract in each census year by taking the mean of the percent of the population with a university degree and the percent employed in the quaternary sector. Change in the social status index between censuses was termed the gentrification index. The top quintile of inner city tracts with regard to the gentrification index were defined as having gentrified during a given decade. Therefore, the 32 tracts that gentrified in the 1970s (the G70 sub-group) make up of the top quintile of tracts in terms of social status change between 1971 and 1981. The definition of inner city used here is from Canadian federal government documents (McLemore et al. 1975), and differs slightly from Ley's definition of inner city.[5] Application of Ley's methods to a differently defined inner city led to a similar but different set of tracts that were found to have gentrified between 1971 and 1981. G80 tracts are the tracts that underwent the most

[4] Necessary data were missing from 11 of the inner city census tracts. These form a strip along Toronto's waterfront, for the most part (figure 6), and were heavily industrialized in early census years. These tracts were excluded from the subsequent analysis.

[5] The inner city as defined here can be seen within the context of the 1981 Toronto CMA in figure 7, appendix 2.

gentrification between 1981 and 1991.[6] Further, a set of 7 elite tracts were identified. These tracts were selected based on reputation, as well as constant placement in the top 10 of Toronto CMA tracts with regard to household income (between 1961 and 2001) and individual income (between 1971 and 2001). Elite tracts were distinguished in order to observe the extent to which gentrification leads to elite characteristics in a neighbourhood.

Examination was made of five census tract sub-groups: the G70, G80, and elite tracts, the Toronto inner city, and the Toronto CMA. Neighbourhoods were operationalized as census tracts, and the region was operationalized as the Toronto CMA. Census tract sub-groups are shown in figures 6 and 7 in appendix 2.

The Analysis

The 1971 value of each explanatory variable was found for each census tract sub-group.[7] Proportional change was measured for each of the ensuing three decades, allowing the characterization of gentrification and changes that occur afterwards. An important consideration is that many explanatory variables had strong relationships with distance to the CBD and that the median distance from the CBD varied amongst the census tract sub-groups studied.

Regression Analysis

Multiple regression analysis was used to examine change in individual variables across the five tract sub-groups. Regression analysis determines whether specific tract

[6] Overlap between tract types was not permitted as it would over-complicate interpretation of regression coefficients. Thus, tracts that were in the top quintile of status change for both the 1971-1981 and 1981-1991 periods were considered G70 tracts but not G80 tracts.

[7] Note that actual values were calculated, as they are more precise than means of tract values (although this was also done, and presented in appendix 1).

sub-groups were significantly differentiated from others with regard to each explanatory variable, holding distance from the CBD constant. Regressions of absolute variable values were undertaken for each census year. Regressions of change between census years were undertaken for each decade.

Multiple regression analysis allowed calculation of the specific effects of a given independent variable on the dependent variable, holding other factors fixed. A model was estimated for each of the 16 variables using the method of ordinary least squares, which minimizes the sum of squared residuals.[8] Each model specified a set of OLS intercept and slope estimates. Two-sided t-tests determined whether each of these estimates was different from 0 at the 10% and 1% significance levels.

Two sets of regressions are presented. The first set is cross-sectional, and indicates differentiation of tract sub-groups in a particular census year, given distance. Modeling took the form shown in equation 1.

$$Ln(Y) = \beta_0 + \beta_1 G70 + \beta_2 G80 + \beta_3 Elite + \beta_4 Distance \quad (1)$$

Where: Y is a dependent variable, β_0 is the intercept coefficient, and $\beta_{1\text{-}4}$ are the slope coefficients for the tract type indicators and distance. The log of the left side variable was used as is standard in situations where change in the dependent variable is thought to be proportional rather than constant.[9] Coefficients can be interpreted as the *semi-elasticity* of the dependent variable with respect to the independent variable (thus, when

[8] A residual is the difference between an actual value of the dependent variable and the value predicted by the model (Wooldridge 2006, p. 869).
[9] The dependent variables in this set of regressions tend to change across distance at either increasing or declining rates.

Y = average individual income, β_1 * 100 represents the % change in average individual income that results from G70 tract status given the distance).

The second set of regressions indicates significant differentiation in the *rate of change* of a dependent variable in tract sub-groups, holding distance constant. The level-level form was used (no logs were taken) because there were no expectations as to how time-difference would change over distance. Coefficients describe the amount by which the dependent variables are expected to change when the independent variable increases by one unit.

Linear Discriminant Analysis

After the regression analysis of the individual explanatory variables, linear discriminant function analysis was used to look at the effects of all the variables taken together. Discriminant analysis determines which variables are the best indicators of group identity and in our case which variables helped the most to distinguish between the tracts that gentrified in the 1970s and the other tracts. The analysis was carried out for each decade and then on the changes in variables during each of the three decades.

Discriminant analysis is a statistical technique which is used to determine which linear combination of variables discriminates most strongly between two or more naturally occurring, mutually exclusive groups. Because the correlations among the explanatory variables are unknown, discriminant analysis was carried out in a stepwise fashion allowing the most discriminating variable as determined by the F-statistic for entry to be included. In this method, variables are added as long as their discriminating function has less than a 0.10 chance of being random. A variable is removed if it fails to yield an F-statistic that had a 0.15 chance of adding only a random effect. The

discriminant analysis yields a new "discriminating" variable describing the axis in the multidimensional space of the included variables that most differentiates the two categories. The estimated coefficients for the variables in the discriminant function maximize the F-ratio (between-groups variance to pooled within-group variance) (Manly 2005, p. 107).

The discriminant function provided information about the differentiation of G70 tracts in two ways: 1) the relative positions of the data cases and group centroids; and 2) the correlations between the individual variables and the discriminant function (Klecka 1980, p. 23). Firstly, the unstandardized coefficients were used to compute discriminant scores for each observation. The scores describe the distribution of the observations and groups in discriminant space.[10]

The unstandardized coefficients used in the discriminant function represent the absolute contribution of a variable in determining the discriminant score (Klecka 1980, p. 29). These are not overly useful, especially when variables are measured on different scales, as is the case in our analysis. Standardizing the coefficients allows determination of the *relative* importance of each variable in separating the groups (Morrison 1969, p. 159).[11] However, interpretation of standardized coefficients remains problematic as the coefficients take into account the simultaneous contributions of all variables in the analysis and become unstable in the event of a high correlation between two variables (Klecka 1980, p. 30). The best interpretation of discriminant functions is provided not by

[10] The number of dimensions of this discriminant space is defined by the number of discriminant functions created in the analysis, each of which represents a dimension; in the case of a two group analysis, there is only one discriminant function, and thus, discriminant space is a single line. The locations of groups in discriminant space are defined by their centroids.

[11] Standardized coefficients can be obtained by 1) recalculating the coefficients after standardizing the data to have standard deviation of 1, or 2) multiplying the unstandardized coefficient by the square root of [sum of squares / (total number of cases – number of groups)]

the coefficients, standardized or un-standardized, but by the structure coefficients which describe the correlation between the variables and the discriminant function (Klecka 1980, p. 31). These correlations between discriminating variables and a discriminant function allow for qualitative description of the function.

The performance of the discriminant function was tested in a variety of ways. Firstly, the R-squared was calculated, describing the proportion of variance in the discriminant scores that is accounted for by differences between G70 and other inner city tracts. Next, a test was undertaken to ensure that the mean vectors of the G70 and other tracts were significantly different. It has been suggested, however, that use of stepwise methods renders this test invalid and that the best way to examine the performance of a discriminant function is to classify data cases, calculate the proportion properly classified, and compare this with the proportion that would be properly classified by chance (Manly 2005, p. 115). However, it has been found that when groups are very different in size, as is in our case, the cases tend to be over-classified into the larger group (Morrison 1969, p. 161). Further, it has been found that the use of a discriminant function to classify the set of data from which the discriminant function was derived leads to an upwardly biased assessment of the accuracy of the discrimination (Landau & Everitt 2004, p. 317). Thus, the "leaving one out" method was used to provide an unbiased assessment of classification accuracy.

Summary

This chapter describes the methods used to analyze Toronto CMA census tract data for 1971, 1981, 1991 and 2001 in the exploration of our four research questions. Analysis of gentrification and ensuing changes was conducted through examination of 16

explanatory variables identified in the review of the literature on gentrification. Gentrified tracts were defined using Ley's (1986) definition. A social status index variable was calculated for each tract in each census year by adding the mean of the percent of the population with a university degree and the percent employed in the quaternary sector. The top quintile of inner city tracts with regard to change in the social status index between censuses were defined as having gentrified.

Five census tract sub-groups were studied: the G70, G80, and elite tracts, the Toronto inner city, and the Toronto CMA. Proportional change tables allow the characterization of gentrification and the period following, evaluation of consistency between the data and the stage model of gentrification and observation of trends at the regional scale. Three sets of regressions were used to indicate significant differentiation between specific tract sub-groups with regard to each explanatory variable, holding distance constant. The first set of regressions describes the semi-elasticity of each explanatory variable with regard to gentrification status and distance from the CBD. The second set of regressions were undertaken for variables of interest and use only distance as a regressand, resulting in estimates of the housing price, income and density functions for the Toronto CMA. The third set of regressions describes the effect of gentrification status and distance from the CBD on the proportional change in an explanatory variable during each decade. Finally, discriminant analysis was used to tie prior analyses together and indicates which linear combination of variables creates the greatest differentiation between G70 and other inner city tracts.

CHAPTER 4: ANALYSIS

Introduction

In this chapter, empirical evidence is compared to theoretical expectations provided by the stage model of gentrification and the monocentric city model in order to answer our four research questions: 1) What happens after a neighbourhood goes through the gentrification process? 2) How does an already gentrified neighbourhood compare to a gentrifying neighbourhood? 3) Are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process? 4) Do the effects of gentrification dissipate over time, or are they instead part of a lasting regime of change evidenced across a region? In general, we expect change after gentrification to be consistent with continued late stage gentrification as defined by the stage model. We further expect that gentrification-related changes in dwelling values, incomes and density are representative of continuing change at the regional scale and do not dissipate with time.

In order to answer the research questions, several techniques were used. The 1971 value and proportional change over time were traced for each explanatory variable by census tract sub-group, allowing for the characterization of gentrification and ensuing changes in G70 tracts. G80 tract trajectories were examined to verify whether found trends were repeated in the next set of gentrifying tracts. Regressions of logged explanatory variables against tract type indicators and distance describe the magnitude and statistical significance of differentiation between specific tract groups and CMA tracts, given distance from the CBD. These regressions were repeated for variables of

interest using only distance as a regressand, resulting in estimates of the dwelling value, income and density curves for the Toronto CMA. A third set of regressions determined the magnitude and significance of differences in the rate of change in explanatory variables by tract type and distance.[12] Finally, discriminant analysis was conducted for each census year and on the change in explanatory variables by decade, indicating which variables were most important in discriminating between G70 tracts and the rest of the inner city.

The analysis begins with consideration of individual explanatory variables in groups of four, and finishes with the discriminant analysis which ties them all together.

[12] In general, the cross-sectional regressions had far greater explanatory power than the ratio regressions, as indicated by their respective R-squared scores. This indicates that tract type and distance from CBD were more successful in predicting the absolute level of explanatory variables than their rate of change over time.

Descriptors of Status

The stage model of gentrification stipulates that rapid increases in social status, as defined by level of education and quality of employment, should occur during all stages of gentrification. Our findings necessarily support the model in this regard; it was in terms of change in university education and quaternary employment that the G70 and G80 tracts were defined. Consistently, G70 and G80 tracts experienced greater proportional increases in university education and quaternary employment than the inner city or the CMA between 1971 and 2001 (tables 2 & 6). Social status grew faster in gentrifying areas, given distance, but grew either slower or at the same rate afterwards (tables 3 & 7).

The proportion of residents with less than a grade 9 education and the proportion unemployed act as indicators of displacement, and stage model literature suggests that they should decline constantly in gentrifying areas as new arrivals to the neighbourhood outbid former residents (and eventually pioneer gentrifiers) for housing. In both variables, levels dropped further in G70 and G80 tracts than the inner city or CMA between 1971 and 2001 (tables 4 & 8), and significantly faster, given distance, between 1971 and 1991 (tables 5 & 9). Displacement characteristic of gentrification continued afterwards, for the most part. Faster than average displacement stopped after 1991, perhaps obscured by displacement related to the next wave of gentrification in other parts of the city.

Table 2: 1971 proportion of degree holders and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	9.6	2.53	3.73	4.83
G80 Tracts (32)	6.0	2.22	4.32	6.28
Elite Tracts (7)	28.0	1.44	1.79	2.15
All Inner city Tracts (159)	7.8	2.00	3.00	4.24
All CMA Tracts (598)	6.7	1.70	2.48	3.46

Table 3: Regression results for proportion degree holders against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion with University Degrees	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	**0.659**	ns	**1.894**	ns	**1.409**	0.074
1981 (log-lev)	**1.129**	**0.347**	**1.609**	ns	**2.103**	0.171
1991 (log-lev)	**1.020**	**0.648**	**1.338**	-0.005	**2.608**	0.212
2001 (log-lev)	**0.803**	**0.538**	**1.062**	**-0.010**	**3.090**	0.252
1971-1981 (lev-lev)	**1.318**	**0.895**	ns	**-0.019**	**2.378**	0.076
1981-1991 (lev-lev)	ns	**0.627**	ns	ns	**1.681**	0.030
1991-2001 (lev-lev)	ns	ns	ns	ns	**1.507**	0.009

n = 582

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 4: 1971 proportion without grade 9 education and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	25.9	0.51	0.28	0.17
G80 Tracts (32)	36.4	0.64	0.35	0.24
Elite Tracts (7)	7.2	0.35	0.17	0.14
All Inner city Tracts (159)	34.6	0.65	0.44	0.32
All CMA Tracts (598)	26.3	0.61	0.43	0.33

Table 5: Regression results for proportion without grade 9 education against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion with < Grade 9 Education	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	**0.278**	**-1.317**	**-0.015**	**3.305**	0.147
1981 (log-lev)	**-0.530**	ns	**-2.113**	**-0.024**	**3.012**	0.212
1991 (log-lev)	**-1.023**	ns	**-2.410**	**-0.026**	**2.740**	0.192
2001 (log-lev)	**-1.151**	**-0.463**	**-2.605**	**-0.025**	**2.434**	0.199
1971-1981 (lev-lev)	**-0.240**	**-0.103**	**-0.398**	**-0.004**	**0.748**	0.090
1981-1991 (lev-lev)	**-0.206**	**-0.189**	-0.227	**0.006**	**0.685**	0.079
1991-2001 (lev-lev)	ns	ns	ns	**0.013**	**0.638**	0.037

n = 582 to 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 6: 1971 proportion of employment in quaternary sector and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	21.5	2.07	2.51	3.21
G80 Tracts (32)	14.8	1.79	2.95	4.22
Elite Tracts (7)	47.2	1.23	1.36	1.68
All Inner city Tracts (159)	17.8	1.66	2.20	3.09
All CMA Tracts (598)	18.9	1.41	1.54	2.44

Table 7: Regression results for proportion quaternary employment against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion Quaternary Employment	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	**0.399**	ns	**1.233**	**0.016**	**2.553**	0.108
1981 (log-lev)	**0.830**	0.224	**1.073**	**0.011**	**2.940**	0.168
1991 (log-lev)	**0.637**	**0.397**	**0.804**	**-0.009**	**3.405**	0.161
2001 (log-lev)	**0.510**	**0.388**	**0.638**	ns	**3.743**	0.206
1971-1981 (lev-lev)	**0.823**	**0.534**	ns	**-0.009**	**1.587**	0.175
1981-1991 (lev-lev)	**-0.267**	**0.290**	-0.366	**-0.016**	**1.551**	0.122
1991-2001 (lev-lev)	ns	ns	ns	**0.042**	**1.167**	0.039

n = 583 to 584

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 8: 1971 proportion of labour force unemployed and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	8.3	0.48	0.86	0.64
G80 Tracts (32)	9.4	0.52	0.94	0.60
Elite Tracts (7)	4.5	0.87	1.07	0.93
All Inner city Tracts (159)	8.4	0.54	1.15	0.76
All CMA Tracts (598)	6.9	0.57	1.25	0.87

Table 9: Regression results for proportion unemployment against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion Unemployment	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	**0.301**	**-0.464**	**-0.013**	**2.037**	0.259
1981 (log-lev)	ns	0.151	ns	**-0.009**	**1.456**	0.070
1991 (log-lev)	**-0.444**	**-0.191**	**-0.709**	**-0.015**	**2.383**	0.167
2001 (log-lev)	**-0.404**	**-0.265**	**-0.520**	**-0.014**	**2.022**	0.134
1971-1981 (lev-lev)	-0.096	-0.084	**0.260**	**0.003**	**0.585**	0.047
1981-1991 (lev-lev)	**-0.763**	**-0.669**	**-1.084**	-0.011	**2.683**	0.037
1991-2001 (lev-lev)	ns	ns	ns	ns	**0.745**	-0.003

n = 586 to 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

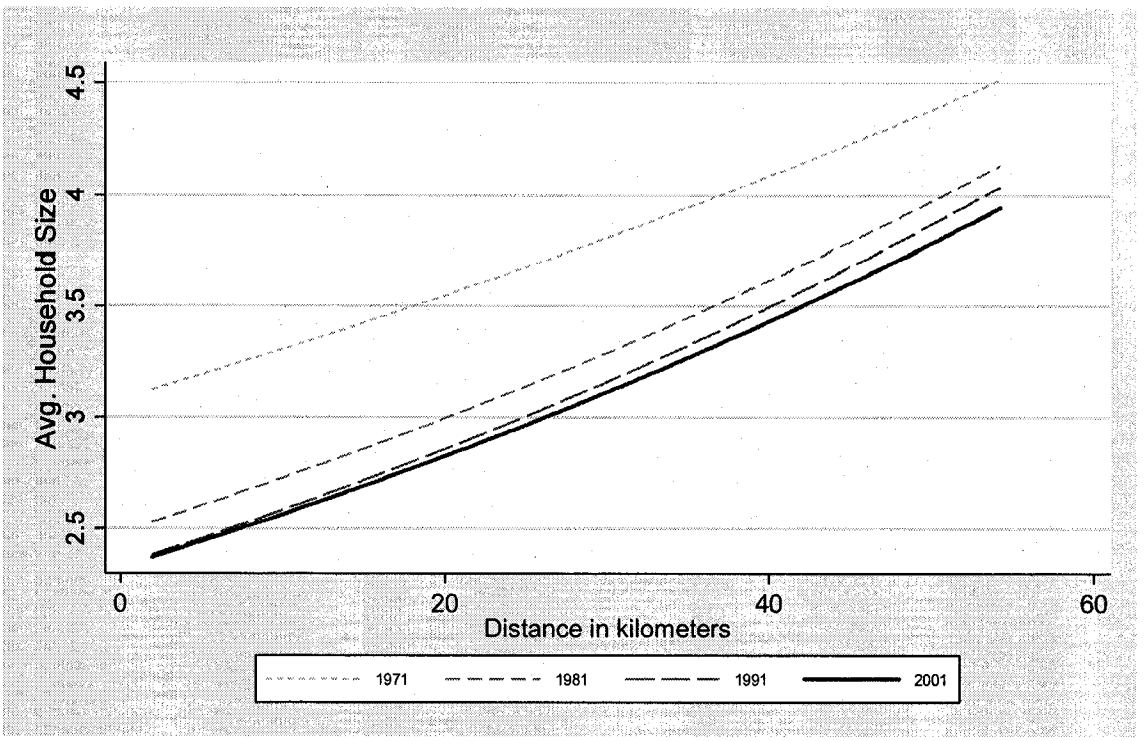
Descriptors of Demographics

Literature on the stage model is not explicit on the subject of demographic change. However, anecdotal evidence suggests that small households and high proportions of non-family households and 25 to 39 year olds are representative of the early stages of gentrification. The proportion of immigrants, like the proportions of under-educated and unemployed discussed in the last section, is an indicator of displacement, and is expected to decline during gentrification. The analysis shows that although patterns are not definitive, G70 and G80 tracts appear to be associated with: 1) households that decline in size at a faster rate than the inner city and CMA (table 11); 2) a proportion of non-family households that is greater than the inner city and CMA (table 14); 3) a proportion of young adults that increases faster than in the inner city and CMA (table 16); and 4) a proportion of immigrants that declines faster than in the inner city or CMA (table 18). These findings suggest that gentrifying areas are subject to a rush of smaller households, non-family households and 25 to 39 year olds during gentrification. There is some convergence with the CMA after gentrification in G70 tracts, although this trend was not evident in the G80 tracts (tables 11, 14 & 16). Consistent with stage theory, the proportion of immigrants (indicative of displacement) declined faster in gentrifying than other neighbourhoods throughout the study period (table 17).

The gentrifying tracts are at the leading edge of CMA-wide demographic change. A decline in household size and increases in the proportions of non-family households and young adults occurred across the CMA between 1971 and 2001 (tables 10 & 13). In the neo-classical framework, smaller households demand smaller amounts of housing, resulting in increased demand for inner city housing relative to the rest of the CMA

(Alonso 1982). Consistently, smaller households increasingly located at the centre (and specifically in gentrifying areas; see above) during the study period, strengthening the relationship between household size and distance, as illustrated in figure 1 (and table 12).

Figure 1: Average household size by distance, Toronto CMA, 1971 to 2001



Further, during the study period the proportion of population made up of immigrants increased by 31% in the CMA but dropped by 5% in the inner city, the traditional locus for immigrant reception. As a result, the curve describing the proportion of immigrants by distance became flatter over time in the CMA (figure 2; table 19). However, when the effects of G70, G80 and elite tracts were accounted for, virtually no flattening took place (table 18), showing that changes in gentrifying and elite tracts were primarily responsible for the proportional decline of immigrants in the inner city.

Figure 2: Proportion of immigrants by distance, Toronto CMA, 1971 to 2001

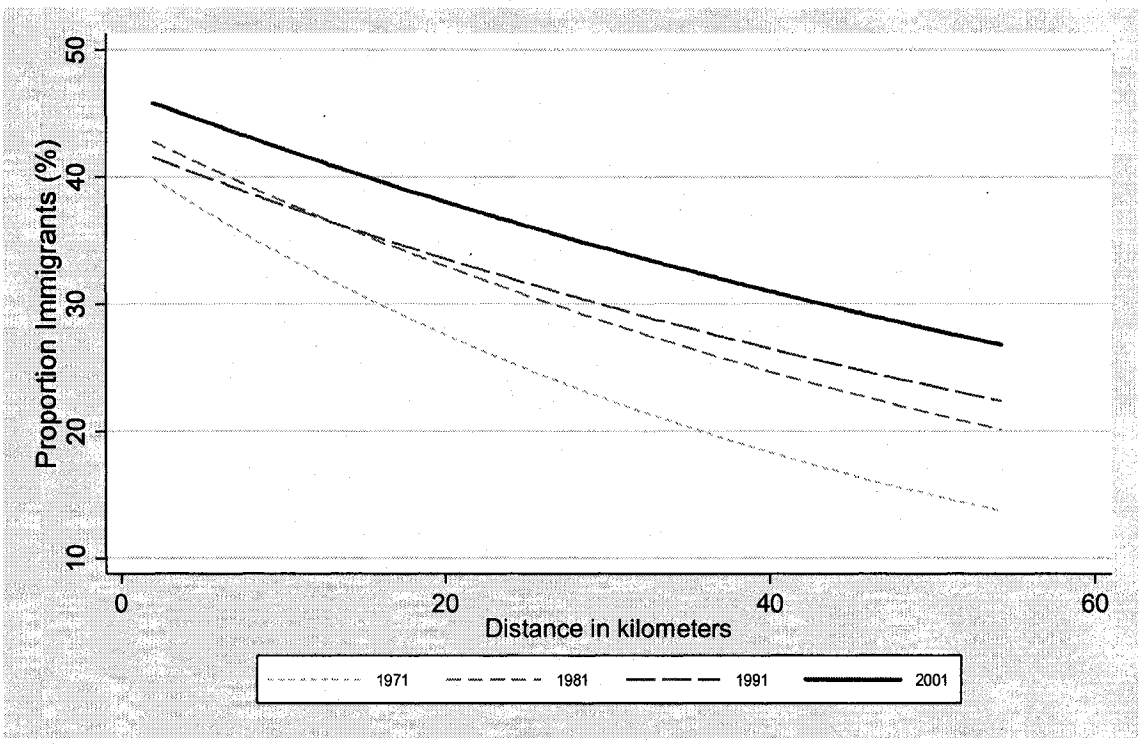


Table 10: 1971 average household size and proportional change to 2001 by census tract sub-group

	1971	1981	1991	2001
G70 Tracts (32)	3.05	0.76	0.72	0.70
G80 Tracts (32)	3.39	0.80	0.73	0.65
Elite Tracts (7)	3.02	0.87	0.87	0.83
All Inner city Tracts (159)	3.18	0.79	0.75	0.71
All CMA Tracts (598)	3.39	0.85	0.84	0.84

Table 11: Regression results for average household size against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Average HH Size	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	**-0.120**	ns	ns	**0.006**	**1.145**	0.169
1981 (log-lev)	**-0.194**	ns	ns	**0.008**	**0.942**	0.226
1991 (log-lev)	**-0.153**	-0.059	ns	**0.009**	**0.876**	0.289
2001 (log-lev)	**-0.180**	**-0.120**	ns	**0.008**	**0.886**	0.331
1971-1981 (lev-lev)	**-0.054**	-0.029	0.062	**0.002**	**0.819**	0.067
1981-1991 (lev-lev)	**0.041**	ns	0.065	**0.001**	**0.935**	0.025
1991-2001 (lev-lev)	-0.027	**-0.060**	ns	-0.001	**1.011**	0.021

n = 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 12: Regression results for the natural log of average household size against distance

	distance	*constant*	Adjusted R-Squared
1971	**0.007**	**1.126**	0.150
1981	**0.009**	**0.909**	0.190
1991	**0.010**	**0.848**	0.259
2001	**0.010**	**0.844**	0.274

n = 587

Table 13: 1971 proportion non-family households and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	33.7	1.36	1.44	1.37
G80 Tracts (32)	28.6	1.38	1.54	1.59
Elite Tracts (7)	31.2	1.15	1.13	1.07
All Inner city Tracts (159)	32.0	1.35	1.44	1.40
All CMA Tracts (598)	19.5	1.36	1.44	1.34

Table 14: Regression results for proportion non-family households against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion Non-Family HHs	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	**0.702**	**0.453**	0.498	**-0.037**	**3.010**	0.359
1981 (log-lev)	**0.484**	0.271	ns	**-0.039**	**3.523**	0.371
1991 (log-lev)	**0.312**	0.207	ns	**-0.036**	**3.716**	0.439
2001 (log-lev)	**0.277**	**0.251**	ns	**-0.031**	**3.656**	0.435
1971-1981 (lev-lev)	ns	ns	ns	0.011	**1.706**	0.016
1981-1991 (lev-lev)	-0.200	ns	-0.281	**0.009**	**1.201**	0.071
1991-2001 (lev-lev)	ns	ns	ns	**0.006**	**0.944**	0.079

n = 585 to 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 15: 1971 proportion aged25 to 39 and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	22.3	1.43	1.50	1.39
G80 Tracts (32)	21.1	1.25	1.56	1.57
Elite Tracts (7)	18.4	1.15	1.17	0.99
All Inner city Tracts (159)	22.8	1.19	1.42	1.36
All CMA Tracts (598)	22.0	1.15	1.27	1.10

Table 16: Regression results for proportion 25 to 39 year olds against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion Aged 25 to 39	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	ns	-0.200	ns	**3.065**	0.008
1981 (log-lev)	**0.333**	**0.159**	ns	0.002	ns	0.099
1991 (log-lev)	**0.148**	**0.160**	**-0.296**	**-0.004**	**3.354**	0.148
2001 (log-lev)	**0.134**	**0.206**	**-0.381**	**-0.008**	**3.282**	0.222
1971-1981 (lev-lev)	**0.345**	**0.293**	ns	**0.004**	**1.065**	0.064
1981-1991 (lev-lev)	**-0.208**	ns	**-0.209**	**-0.007**	**1.264**	0.141
1991-2001 (lev-lev)	ns	0.045	-0.076	**-0.003**	**0.932**	0.075

n = 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 17: 1971 proportion of immigrants and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	39.2	0.91	0.78	0.84
G80 Tracts (32)	44.8	0.96	0.78	0.78
Elite Tracts (7)	24.0	0.95	0.84	0.89
All Inner city Tracts (159)	44.2	0.99	0.90	0.95
All CMA Tracts (598)	34.1	1.10	1.12	1.31

Table 18: Regression results for proportion immigrants against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion Immigrants	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	0.091	**-0.495**	**-0.020**	**3.726**	0.391
1981 (log-lev)	**-0.255**	ns	**-0.665**	**-0.017**	**3.851**	0.279
1991 (log-lev)	**-0.401**	**-0.275**	**-0.827**	**-0.017**	**3.872**	0.144
2001 (log-lev)	**-0.533**	**-0.434**	**-0.896**	**-0.017**	**4.010**	0.241
1971-1981 (lev-lev)	**-0.271**	**-0.178**	-0.196	**0.005**	**1.148**	0.111
1981-1991 (lev-lev)	ns	ns	ns	**0.016**	**0.847**	0.045
1991-2001 (lev-lev)	ns	ns	ns	**0.013**	**1.017**	0.046

n = 585

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 19: Regression results for the natural log of proportion immigrants against distance

	distance	*constant*	Adjusted R-Squared
1971	**-0.020**	**3.725**	0.364
1981	**-0.014**	**3.784**	0.204
1991	**-0.012**	**3.749**	0.067
2001	**-0.010**	**3.844**	0.067

n = 585 for CMA

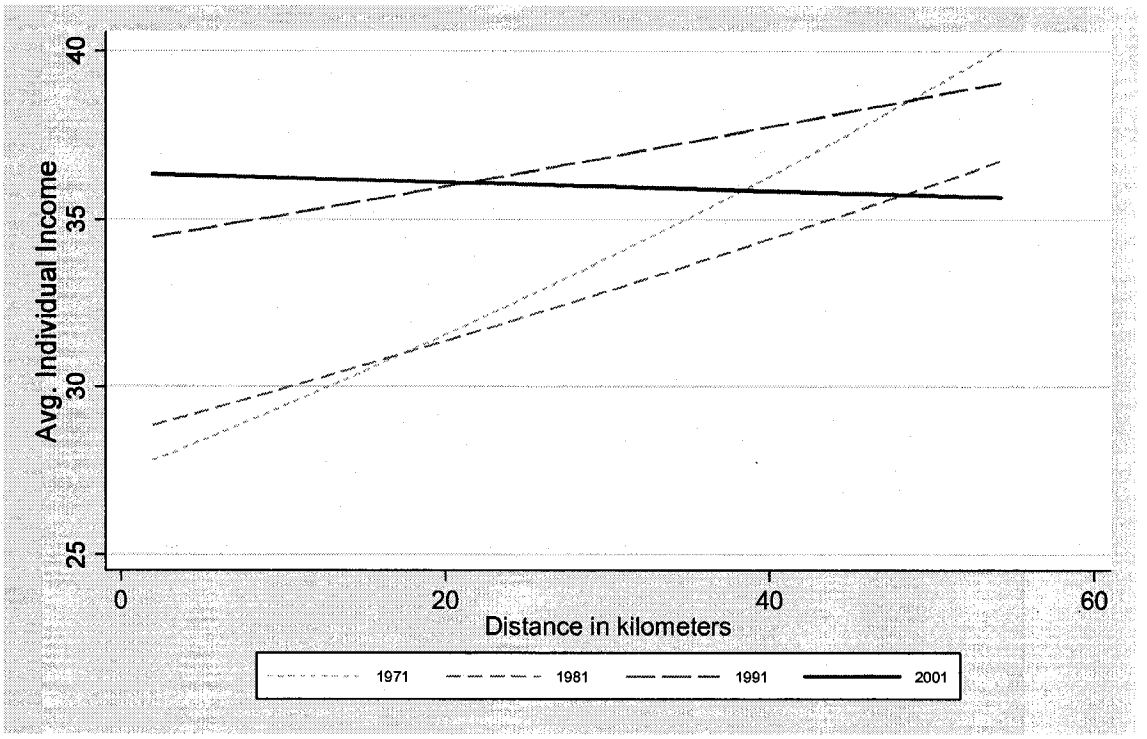
Descriptors of Income and Housing Costs

The stage model of gentrification predicts rapid increases in incomes and housing costs during gentrification and afterwards, causing gentrifying neighbourhoods to increasingly differentiate from the rest of the city, becoming more like elite neighbourhoods over time. Correspondingly, it was found that between 1971 and 2001 average and individual income levels, average dwelling values and average gross rents did indeed increase faster in G70 and G80 census tracts than in the inner city or the CMA (tables 20, 22, 25 & 28). However, they did not approach elite values, which grew at an even greater rate. Income growth in gentrifying districts was at all times significantly faster than CMA income growth at a given distance (tables 21 & 23), indicating continual divergence in terms of income. The pattern whereby one set of tracts after another is seen to differentiate from the rest (elite, G70, G80) is a product of differential income standings in 1971: while elite tracts had significantly higher household and individual incomes relative to the CMA, G70 incomes were not significantly differentiated and G80 incomes were significantly *lower* (tables 21 & 23). All three tract sub-groups had attained significantly higher incomes relative to the CMA given distance by 2001. Dwelling values increased at significantly higher rates only during gentrification itself, and grew with the rest of the CMA afterwards (table 26). Gross rents increased faster in G70 and G80 tracts than in other CMA tracts at a given distance, between 1971 and 1991. Differentiation in rents could have been slowed after 1991 by changes relating to the next wave of gentrification in other parts of the inner city.

Is the income and housing cost growth observed in gentrifying areas representative of patterns at the regional scale? Our findings show that incomes varied

positively with distance in 1971, supporting the idea that the valuation of housing consumption dominates the valuation of commute time in the location decision of households (figure 3; tables 21 & 23). However, average household and individual incomes increased faster in the inner city than the CMA (and faster still in G80, G70 and elite tracts) during the study period (tables 21 & 23). As a result, the curve describing individual income by distance for the Toronto CMA, which had been positively sloped in 1971, rotated steadily over time to become flat in 2001 (figure 3; table 24).

Figure 3: Average individual income by distance, Toronto CMA, 1971 to 2001

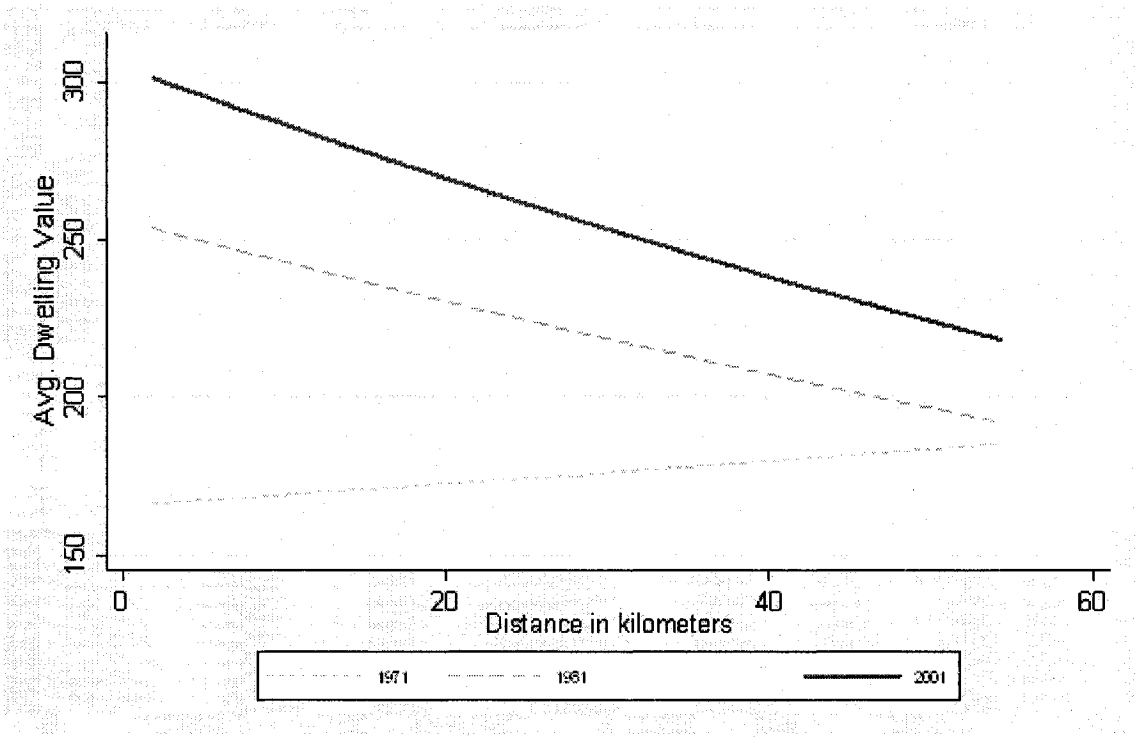


The movement of the individual income-distance curve described in figure 3 was primarily caused by income growth in gentrifying and elite neighbourhoods: the distance coefficients of inner city tracts did not change at all over time, when G70, G80 and elite status were controlled for in regression (table 23). A corresponding movement in the curve describing average household income by distance was not found, but this can be

explained: the high prevalence and increasing concentration of smaller households at the city-centre (figure 1) obscured relative increases in household income in the inner city. Just the fact that 2001 inner city average household income ($80,597) drew almost even with its CMA equivalent ($82,417) represents a clear departure from the classic prediction of the monocentric city model regarding location by income.

Gentrification in the inner city appears to have had no less of an effect on the city's housing price-distance profile. Assuming that the value placed on housing consumption dominates that of commuting time in location decisions, demand is expected to shift to parts of the city where housing is cheaper (the suburbs), flattening the housing price curve as a result of income growth. This flattening was not observed. Average dwelling values and gross rents, led by gentrifying districts, grew faster in the inner city than in peripheral parts of the CMA between 1971 and 2001, starting with below-average housing costs in 1971 and surpassing the regional levels over time (tables 25 & 28). As a result, the dwelling value and gross rent curves steepened and centrally located housing became relatively more expensive (figure 4; table 26). Again, this primarily reflects successive differentiation in housing costs in elite and gentrifying districts: when G70, G80 and elite tracts are controlled for in regression, dwelling value was found to vary *positively* with distance, and the curve was found to steepen slightly over time (table 25).

Figure 4: Average dwelling value by distance, Toronto CMA, 1971 to 2001[13]



[13] The 1991 dwelling value gradient had a slope that was not significantly different from 0 at the 10% level. The 1971, 1981 and 2001 gradients, on the other hand, show a smooth rotation over time.

Table 20: 1971 average household income ($) and proportional change to 2001 by census tract sub-group

	1971	1981	1991	2001
G70 Tracts (32)	58,009	1.09	1.43	1.74
G80 Tracts (32)	54,634	1.02	1.31	1.49
Elite Tracts (7)	123,928	1.07	1.50	2.50
All Innercity Tracts (159)	55,237	1.00	1.23	1.46
All CMA Tracts (598)	61,123	1.02	1.24	1.35

Table 21: Regression results for average household income against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Household Income	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	-0.106	**0.815**	**0.007**	**3.995**	0.206
1981 (log-lev)	**0.183**	ns	**0.962**	**0.011**	**3.927**	0.247
1991 (log-lev)	**0.355**	0.109	**1.193**	**0.014**	**4.020**	0.301
2001 (log-lev)	**0.510**	**0.211**	**1.494**	**0.014**	**4.048**	0.277
1971-1981 (lev-lev)	**0.216**	0.063	0.151	**0.005**	**0.937**	0.108
1981-1991 (lev-lev)	**0.217**	**0.194**	**0.296**	**0.004**	**1.094**	0.138
1991-2001 (lev-lev)	**0.171**	**0.107**	**0.356**	ns	**1.041**	0.066

n = 582

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 22: 1971 average individual income ($) and proportional change to 2001 by census tract sub-group

	1971	1981	1991	2001
G70 Tracts (32)	24,356	1.31	1.72	2.28
G80 Tracts (32)	21,647	1.17	1.53	2.00
Elite Tracts (7)	51,960	1.18	1.64	2.90
All Innercity Tracts (159)	23,117	1.16	1.39	1.82
All CMA Tracts (598)	25,108	1.10	1.27	1.44

Table 23: Regression results for average individual income against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Individual Income	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	**-0.155**	**0.728**	**0.007**	**3.318**	0.205
1981 (log-lev)	**0.266**	ns	**0.875**	**0.007**	**3.294**	0.223
1991 (log-lev)	**0.437**	**0.134**	**1.072**	**0.007**	**3.421**	0.253
2001 (log-lev)	**0.607**	**0.277**	**1.530**	**0.007**	**3.421**	0.268
1971-1981 (lev-lev)	**0.371**	**0.116**	**0.152**	ns	**0.982**	0.250
1981-1991 (lev-lev)	**0.215**	**0.222**	**0.249**	ns	**1.137**	0.167
1991-2001 (lev-lev)	**0.182**	**0.150**	**0.634**	ns	**1.017**	0.133

n = 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 24: Regression results for the natural log of average individual income against distance

	distance	*constant*	Adjusted R-Squared
1971	**0.007**	**3.312**	0.079
1981	**0.005**	**3.353**	0.032
1991	0.002	**3.535**	0.005
2001	ns	**3.594**	-0.002

n = 587

Table 25: 1971 average dwelling value ($) and proportional change to 2001 by census tract sub-group

	1971	1981	1991	2001
G70 Tracts (32)	178,023	1.86	2.24	2.25
G80 Tracts (32)	163,217	1.69	2.21	2.12
Elite Tracts (7)	282,982	2.55	3.23	3.11
All Innercity Tracts (159)	164,572	1.75	1.98	2.01
All CMA Tracts (598)	172,071	1.46	1.81	1.67

Table 26: Regression results for average dwelling value against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Dwelling Value	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	0.076	ns	**0.549**	0.002	**5.100**	0.038
1981 (log-lev)	**0.385**	ns	**1.135**	ns	**5.541**	0.176
1991 (log-lev)	**0.379**	ns	**1.220**	0.005	**5.565**	0.069
2001 (log-lev)	**0.404**	**0.186**	**1.197**	ns	**5.599**	0.194
1971-1981 (lev-lev)	**0.465**	ns	**0.840**	**-0.006**	**1.480**	0.101
1981-1991 (lev-lev)	ns	0.139	ns	**0.005**	**1.232**	0.020
1991-2001 (lev-lev)	ns	ns	ns	**-0.007**	**1.084**	0.015

n = 570 to 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 27: Regression results for natural log of average dwelling value against distance

			Adjusted R-Squared
	distance	*constant*	
1971	0.002	**5.110**	0.006
1981	**-0.005**	**5.547**	0.020
1991		**5.649**	-0.001
2001	**-0.006**	**5.720**	0.026

n = 570 to 587

Table 28: 1971 average gross rent and proportional change to 2001 by census tract sub-group

	1971	1981	1991	2001
G70 Tracts (32)	749	1.20	1.50	1.39
G80 Tracts (32)	720	1.14	1.50	1.33
Elite Tracts (7)	990	1.02	1.45	1.26
All Innercity Tracts (159)	737	1.07	1.31	1.25
All CMA Tracts (598)	769	1.03	1.24	1.22

Table 29: Regression results for average gross rent against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Gross Rent	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	**-0.143**	**0.242**	ns	**2.198**	0.039
1981 (log-lev)	**0.246**	ns	**0.297**	**0.007**	**2.160**	0.105
1991 (log-lev)	**0.320**	**0.160**	**0.506**	**0.008**	**2.321**	0.144
2001 (log-lev)	**0.209**	ns	**0.373**	**0.005**	ns	0.105
1971-1981 (lev-lev)	**0.318**	0.135	ns	**0.007**	**0.970**	0.068
1981-1991 (lev-lev)	0.089	**0.265**	**0.283**	ns	**1.188**	0.048
1991-2001 (lev-lev)	ns	ns	ns	ns	**0.973**	0.001

n = 579 to 584

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Descriptors of Dwelling Stock

The stage model of gentrification provides two major expectations regarding the dwelling stock in gentrifying neighbourhoods. First, a shift in tenure is expected, with conversion from rentals to ownership occurring during the late stages of gentrification. Second, development and redevelopment might be expected during the same time frame, as developers profit on the proven demand for housing in the area. Such activity might be expected to increase dwelling density and reduce proportion of single family dwellings. However, it has been suggested that this second expectation could be tempered by increased political power in gentrified neighbourhoods leading to anti-development activism (NIMBYism), which is sometimes expressed through implementation of historic neighbourhood designations (Filion 1991). It was found here that G70 and elite tracts increased in proportion of owner-occupied dwellings slightly faster than the rest of the inner city (table 30). This trend was not repeated in G80 tracts. However, the rates of increase in ownership in G70 and elite tracts were not significantly greater than in the CMA, given distance from the CBD (table 31). Despite this, elite tracts did have significantly high levels of ownership, given distance, throughout the study period (table 31). It was further found that gentrifying neighbourhoods underwent redevelopment at roughly the same pace as the rest of the inner city, as evidenced by a similar decline in single family dwellings and increase in dwelling density (tables 32 & 34). The rate of decline in the proportion of single family dwellings was significantly greater in G80 tracts than other CMA tracts between 1981 and 1991, while the rate of decline was significantly less in G70 tracts after 1991, given distance (table 33). It is possible that the resistance to further densification and redevelopment suggested by

Filion occurred after 1991 in G70 tracts. There was virtually no evidence of redevelopment or densification in the elite census tracts, further supporting his idea (tables 32 & 34). Neither gentrification nor the period after brought with it significant divergence with other parts of the city in terms of dwelling stock.

Gentrification was found to have no significant effect on density or density change. A look at changes across the region shows that the density gradient declined regardless. In the inner city, dwelling density increased over time; population density dropped during the 1970s, increasing slowly thereafter; and the proportion of single family dwellings dropped more quickly than in the CMA. These changes describe denser constructions on inner city land and a corresponding reduction in single family dwellings. At the same time, the inner city became home to more households, but fewer people, due to declining average household size. The fastest increases in dwelling and population densities were found in peripheral parts of the CMA (table 34 & 37). This caused the density function to flatten over time while simultaneously shifting upwards, a trend which is illustrated in figure 5 (and table 36). The upwards shift of the density function between 1971 and 2001 resulted from population growth causing the city to cover more land and to be developed more intensively. Income increases during the same period led to an indeterminate change in the gradient.[14] However, several other factors explain the observed reduction in the density gradient. Durable buildings and anti-development attitudes make it difficult to increase densities in the central city (even if there is pressure to do so) whereas low density development on farmers' fields is sufficient to drastically increase the gross density of a suburban tract. Also, fiscal and social problems in the

[14] Clark tells us that the density gradient should flatten as the cost of commuting becomes relatively less, which is an implicit acceptance of the fact that valuation of housing consumption dominates that of commute time – thus the impact of income change on the density gradient is uncertain.

inner city cause decentralization for reasons unrelated to income growth (Mieszkowski & Mills 1993).

Figure 5: Dwelling density by distance, Toronto CMA, 1971 to 2001

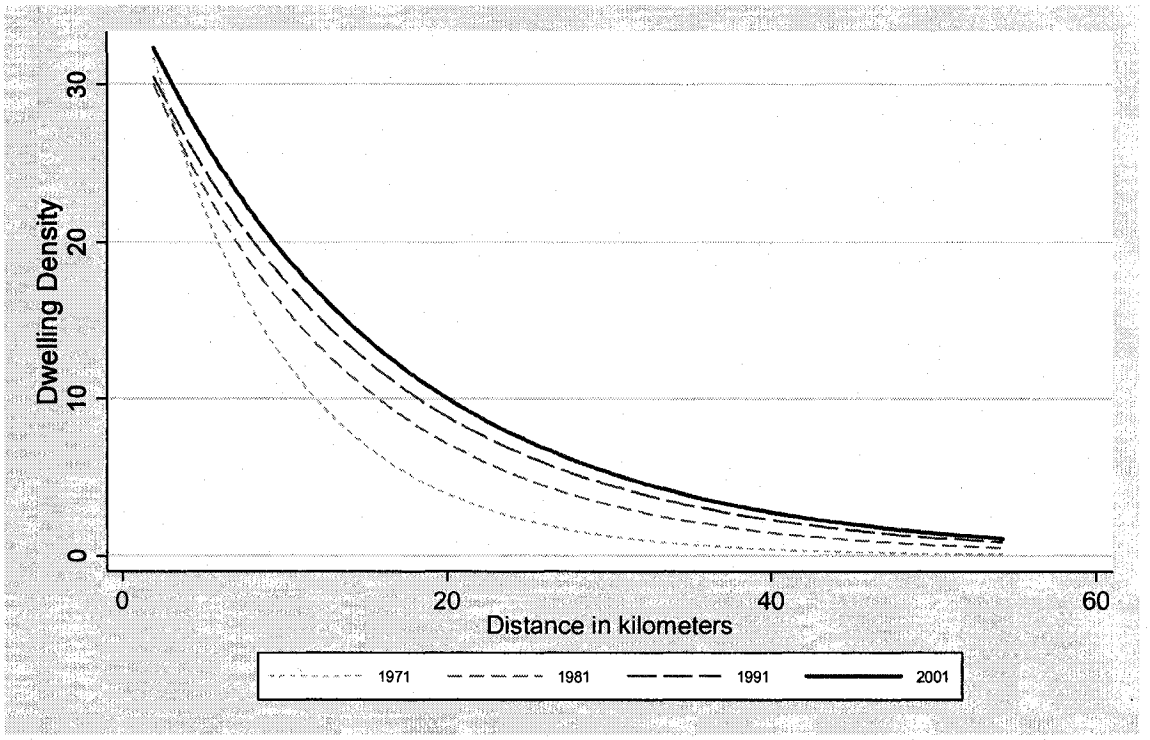


Table 30: 1971 proportion of owner occupied dwellings and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	47.7	1.02	0.99	1.04
G80 Tracts (32)	52.0	1.02	0.92	0.97
Elite Tracts (7)	58.3	1.08	1.14	1.19
All Inner city Tracts (159)	45.3	0.99	0.91	0.97
All CMA Tracts (598)	54.9	1.03	1.05	1.14

Table 31: Regression results for proportion owner occupied dwellings against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion Owned	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	ns	0.499	**0.029**	**3.461**	0.109
1981 (log-lev)	ns	ns	0.516	**0.026**	**3.530**	0.104
1991 (log-lev)	ns	ns	0.604	**0.026**	**3.489**	0.135
2001 (log-lev)	ns	ns	**0.547**	**0.023**	**3.609**	0.142
1971-1981 (lev-lev)	ns	ns	ns	ns	4.771	-0.004
1981-1991 (lev-lev)	ns	ns	ns	ns	**1.070**	0.003
1991-2001 (lev-lev)	ns	ns	ns	**-0.003**	**1.126**	0.014

n = 585 to 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 32: 1971 proportion of single family dwellings and proportional change to 2001 by census tract sub-group

(%)	1971	1981	1991	2001
G70 Tracts (32)	33.0	0.88	0.80	0.78
G80 Tracts (32)	29.4	0.98	0.82	0.78
Elite Tracts (7)	52.8	1.02	1.04	1.03
All Inner city Tracts (159)	28.2	0.90	0.81	0.80
All CMA Tracts (598)	45.9	0.88	0.95	0.95

Table 33: Regression results for proportion single family dwellings against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Proportion SFD	Coefficients					Adjusted
	G70	*G80*	*elite*	*distance*	*constant*	R-Squared
1971 (log-lev)	ns	ns	0.801	**0.045**	**2.973**	0.217
1981 (log-lev)	ns	ns	0.992	**0.040**	**2.830**	0.136
1991 (log-lev)	ns	ns	**1.091**	**0.042**	**2.739**	0.146
2001 (log-lev)	ns	ns	**1.189**	**0.046**	**2.615**	0.142
1971-1981 (lev-lev)	ns	ns	ns	ns	**0.858**	-0.003
1981-1991 (lev-lev)	ns	-0.135	ns	**0.008**	**0.873**	0.037
1991-2001 (lev-lev)	0.209	ns	ns	-0.005	**1.093**	0.024

n = 569 to 579

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 34: 1971 dwelling density and proportional change to 2001 by census tract sub-group

(units / km2)	1971	1981	1991	2001
G70 Tracts (32)	2,347	1.10	1.20	1.29
G80 Tracts (32)	2,487	0.99	1.11	1.27
Elite Tracts (7)	1,330	0.99	0.98	1.03
All Inner city Tracts (159)	2,403	1.06	1.16	1.27
All CMA Tracts (598)	202	1.36	1.70	2.02

Table 35: Regression results for dwelling density against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Dwelling Density	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	ns	ns	**-0.117**	**3.712**	0.524
1981 (log-lev)	ns	ns	ns	**-0.080**	**3.576**	0.398
1991 (log-lev)	ns	ns	-0.638	**-0.068**	**3.535**	0.361
2001 (log-lev)	ns	ns	-0.652	**-0.064**	**3.572**	0.368
1971-1981 (lev-lev)	ns	ns	ns	**0.269**	ns	0.079
1981-1991 (lev-lev)	ns	ns	ns	**0.042**	**0.645**	0.031
1991-2001 (lev-lev)	ns	ns	ns	**0.013**	**0.963**	0.023

n = 583

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Table 36: Regression results for natural log of dwelling density against distance

	distance	*constant*	Adjusted R-Squared
1971	**-0.116**	**3.680**	0.525
1981	**-0.080**	**3.555**	0.398
1991	**-0.069**	**3.550**	0.359
2001	**-0.065**	**3.600**	0.364

n = 583

Table 37: 1971 population density and proportional change to 2001 by census tract sub-group

(residents / km^2)	1971	1981	1991	2001
G70 Tracts (32)	7,154	0.83	0.87	0.90
G80 Tracts (32)	8,439	0.79	0.80	0.83
Elite Tracts (7)	4,025	0.86	0.85	0.85
All Inner city Tracts (159)	7,640	0.84	0.87	0.90
All CMA Tracts (598)	684	1.16	1.43	1.70

Table 38: Regression results for population density against tract type indicators and distance; cross-sectional regressions use log-level form, ratio regressions use level-level form

Population Density	Coefficients					Adjusted R-Squared
	G70	*G80*	*elite*	*distance*	*constant*	
1971 (log-lev)	ns	ns	ns	**-0.113**	**4.925**	0.511
1981 (log-lev)	ns	ns	-0.633	**-0.074**	**4.585**	0.362
1991 (log-lev)	ns	ns	-0.613	**-0.062**	**4.485**	0.317
2001 (log-lev)	ns	ns	-0.664	**-0.058**	**4.524**	0.318
1971-1981 (lev-lev)	ns	ns	ns	**0.245**	-1.173	0.079
1981-1991 (lev-lev)	ns	ns	ns	**0.046**	**0.552**	0.028
1991-2001 (lev-lev)	ns	ns	ns	**0.012**	**0.964**	0.021

n = 587

coefficients in **bold font** are different from 0 at the 1% significance level

coefficients in regular font are different from 0 at the 10% significance level

Discriminant Analysis

The regression analyses conducted in the previous sections described the effect of gentrification on each explanatory variable, allowing us to characterize the period of gentrification and the ensuing period, determine if gentrification in Toronto during the study period conformed to the specifications of the stage model, and investigate whether gentrification's effects were temporary or were part of a lasting change at the regional scale. However, the analyses conducted thus far provide no input regarding the relative importance of the explanatory variables in differentiating gentrifying neighbourhoods from other parts of the city. Therefore, linear discriminant analysis is used to look at the effects of all the variables taken together, determining which ones distinguish the most between G70 and other inner city tracts. The analysis is carried out for each decade and then on the changes in variables during each of the three decades making up the study period.

In 1971, G70 tracts were most differentiated from the rest of the inner city by their low levels of under-education and dwelling density and high average individual incomes and dwelling values (table 55). These were not downtrodden low income neighbourhoods. Studies using certain other definitions of gentrification would not have considered the transformation that occurred in the G70 tracts gentrification at all (Meligrana & Skaburskis 2005). It is possible that gentrification began before 1971 or that G70 tracts were always relatively well off due to their close proximity to elite neighbourhoods.

During gentrification (1971 to 1981), change in G70 tracts was most differentiated from change in the rest of the inner city by above average growth in

average individual income and in proportion of 25 to 39 year olds (table 56). Both of these characteristics are in keeping with the stage model of gentrification. By 1981, the function that maximized discrimination between G70 and other inner city tracts included ten variables (table 55). At the "gentrified" end of the dimension separating groups were young, university educated quaternary sector employees living in high-rent neighbourhoods characterized by non-family households. At the "ungentrified" end were under-educated, larger households living in single family dwellings in dense neighbourhoods. The discrimination between groups in 1981 (which was the strongest of all of our discriminant analyses) is defined more along the lines of status than income. This could be the result of G70 tracts having been defined by 1971-1981 increases in university education and quaternary sector employment, or could alternatively indicate that income is highly correlated with one or more of the variables that were included in the discriminant function. Regardless, the results are again in keeping with the stage model.

The post-gentrification period (1981 to 2001) was characterized by reduced discrimination between groups in the explanatory variables as a whole, as described by the R-squared statistics in tables 55 & 56. Despite this the discriminating power of status variables remained high (quaternary sector employment was the most important discriminating variable in 1991 and university degrees the most important a decade later). Likewise the discriminating power of income and housing cost variables: high individual income growth between 1981 and 1991 and high average household income levels in 1991 were important factors in the differentiation of G70 tracts. Both of these findings

support the interpretation of changes after gentrification as a continuance along the path set by the stage model.

Table 39: Discriminant functions reporting structure coefficients, 1971 to 2001

1971 $R^2 = 0.174$	**1981** $R^2 = 0.516$	**1991** $R^2 = 0.314$	**2001** $R^2 = 0.194$
Proportion with < Grade 9 Education (0.661)	Proportion Quaternary Employment (-0.536)	Proportion Quaternary Employment (0.846)	Proportion with University Degree (1.000)
Median Dwelling Value (-0.359)	Average Gross Rent (-0.470)	Average Gross Rent (0.650)	
Dwelling Density (0.258)	Proportion with University Degree (-0.446)	Average Household Income (0.383)	
Average Individual Income (-0.148)	Proportion Persons Aged 25-39 (-0.383)	Proportion of Non-Family Households (0.314)	
	Proportion with < Grade 9 Education (0.373)		
	Average Household Size (0.310)		
	Proportion of Non-Family Households (-0.219)		
	Population Density (0.160)		
	Dwelling Density (0.074)		
	Proportion Single Family Dwellings (0.028)		

Numbers below variable names are pooled within-groups correlations between discriminating variables and standardized canonical discriminant function

Table 40: Discriminant functions reporting structure coefficients – proportional change in variables by decade

1971 – 1981 $R^2 = 0.421$	**1981 – 1991** $R^2 = 0.285$	**1991 – 2001** $R^2 = 0.139$
Proportion Aged 25 to 39 (0.613)	Proportion Aged 25 to 39 (0.884)	Proportion Quaternary Employment (0.876)
Average Individual Income (0.563)	Average Individual Income (-0.613)	Proportion with < Grade 9 Education (0.445)

Summary

In this chapter, empirical evidence was compared to theoretical expectations provided by the stage model of gentrification and the monocentric city model in order to answer our four research questions. It was found that trends characteristic of gentrification generally continue afterwards; that observed changes during and after gentrification fit within the framework of the stage model; and that gentrification represented the leading edge of several changes at the regional scale.

Supporting the stage model, gentrification as defined by social status change was found to be accompanied by rapid displacement (declines in under-education, unemployment and immigrants); an increase of smaller households, non-family households and young adults; rapid income and housing cost increases; and some redevelopment.

These trends were generally found to continue in the post-gentrification period, which started in 1981 in the G70 tracts and 1991 in the G80 tracts. Gentrified tracts continued to pull away with regard to incomes. Displacement continued to occur. Ownership became more prevalent in G70 tracts. The exception is found in demographic terms: the prevalence of small households, non-family households and young adults that built up during gentrification declined afterwards. As gentrifying neighbourhoods become increasingly like elite neighbourhoods, perhaps small households, non-family households and young adults become disadvantaged relative to established families in the housing market.

Gentrification was found to represent the leading edge in several trends at the regional level. Income growth in gentrifying central neighbourhoods was found to be

representative of a new pattern of location by income. The housing price curve also steepened despite income growth in Toronto. These events may have been caused by a shift in the relative valuation of housing consumption and commute time in location decisions. Density increased faster in the suburbs than in the inner city, despite evidence of a new relationship between commuting and demand for housing. This likely resulted from the fact that several factors other than income growth contribute to decentralization.

CHAPTER 5: CONCLUSIONS

Introduction

This thesis explores change that occurs after gentrification, and its relation to and implications for broader urban change. This is achieved primarily through the comparison of empirical evidence from Toronto, Canada with theoretical expectations derived from gentrification theory and neo-classical economic theory. The explanatory approach is structured as a series of four research questions:

1) What happens after a neighbourhood goes through the gentrification process?
2) How does an already gentrified neighbourhood compare to a gentrifying neighbourhood?
3) Are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process?
4) Do the effects of gentrification dissipate over time, or are they instead part of a lasting regime of change evidenced across a region?

In this chapter, the four research questions are answered, drawing from theoretical and empirical evidence. Afterwards, the relevance of the thesis' findings for planning policy and future research are discussed.

Findings

In this section the findings are presented within the framework of the four research questions that have guided this thesis. The answers to the first two questions are purely empirical in nature, while the answers to the last two require the comparison of empirical evidence with theoretical expectations.

It is useful to characterize the changes that occur in a neighbourhood *after* the period during which it gentrified so that they can be contrasted with gentrification itself and examined for consistency with theoretical frameworks. The discussion of changes occurring after gentrification is of little use without comparison to changes characteristic of gentrification itself. Therefore the first two research questions are answered together.

What happens after a neighbourhood goes through the gentrification process and how does an already gentrified neighbourhood compare to a gentrifying neighbourhood?

Our findings indicate that gentrification was characterized by increases in status (university education and quaternary employment), incomes (individual and household), housing costs (dwelling value and gross rent), displacement (declines in under-education, unemployment and immigrants) and redevelopment (increasing dwelling density and decreasing prevalence of single family dwellings); declining population density; and demographic change (smaller households, more non-family households and young adults). Many of these changes occurred faster in gentrifying than other areas, and by the end of gentrification (1981 for G70 tracts; 1991 for G80 tracts) gentrified neighbourhoods were highly differentiated from the rest of the city. When the effect of distance was accounted for, G70 and G80 tracts generally had higher levels of status, incomes and housing costs; significantly lower levels of under-education, unemployment and immigrants (indicative of displacement); smaller households; and higher proportions of non-family households and 25 to 39 year olds. There was no significant differentiation in terms of density or tenure. The most important variables in discriminating between G70 and other inner city neighbourhoods in 1981 were the higher proportions of quaternary employment and university education, higher average gross rent and

proportion of 25 to 39 year olds, the lower proportion with less than a grade 9 education, and the smaller average household size.

The period after gentrification was also characterized by increasing status levels, incomes, housing costs, displacement and redevelopment, but rates of increase were not always greater in G70 and G80 tracts than in other areas. Some of the differences resulting from gentrification grew more pronounced afterwards and others were only maintained. Some differences were notably absent. In only one respect did gentrification related trends change markedly during the post-gentrification period.

Two major differences between gentrified and ungentrified neighbourhoods became more pronounced after gentrification. Gentrified neighbourhoods outpaced other parts of the city in terms of income growth both during and after gentrification. Growth in average individual income was the second most influential variable in discriminating between change in G70 and other tracts between 1971 and 1991. Similarly, the uncommonly rapid displacement of earlier residents that occurred during gentrification continued in some ways afterwards. Thus, in certain ways, the differentiation brought about by gentrification was found to become more important afterwards.

Two other major differences between gentrified and ungentrified neighbourhoods were maintained after gentrification. Social status increased steadily across the region between 1971 and 2001. Gentrification was characterized by faster than average status increases, but afterwards, increases in gentrified neighbourhoods were consistent with change in the region as a whole.[15] Similarly, housing costs grew faster in gentrifying neighbourhoods than in other parts of the city, but grew apace with the region afterwards.

[15] Relatively high status increases in gentrifying tracts are to be expected as gentrification was defined in terms of change in proportion of degree holders and proportion of quaternary sector employees

Therefore, some of the differentiation that resulted from gentrification was preserved afterwards, but did not increase.

Differences between the built environments of gentrified and ungentrified neighbourhoods were not found to be statistically significant. Redevelopment proceeded steadily in the inner city between 1971 and 2001 but it did not occur at a significantly different rate in gentrifying neighbourhoods. The same is true of change in population density, which declined at a similar rate in neighbourhoods undergoing gentrification as in other neighbourhoods. These trends were true of the post-gentrification period as well. Exceptional change in the built environment was not characteristic of either gentrification or the period following.

Finally, one major difference between gentrified and other neighbourhoods was found to dissipate after gentrification. An increase in smaller households, non-family households and young adults occurred in gentrifying neighbourhoods and differentiation from the rest of the city was important at the end of gentrification, but declined substantially after. In fact the speeds with which young adults moved into and then out of G70 tracts made this the most important variable in discriminating between change in G70 and other inner city tracts between 1971 and 1991. Thus, in some ways the differentiation brought about by gentrification was found to fade with time.

Are the changes associated with gentrification and the post-gentrification period in keeping with theoretical formulations of the process?

The literature on the stage model of gentrification details the way in which gentrifying neighbourhoods become increasingly wealthy, expensive and exclusive over time as original residents are continuously displaced by incomers with higher status and

incomes. Often displacement is accompanied by tenure change as owners replace renters. In the later stages, redevelopment may or may not occur. Developers seek to capitalize on the proven popularity of the neighbourhood, but resident associations may attempt to preserve the neighbourhood (in the form that made it popular). There is no evidence in the literature of any reason for neighbourhood upgrading to stop. Some researchers have even found evidence of a second round of gentrification during which earlier gentrifiers are displaced. Gentrification may continue to the point where new elite neighbourhoods result.

Stage model theory led us to hypothesize that the post-gentrification period would represent a continuation of gentrification. This hypothesis was generally supported by empirical evidence. Change during gentrification and the period after followed the pattern set forth in the stage model: status, incomes and housing costs increased steadily between 1971 and 2001, while displacement was continuous. Redevelopment occurred throughout the study period. However, these changes were not limited to gentrifying tracts. The entire inner city underwent change consistent with the stage model of gentrification, as did the region as a whole. Gentrifying neighbourhoods stand separated from other neighbourhoods only by the rate at which these changes occurred. Therefore, change *relative to the rest of the city* is more valuable in contrasting empirically evidenced change with stage model theory. While income growth and displacement continued to occur at greater-than-average rates after gentrification, status levels and housing costs grew only at average rates. Change in the built environment took place at average rates during both gentrification and afterwards. Demographic change was extensive during gentrification but receded afterwards. When relative change is

considered, conformity of our findings with the stage model is less precise. The lack of continuing differentiation between gentrified and other neighbourhoods after gentrification may be the result of the next wave of gentrification beginning in other sets of inner city neighbourhoods.

Do the effects of gentrification dissipate over time, or are they instead part of a lasting regime of change evidenced across a region?

One of the classic predictions of the monocentric city model is that income varies positively with distance from the centre. Rising incomes result in both an increase in demand for housing and a countering increase in the cost of commuting. In predicting that incomes rise with distance, Mills assumed that increased demand for housing was the dominant effect. However, there is evidence to the contrary. Since 1970, demographic and lifestyle factors may have increased the importance of commuting time relative to consumption of housing in the location decisions of households. Our analysis supports this. The function describing individual income over distance went from being positively sloped in 1971 to flat in 2001. The lack of a similar rotation of the household income function is explained by the increasing concentration of smaller households at the centre. Gentrification as specified by the stage model was found to be an important factor in the changing income distribution: when gentrified and elite neighbourhoods were accounted for in the analysis, the individual income function was found to be upward sloping and unchanging between 1971 and 2001.

Another classic prediction of the monocentric city model describes the effect of income growth on the housing price-distance curve. Mills showed that the slope of the curve is equal to the negative of commute cost over quantity of housing consumed. If

increased demand for housing is the dominant effect of rising income, the housing price profile should flatten as income rises. If increased commuting costs are the dominant effect, the housing price-distance curve should become steeper. Our results again support commuting costs as the dominant effect of rising incomes on location choice. Toronto's housing price curve grew steeper between 1971 and 2001 despite steadily increasing income levels. Gentrification as described by the stage model was again found to be very important: when gentrifying and elite neighbourhoods were excluded from the analysis, the housing price-distance curve was found to have a positive slope and to steepen over time.

A third prediction of the monocentric model describes decentralization over time. Clark showed that the density function has a negative exponential form. He found that density gradients vary with the ratio of commute cost to income, and observed that this ratio declined over time, and that the density function flattened accordingly. This decentralization over time has been described as one of the strongest empirical regularities relating to urban spatial structure. However, the findings regarding income and housing price distributions imply that income increases should have resulted in an increase in the density gradient. This was not supported by our findings, as Toronto's density gradient declined during the study period. This lack of consistency with expectations provided by theory can be explained in a number of ways. Firstly, any upward pressure on the density gradient resulting from the increased relative importance of commute costs would tend to lag in its expression due to the durability of centrally located buildings and development controls. Secondly, findings may be impacted by the use of gross rather than net densities in the analysis. The presence of vast expanses of

undeveloped land in earlier census years could result in artificially low measurements of peripheral density and artificially high density gradients. These inflated density gradients would be almost certain to decline over time as the vacant land is developed. Further, transport costs may have decreased for everyone as a result of improved roads and transit. A fourth factor potentially influencing the density function involves the social problems characteristic of inner cities and the fiscal benefits of location in separate suburban municipalities. Regardless of the reasons for continuing decentralization, gentrification as specified by the stage model was not found to be important in density change. Gentrifying neighbourhoods showed evidence of neither exceptionally high nor low amounts of redevelopment or densification.

Changes characteristic of gentrification did not fade over time but were instead part of a lasting regime of change evidenced across the region. Gentrification was not influential in urban structural change. Gentrified tracts were part of the same pattern of decentralization as the rest of the city. With regard to the distribution of incomes and housing prices, however, gentrification was found to be representative of a new pattern. Successive changes occurring in one group of neighbourhoods after another over time have led to steady change in the region-wide income and housing price profiles.

Relevance for Planning Policy

The findings of this thesis have two major implications for planning policy. The first has to do with the effects of gentrification on displaced residents and the supply of affordable housing. The second has to do with the potential for gentrification to result in an inefficient distribution of density in an urban area.

The first set of implications follow from the fact that gentrification shows no sign of slowing. It seems plausible that gentrification will eventually spread to affect the entire inner city as it is representative of a vast urban restructuring (Newman & Wyly 2006). An exception might be made for neighbourhoods that contain large social housing projects if these weren't being rapidly redeveloped, usually to include market as well as non-market housing (Newman & Wyly 2006). The extensive gentrification of our central cities will lead to widespread displacement, and may also result in a shortage of affordable housing. Affordable housing is traditionally produced by the public sector and through the market process of filtering – the increase in affordability over time of a dwelling suffering physical depreciation and functional obsolescence. However, governments have increasingly withdrawn from the provision of affordable housing and gentrification has been found to reverse the production of affordable housing through filtering (Skaburskis 2006). There is mounting concern that the current and future supplies of central affordable housing are inadequate. This concern is especially poignant when it is considered that people with low incomes may rely for their well-being on government services such as public transit that are primarily available in central cities (Glaeser et al 2006).

The second major implication of extensive gentrification for planning policy relates to development controls. It has been suggested that residents in gentrified neighbourhoods sometimes use collective political action in order to limit change in their areas (Filion 1991). Residents' expectations of an unchanging built environment are sometimes encouraged and reinforced by long-standing low-density zoning policies (Skaburskis 1989). Inappropriate zoning policies and anti-development actions have

been found to entrench troughs in the density-distance profile over time. These can result in inefficient density distributions that require more commuting than necessary (Skaburskis 1989). In this age of environmental concern especially, it is desirable to avoid unnecessary use of motor vehicles.

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APPENDICES

Appendix 1: Means and Standard Deviations By Tract Type and Year

Table 41: Means and standard deviations of descriptors of dwelling stock, by tract type and year
A_ DESCRIPTORS OF DWELLING STOCK

G70 Tracts (32)	1971	1981	1991	2001
% owned	**44.1**	**47.5**	**48.7**	**52.4**
	(16.3)	(20.8)	(18.0)	(18.7)
% SFD	**29.0**	**26.0**	**24.8**	**26.3**
	(19.1)	(20.1)	(19.8)	(20.8)
% pre-1946	**74.2**	**59.9**	**53.3**	**49.6**
	(19.8)	(26.1)	(26.8)	(25.9)
dwelling density (units / km^2)	**2,481**	**2,858**	**3,176**	**3,450**
	(1,027)	(1,496)	(1,531)	(1,705)
population density (units / km^2)	**7,619**	**6,455**	**6,852**	**7,279**
	(3,305)	(3,081)	(2,764)	(3,202)
G80 Tracts (32)				
% owned	**49.0**	**50.6**	**47.0**	**50.6**
	(21.6)	(24.2)	(19.8)	(18.1)
% SFD	**26.2**	**25.8**	**22.5**	**23.5**
	(18.3)	(19.8)	(20.1)	(19.3)
% pre-1946	**79.4**	**68.9**	**62.2**	**58.9**
	(18.1)	(21.1)	(22.1)	(22.6)
dwelling density (units / km^2)	**2,718**	**2,663**	**3,008**	**3,430**
	(1,239)	(1,113)	(1,097)	(1,366)
population density (units / km^2)	**9,417**	**7,313**	**7,439**	**7,864**
	(4,471)	(3,100)	(2,669)	(2,720)
Elite Tracts (7)				
% owned	**63.7**	**67.2**	**70.1**	**73.1**
	(17.5)	(14.5)	(12.7)	(11.1)
% SFD	**59.4**	**60.3**	**61.5**	**61.0**
	(20.2)	(20.2)	(20.3)	(20.5)
% pre-1946	**79.1**	**74.8**	**73.2**	**69.1**
	(13.8)	(15.0)	(14.6)	(16.9)
dwelling density (units / km^2)	**1,328**	**1,322**	**1,308**	**1,376**
	(342)	(370)	(394)	(450)
population density (units / km^2)	**4,093**	**3,557**	**3,542**	**3,581**
	(826)	(750)	(864)	(945)
All Inner city Tracts (159)				
% owned	**48.2**	**50.1**	**46.3**	**49.1**
	(21.8)	(23.6)	(20.2)	(20.2)
% SFD	**28.7**	**27.3**	**24.8**	**25.7**
	(20.1)	(21.1)	(21.0)	(20.9)
% pre-1946	**69.8**	**59.7**	**53.1**	**48.5**
	(24.6)	(25.1)	(23.8)	(23.4)
dwelling density (units / km^2)	**3,131**	**3,361**	**3,696**	**4,026**
	(2,790)	(3,203)	(3,302)	(3,447)
population density (units / km^2)	**9,786**	**8,250**	**8,655**	**9,134**
	(5,786)	(5,300)	(5,940)	(6,762)
All CMA Tracts (598)				

% owned	**59.5**	**60.8**	**58.1**	**60.6**
	(22.9)	(25.0)	(23.4)	(23.2)
% SFD	**50.9**	**44.9**	**43.8**	**42.7**
	(27.5)	(29.4)	(29.3)	(28.3)
% pre-1946	**28.0**	**22.6**	**20.1**	**18.1**
	(31.5)	(28.7)	(25.8)	(23.9)
dwelling density (units / km^2)	**1,444**	**1,757**	**1,941**	**2,098**
	(1,878)	(2,108)	(2,212)	(2,334)
population density (units / km^2)	**4,676**	**4,675**	**4,935**	**5,303**
	(4,726)	(4,138)	(4,441)	(4,922)

Table 42: Means and standard deviations of descriptors of income and housing costs, by tract type and year

B_ DESCRIPTORS OF INCOME AND HOUSING COSTS

G70 Tracts (32)	**1971**	**1981**	**1991**	**2001**
avg household income ($)	**58,443**	**66,349**	**88,978**	**108,474**
	(17,103)	(16352)	(27,487)	(36,375)
avg individual income ($)	**28,799**	**37,605**	**51,254**	**61,547**
	(7,954)	(10,053)	(16,799)	(20,998)
avg dwelling value ($)	**183,935**	**359,514**	**426,771**	**418,998**
	(43,685)	(118,745)	(162,331)	(115,003)
avg gross rent ($)	**755**	**979**	**1,251**	**1,106**
	(150)	(236)	(327)	(197)
G80 Tracts (32)				
avg household income ($)	**50,473**	**51,546**	**70,173**	**80,494**
	(10,855)	(18,773)	(22,171)	(26,666)
avg individual income ($)	**23,952**	**27,995**	**38,052**	**44,041**
	(5,345)	(10,461)	(14,340)	(16,566)
avg dwelling value ($)	**161,795**	**250,447**	**341,858**	**332,672**
	(40,439)	(135,006)	(150,031)	(160,827)
avg gross rent ($)	**651**	**753**	**1,063**	**952**
	(114)	(209)	(261)	(186)
Elite Tracts (7)				
avg household income ($)	**119,396**	**138,889**	**194,876**	**307,989**
	(14,458)	(21,139)	(34,085)	(89,689)
avg individual income ($)	**57,096**	**67,386**	**93,141**	**153,926**
	(4,101)	(6,367)	(8,423)	(56,521)
avg dwelling value ($)	**289,527**	**725,757**	**918,912**	**896,528**
	(29,499)	(106,369)	(155,601)	(137,558)
avg gross rent ($)	**937**	**1,026**	**1,521**	**1,307**
	(150)	(200)	(404)	(244)
All Inner city Tracts (159)				
avg household income ($)	**52,914**	**56,532**	**71,429**	**86,053**
	(14,929)	(23,354)	(35,279)	(60,403)
avg individual income ($)	**26,079**	**30,491**	**38,701**	**46,165**
	(7,421)	(12,217)	(18,673)	(32,377)
avg dwelling value ($)	**163,223**	**276,828**	**348,146**	**337,657**
	(47,022)	(152,724)	(183,233)	(176,292)
avg gross rent ($)	**686**	**788**	**1,023**	**940**
	(136)	(212)	(285)	(217)
All CMA Tracts (598)				
avg household income ($)	**62,339**	**64,255**	**76,738**	**83,537**
	(15,821)	(25,338)	(29,582)	(47,310)
avg individual income ($)	**31,133**	**31,758**	**37,422**	**40,001**

	(7,522)	(9,586)	(13,372)	(23,131)
avg dwelling value ($)	**175,799**	**253,387**	**326,964**	**299,438**
	(41,360)	(116,391)	(157,887)	(144,049)
avg gross rent ($)	**766**	**835**	**1,027**	**968**
	(158)	(234)	(287)	(244)

Table 43: Means and standard deviations of descriptors of demographics, by tract type and year
C_ DESCRIPTORS OF HOUSEHOLDS AND DEMOGRAPHICS

G70 Tracts (32)	**1971**	**1981**	**1991**	**2001**
avg household size	**2.90**	**2.23**	**2.17**	**2.13**
	(0.42)	(0.39)	(0.31)	(0.32)
% non-family households	**36.3**	**47.3**	**48.4**	**45.6**
	(12.7)	(13.3)	(10.1)	(11.5)
% aged 25 to 39	**23.1**	**32.2**	**32.8**	**29.9**
	(4.6)	(3.4)	(4.7)	(6.4)
% immigrants	**38.8**	**34.9**	**30.8**	**31.5**
	(9.2)	(9.7)	(8.4)	(10.9)
G80 Tracts (32)				
avg household size	**3.32**	**2.64**	**2.39**	**2.26**
	(0.68)	(0.57)	(0.37)	(0.34)
% non-family households	**29.9**	**40.5**	**44.4**	**44.5**
	(15.8)	(18.2)	(12.5)	(11.1)
% aged 25 to 39	**20.8**	**27.3**	**33.3**	**32.2**
	(4.2)	(5.2)	(4.9)	(7.2)
% immigrants	**43.2**	**42.1**	**34.7**	**34.0**
	(12.4)	(12.0)	(8.2)	(8.0)
Elite Tracts (7)				
avg household size	**3.06**	**2.72**	**2.74**	**2.64**
	(0.38)	(0.39)	(0.41)	(0.41)
% non-family households	**28.5**	**32.4**	**31.6**	**29.6**
	(8.8)	(10.8)	(11.9)	(11.6)
% aged 25 to 39	**17.8**	**20.6**	**21.0**	**17.6**
	(3.0)	(2.8)	(3.6)	(2.5)
% immigrants	**23.2**	**22.3**	**19.6**	**20.8**
	(5.2)	(3.6)	(4.4)	(3.4)
All Inner city Tracts (159)				
avg household size	**3.24**	**2.64**	**2.47**	**2.37**
	(0.73)	(0.65)	(0.51)	(0.44)
% non-family households	**29.7**	**39.2**	**42.4**	**41.6**
	(16.0)	(17.9)	(14.6)	(13.1)
% aged 25 to 39	**22.6**	**27.4**	**32.0**	**30.0**
	(5.0)	(6.3)	(5.8)	(6.9)
% immigrants	**42.7**	**42.3**	**39.0**	**39.9**
	(12.4)	(13.5)	(12.4)	(13.1)
All CMA Tracts (598)				
avg household size	**3.49**	**2.93**	**2.78**	**2.74**
	(0.57)	(0.57)	(0.52)	(0.49)
% non-family households	**16.4**	**24.3**	**28.3**	**28.0**
	(13.1)	(16.2)	(15.1)	(13.7)
% aged 25 to 39	**22.0**	**24.8**	**27.6**	**24.5**
	(5.0)	(6.1)	(5.9)	(6.2)
% immigrants	**32.0**	**36.7**	**38.6**	**43.5**
	(11.1)	(11.4)	(19.2)	(24.3)

Table 44: Means and standard deviations of descriptors of status, by tract type and year
D_ DESCRIPTORS OF STATUS - EDUCATION AND EMPLOYMENT

G70 Tracts (32)	1971	1981	1991	2001
% with university degree	**10.3**	**26.9**	**38.1**	**47.6**
	(6.1)	(9.0)	(10.0)	(9.1)
% with < grade 9	**24.9**	**12.3**	**6.6**	**3.9**
	(11.9)	(7.0)	(4.9)	(3.5)
% quaternary employment	**23.5**	**46.6**	**55.4**	**70.6**
	(11.0)	(9.6)	(8.7)	(9.1)
% unemployment	**8.2**	**3.9**	**6.9**	**5.1**
	(3.6)	(1.4)	(2.8)	(2.1)
G80 Tracts (32)				
% with university degree	**6.9**	**14.1**	**27.5**	**37.4**
	(7.8)	(8.8)	(11.1)	(10.6)
% with < grade 9	**37.2**	**23.5**	**12.7**	**8.7**
	(13.7)	(10.5)	(6.8)	(5.0)
% quaternary employment	**15.7**	**27.0**	**44.2**	**62.6**
	(11.5)	(11.7)	(10.5)	(9.2)
% unemployment	**9.9**	**5.3**	**9.1**	**5.8**
	(3.7)	(2.5)	(3.5)	(2.6)
Elite Tracts (7)				
% with university degree	**28.3**	**41.0**	**50.5**	**60.3**
	(3.4)	(3.4)	(4.5)	(4.7)
% with < grade 9	**7.1**	**2.4**	**1.1**	**0.8**
	(2.4)	(1.3)	(0.6)	(0.8)
% quaternary employment	**48.1**	**58.7**	**64.4**	**79.5**
	(4.3)	(5.4)	(3.9)	(3.7)
% unemployment	**4.6**	**3.8**	**5.0**	**4.4**
	(0.8)	(1.4)	(1.0)	(1.8)
All Inner city Tracts (159)				
% with university degree	**7.9**	**16.1**	**24.4**	**33.0**
	(8.6)	(12.6)	(15.1)	(16.7)
% with < grade 9	**34.8**	**22.8**	**15.4**	**10.9**
	(17.2)	(14.2)	(11.7)	(9.0)
% quaternary employment	**17.6**	**29.3**	**39.0**	**54.8**
	(13.8)	(17.4)	(16.6)	(18.6)
% unemployment	**8.7**	**4.6**	**10.0**	**6.4**
	(3.2)	(1.8)	(3.9)	(2.6)
All CMA Tracts (598)				
% with university degree	**6.8**	**11.8**	**18.2**	**24.5**
	(6.0)	(9.0)	(15.8)	(18.3)
% with < grade 9	**24.7**	**16.5**	**12.1**	**9.2**
	(13.3)	(10.5)	(8.5)	(7.0)
% quaternary employment	**19.7**	**26.9**	**33.7**	**4.7**
	(10.6)	(12.9)	(26.4)	(15.5)
% unemployment	**6.7**	**4.0**	**8.8**	**6.2**
	(2.5)	(1.5)	(3.3)	(2.4)

Appendix 2: Gentrification Maps

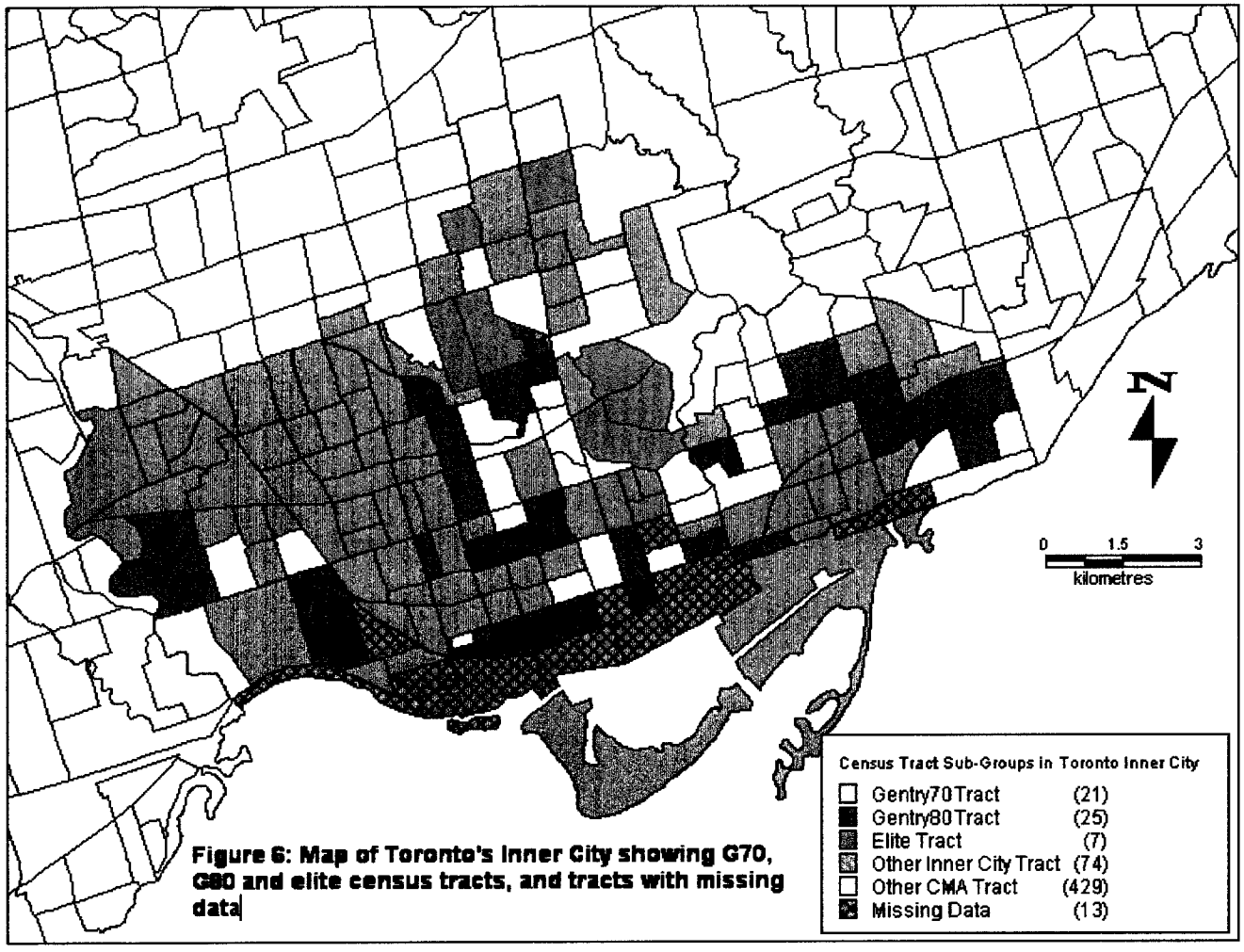

Figure 6: Map of Toronto's Inner City showing G70, G80 and elite census tracts, and tracts with missing data

Figure 7: Map of 1981 Toronto CMA Census Tracts, showing Inner City