

Economic and Social Attributes of Sold Homes Inside a House Price Bubble in Two Inner-City Neighbourhoods since 2020

Alan G. Phipps

Department of Sociology and Criminology, University of Windsor, Windsor, Canada
Email: phipps@uwindsor.ca

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Abstract

The types, times and locations of sold homes during a house price bubble are compared with those observed before the bubble in a neighbourhood. Hypotheses are about homes' different prices, attributes, times sold, locations, and social utilities. Economic and social data for sold houses in two inner-city neighbourhoods in Windsor, ON, are statistically analyzed and mapped. A hybrid housing price model's statistically significant coefficients for time of sale or resale predict the beginning of a house price bubble at a conversion point in early 2020 in the neighbourhoods. The hybrid model's additional coefficients for home and neighbourhood attributes confirm that bubble higher house prices exceeded predicted gains from home improvements or neighbourhood changes. Sold houses during the bubble were more likely repeated and sooner resales of slightly less desirable single-detached(-like) houses from a resident's point of view than those before it. Bubble prices of some homes and not others should clarify policymakers' post-bubble priorities.

Keywords

Bubble, House Prices, Hybrid Housing Price Model, Inner City, Social Utilities

1. Introduction

This study was inspired by published stories of unprecedented changes in prices and sales of homes in a local market (e.g., [Waddell, 2024](#)). Real estate professionals' reported reasons for these changes in Windsor, ON, were out-of-towners' discovery of the quality and affordability of life in the area, the migration of retirees and mobile or remote workers from Toronto, the growing numbers of interna-

tional students coming and staying on, and large-scale investors from Toronto, Montreal and Vancouver “doing bigger things” (Waddell, 2022). Note the COVID-19 pandemic was not reported as a factor in these house price changes (cf., Doruk, 2024). The subsequent speculation was whether this would be the beginning of a long-term sustainable trend or a short-term bubble in prices and sales (e.g., Burnside, Eichenbaum, & Rebelo, 2016; Case & Shiller, 2003; Mayer, 2011; McKnight, 2021). A long-term upward trend is related to sustainable market conditions and it will continue favourably for providers and sellers though not for buyers (Hanweck, 2020). Alternatively, a bubble occurs in a neighbourhood when sold homes’ increasing prices and then decreasing ones are related not to the quality and quantity of those homes but rather to people’s expectations of future sale prices (Brzezicka, 2021; Shiller, 2016).

The occurrence of a house price bubble is before-the-fact unpredictable and so the research question is whether the types, times and locations of sold homes inside the bubble are predictable after-the-fact besides their inflated sale prices. Bubble prices of some homes and not others will provide different opportunities and constraints for residents. This complements the recent literature’s emphasis on detecting the occurrence of a house price bubble at various geographic scales (e.g., Bangura & Lee, 2022; Basco, 2018; Bourassa, Hoesli, & Oikarinen, 2019; Caspi, 2016; Chen & Chiang, 2021; Coskun et al., 2020; Martin, 2011; Phillips & Shi, 2018). This detection is salient for residents and investors if it soon exposes inflating prices sending false signals to them. Otherwise, residents who want to live somewhere, or investors who want to sell or rent to them, may impulsively enter the market with the hope of not paying more to move in or recouping financial gains before it is too late, respectively. Residents who already live there may worry about selling and moving before it is too late or remaining with new and different neighbours than them. The detection of the occurrence of a house price bubble will not necessarily differentiate between types of houses that have bubble prices or not (cf., Lai & Van Order, 2010).

Bubble prices of some homes and not others will clarify policymakers’ post-bubble priorities. Homes’ sale prices rarely decline as quickly and as much as they increased at the beginning of a bubble. Owner-occupants have a stronger aversion than investors to a loss from reducing their listing price below their original purchase price (Andersen et al., 2022; Genesove & Mayer, 2001). Meanwhile, newly increased rents synchronized with sale prices may still be slow to adjust. Prioritized public policy options for improving affordability of rental and owned housing after a price bubble’s burst may include, respectively, financial incentives and waived municipal regulations for builders of rental housing, and high-ratio financing and conditional subsidies for first-time owner-occupants (e.g., Ahn et al., 2024; Evanoff & Malliari, 2018; Glaeser & Nathanson, 2015).

This study accordingly analyzes the trends in prices and types of sold houses inside a house price bubble since 2020 in the Glengarry (G) and Wellington-Crawford (WC) inner-city neighbourhoods in Windsor, ON (Figure 1 on

<https://alanorpaulinehipps.ca/courses/np/gwcmaps.html>). These houses' data are at the end of the first dataset including the sale prices and attributes of approximately 3100 sold single-detached(-like) houses since 1986 in the two neighbourhoods. Each home is described with the attributes of its dwelling unit, neighbourhood environment and residents, and location at times of sale and resale. In addition to calculating the types of sold homes during the bubble from these data, there are also the times of the previous sale of each home and its changed attributes if it has them.

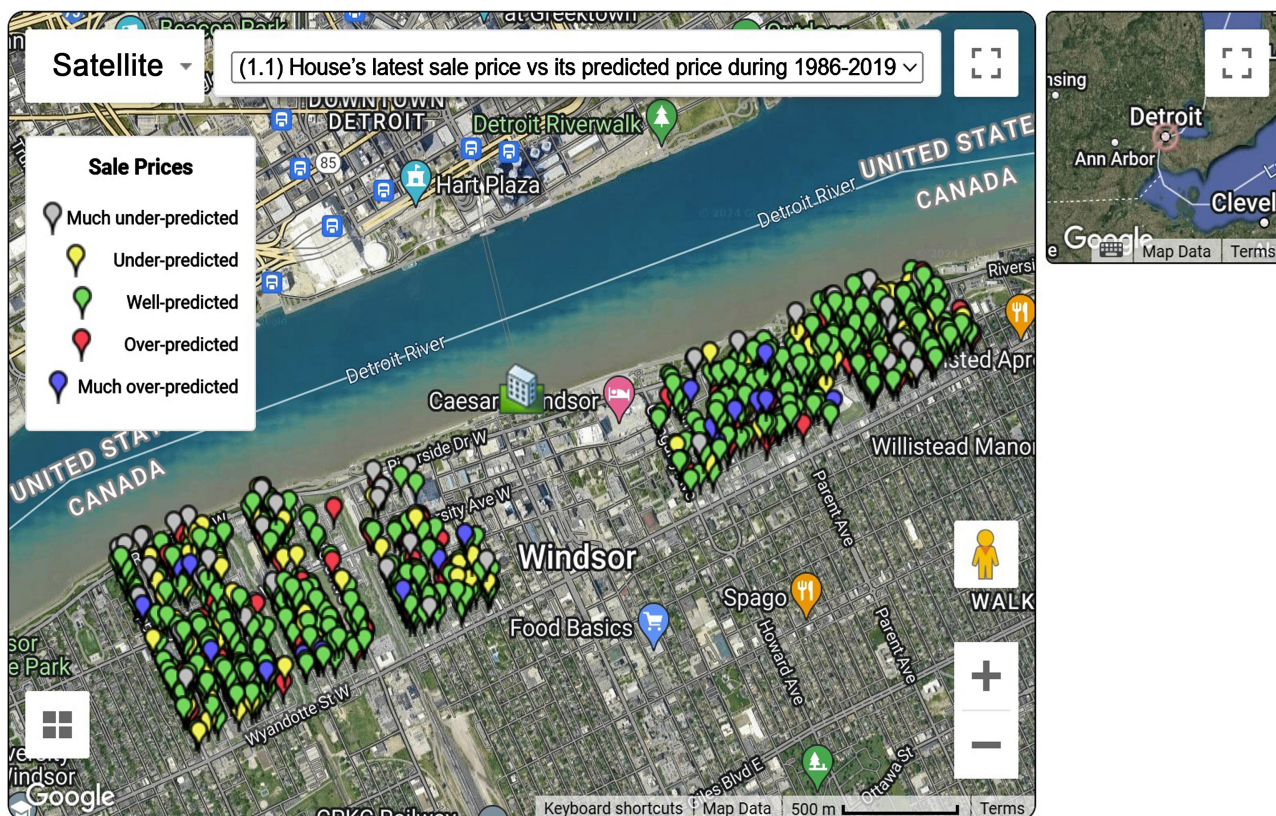


Figure 1. Sold houses in the Glengarry and Wellington-Crawford neighbourhoods in Windsor, ON. Source: Figure programmed by author.

Each home's desirability from a resident's point of view supplements these economic data in the second dataset. Its predicted overall utility is calculated from the social utilities of 74 inner-city residents for the attributes of single-detached(-like) houses located inside and outside the two inner-city neighbourhoods in 2020. These social utilities of family-oriented residents may differ from the more economic ones of investors.

Section 2 synthesizes these economic and social points of view in a theory of the type, time and location of sold houses in a price bubble. After explaining the data and methods for testing hypotheses from this theory in Section 3, the results of these tests are in Section 4. The key results are that, compared to earlier sold homes, they were more likely repeat-sold ones rather than once-sold ones, ten-

anted ones as opposed to owner-occupied ones, and undesirable rather than desirable ones from a resident's utilitarian point of view. Section 5 concludes with four consequences of the price bubble for homes in the two neighbourhoods. Heretofore, these homes have been gateways to affordable ownership or renting of a single-detached(-like) home instead of a condominium or apartment in a building. Their monthly average sale prices have historically been approximately two-thirds of the monthly average sale prices in the broader Windsor-Essex area.

2. Theory

2.1. Changes in House Prices

A short-term trend of a house price bubble begins at a conversion point when homes' surging prices diverge from their long-term trend; this short-term trend ends when sinking prices resume the past long-term trend or begin a new one (Brzezicka, 2016, 2021). Bubble priced homes should, therefore, be distinctive from those having four long-term price, temporal and geographical baselines in a previously published hybrid housing price model (Phipps, 2023). This model had data of approximately 2900 sold and resold homes in the two inner-city neighbourhoods until the end of 2018.

The first baseline is the predicted long-term trend of marginal increases in house prices averaging 6% in G since 1981 and 5% in WC from 1986 until December 2018. Normal changes in a house's price will be caused by changes in its attributes such as home improvements and renovations, changes in neighbouring homes' attributes such as their exterior condition and surroundings, and other events inside or outside the neighbourhood such as a recession or high unemployment over time.

Bubble prices should, therefore, likewise exceed the second baseline of the predicted increased price from improvements to attributes of the dwelling unit and neighbourhood. For example, the averages of 11% and 16% increases in price were predicted for up to one-fifth of sold homes in G and WC with installed central air conditioning between times of sale and resale. Also, up to one-fifth of sold homes in the former neighbourhood and one-quarter in the latter with more bedrooms had respective average 5% and 4% increases in price for each additional bedroom; similar proportions had comparable percentage price increases for an additional bathroom. Finishing a full basement increased prices by 2% in G and 5% in WC in a slightly lower one-tenth and one-seventh of sold houses.

Third, new predicted price changes are hypothesized for even higher numbers and proportions of resold homes versus once-sold homes during a bubble than before it, especially if the bubble coincides with an undersupply of new homes on the market. Parenthetically, all homes' sales should be resales in an older inner-city neighbourhood unless they are rare brand-new homes—and they would be recorded as that in a longer dataset. Once-sold homes were less than one-fifth of sales until the end of 2018; the remainder were resales, with the first sale of these resold homes comprising one-quarter of all sales.

The last hypothesis about house sales inside a price bubble is their same dispersed locations as before in the small neighbourhoods. None of the spatial autocorrelation coefficients between nearby recent house prices were statistically significant in the previous hybrid model and so they are not entered in the new model. Instead, the geography of sold homes up and down the streets will be measured by the autocorrelation between odd- or even-numbered next-door neighbour homes' numbers of times sold. The implicitly tested hypothesis is for similar numbers if owners react to neighbouring house sales during a house price bubble by becoming investors and putting their own homes on the market (Bayer, Mangum, & Roberts, 2021).

2.2. Changes in House Social Utilities

The literature speculates about the activities of investors in initiating house price bubbles (e.g., Ali et al., 2024; Arestis, Gonzalez-Martinez, & Jia, 2017; Cascão, Quelhas, & Cunha, 2023; Waddell, 2022). They are more likely to have an “emotional speculative interest” that supports a psychological theory of bubbles (Bangura & Lee, 2022: p. 144). However, novice and “infected” investors may especially perform more poorly than experienced investors if they enter the market after observing investment activity in their own neighbourhood (Bayer, Mangum, & Roberts, 2021: p. 609). Investors may be prone to decision-making biases that lead to satisficing reinvestments (Pandey & Jessica, 2019). Real estate investors may be inferred from their number and type of acquired properties during a period (Bayer, Mangum, & Roberts, 2021), but they really should be distinguished by their different evaluation of a home than family-oriented residents for its investment potential (Jones & Trevillion, 2022; Sharmila Devi & Perumandla, 2023). Coincidentally, the crosscheck of real estate investors by names may be unreliable in modern multi-cultural Canada except in legal documents.

In general, a home's utilitarian value at time of sale is a function of a person's social and economic utilities for the home's attributes (Fishburn, 1970; Phipps, 2023). If an investor's residential utility function is weighted toward high values of economic attributes, then sold homes during a price bubble may be less desirable from a family-oriented resident's point of view. This resident's overall social utilities as opposed to those of an investor would consequently be weakly correlated with homes' sale prices on the market.

In reality, a resident's unconstrained (UC) residential utilities will be constrained by their budget for housing. Their budget-constrained (BC) utilities adapted to the affordability of attribute levels are therefore more realistic than UC utilities for calculating a home's overall social utility. In this study, their budget constraints might still apply earlier as house prices fluctuated around no change during a 22-year period from 1990 to 2012 in the two inner-city neighbourhoods and then were marginally higher from 2012 to 2018.

A home's overall social utility may change over time for one similar reason to a change in its price and two different reasons even if prices for levels of an attribute

remain proportionally the same over time. The similar reason is that upgrades of home attributes such as dwelling renovations or neighbourhood changes over time will not only translate into higher prices but also better overall social utilities if these attribute changes are more preferred.

Two different reasons are rooted in people purposely revising their social utilities for attributes (Phipps, 2021). First, they may revise their residential preferences in line with their evolving social and economic needs and desires over the long term. For example, a typical Windsorite in 2020 was indifferent about some types and sizes of houses in comparison with a typical Saskatonian in 1987. The latter had strong negative utilities for their least preferred bungalow or one-and-a-half-storey with two bedrooms.

Alternatively, people may reassess the desirability of home attributes by means of the calculation or interpolation of social utilities for new types of homes over the long term. For example, a typical inner-city Windsorite in 2020 was less confident than a city-wide Saskatonian in 1987 about a previous resident's finishing a full basement as if they anticipated the removal and reconstruction of this after-market home improvement. They also adapted to high-rise apartment buildings as neighbouring types of homes and now preferred them more than low-rise walk-up types. All in all, residents in 2020 should have higher mean BC utilities for homes in the study neighbourhoods than they would have over 30 years earlier. The next section has the economic and social data for testing the hypotheses about homes' prices, attributes, times sold, locations, and social utilities during and before a house price bubble.

3. Data and Methods

The first of two datasets has the data of all 3138 inhabitable single-detached, duplex and row houses sold since the mid-1980s through the Multiple Listing Service (MLS) in the G and WC inner-city neighbourhoods in Windsor, ON. These sales of 568 houses in G and 810 in WC through the dominant listing service in Windsor represent more than three-quarters of the total estimated number of single-detached(-like) houses in the former in 2011, and almost all in the latter in 2015, based on separate surveys of their exterior quality (Phipps, 2016). The remainder may have been sold earlier through the MLS or later in exclusive listings of realtors or pocket listings for private sales—or demolished for parking lots in G.

Most houses in the neighbourhoods have the diverse sizes and designs of their small-scale builders during and after the First World War, and they may have had vacant neighbouring lots until much later (Figure 2). Others were built on those vacant lots or on demolished earlier houses' lots during and after the Second World War (Figure 3). A few were built as infill during the 1970s and afterwards.

The second dataset has the social utilities of 74 inner-city residents for the attributes of single-detached(-like) houses located inside and outside the two inner-city neighbourhoods in Windsor in 2020. These random residents responded to flyers delivered in the mailbox of all single-detached(-like) houses in the neigh-

bourhoods; the number of people who respond nowadays seems an insurmountable liability of an online experiment. Phipps (2023) more fully describes the sale prices and attributes of the single-detached(-like) homes and similarly the social experimental data that are summarized in the next two subsections.



Figure 2. Examples of 1920s single-detached homes in Glengarry neighbourhood in 1995. Source: Photograph taken by author.



Figure 3. Examples of 1950s single-detached homes in Glengarry neighbourhood in 1991. Source: Photograph taken by author.

3.1. Housing Data

The method of hybrid price modelling of observed housing data with temporal and attribute independent variables is more fully explained in Phipps & Li (2019). A hybrid price model is more efficient than a single sales hedonic housing price model if resales occur more frequently than new sales in a fully developed neighbourhood as time goes on. The hybrid model statistically exploits the inclusion of the resales of the same homes in a dataset. It does this by updating the error structure of a single sales hedonic price model and removing unobserved specification errors due to dependencies between resales (Phipps & Li, 2019). In contrast with

other detection methods, the hybrid model is useful for detecting a price bubble in a micro neighbourhood because it analyzes each sold home's attributes of its dwelling unit, neighbourhood environment and residents, and location as well as its price at time of sale. The hybrid price model's coefficients will predict price surges in year-quarters when a short-term trend is a house price bubble.

Observed houses in the hybrid price model were sold and resold between the beginning of January 1986 and end of December 2023. Home attribute levels of the dwelling unit, neighbourhood environments and neighbours, and locations are represented by combinations of 23 variables constructed from MLS and census data. Ten attributes of the dwelling unit from the MLS at each time of sale are lot size in thousands of square feet; numbers of garages, bedrooms, bathrooms, and storeys; and dummies for age of construction, exterior brick finish, finished full basement, central air conditioning, and neighbourhood location (**Table 1**). Note that classes of up to three observed house variables (in the right three columns of **Table 1**) are matched with the levels of each 2020 experimental attribute (in the left three columns); respondents' mean social utilities for attribute levels (in the middle two columns) are explained in the next subsection. For example, an observed house with 1.5 storeys, 2 bedrooms and one bathroom corresponds with the two-bedroom bungalow or one-and-a-half storey house displayed to respondents in the online surveying project.

Merged neighbourhood data are from the quinquennial national census since 2001 nearest to a home's time of sale or resale in one of 25 dissemination areas (DAs) covering the two neighbourhoods. A DA with an average of 500 residents in this part of Windsor has a mostly rectangular shape; an approximately one-half kilometre by one-quarter kilometre area; and boundaries aligned with a grid street pattern (*Statistics Canada, 2021*). The population of the DAs covering the two neighbourhoods was 12,594 in 2021. As shown in **Figure 1**, the Glengarry neighbourhood begins approximately 0.6 km from downtown and extends approximately 2 km east. Wellington-Crawford begins approximately halfway between the University of Windsor and downtown Windsor, and its farthest-west home is 1.8 km west of downtown and its farthest-east home is 0.5 km west of downtown.

Ten attributes of the neighbourhood include the median annual income of adults in a DA in thousands of dollars; percentages in a DA of dwelling units needing major repairs; percentages of households with at least one child at home, visible minority population, and percentages of adults who are unattached or university educated. The remaining four of 10 attributes are excluded from the hybrid housing price model as they were not statistically significant in its constituent single sales hedonic housing price model or repeat sales model. Four excluded attributes are the percentages in a DA of single- and semi-detached dwelling units and having owner-occupiers; percentages of adults who were young adults aged 20- to 24-years old; and percentages of residents who moved into or within a DA during the last five years. In addition, three attributes of the homes' immobile and thus undifferentiated locations in the compact neighbourhoods are

Table 1. Experimental and observed house attributes of the dwelling unit.

2020 Experimental Attribute and Level			2020 BC Utilities		1986-2023 Observed House Variable Classes				
			Number of Respondents	Mean Utility	1.1 Storeys (Number)	1.2 Bedrooms (Number)	1.3 Bathrooms (Number)		
1. House Type and Style	0. Bungalow or one-and-a-half-storey house.	3. Two bedrooms.	48	2.02	2.1 Age (-1 = More than 30 yrs; 0 = 5 - 30 yrs; 1 = Less than 5 yrs)	2.2 Exterior brick, stucco, stone or cement (1 = Yes)	1.0		
	0. Bungalow.	4. Three bedrooms.	48	2.37			1.5	3.0	1.5
	1. Two-storey house.	5. Three-and-a-half bedrooms.	48	2.54			2	3.5	2.0
	1. Two-storey house.	6. Four bedrooms.	29	2.91			2	4.0	2.5
	2. Two-and-a-half-storey house.	7. Four-and-a-half bedrooms.	29	2.56			2.5	4.5	2.5
2. House Age and Exterior Finish	0. Less than 5 years old.	3. Brick or stucco exterior finish.	48	2.00	-1	0	1		
	1. Between 5 and 30 years old.	4. Vinyl or wooden siding exterior finish.	29	1.66			0	0	
	2. More than 30 years old.	3. Brick or stucco exterior finish.	29	1.95			-1	1	
3. Basement Condition and Home Renovations	0. No basement or a partial one.	3. No central air conditioning and outstanding features if it is newer; or no central air conditioning and major renovations if it is older.	48	2.02	3.1 Basement (None or part = -1; Unfinished Full = 0; Finished Full = 1)	3.2 Central air conditioning (1 = Yes)	-1		
	1. An unfinished or partly finished full basement.	3. No central air conditioning and outstanding features if it is newer; or no central air conditioning and major renovations if it is older.	48	2.20			0	0	

Continued

1. An unfinished or partly finished full basement.	4. Some modern features including central air conditioning if it is newer; or some renovations, such as central air conditioning, new wiring, plumbing, windows and roof if it is older.	48	3.16	0	1
2. An insulated, completely finished full basement.	4. Some modern features including central air conditioning if it is newer; or some renovations, such as central air conditioning, new wiring, plumbing, windows and roof if it is older.	29	3.00	1	1
2. An insulated, completely finished full basement.	5. All modern features including central air conditioning if it is newer; or central air conditioning and extensive interior/ exterior renovations if it is older.	29	2.95	1	1

Source: Table created by author.

also excluded. These last seven attributes of the neighbourhood and location are mentioned as their values enter in the prediction of an observed home's overall social utility.

3.2. Social Experimental Data

An observed home's overall social utility is predicted with the average social utilities of a random sample of residents in and around the two inner-city neighbourhoods. Seventy-four inner-city residents rated the desirability of owned single-detached(-like) homes in a conjoint choice experiment in an online surveying project in 2020; this method is more fully explained in Phipps (2023). Respondents' ratings are statistically decomposed into UC social utilities for levels of 12 attributes of the dwelling unit, neighbourhood environment, neighbours, and home accessibilities (Table 1). Their search price range for a new home "if they looked for one tomorrow" is superimposed on their UC social utilities to transform them into BC ones. Most respondents had a search price range in the middle of the observed house prices during the study period. Displayed home attributes were

realistic for their budgets in 2020.

Respondents' average BC social utilities for attribute levels are additively combined to predict the overall social utility of each observed sold house in the two inner-city neighbourhoods. Note that average BC utilities for attributes naturally have middle values away from the 0-totally dislike and 5-totally like values on the original rating scale in the online surveying project. Predicted overall utilities, consequently, have small percentage differences between their relative minimum and maximum average social utilities, which are for the BC least and most preferred attribute levels of a hypothetical home, respectively. No houses have average predicted overall utilities between this relative minimum and the absolute minimum of 0%, and this relative maximum and the absolute maximum of 100%, though they will have them for individual respondents. The middle two columns of **Table 1** and **Table 2** summarize respondents' mean BC utilities for the experiment's attribute levels.

The overall social utility for an observed house attribute represented by more than a single house variable is the averaged sum of the mean BC utility for the attribute level matching each variable's classified observed value. For example, in **Table 2**, an observed house with 60% and more unattached adults in its DA, 10% and fewer families with a child at home in its DA, and more than 25% young adults in its DA has the averaged sum of the mean BC utility of 39 respondents for an experimental home with youthful single-person neighbours who have no children at home. Five attributes of rated house descriptions in the online surveying project correspond the best with single or multiple observed house variables constructed from MLS and census data. These are the displayed attributes of house type and size, age of construction and exterior finish, basement condition and home renovations, lot size and garage, and neighbours' mobility (**Table 1**). The more subjective correspondences in a second group of six attributes are based on classified percentages of neighbouring home types and repair, neighbours' ages, ethnic group and education, and representative kilometres to stores and work, schools, and the riverbank (**Table 2**).

The predicted overall BC social utilities for observed houses are more likely those of family-oriented households than entrepreneurial types. Respondents had statistically representative personal characteristics of all residents of DAs encompassing the inner-city neighbourhoods in the most recent national census of 2021, as an update of Table 3.2 in Phipps (2023). Their proportions within 99% confidence intervals were not statistically significantly different from those of all residents' gender, ages, marital status, length of residence, and occupation(s) of wage earner(s) in the household. Respondents living in conventional houses and not apartment buildings probably account for the significantly higher proportion of them with owner tenure and the lower proportion with unattached cohabitants. In detail, equal numbers of respondents self-identified as males or females. They most frequently were younger than 40 years old; they were either in families with live-in children or unattached individuals, who lived in the current home for five

Table 2. Experimental and observed house attributes of the neighbours.

		2020 BC Utilities			1986-2023 Observed House Variable Classes		
2020 Experimental Attribute and Level		Number of Respondents	Mean Utility				
7. Ages of neighbours	0. Youthful single-person households.	39	3.01	7.1 Unattached adult residents in a DA (%)	7.2 Families with at least one child at home in a DA (%)	7.3 Young adult residents in a DA (%)	25%
	1. Middle-aged residents.	39	3.45		60%	10%	17%
	1. Middle-aged residents.	39	3.49		40%	50%	10%
	2. Elderly residents.	39	3.15		30%	50%	5%
8. Ethnic Group and Education of Neighbours	0. Working people with high-school education.	39	3.01	8.1 Blue collar workers in a DA (%)	8.2 University educated adults in a DA (%)	8.3 Visible minority residents in a DA (%)	10%
	0. Working people with high-school education.	39	2.68		40%	0%	40%
	1. Skilled and white-collar workers with high-school or technical-college education.	39	3.05		20%	15%	10%
	1. Skilled and white-collar workers with high-school or technical-college education.	39	3.16		20%	15%	40%
	2. Professional workers with university or college degree.	39	3.05		10%	30%	10%
9. Mobility of Neighbours	0. Few neighbours move each year.	39	3.01	9. Residents moving into or within a DA during past 5 years in a DA (%)	20%		

Continued

1. Several neighbours move each year.	39	2.75	40%
2. Lots of neighbours move each year.	39	2.64	60%

Source: Table created by author.

years or less; and the occupation(s) of their primary wage earner(s) was(were) managerial or professional, retired, student, or administrative professional or office worker. The predicted overall social utilities for observed sold homes from these respondents' ratings are discussed after the predictions of the same homes' sale prices by the hybrid housing price model in the next section.

4. Results

The hybrid housing price model's statistically significant coefficients for time of sale or resale predict the time of a conversion point of a house price bubble in two inner-city neighbourhoods: This predicted time is early-2020 for a bubble that bursts at or after the end of the study period in 2023 (Figure 4). The beginning is when the observed quarterly average prices (as a blue solid line for G and red solid line for WC in Figure 4) diverge from their predicted quarterly average prices (as a blue dashed line for G and red dashed line for WC) in the first quarter of

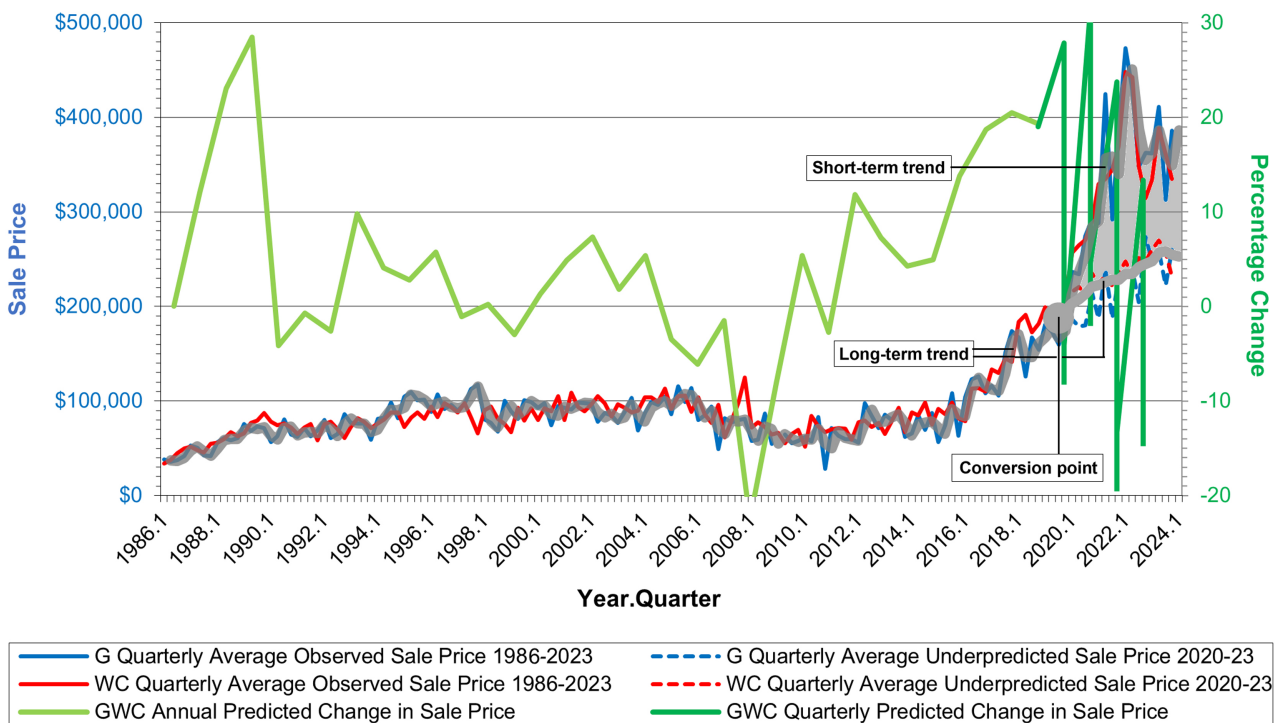


Figure 4. Observed and predicted quarterly house prices over time. Source: Figure created by author.

2020. The moving average trend after the conversion point (as an upper, grey solid line) has a much higher observed short-term trend than the predicted long-term trend (as a lower, grey solid line) if it would have continued at past 5% to 6% annual increases. The moving average trends for G are displayed as the neighbourhoods' observed quarterly average sale prices are highly correlated over time ($\rho = 0.93$).

In particular, the hybrid model's coefficients predict annual changes in prices that jump from 19% in 2019 to 34% in 2020, 30% in 2021, and 14% in 2022 (**Table 3**). Also reported as well as these predicted changes in prices in **Table 3** are the descriptive lower and upper bounds of the 95% confidence intervals of the dependent and independent variables, and the standard errors and statistical significance of their and the time of sale coefficients. Note the predicted annual changes in sale prices for the years from 1987 to 2018 are suppressed in **Table 3** as percentage changes were mostly small; they are graphed in **Figure 4**. The quarterly predicted percentage changes (as a darker green solid line) help to magnify the short-term trend since 2020, during which predicted first-quarter price increases averaging 24% in each year of 2020-2023 were consistently higher than those in remaining quarters averaging -2%. Acquisitions propelling the prices such as those of out-of-town investors, therefore, occurred during the first quarter of each year, after which sale prices fluctuated around the new level until the beginning of the next year.

The hybrid model's R-square between observed and predicted LN house prices is a robust 85%. It predicts well three-quarters of the sold houses' latest prices within 28% or minus-one and plus-one standard deviation of the approximate mean of 5%. The few houses with a much under-predicted sale price—that is, with a much higher observed sale price than predicted for its attributes by the hybrid model—may be located on the Detroit Riverbank (remembering the hybrid model has no coefficients for houses' immobile and undifferenced locations). The “not-well” predicted remainder are all over the selected maps as Options (1.1) and (1.2) of online **Figure 1**.

Meanwhile, the hybrid model's coefficients for home and neighbourhood attributes confirm that bubble higher house prices were not commensurate with gains from home improvements and neighbourhood changes. For example, an older four-bedroom two-story detached house in **Figure 2** had much higher sale prices of \$425,000 in December 2020, and \$580,000 almost a year later, than its sale price of \$274,000 in September 2019 and a lower one of \$174,000 in April 2016. This home's last price increases were much larger than the hybrid model's predicted 7% increase in price of one-quarter of resold houses with an additional one or more bedrooms, and an 8% increase in price of one-fifth with another bathroom. Besides, this home only benefitted before 2019 from neighbourhood changes such as the highest two of 7% increase in price of one-third of resold houses with an average \$7101 increase in median adult income in their DA, and 3% increase in price of one-third of resales with an average 22% increase in university-educated adults in their DA. As it also had central air conditioning in

Table 3. Hybrid price model statistics and coefficients.

Variables	Number of Sales	Attribute 95% Confidence Interval		Coefficient	Predicted Change (%)	Coefficient Standard Error	Significance Level		
		Lower	Upper						
<i>Dependent</i>	1986.01-2019.12	Once Sold	473	\$76,644	\$84,452				
		First-time Resale	839	\$64,452	\$68,555				
		Resale	1485	\$88,438	\$92,770				
	2020.01-2023.12	Once Sold	52	\$323,980	\$391,301				
		First-time Resale	13	\$263,929	\$346,021				
		Resale	276	\$321,796	\$347,531				
<i>Dwelling Unit</i>	Lot size in 000s of sq. ft.		3.932	4.030	0.04	4%	0.005	0.00	‡
	Number of bathrooms		1.6	1.7	0.08	9%	0.009	0.00	‡
	Number of bedrooms		3.6	3.6	0.05	5%	0.005	0.00	‡
	Number of garages		0.4	0.4	0.07	7%	0.008	0.00	‡
	Number of storeys		1.7	1.8	0.08	8%	0.013	0.00	‡
	Central air conditioning, 1 = yes		0.4	0.5	0.15	16%	0.011	0.00	‡
	Exterior brick finish, 1 = yes		0.4	0.4	0.11	12%	0.013	0.00	‡
	Finished full basement, 1 = yes		-0.1	0.0	0.03	3%	0.007	0.00	‡
<i>Neighbourhood</i>	Median annual income of adults in a DA in \$000s		\$23.234	\$23.630	0.01	1%	0.001	0.00	‡
	Percentage of dwelling units in a DA needing major repairs		11%	12%	-0.003	-0.3%	0.001	0.00	‡
	Percentage of households in a DA with at least one child at home		46%	47%	-0.002	-0.2%	0.000	0.00	†
	Percentage of university educated adults in a DA		28%	29%	0.001	0.1%	0.001	0.01	†
	Percentage of visible minority population in a DA		33%	34%	-0.002	-0.2%	0.000	0.00	‡
	Percentage of unattached adults in a DA		57%	58%	0.001	0.1%	0.001	0.30	
<i>Year. Quarter of Sale or Resale</i>	2023.4	19			1.96	7%	0.060	0.00	‡
	2023.3	15			1.89	-14%	0.070	0.00	‡
	2023.2	23			2.05	11%	0.059	0.00	‡

Continued

	2023.1	7	1.95	13%	0.087	0.00	‡
	2022.4	14	1.82	-13%	0.069	0.00	‡
	2022.3	12	1.96	-19%	0.069	0.00	‡
	2022.2	19	2.18	-1%	0.058	0.00	‡
	2022.1	27	2.18	24%	0.053	0.00	‡
	2021.4	34	1.97	5%	0.049	0.00	‡
	2021.3	22	1.93	-2%	0.056	0.00	‡
	2021.2	28	1.94	4%	0.052	0.00	‡
	2021.1	31	1.91	32%	0.050	0.00	‡
	2020.4	24	1.63	-4%	0.055	0.00	‡
	2020.3	16	1.67	14%	0.062	0.00	‡
	2020.2	19	1.54	-8%	0.058	0.00	‡
	2020.1	31	1.62	28%	0.047	0.00	‡
<i>Year of Sale or Resale</i>	2019	96	1.38	19%	0.039	0.00	‡
	↓						
	1986	162	0.00	0%			
<i>Constant</i>			9.78		0.076	0.00	‡
	R-Squared		85%				
	Degrees of Freedom		3074				
	Number of Houses		3138				

‡Significance at alpha less than 0.001, †Significance at alpha less than 0.01. Source: Table created by author.

2019, it was not among the one-fifth of resold houses with the single highest predicted 16% average increase in price for installation of this.

In addition to inflated prices, sold houses during the bubble's year-quarters had three different features than those sold earlier. This is despite having the same-as-before statistically insignificant autocorrelations between odd- or even-numbered next-door neighbour houses' numbers of times sold. The selected maps as options (2.1) and (2.2) of online [Figure 1](#) have no noticeable clusters of addresses with similar numbers of times a house was sold since 1986 and whether sold at least once since 2020, aside from the blue and black pins for five or more times sold in WC's south-west subarea. The differences are also despite sold houses comprising a similar more than three-quarters of a similar average number of 25 sales as in year-quarters in the preceding four-year period of 2016.1 to 2019.4 ([Figure 5](#)). Quarterly numbers of single sales including first-time sales of resales and quarterly subsequent resales are displayed in stacked bars in [Figure 5](#).

The first difference between sold houses during the bubble and earlier is the sale of more frequently resold houses ([Figure 5](#)). They were resold for an average third time (as a blue solid line in [Figure 5](#)) and an average maximum sixth time (as a

blue triangle) in comparison with an average twice resold and maximum fifth resale during the preceding four years. In other words, an already twice- or more-times sold house would sell again during the bubble and sooner than before. The latter is the second difference as more than one-quarter of resales after the beginning of 2020 were within two years of a previous sale in comparison with less than one-sixth of resales during the preceding four years, and one-fifth before that (Figure 6). Numbers of resales with classified years and months between sale and previous sale during the three periods are in horizontal stacked bars in Figure 6.

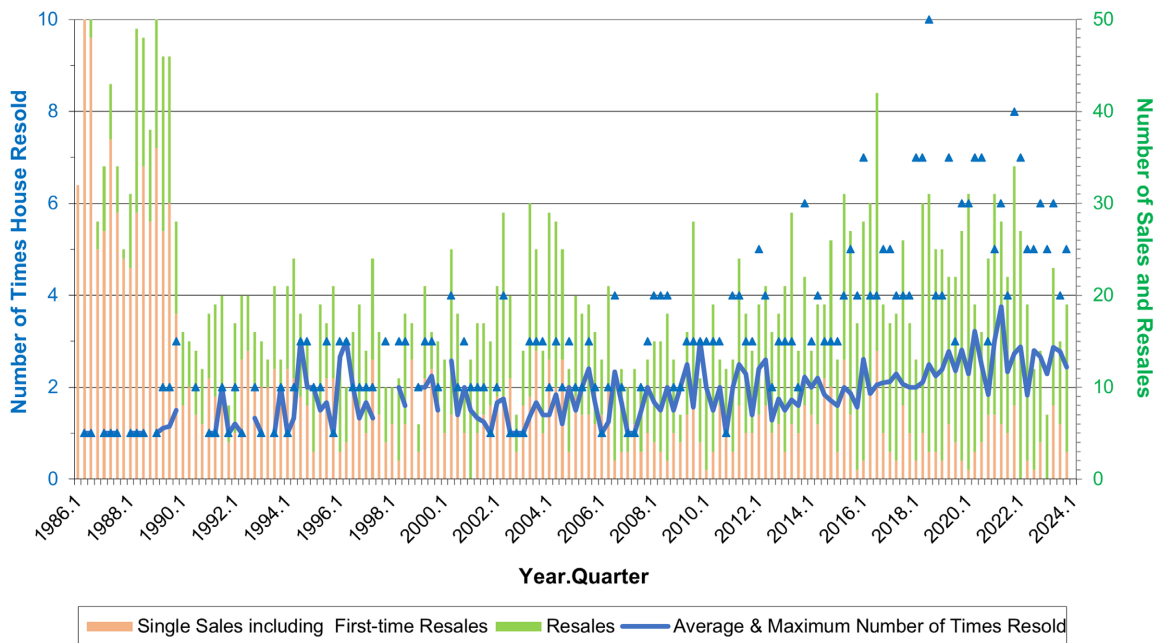


Figure 5. Observed numbers of house sales and times resold. Source: Figure created by author.

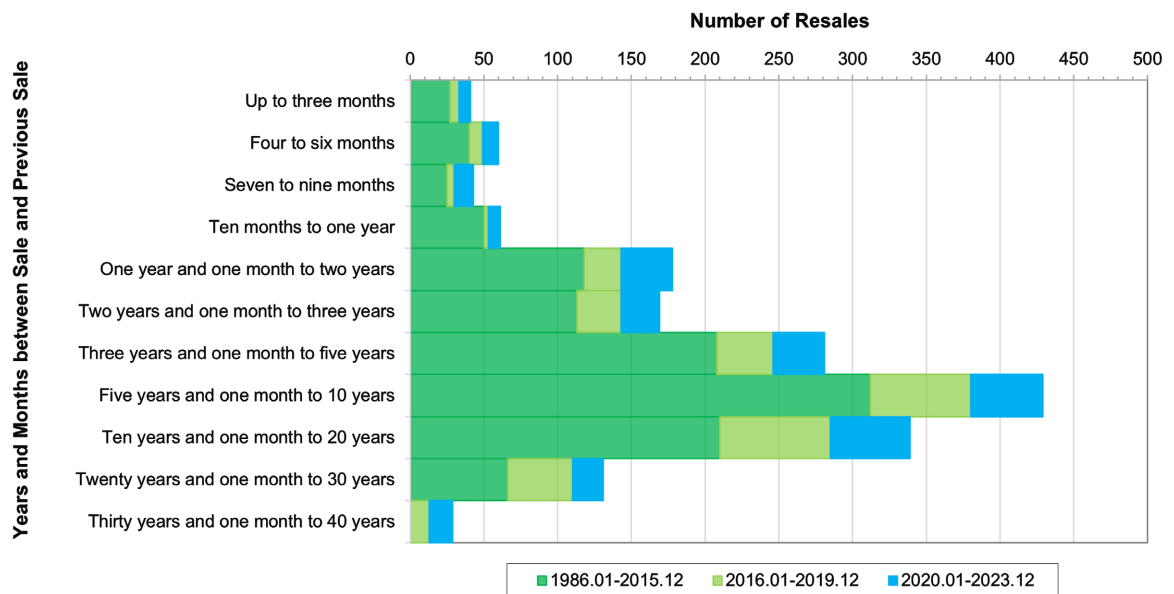


Figure 6. Time between home resales. Source: Figure created by author.

Third, bubble sold houses were slightly less preferred by residents as their overall social utilities would be marginally lower than before (Figure 7). Overall BC utilities for G and WC sold houses are on the secondary vertical axis of Figure 7 between the labelled approximate relative maximum and minimum values. Their monthly averages (as light blue and orange solid lines, respectively) are summarized as (similar coloured dashed) trend lines that have recent declines measured by the negative second order polynomial coefficients listed in Table 4. Coincidentally, sold houses in the first quarters with the spiking prices were not more or less preferred by residents as they would have virtually the same average overall BC utilities as those in the remaining year-quarters (Table 4).

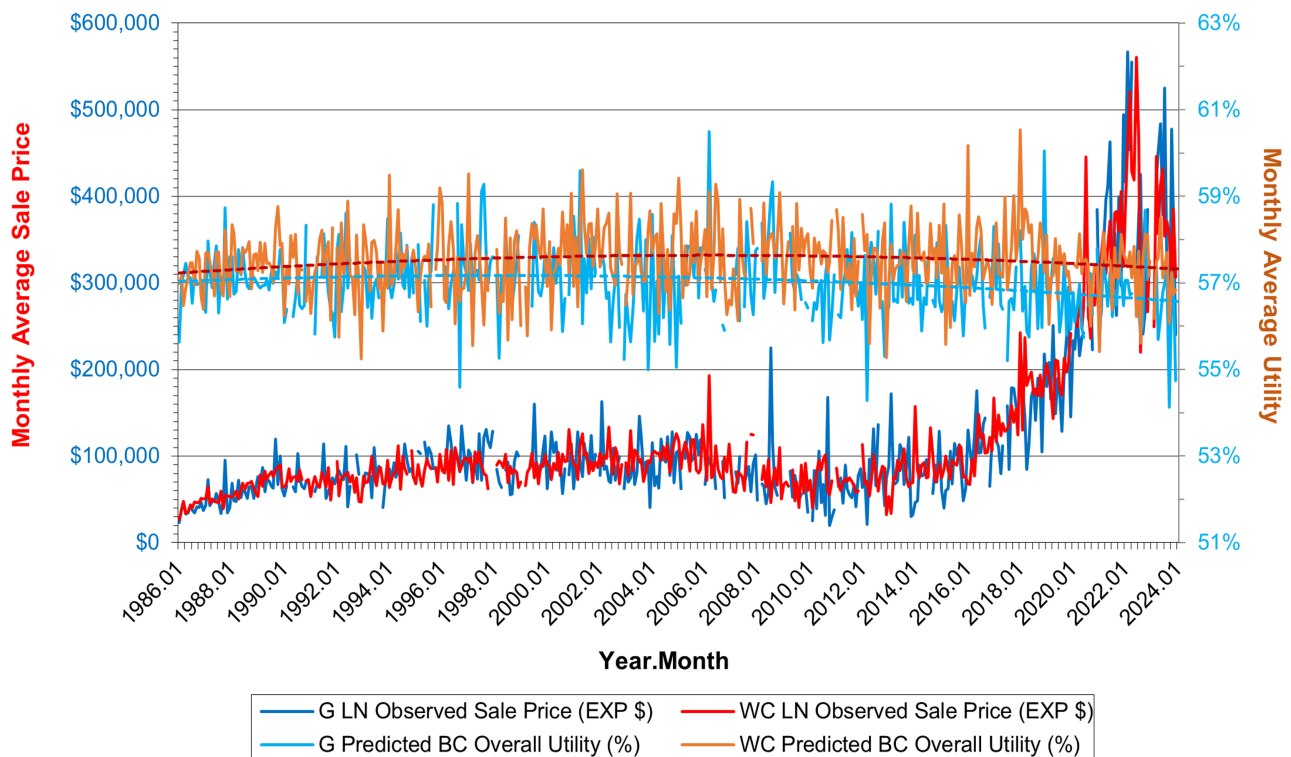


Figure 7. Observed sale prices and predicted overall utilities of houses over time. Source: Figure created by author.

Indeed, average overall BC social utility of sold houses at the time of their latest sale is the summary prediction with a few exceptions. An average description of them is valid as the pooled mean in Table 4 is approximately halfway between not only the relative minimum and maximum overall utilities but also the absolute ones of 0% and 100%. In detail, two-thirds or more of the latest sold houses in each neighbourhood would have average overall 2020 utilities within minus-one and plus-one (pooled) standard deviation of the (pooled) mean in Table 4. Then, one fifth in G would have under- and below-average overall 2020 utilities lower than one and two standard deviations below the mean, respectively. In contrast, one quarter in WC would have over- and above-average 2020 utilities greater than one and two standard deviations above the mean. These above- and over-average

Table 4. Predicted overall social utilities of sold houses.

Statistics		Predicted Overall 2020 BC Utility (%)				
		Glengarry		Wellington-Crawford		
		1986-2019	2020-23	1986-2019	2020-23	
Descriptives	Mean	57.0%	56.7%	57.5%	57.4%	
	Standard deviation	1.1%	1.0%	1.4%	1.3%	
	Observed minimum	54.1%	53.8%	53.9%	54.0%	
	Observed maximum	60.7%	58.9%	61.8%	60.9%	
	Number of sales	1106	127	1691	214	
	Relative minimum	50.7%		50.7%		
	Relative maximum	65.4%		65.4%		
	Correlation with house prices	0.13		0.18		
	Regression with Year-Months	Linear coefficient	0.003%		0.003%	
		Second order polynomial coefficient	-0.000006%		-0.000007%	
Intercept		56.9%		57.2%		

Source: Table created by author.

houses would be clustered in a subarea of WC with larger houses, wider lots, and garages on the west side of downtown; Options (3.1) and (3.2) of online **Figure 1** are maps of these. This cluster has endured as sold houses' latest sales are quite dispersed through time, for example, with approximately 40% of them happening since the end of 2015.

5. Conclusion

A house price bubble emerged unpredictably in Windsor, ON, in early 2020. Single-detached(-like) homes experienced short-term price surges far exceeding those predicted by the homes' quantity and quality after home improvements and renovations and neighbourhood changes. Four consequences for homes inside the bubble in two-inner neighbourhoods have been inferred.

First, the sale prices spiked during the first quarter of each year in the bubble, stabilizing at elevated levels until the next surge. Some activities causing these

surges were the strategies of investors as inferred from the second finding. The dispersed sold houses with these inflated prices were more likely repeated and sooner resales of slightly less desirable homes from a resident's point of view. They were therefore resales of frequently sold homes presumably for rent, though this cannot be verified without deducing a buyer's intentions or crosschecking their name as an owner of multiple properties.

Third, most frequently sold homes during the bubble were scattered across the older neighbourhoods where next-door neighbour homes are quite diverse in their dwelling unit attributes. These neighbourhoods had only one identifiable subarea of concentrated turnover if policymakers wanted to locally improve the affordability of rented rather than owned homes for post-bubble displaced residents. Unfortunately, there is limited space for new affordable rental housing that, in any case, would not be modern (costly) versions of the single-detached(-like) homes already there (Campbell, 2024).

Fourth and in any case, the single-detached(-like) houses in the neighbourhoods are not most preferred by family-oriented residents, as the majority of sold homes would have average overall social utilities. Only one subarea would have above- and over-average overall social utilities according to these residents.

All the same, home improvements and renovation should significantly improve these homes' social utility for residents, whereas their subdivision into rented rooms may not. For example, the overall social utility of the house in **Figure 2** would increase by two and a half percent from 56.1% in 2016 to 58.6% in 2019 after its improvements of central air conditioning, a finished full basement, and a garage. However, its subsequent two additional bedrooms from four to six and its additional bathroom from one to two would only add value of one-third of a percent to 58.9% in 2020, as a typical resident prefers four bedrooms. In conclusion, the question for future research is whether homes' higher prices in these two inner-city neighbourhoods will be sustained by home improvements and renovations. Or will their prices sink to those predicted in **Figure 4**'s continuation of the previous long-term trend and the homes again become somewhat undesirable but affordable gateways to renting and ownership.

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Research Involving Human Subjects

The University of Windsor Research Ethics Board approved the online surveying project reported in this study on January 16, 2018. The title of the project was the Glengarry and Wellington-Crawford Geographical Monitoring Project: Housing Surveys. The final report for the project was submitted on August 17, 2022: It states that no ethical concern arose in the course of the research. An introductory

webpage obtained the informed consent of each respondent before they participated in the project, and they could freely withdraw at any time by closing their internet browser. Research ethics review was not instituted at the time of the corresponding surveying project in Saskatoon in 1987.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

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