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# Housing Sustainability: The Effects of Speculation and Property Taxes on House Prices within and beyond the Jurisdiction

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**Abstract:** Housing plays an essential role in sustainable governance due to its socio-economic and environmental connection. However, the relationship between governance policies, market behavior, and socio-economic outcomes varies geographically and demographically. Therefore, segregated policies developed and implemented may fail to achieve their desired objectives because of the sensitivity of housing policies for their connection to human wellbeing. The effectiveness of housing policies in geographically connected regions is one of the areas that has received little attention in the Canadian context. The study follows a multi-step empirical method using a multiple linear regression model and a difference-in-difference approach to assessing the geographical variation of speculation and property taxes on housing markets. The study confirms that speculation taxes are not an effective tool in curbing house prices. Similarly, considering the role of property taxes in providing public services, delinking property taxes from a potential contributor to house prices would provide a better lens to develop local housing policies. Furthermore, the study also confirms that the housing market can be better assessed at a local scale, considering geographical influence in conjunction with investment trends.

**Keywords:** housing; sustainability; property taxation; regions; real estate



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## 1. Introduction

The housing system's multidimensionality as well as its multi-factor influence make it complex and highly sensitive to policies [1]. Moreover, the sustainability challenges imposed by a rapidly changing global socio-economic structure (such as globalization and financialization) may not be dispensed by orthodox policy instruments that cannot make housing environmentally sustainable and affordable to all [2]. Moreover, the housing system makes policies sensitive to human wellbeing. Therefore, policies developed and implemented without an integrated approach may fail to achieve their desired objectives [3].

The literature to date has identified several factors affecting the adoption of housing sustainability. These factors are generally based on household behavior, socio-economic conditions, geography, environment, policy, and policy instruments. The policy instruments include financial, monetary, and regulatory measures to manage consumption and public services, and to regulate market activities to meet socio-economic and environmental objectives [4,5]. However, the multilateral and dynamic nature of governance objectives and instruments used make it challenging to achieve an optimum and sustainable outcome [6,7]. For instance, the quality of public services, environmental ambiance, and energy efficiency play a key role in property values. These values are judged against housing cost and availability, which influences real estate market activities [8–10]. Thus, this poses another policy challenge in balancing local economic objectives and housing affordability. Furthermore, housing regulations are not just limited to offsetting the cost and supply of housing market interventions through market control and providing subsidies; they also affect housing rent, energy consumption, and efficiency [7,11].

Housing markets are exposed to exogenous and endogenous factors subject to socio-economic policy interaction at upper and lower tiers of governance. There is considerable literature on tax competition between municipalities in response to constraints imposed by central government [12]. However, most studies have contextualized outcomes due to geographic variances and the combination of variables used to assess policy outcomes. For instance, Lyytikäinen [13] studied the impact of property tax competition between taxed and non-taxed local governments resulting from the tax reforms imposed by the central government of Finland. However, the study was focused on the federal government restricting municipalities' property tax rates. Housing policy is a provincial mandate, limiting local government influence on public services through property taxation in the Canadian context. Policy jurisdiction implies policy integration between upper and lower tiers of governance that relies on governance structure and contextual setting. Furthermore, tax implications and concurrent policies, such as a policy response to central or provincial regulations at the local scale, are essential areas of research that require more emphasis [12].

In addition to policy integrational challenges, geographic and demographic differential outcomes add to the complexity of the relationship between housing policies and the housing market. Per several researchers [14–17], housing policy outcomes will have a spatial disparity and spillover effect due to the difference in market characteristics, homeownership status, and timing and choice of policy delivery mode. Therefore, the complexity of the housing system advocates intraregional and localized scales of assessment of housing policies [18,19].

Researchers [20,21] have theorized on the housing system and policy configurations under liberal and social-democratic regimes. However, such theories still lack some contemporary factors such as financialization [22], market regulation, and environment, which are all considered significant factors of change in the housing system [23]. Furthermore, the net outcome of the regulatory policies is highly contextualized in terms of local connections, policy configuration, obligations, and local capacity [24,25]. The interaction between housing affordability and housing regulations at the inter-metropolitan scale is a crucial research domain that lacks emphasis [26,27].

The relationship between taxes and house prices is one of the areas of interest that is considerably investigated, but no clear consensus has been achieved [9]. However, in the Canadian context, this is one of the areas that has gained little attention. Additionally, the behavior of multiple taxes and spatial variation have not been much emphasized by academia [28]. The objective of this paper is to assess inter-city variation in tax policies in a compact regional setting. It investigates the behavior of local property taxes and the impact of a regional speculation tax on house prices within and beyond tax jurisdictions, using the multivariable regression method to investigate spatial variation in house prices. This study confirms the distortionary behavior of regulatory policy, but such policies are ineffective in controlling house prices. In contrast to some previous studies, the regulatory approach is futile in the long run by contributing to a house price increase. Furthermore, the study confirms that the impact of regulatory policies resonates beyond policy jurisdiction.

This paper details the case analysis of nine cities that are from multiple administrative regions in the province of Ontario. It produces an interesting study in its assessment of the housing markets' response to regulatory measures in administratively different but geographically compact areas. In addition, the research provides a different angle of analysis by evaluating the varying impacts of regulatory policies corresponding to local demographic factors and intra-regional housing market interaction [29]. The research contributes to advancing knowledge and theory in housing system analysis, sustainable housing, and policy-related decision making. It provides insight into the cumulative effect of policies and demographic factors that shape local housing markets, while further paving the way for an integrated assessment of multiple elements based on multidisciplinary theories.

The following section reviews the literature on the relationship between housing taxes and prices. The study area, variables, and methods adopted for empirical analysis are

discussed in the subsequent section. The third section details the empirical outcomes and discussions. Finally, the last section concludes with the findings.

## 2. Literature Review

### *2.1. Housing Affordability and Sustainability*

Housing-related global, societal, and policy issues are becoming a significant concern for policymakers and academia [30]. The core of this issue is rising housing costs surpassing household income increase [31]. Housing affordability, particularly for starters, has become a significant concern in recent years [32,33]. According to United Nations Habitat, more than 880 million people around the globe live in slums. The situation worsens with a shortage of houses; for instance, in South Asian countries, thirty-eight million homes are required to meet the demand [34]. Similarly, 440 households worldwide—1.6 billion people—will be struggling for suitable housing by 2025 [35]. Moreover, rising urbanization, economic disparities, and environmental challenges make it hard to provide adequate, suitable, affordable, and sustainable housing for all.

In terms of housing sustainability, the housing market is influenced by how sustainability is defined, driving factors, policy objectives, and the way demand and supply are managed in response to housing market activities [36,37]. For instance, in Canada, the core aspects of sustainable housing are adequacy, suitability, and affordability [38]. However, these objectives can only be achieved through balancing social, environmental, and economic goals to achieve overall sustainable housing development [39].

Governments around the world use various policies to address housing sustainability. Their goals are energy efficiency, reducing carbon emissions, addressing urban sprawl and the connection between housing and mobility, housing affordability, and reducing social and health inequalities [40]. However, some conflict between objectives, such as the environmental standard of houses, energy consumption, and affordability, are considered a significant barrier to progress [41]. Additionally, economic and planning policies shape housing costs and socio-economic disparity across residential spaces and tenures [42].

The research acknowledges that housing is sensitive to varying institutional and policy structures influenced unevenly across scales and population geographies [2]. Therefore, a relationship between governing policies, the housing market, and housing affordability is crucial. For example, an interaction between housing affordability measures and planning regulations [26,27,43] and managing energy consumption and housing cost through taxes [4–6,44–46]. However, economic and development policies are driven under different regimes. As discussed above [20,21], theories about the housing system and policy configurations lack speculative investment for the sake of profit [22] and government response to regulate speculative investment impacts the housing disproportionately [23]. Therefore, it is worth investigating the behavior of housing markets under varying regulatory measures intended to influence house prices.

### *2.2. Real Estate Taxes and House Prices*

Real estate and property taxation literature contains mixed opinions about the relationship between property-related tax policies and house prices. Some researchers [47–51] have found taxation policies helpful in curbing house prices, whereas some have not [52–55]. The disparity in conclusions is mainly due to a difference in the combination of variables used, study setting, research design, and tax policies analyzed. Research suggests that the net outcome of policies would depend on a combination of taxation policies applied, their scope, and demographic and geographic variation.

The real estate and property taxation literature considers tax policies from two major perspectives: policies impacting transfer of ownership and policies impacting the user's cost of housing. The former, which is applicable on the housing transaction link, implies tax payable when transferring ownership or policies restricting investing in secondary residential properties. The latter form of policies relates to the retention of houses, usually recurring and applicable to housing value, or in the form of tax incentives such as mort-

gage tax credits. These taxes on the retention of housing directly impact the user's cost of housing.

Previous studies have adopted various approaches to determine the influence of taxation on house price volatility. Most studies have used policies related to transaction or retention links of housing and aggregate national-scale data to assess policy implications on housing prices [56,57]. In addition, they have either framed the analysis in the context of market distortion [47,49,52,58,59], analyzing investment behavior [60,61], or cost–value analysis [62,63]. Many empirical studies have indicated that both transaction and transfer links have significant explanatory power for price differences before and after the implementation of taxes. However, limited studies [57,64] have adopted the aggregate impact of both forms of tax policies and have analyzed price variation between cities. Furthermore, national- and provincial-scale aggregate data, ignoring intercity demand and supply heterogeneity, will limit the strength of a conclusion [53,65]. Additionally, considering the importance of geographic variation, the tax policy impact beyond its administrative jurisdiction is one of the vital aspects that remains under-researched.

Studies conducted to assess the retention taxes have framed their analysis in the context of cost capitalization [16,56] and impact variation [66–68] due to variation in population income level, tenure status, investment choice, and service value. The aggregate outcome of these policies is not uniform. For instance, housing purchase subsidies may contribute to driving up real estate prices [69]. Similarly, mortgage tax credit in the United States is meant to facilitate homeownership. However, many researchers believe that the mortgage tax credit policy is inefficient and somewhat counterproductive [70]. The literature shows that instead of price capitalization, a mortgage tax credit limit reduction decreases house prices [10,71,72]. This is mainly due to the increasing cost of housing ownership, which reduces investment interest in a secondary home. In contrast, primary homeowners are more concerned with house prices than with homeownership costs [73].

Furthermore, the policy measure impacts differently across population income tiers, housing tenure status, and spatial variations [66,70,73]. Mortgage tax credit facilitates the rich more than the poor. It is believed that incentivizing retention cost encourages secondary house investment, speculates house prices, and promotes inequality. Similarly, recurrent property taxes implemented by local governments to fund public services are highly dependent on the quality of services provided. The relationship between tax rate and public service expenditure determines the quality of public goods [50,56]. However, the impact of property taxes on house prices may cause a differential outcome. Increased property taxes with low-value public goods may negatively impact house prices. This may lead to population sorting, encouraging people to move to either low-taxed areas or communities with quality public goods to compensate for additional user cost of housing [66,74]. Subsequently, neighborhoods with high-value public services increase housing demand, resulting in increased house prices [62,75]. Therefore, an aggregate impact of retention taxes and incentives is driven by a cumulative user cost, service value, and household income that varies geographically.

The literature on transfer taxes has no definitive answer to the effectiveness of transaction policing in curbing house prices. As per some researchers [47–49], transfer taxes efficiently control house prices, whereas, for others [52,53,55], there is a positive correlation between transfer taxes and house prices. However, there is a consensus on the stimulus behavior of taxes on the transaction link, creating market distortion in the short run [52,58,59]. Most of these studies have used short-term or event analysis to assess the impact of transfer tax on house prices, ignoring long-term and integrated impact at the regional scale. In general, property-related taxes might be significant in the short run, but they are not driving housing demand in the long run [76]. This means that investment decisions may not be affected by property-related taxes if the benefit outweighs the cost [55,61,77]. In these circumstances, price speculation is the most crucial factor driving the housing market. Policies controlling drivers of housing speculation, such as taxing secondary home investments or capital gain from property flipping, are also ineffective unless restrictions are imposed on

executing such investment moves [78]. Wei et al. [55] concluded that house prices do not react to the conventional market asymmetric volatility phenomenon. They are primarily driven by past trends and speculation about future price growth. The effectiveness of tax regimes relies on the combination of real estate and housing policies. Agrawal et al. [12] emphasized that a singular approach to policy assessment, ignoring local response to the federal constraints, would limit its relevance to determining the effectiveness of the policy outcome. Subsequently, single-ended measures will not be adequate in achieving house price control objectives [79].

In addition to a combination of tax policies, geographical variation of tax instruments, qualification, and spillover effect will alter the aggregate outcome [80]. Very few studies have attempted to assess the aggregate outcome of policies on retention and transfer links of housing transactions [57,61,80]. However, studies that have attempted cumulative assessment were limited to one city or multiple cities from geographically disconnected regions. No studies were found regarding evaluating market response to housing policies within and beyond policy jurisdiction in geographically related areas.

### *2.3. Ontario Non-Resident Speculation Tax (NRST)*

Rising house prices are one of the key challenges in Canadian Cities. An influx of immigrants, a short supply of new units, and government lack of interest in public housing are considered primary reasons for increased housing costs. Additionally, financialization of the housing market and growing interest in foreign investment are also believed to fuel house prices in Canadian cities. A foreign buyer is classified as a buyer who is neither a citizen nor a permanent resident of Canada. Two Canadian provinces have introduced an additional tax on foreign buyers. The objective was to limit the alleged role of foreign investors in speculating Canadian housing markets. British Columbia (BC) took the lead in imposing a 15 percent additional tax on foreign buyers in July 2016. Later, BC raised the tax rate to 20 percent in February 2018. The BC foreign buyer's tax covered five major districts, of which four are closely packed.

Ontario was the second province to introduce a tax on foreigners purchasing property [81]. The Ontario Non-Resident Speculation Tax (NRST) tax received royal assent on 1 June 2017. However, the tax came into effect on transactions that happened on or after 21 April 2017 [82]. Following the global reaction to the impact of the COVID-19 pandemic [83], the tax was later suspended during the Government of Ontario's emergency declaration from 17 January to 24 July 2020 [82]. The tax rate of 15 percent is applied to the sale price of a residential property purchased within the Greater Golden Horseshoe Area (GGH) by foreign nationals or entities. However, GGH neighboring cities are exempted from NRST. This makes the Ontario case different from BC due to a large number of neighboring densely populated cities outside of NRST jurisdiction.

Based on the literature discussed above, this study examines how effectively transfer tax policy, such as NRST implemented in the GGH region, fulfills its intended objective of controlling housing market speculation. Additionally, the study assesses how speculation tax implemented in one region influences markets beyond its administrative jurisdiction. Furthermore, it examines the contribution of local property taxes and mortgage interest rates to local house prices. In this case, the study combines assessing the role and geographical variation in retention and transfer taxes on house prices. Thus, it would help to determine the effectiveness of housing policies in an intra-regional setting against the speculative investment behavior of conventional financialized housing markets.

## 3. Method

### *3.1. Study Area and Data Description*

The research was conducted in the province of Ontario. Ontario is the most populous province in Canada, holding over 36 percent of the total housing stock. Ontario contributes around 22 percent of Canada's total GHG emissions, which includes an 18 percent contribution by the residential sector [84]. Ontario is a critical region to study house price response

to various housing policies in markets located in geographically adjacent but administratively different regions. The intra-regional markets comprise multiple administrative regions and CMAs (Census Metropolitan Areas) of Ontario. The city of Toronto, being the largest city, is considered a regional economic center [85]. For this study, secondary regions are defined on policy-based provincial subdivisions: the Greater Golden Horseshoe (GGH) and the non-GGH region. GGH is the mega metropolitan region in Southern Ontario. We selected CMA boundaries for data consistency. A CMA is defined as a territory with more than 100,000 residents, of which more than 50,000 live in its core. There are sixteen CMAs in Ontario, of which nine CMAs are in the region of GGH. The list of sample geographical areas is presented in Table 1. The sample includes five CMAs from the GGH region and four CMAs from the non-GGH region.

**Table 1.** Sample geographical area.

| CMA | House Price—CREA Boundary | Region |
|---|---|---|
| Toronto | City of Toronto | GGH |
| Guelph | Guelph and District | GGH |
| Hamilton | Hamilton–Burlington | GGH |
| KWC | Kitchener–Waterloo and Cambridge | GGH |
| St. Catherine Niagara | Niagara Falls and Fort Erie | GGH |
| London | London and St. Thomas | Non-GGH |
| Windsor | Windsor-Essex | Non-GGH |
| Ottawa (Ontario part) | Ottawa—Ontario | Non-GGH |
| Kingston | Kingston | Non-GGH |

We have gathered a data set to assess major drivers of house prices in their regional and contextual settings. The housing data cover the period from January 2011 to December 2021. The data for monthly average house prices and the number of units sold for all CMAs, excluding the city of Toronto, were obtained from the Canadian Real Estate Association (CREA). In contrast, average Toronto house prices were not available through CREA. Therefore, we retrieved Toronto's average house prices and the number of units sold from Toronto Regional Real Estate Board (TRREB) monthly sales reports. The real estate boards rely on the data obtained through Canada's Multiple Listing Services (MLS) platform that facilitates home sales in Canada. Real estate agents associated with CREA use this platform for property listings. Generally, most of the Canadian housing market that operates through the MLS platform captures the majority of housing activities in the region. As a result, there might be some differences in housing market boundaries assigned by CREA and the CMA boundaries. However, in this study, we have assumed this difference insignificant and have adopted the same data assignment methodology for all CMAs included in this study.

Table 2 presents a list of the variables and data descriptions. The number of units sold is the sum of detached, semi-detached, townhouses, and apartment units. Other independent variables are categorized into housing supply, housing demand, and housing policy. The supply-side indicators include the total number of units created, the absorption rate of new housing units created, and the housing vacancy rate. The monthly data for the number of units created and the absorption rate of new housing units were obtained from Statistics Canada. The annual vacancy rate for each CMA was available from Statistics Canada. The demand side variables, such as unemployment rate and population, were controlled in this study. Monthly data for the unemployment rate and people of 15 years of age and above were obtained for each CMA from Statistics Canada. Three different levels of housing policies were used in this study. The housing Mortgage rate, non-resident speculation tax (NRST), and residential property interest rate were used as proxies for national, regional, and local policies. We used a five-year variable discounted mortgage rate from ratehub.ca. It is an average rate closer to the actual mortgage rate a bank would offer. For convenience, the remainder of the paper uses the term "City", which refers to a CMA.

**Table 2.** Variable description, data range, frequency.

| Domain | Variables | Period/Frequency |
|---|---|---|
| National Policy | Mortgage Rate (5Y-Var.) | January 2011–December 2021 (Monthly) |
| Regional Policy | NRST | Yes/No (1, 0) |
| Local Policy | Property Tax Rate | January 2011–December 2021 (Annual) |
| Market Outcome | Average Price | January 2011–December 2021 (Monthly) |
| Supply Side | Units Sold | January 2011–December 2021 (Monthly) |
| | Units Created | January 2011–December 2021 (Monthly) |
| | Absorption Rate (New Units) | January 2011–December 2021 (Monthly) |
| | Vacancy Rate | January 2011–December 2021 (Annual) |
| Demand Side | Unemployment Rate | January 2011–December 2021 (Monthly) |
| | Population (15+ × 1000) | January 2011–December 2021 (Monthly) |

### *3.2. Dependent Variable*

We conducted two separate tests to perform multivariate regression for average house prices and the number of units sold. Testing was performed to understand how NRST relates to average house prices and units sold. The adjusted R-square value is 0.702 and 0.763 for average house prices and units sold, respectively. This indicates that the model explains 70.2% and 76.3% of variance with house prices and units sold, respectively. Additionally, the centered fitted values are taller than the residual values for both the average house prices and the units sold. Therefore, we can conclude that the spread of fitted values is greater than the spread of residual values. The distribution of the values is also normally distributed. This means variables account for the significant variations in the model, with small residual variation.

The coefficient for NRST is significant for average house price ($p \leq 0.0001$, t = 12.47) and units sold ($p = 0.0398$, t = −2.06). This indicates that introducing the NRST tax contributes to increasing the house price, while negatively impacting the units sold. However, the relative influence of NRST on units sold is low (St. Est. −0.03814) compared to average house prices (St. Est. = 0.31012). Therefore, we continue our analysis with average house prices as the dependent variable. The test results are presented in Table 3.

The total number of observations used in this model is 1188, excluding the missing values. The number of effects is 10, including the intercept. The *p*-values for average house price and units sold are both significant ($p < 0.0001$). However, the coefficient of the variable for house price (24.21) is stronger than for units sold (47.33). Therefore, we can conclude that the independent variables selected in the model can reliably predict house prices (dependent variable) compared to the units sold. Furthermore, the adjusted R-square value (0.7018) indicates that 70 percent of variation in the dependent variable is predictable with the independent variable selected in the model. Therefore, we can conclude that the impact of independent variables, including housing policies, can be better understood with the average house price variable compared to the unit sold variable.

Our full model (Table 3) includes key variables to assess house price response to market supply, market demand, and control measures. For this study, we have controlled the population and unemployment rate. Vacancy rate and absorption rate contribute to housing supply. The mortgage rate, NRST, and property taxes are considered controlled measures at the national, regional, and local scales. The fluctuation in the number of units sold, depicting the market response to policies, significantly correlates with house

prices ($p < 0.0001$). Similarly, vacancy rate ($p < 0.0001$, t = −6.54) and absorption rate ($p = 0.0469$, t = 1.99) significantly influence house prices. However, the number of units created ($p = 0.1241$) has no significant relationship with house price. On the other hand, government control measures have a varying impact on house prices. The property taxes have a significant ($p < 0.0001$) but relatively weaker (t = −5.52) influence on house prices, whereas NRST tax ($p < 0.0001$, t = 12.47) and the mortgage rate ($p < 0.0001$, t = −18.14) show a strong and significant relationship with regional house prices.

**Table 3.** Cumulative impact of housing policies on average house prices.

| Variables | DF | t Value | Pr > \|t\| | St. Estimate | t Value | Pr > \|t\| | St. Estimate |
|---|---|---|---|---|---|---|---|
| Dependent Variables | | | Average House Price | | | Units Sold | |
| Intercept | 1 | 20.76 | <0.0001 | 0 | 6.55 | <0.0001 | 0 |
| Independent Variables | | | | | | | |
| Mortgage Rate | 1 | −18.14 | <0.0001 | −0.33393 | −2.91 | 0.0037 | −0.05532 |
| NRST Tax | 1 | 12.47 | <0.0001 | 0.31012 | −2.06 | 0.0398 | −0.03814 |
| Property Tax Rate | 1 | −5.52 | <0.0001 | −0.13753 | −6.40 | <0.0001 | −0.15285 |
| Units Sold/Average Price | 1 | 2.33 | 0.0201 | 0.07385 | 2.33 | 0.0201 | 0.06196 |
| Units Created | 1 | 1.54 | 0.1241 | 0.06229 | 5.38 | <0.0001 | 0.19727 |
| Absorption Rate | 1 | 1.99 | 0.0469 | 0.03637 | 4.14 | <0.0001 | 0.06901 |
| Vacancy Rate | 1 | −6.54 | <0.0001 | −0.12946 | 2.56 | 0.0104 | 0.04722 |
| Unemployment Rate | 1 | −0.24 | 0.8100 | −0.00481 | −1.38 | 0.1676 | −0.02531 |
| Population | 1 | 6.66 | <0.0001 | 0.32153 | 11.78 | <0.0001 | 0.50194 |
| Dependent Variable | | | Average House Price | | | Units Sold | |
| F Value | | | 311.38 | | | 396.28 | |
| Pr > F | | | <0.0001 | | | <0.0001 | |
| Root MSE | | | 105,071 | | | 443.1225 | |
| Dependent Mean | | | 434,023 | | | 936.18 | |
| Coeff Var (R-MSE/D-Mean) | | | 24.2085 | | | 47.3329 | |
| R-Square | | | 0.7040 | | | 0.7517 | |
| Adj R-Sq | | | 0.7018 | | | 0.7498 | |
| Observation Used | | | 1188 | | | 1188 | |

### *3.3. Empirical Model*

The study uses descriptive analyses and inferential statistics to analyze the variables. Multiple linear regression (MLR) is widely used to assess the response of house prices to socio-economic, environmental, and policy factors [86,87]. This study uses the ordinary least square (OLS) regression method to explain a response of a dependent variable to changes in more than one explanatory variable [88]. Our model assumes a linear relationship between variables as well as assuming no significant correlation between independent variables. Additionally, having panel data for treatment and control groups before and after an event, the difference-in-difference (DID) method is useful to assess the impact of an event [89,90]. Therefore, we use the DID method to assess the relation between tax intervention and house prices.

The study developed a multiple linear regression model to evaluate the influence of policy frameworks on intra-regional house prices. The empirical analysis follows three steps. First, multivariate regression analysis selects an appropriate dependent variable, ensuring the model's reliability to predict the response variable. The second step involves impact assessment of policy intervention at short and longer durations using the Wilcoxon rank-sum two-tailed test [91]. Finally, the third approach uses multiple linear regression [92] and DID methods [89] to assess the geographical variation in tax policies within and beyond tax administrative jurisdictions.

The method adopted in this research is the Multiple Linear Regression (MLR) model using multiple explanatory variables. We use a regression model to measure the response

variable (Y) as a linear function of the parameters ($b_{0\text{-}p}$), using various predictor variables ($x_{1\text{-}p}$). The MLR scalar form is presented below.

$$y_i = b_0 + \sum_{j=1}^{p} b_j x_{ij} + e_i \quad (1)$$

$y_i$ is the real-valued response (dependent/regressand/outcome) for the $i$th observation, and $x_{ij}$ is the $j$th predictor for the $i$th observation. Additionally, $b_0$ and $b_j$ are regression intercept and $j$th predictor's regression slope, respectively. An error term ($e_i$) is with conditional mean zero for the given regressors. It is assumed that $x_j$ is in a linear relationship with $y$, experiencing $b_j$ increase in value for every 1 unit increase in $x_j$, keeping other predictor variables constant.

The coefficient of variation will be used to select an appropriate dependent variable (e.g., average house price and the number of units sold). The regressor's ability to predict the response variation will determine the reliability of the regression model. We use the standard set of predictors (policy, demand, and supply variables) to test models with available response variables. Additionally, the study uses the response variable with a more robust coefficient of variation in combination with the predictors. This step will confirm the reliability of regressors to predict the variation in the response variable (for instance, average house price) used for the statistical estimation.

To obtain robust estimates of the effects of independent variables and assess the degree of similarity, lagged values of the dependent variable are used in the regression model [93]. The use of both current and past values of the dependent variable assesses bias and the degree of autocorrelation between variables [94]. This step provides a regional model and relative predictive capacity of independent variables at the regional/provincial scale.

The diagnostic test helps in confirming regression assumptions. We conducted a diagnostic test to find multicollinearity and heteroskedasticity issues [95]. High collinearity may cause problems in estimating regression coefficients. In the case of collinearity between variables, one will be dropped. On the other hand, the independent variables' heteroskedasticity will help achieve the ideal concept of BLUE (Best Linear Unbiased Estimator). BLUE is one of the main assumptions for ordinary least squares regression (i.e., homogeneity of variance of the residuals). Additionally, the study uses a residual fit spread plot to assess the explanatory power of variables. The comparison between fit-mean and residual plots determines how well explanatory variables can explain the variation in the dependent variable.

## 4. Results

### *4.1. Descriptive Statistics*

We used nine regressors after performing diagnostic tests to confirm regression assumptions and achieved the best linear unbiased estimators. First, a collinearity test was conducted. The prime rate was excluded from the study due to high collinearity with the mortgage rate. Second, to check heteroscedasticity, we conducted a White test. The results obtained from the test show degree of freedom (DF) value 53 and Chi-square value 232.86, with $p < 0.0001$. The White test was significant; therefore, we could reject the null hypothesis and conclude that the variance is not homogenous. The descriptive statistics of the variables are presented in Table 4.

Average growth in house prices between January 2011 and December 2021 varied between the cities; see Figure 1. In the GGH region, the city of Toronto had the lowest price growth. The average growth in the other cities from the GGH region and the city of London from the non-GGH region witnessed an over 200 percent increase in house prices, whereas Niagara from the GGH region and Windsor from the non-GGH region experienced house price growth of 310 percent and 262 percent, the highest in the sample. The lowest price growth recorded in Ottawa (89 percent) and Kingston (139 percent) are from the non-GGH region.

**Table 4.** Descriptive data.

| Variable | Mean | Std Dev | Minimum | Maximum | N |
|---|---|---|---|---|---|
| NRST-Tax | 0.3787879 | 0.4852895 | 0 | 1.0000000 | 1188 |
| Mortgage Rate (5Y) | 2.0668182 | 0.4715543 | 0.8500000 | 2.7500000 | 1188 |
| Units Sold | 936.1826599 | 885.9169593 | 66.0000000 | 5090.00 | 1188 |
| Average Price | 434,023.29 | 192,405.68 | 143,149.26 | 1,123,076.53 | 1188 |
| Total Units Created | 590.9452862 | 1072.10 | 3.0000000 | 6796.00 | 1188 |
| Absorption Rate | 49.5047097 | 20.0489838 | 0 | 92.1428571 | 1188 |
| Property Tax Rate | 1.1692095 | 0.2384062 | 0.5948453 | 1.8200000 | 1188 |
| Vacancy Rate | 2.5767677 | 1.2305158 | 0.6000000 | 8.3000000 | 1188 |
| Unemployment Rate | 6.9237374 | 1.9343720 | 1.8000000 | 16.7000000 | 1188 |
| Population | 932.2348485 | 1500.86 | 119.2000000 | 5599.60 | 1188 |

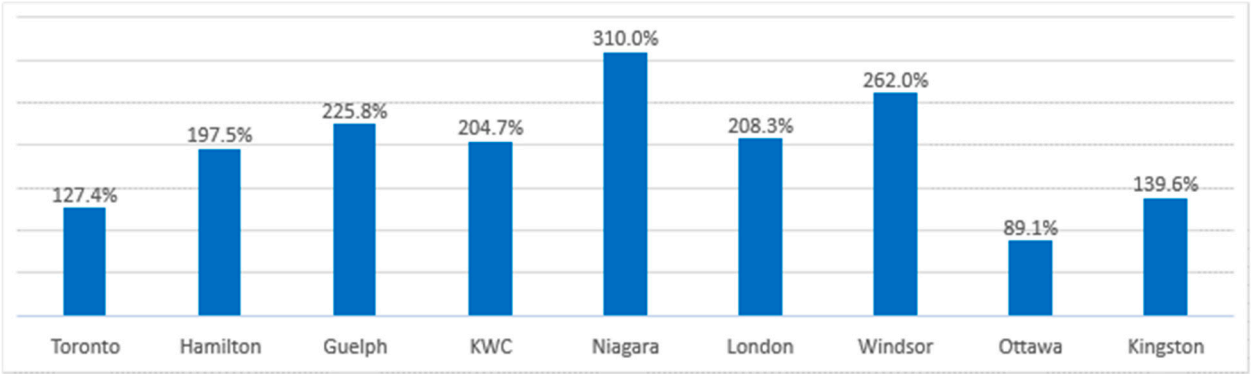


**Figure 1.** Change in house prices (January 2011–December 2021).

Thus, the house prices in the majority of GGH cities, close to the city of Toronto, are synchronized, whereas the non-GGH region experienced differential growth, indicating geographical alignment rather than administrative. Relatively high price growth in the cities around Toronto, and even stronger market activity in the western and southern regions of Ontario, indicate buyers' geographical priorities. For example, Windsor, London, and Guelph experienced greater price growth compared to Ottawa and Kingston in the east of Toronto (see Table 5).

**Table 5.** Cumulative and year-over-year house price change.

| Average Price Change | Toronto | Hamilton | Guelph | KWC | Niagara | London | Windsor | Ottawa | Kingston |
|---|---|---|---|---|---|---|---|---|---|
| | | | GGH | | | | Non-GGH | | |
| Cumulative 2011 to 2021 | 127.4% | 197.5% | 225.8% | 204.7% | 310.0% | 208.3% | 262.0% | 89.1% | 139.6% |
| YOY 2011 to 2021 | 7.92% | 10.66% | 11.91% | 10.98% | 14.34% | 11.25% | 12.95% | 6.22% | 8.60% |
| YOY 2018 to 2021 | 7.29% | 13.33% | 16.55% | 15.34% | 18.87% | 19.02% | 21.57% | 10.89% | 14.14% |

Table 5 indicates a steady growth in the city of Toronto after the implementation of NRST, whereas the Year-Over-Year (YOY) growth in the GGH and non-GGH regions remained 12 percent and 10 percent, respectively, from 2011. However, following the implementation of NRST in 2017, the YOY increased to 16 percent average in both the GGH and non-GGH regions, excluding Toronto. The rapid increase in house prices in both the GGH and non-GGH regions indicates a possible spill-over effect of tax intervention to the neighboring cities out of the NRST jurisdiction. The significance of NRST in driving house prices is discussed in detail in the next sections.

### *4.2. Policy Intervention Impact*

The data on international buyers and ownership of residential property by foreigners are very limited and come from the Statistics Canada study covering 2017–2018. Furthermore, little information is published on the number of transactions involving foreign nationals after the implementation of NRST on 21 April 2017. The information provided by the provincial government is limited to the total number of transactions involving foreign buyers and the total amount collected. The information gathered from the land registry office (LRO) scale usually does not correspond with municipality boundaries. Therefore, we cannot compare the data collected at the LRO scale to the average house prices at different scales.

The number of units sold dropped after the introduction of NRST in April 2017 (see Figure 2). However, it is not very clear to what extent taxation on foreign buyers contributed to the drop in sales because the average monthly unit sales constantly fluctuated from 2011.

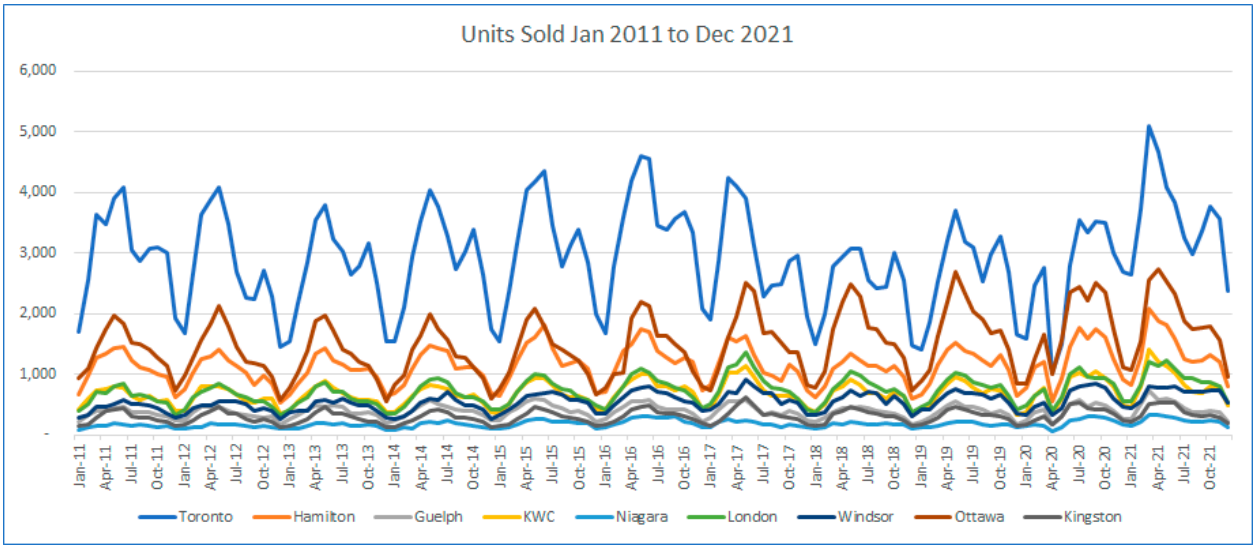


**Figure 2.** Monthly housing units sold from January 2011 to December 2021.

We assessed the fifty-six-month average before and after the implementation of NRST. The change in the monthly average is presented in Table 6. The average monthly unit sale in Toronto was reduced by 5 percent, the highest reduction in the GGH and Non-GGH regions. However, in the surrounding areas and in the non-GGH region, market activity increased following the implementation of NRST, complementing our discussion in the previous section.

**Table 6.** The number of units sold before and after NRST—Fifty-six months on average.

| | **Toronto** | **Hamilton** | **Guelph** | **KWC** | **Niagara** | **London** | **Windsor** | **Ottawa** | **Kingston** |
|---|---|---|---|---|---|---|---|---|---|
| **Average Units Sold (Month)** | | | **GGH** | | | | **Non-GGH** | | |
| September 2012 to April 2017 | 2992 | 1137 | 395 | 666 | 179 | 683 | 517 | 1306 | 283 |
| May 2017 to December 2021 | 2841 | 1183 | 391 | 733 | 192 | 795 | 608 | 1722 | 335 |
| Change | −5% | 4% | −1% | 10% | 7% | 16% | 18% | 32% | 18% |
| Average Price | | | | | | | | | |
| January 2014 to April 2017 | 646,332 | 416,319 | 436,289 | 350,617 | 255,885 | 261,942 | 197,367 | 352,869 | 294,359 |
| May 2017 to December 2021 | 913,780 | 656,046 | 682,109 | 573,252 | 474,333 | 455,463 | 370,390 | 470,924 | 431,095 |
| Change | 41% | 58% | 56% | 63% | 85% | 74% | 88% | 33% | 46% |

To infer the descriptive analysis above, we determined the significance of the difference between the means of the GGH and non-GGH groups. Considering the sample size, we used the Shapiro–Wilk normality test to determine the distribution of data. The Shapiro–Wilk *p*-value of less than 0.05 rejects the null hypothesis, confirming a significant departure from normality. Therefore, we used the Wilcoxon rank-sum two-tailed test to determine the difference between the two groups. The results are presented in Table 7.

**Table 7.** Multi-day effects of tax implementation.

| | **GGH Region** | | | | **Non-GGH Region** | | | |
|---|---|---|---|---|---|---|---|---|
| **Period/Months** | **−3, +3** | **−6, +6** | **−12, +12** | **−56, +56** | **−3, +3** | **−6, +6** | **−12, +12** | **−40, +40** |
| N (0/1) | 15/20 | 30/35 | 60/65 | 281/284 | 12/16 | 24/28 | 48/52 | 224/228 |
| DF | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| Units Sold | | | | | | | | |
| Z | −0.5167 | −0.3356 | 1.0971 | −0.3608 | −1.7876 | −2.1661 | 0.1483 | −3.0738 |
| X2 | 0.2844 | 0.1171 | 1.2090 | 0.1304 | 3.2789 | 4.7316 | 0.0230 | 9.4505 |
| Pr > X2 | 0.5938 | 0.7322 | 0.2715 | 0.7181 | 0.0702 | 0.0296 | 0.8794 | 0.0021 |
| Avg Price | | | | | | | | |
| Z | −0.5833 | −1.0988 | −2.115 | −14.383 | −1.1374 | −1.6245 | −3.239 | −15.358 |
| X2 | 0.3600 | 1.2218 | 4.4734 | 206.8732 | 1.3470 | 2.6688 | 10.5150 | 235.8951 |
| Pr > X2 | 0.5485 | 0.2690 | 0.0344 | <0.0001 | 0.2458 | 0.1023 | 0.0012 | <0.0001 |

The difference between the number of units sold before and after the tax implementation is insignificant in both regions. Similarly, the difference in average price up to six months is not significant. This confirms no short-term impact on market transactions and average house prices. However, the average price *p*-values for twelve months and fifty-six months are significant for both regions. This indicates that the difference between the means before and after the tax implementation is significant, confirming the long-term impact on house prices. The GGH region z-values (−2.115, −14.383) and non-GGH region z-values (−3.239, −15.358) indicate that the impact on the non-GGH (non-taxed region) is greater than on GGH (taxed region). This indicates a spillover effect due to a shift in investment preferences to the non-GGH region. Although the difference in market activity (units sold) before and after the tax implementation is insignificant, the absolute numbers presented in Table 6 indicate positive growth in the non-GGH region compared to sales decline in the GGH region. Hence, we can say that there is an increase in average house prices over time and that taxes play a certain role in addition to other indicators. For further reliability, we have performed a DID panel regression in the next section.

### *4.3. Difference-in-Difference Analyses*

As discussed above, NRST has shown a positive correlation with house prices. To determine tax response at the intra-regional scale, we have conducted a DID panel regression. The treatment variable is NRST because municipalities in the GGH region introduced the NRST at a certain time. The control variable is whether a municipality introduced the NRST at all. The dependent variables are average house price, units sold, units created, absorption rate, and vacancy rate.

The DID panel regression tests the difference-in-difference in the dependent variables for municipalities with and without NRST over time. Figure 3 presents the increase in the average house price over time for NRST municipalities and non-NRST municipalities. This demonstrates a stronger increase in the price for NRST municipalities.

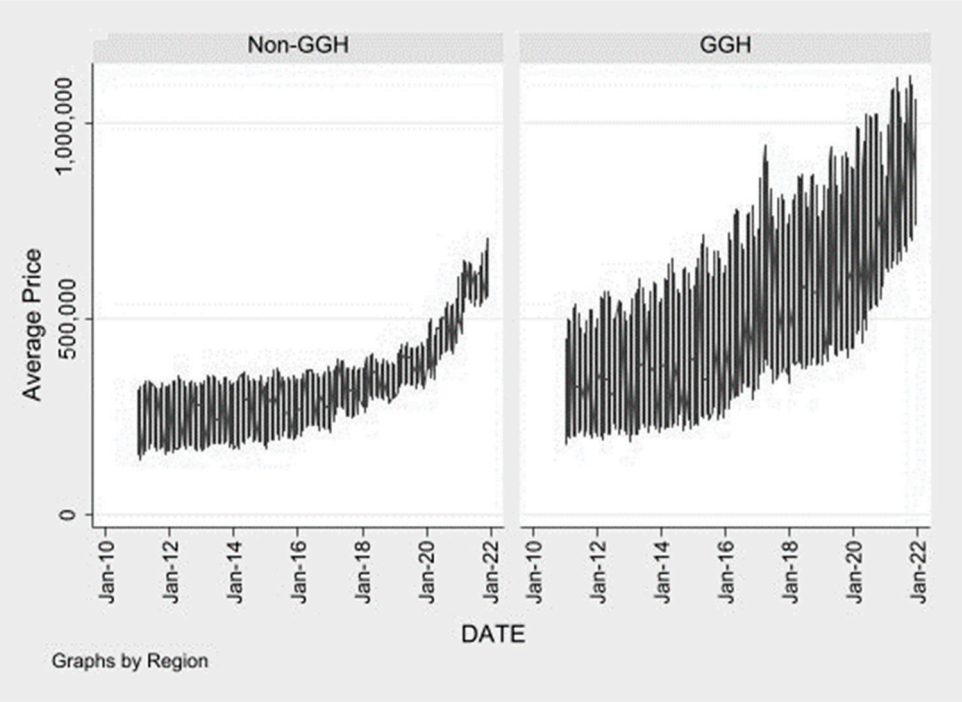


**Figure 3.** DID effect for Average House Price.

Furthermore, we created the same graph for units sold. In contrast to the price development, we cannot identify a DID effect for units sold. See Figure 4.

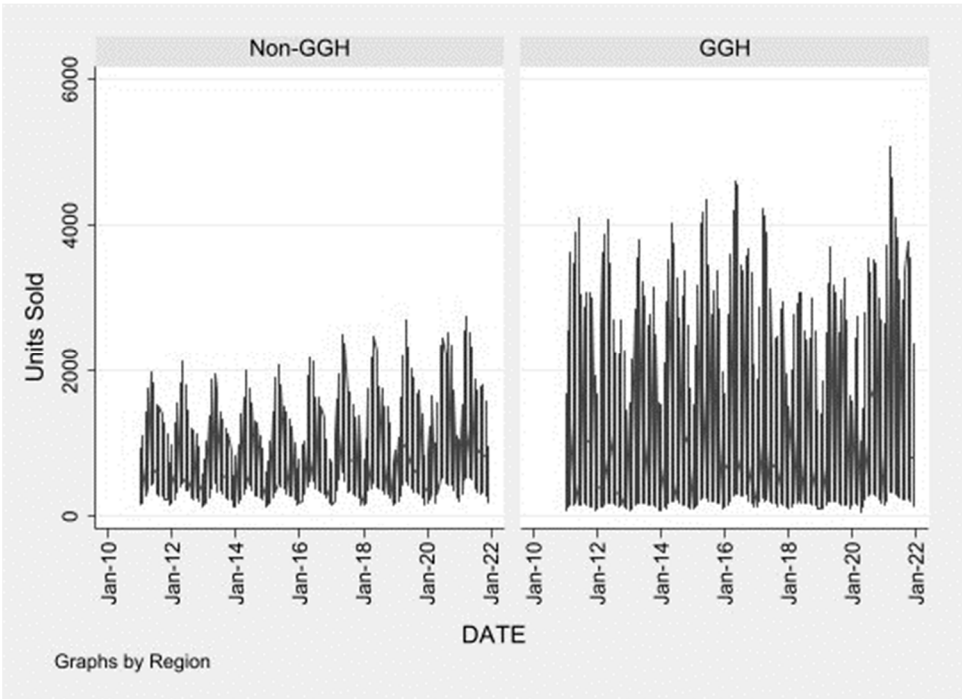


**Figure 4.** DID effect for Units Sold.

The following table presents the DID panel regressions for the variables mentioned above, including average price and units sold.

The results in Table 8 demonstrate a significant DID for the average price. The price difference over time is significantly bigger for GGH municipalities that have implemented

NRST compared to non-GGH municipalities. All other variables do not show significant DIDs. The results validate our discussion above that NRST has driven the house prices in both the GGH and non-GGH regions.

**Table 8.** DID panel regression for the selected variables.

| Dependent Variable | Coefficient | Std. Err. | t | $p > t$ | 95% Conf. | Interval |
|---|---|---|---|---|---|---|
| Average price | 91,853.120 | 19,422.480 | 4.730 | 0.001 | 47,064.810 | 136,641.400 |
| Units sold | −131.038 | 73.151 | −1.790 | 0.111 | −299.724 | 37.648 |
| Units created | 40.510 | 101.641 | 0.400 | 0.701 | −193.875 | 274.896 |
| Absorption rate | −12.307 | 9.551 | −1.290 | 0.234 | −34.331 | 9.716 |
| Vacancy rate | 0.987 | 0.474 | 2.080 | 0.071 | −0.107 | 2.081 |

### *4.4. Geographical Variation of Housing Policies—Mortgage and Property Tax*

To assess the influence of mortgage rates and property taxes on house prices across cities, we conducted a linear regression analysis, presented in Table 9. The mortgage rate and property taxes relationships with house prices vary across cities. The Toronto housing market shows no sensitivity to mortgage rates ($p = 0.2533$) and property taxes ($p = 0.1695$). Hamilton house prices show strong sensitivity to mortgage rates ($p < 0.0001$, t = −9.90).

**Table 9.** Geographic impact of variables on house prices.

| CMAs | | Toronto | Hamilton | Guelph | KWC | Niagara | London | Windsor | Ottawa | Kingston |
|---|---|---|---|---|---|---|---|---|---|---|
| **Region** | | | | **GGH Region** | | | | **Non-GGH Region** | | |
| Mortgage | *p* | 0.2533 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | 0.0008 | <0.0001 | <0.0001 |
| | t | −1.15 | −9.90 | −12.44 | −8.94 | −10.16 | −7.88 | −3.43 | −6.32 | −9.06 |
| Property Tax | *p* | 0.1695 | 0.0770 | 0.0356 | 0.0029 | 0.0109 | 0.0007 | <0.0001 | <0.0001 | <0.0001 |
| | t | −1.38 | 1.78 | 2.12 | 3.04 | 2.59 | 3.46 | 5.28 | 5.47 | 4.32 |
| Units Sold | *p* | <0.0001 | <0.0001 | 0.0001 | 0.0073 | 0.2379 | 0.3203 | <0.0001 | 0.0002 | 0.0728 |
| | t | 10.33 | 4.36 | 3.99 | 2.73 | 1.19 | 1.00 | 4.08 | 3.86 | 1.81 |
| Units Created | *p* | 0.2611 | 0.7281 | 0.0548 | 0.2295 | 0.5833 | 0.7831 | 0.9843 | 0.6795 | 0.4844 |
| | t | −1.13 | 0.35 | −1.94 | −1.21 | −0.55 | −0.28 | 0.02 | −0.41 | 0.70 |
| Absorption Rate | *p* | 0.2571 | 0.0031 | 0.0001 | 0.0897 | 0.1410 | 0.5674 | <0.0001 | 0.0058 | 0.3506 |
| | t | 1.14 | 3.02 | 4.01 | 1.71 | 1.48 | 0.57 | 5.68 | 2.81 | −0.94 |
| Vacancy Rate | *p* | 0.7740 | 0.0470 | <0.0001 | 0.2146 | 0.0036 | 0.1314 | 0.0014 | <0.0001 | 0.4039 |
| | t | −0.29 | −2.01 | 6.65 | 1.25 | 2.97 | 1.52 | 3.26 | 6.73 | 0.84 |
| Unemployment Rate | *p* | 0.7362 | 0.4212 | 0.0027 | 0.6242 | 0.0014 | 0.0667 | <0.0001 | 0.4316 | 0.1829 |
| | t | −0.34 | 0.81 | −3.06 | −0.49 | 3.27 | 1.85 | −4.58 | −0.79 | −1.34 |
| Population | *p* | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 | <0.0001 |
| | t | 10.78 | 14.47 | 17.42 | 22.03 | 16.87 | 21.54 | 9.12 | 10.57 | 20.10 |

However, property tax has no significant influence on the Hamilton housing market. In contrast, mortgage rates and property tax significantly influenced house prices in all other cities analyzed in the sample. However, a negative, and relatively higher, t-value for mortgage rate indicates the contribution to price suppression matching with the general perception of the inverse relationship between mortgage rate and house prices. Property tax has a positive but relatively smaller t-value, indicating some contribution to the price increase. This relationship is a behavior not conforming to the general perception of the inverse response of house prices to property taxes, but less distortionary, as suggested by the literature [96]. This situation can be better understood by considering significant ($p < 0.0001$) and relatively more robust population demand factors. Furthermore, the geographical placement of the city of Hamilton closer to the regional economic centers further illuminates the nonconforming behavior of the market.

The analysis above shows that national, regional, and local sale policies are distinctly and inconsistently influencing housing markets. Moreover, it is evident that other factors may become stronger to override a generic policy influence on the housing markets. A

further detailed study is required to assess how neighboring market policy interventions override local variables to influence house prices in the local market.

## 5. Conclusions

In this study, we have studied housing market behavior in nine major cities from different administrative regions in Ontario. We have used housing market data from January 2011 to December 2021 to assess the impact of the provincial government intervention introduced in 2017 to control speculative investment. The study examines how effectively the transfer tax policy implemented in the GGH region fulfills its intended objective of controlling housing market speculation. Additionally, the investigation assesses how geographical variation impacts the effects of real estate taxes and mortgage interest rates on house prices. Finally, it adds to the literature through its evaluation of the effectiveness of housing policies, in an intra-regional setting, against the speculative investment behavior of conventional financialized housing markets.

The study analyzed the varying impact of national, regional, and local policies in relationship with local demand and supply. For example, national mortgage rates determine access to finance, driving home investment decisions [97]. Similarly, the NRST is a regional initiative to influence foreign investment in the local housing markets, a policy influencing property transfer [54]. Considering a possible housing market spillover effect [15], the NRST impact was studied within and beyond its jurisdiction. Subsequently, local property taxes not only influence the cost of housing, but they are one of the significant sources of funding for local services and the provision of amenities [63].

Similarly, unemployment and population cover housing demand, whereas the number of units created and the vacancy rate represent the local supply of the houses [65]. All these variables are significant in assessing local housing market response in terms of housing market activity (units sold) and changes in house prices across multiple cities [28]. The combination of variables helped assess the net outcome of multi-level policies applied, their scope, and demographic and geographic variation. However, the scope of the study, data, and geographic limitations, and the possible impact of other demographic and economic factors, limit the generalizability of the research.

Housing plays an essential role in sustainable governance due to its socio-economic and environmental connection. Housing contributes to a significant part of household spending [98], playing a vital role in economic growth [99]. Historically, the housing market has remained a crucial medium for the transmission of socio-economic objectives. Additionally, this sector is attractive to investors for secured wealth generation and provides a stable source of revenue for public expenditures. Therefore, it makes efficient housing and real estate management significant for sustainable development. However, the relationship between governance policies, market response, and socio-economic outcomes varies geographically and demographically.

The literature has assessed the role of speculation tax distortionary in its administrative jurisdiction [58,59] and across economic sectors [100]. Our study determines that speculation taxes, such as NRST, play a role in increasing house prices within and beyond tax administrative jurisdiction. This indicates a spillover effect due to a shift in investment preferences to non-taxed regions. Furthermore, our research finds that the regional market leader with strong local demand is not responsive to housing market policy intervention. This confirms that investment interests are irrespective of transfer taxes, considering the benefit outweighing the cost [61].

Our results also indicate a geographical variation of local and regional scale tax policies. Investors' geographical interest in the western non-GGH regions could be one of the reasons for increasing house prices, further complemented by the high buying cost in the GGH region. However, the tax policy spillover effect has a geographic limitation. The study finds that the distant markets remained independent of local policy interventions, whereas housing markets are more sensitive to neighboring markets' policy changes conforming to a spatial clustering behavior [101].

The mortgage rate and property taxes have shown geographically inconsistent behavior. Most of the cities have shown a significant and negative correlation with mortgage rates. This phenomenon does not match a general perception of an inverse relationship between mortgage rates and house prices. In contrast, the economic hub, such as the city of Toronto housing market has no influence from the mortgage rate. On the other hand, property tax seems to be ineffective in suppressing housing prices in the presence of strong market demand. On the other hand, property taxes are found non-distortionary in most cities, according to the literature [96]. The study confirms that, irrespective of mortgage and property tax rates, local demand factors, and geographical closeness to the major economic centers contribute to speculative investment that is driving house prices [77,102].

The analysis above shows that national, regional, and local policies are distinctly and inconsistently influencing housing markets. Market factors may become stronger to override a generic policy influence on the housing market. Although the study does not confirm any pattern in local market behavior responding to local market conditions, it does, however, demonstrate that housing market interventions such as speculation tax is ineffective in controlling house prices both in the short and long run [52,54,77,96]. Additionally, the study confirms that such policies influence beyond their administrative jurisdiction. In this case, speculation taxes may not be considered an effective tool in curbing house prices. Similarly, assuming the role of property taxes in providing public services, delinking property taxes from a potential contributor to house prices would provide a better lens to develop local housing policies. Furthermore, the study also confirms that the housing market can be better assessed at a local scale, considering the neighboring market's influence in conjunction with investment trends.

The analyses help determine the relationship between policy objectives, policy instruments, and their counteracting effects in an intra-regional setting. This will further help develop a framework for coordinative measures required between the institutions to enhance the effectiveness of housing sustainability policies.

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