DETERMINANTS OF HOUSE PRICES IN NOVA SCOTIA DURING THE 2010-2020 PERIOD

by

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ABSTRACT

This study seeks to examine the factors that affected real house prices in Nova Scotia in the last decade (2010 to 2020) using Nova Scotia census data from Statistics Canada along with parcel sales history and residential dwelling characteristics data from Datazone's Nova Scotia property and municipal datasets. Hedonic price model theory is applied to house sale prices for Census Divisions in Nova Scotia over the decade 2010 to 2020 and the datasets were analyzed using Ordinary Least Square regression technique to estimate the factors that influenced house prices in the province during the time period under consideration. The results of the study showed that the main factors that affected the real price of houses in Nova Scotia during 2010 to 2020 were: location; sale date; building size; the number of bathrooms in a house; availability of a garage; availability of a finished basement; the construction quality of a house; if a house was detached, multi-unit, or multi-parcel; population; unemployment rate; housing supply; the percentage of the housing supply that is occupied; and the percentage of tenants living in subsidized housing. The number of bedrooms in a house and the percentage of the province's population that is Aboriginal were other factors that were revealed to have affected the real price of houses in Nova Scotia. This study is valuable as the understanding of the factors that affect house prices is essential to policy makers in their devising of policies relating to the housing market, especially given the overall rise in house prices and the well-publicized issue of housing affordability in the province.

1. INTRODUCTION

The purpose of this study is to investigate the main factors that influenced the price of housing in Nova Scotia, Canada, during the years 2010 to 2020, and its significance is premised on the importance of the real estate sector to the Canadian economy.

Purchasing a house is the greatest investment a household may make and the largest single item of consumer's wealth (Nistor and Reianu, 2018). The housing markets of economies are of great significance because house prices have an impact on consumers' personal wealth, and the wealth of consumers influences their spending. Changes in the prices or values of properties in housing markets cause changes in the wealth of individuals in the economy, individuals will alter their spending decisions with respect to their wealth change, and this in turn affects economic conditions. Increases in house prices generally encourage more consumer spending as consumers are more confident about spending and willing to borrow more against the increased value of their homes, leading to higher economic growth. While house price declines negatively affect consumer confidence and spending in general, leading to lower economic growth. Therefore, it is important for people in an economy to know and understand the factors that drive the values of properties in their housing markets. Knowledge of the determinants of house prices is particularly useful to government authorities as it provides them with tools to manage and control the housing market and influence the state of the economy. Hence, because the real estate sector of any country forms one of the main determinants of the country's economic growth, neglecting a study like this on the province's real estate sector could be as significant as neglecting information on the nation's economy itself.

It is interesting to look back at the last decade as a this new one begins to form expectations of what the market would look like in the near future, especially considering that

at the beginning of the decade under consideration, world economies were still recovering from the 2008 global economic downturn. In 2009, in Canada, although the population continued to increase, demand for housing was constrained in the early part of the year by the global economic downturn which decreased labour market activity and lowered consumer confidence (Statistics Canada, 2010). Also mentioned in the same report, on average, new housing prices in 2009 were 2.3 percent below the 2008 average, and although they started to rebound in the second half of the year due to strong resale price increases, new housing prices as of December 2009 were still 1.7 percent below their peak month of September 2008 (Statistics Canada, 2010). On the other hand, average annual home resale prices were up 5 percent on average over 2008 after being flat for the first quarter of the year, they reached a record high in December 2009, a full 5.7 percent above their previous peak (Statistics Canada, 2010). Furthermore, economic activity picked up in the residential building construction sector after the beginning of the year with the smallest number of new units approved since 1996, by the fourth quarter this number had doubled (Statistics Canada, 2010). Provincially, Newfoundland and Labrador recorded the fastest provincial increases in both new housing and resale prices due to solid economic activity and a growing population; elsewhere in the Atlantic region, price gains were moderate, but they however reached new all-time highs (Statistics Canada, 2010). In Quebec, new housing and resale prices continued to climb, reflecting steady population growth and increased labour market activity. Ontario, however, saw no change in new housing prices but recorded new peaks in resale prices due to the gradual economic recovery that unfolded during the year especially in the manufacturing sector (Statistics Canada, 2010). And in the Prairies, only Manitoba posted new housing price increases, however resale prices rose moderately in both Manitoba and Saskatchewan. Alberta saw its new and resale prices continue to decline in 2009. And in British Columbia new housing prices were down 6.5 percent in 2009, but resale prices were up by 2.4 percent (Statistics Canada, 2010).

Currently, as of October, 2020, Nova Scotia is experiencing the second highest growth rate (21.15 percent) in average house prices of Canadian provinces since September 2019, second to New Brunswick's 31.36 (Davie, 2020). This is largely due to the Nova Scotia's real estate industry proving to be a seller's market. There is more demand for houses and properties, with plenty of buyers and less supply of houses as there are few homes available for sale, the increase of demand over supply has resulted in increases in owners' profit and the price of properties in the last decade (Wilkins, 2020). The limited housing inventory in the province is also failing to meet potential buyers' tastes; buyers seeking certain property types are left unsatisfied as new builds in the market are at times failing to meet their demands. In addition, since 2016 the province's inventory has been dropping to its current state of between 3 and 4 months, from between 12 to 13 months where it was in prior years (Re/Max Canada, 2020). Recent statistics have shown the value of the excess demand in the Nova Scotia housing demand, according to Wilkins (2020), the average house price in Nova Scotia was 289,243 dollars in July 2020, a 15 percent increase over the average home price in July 2019, and comparatively the average house price throughout the first seven months of 2020 rose 8.2 percent from 2019 to 277,940 dollars. According to data from the Nova Scotia Association of Realtors, there were 5,530 properties sold between June 1st and September 30th in the province with 960 of those sales C$10,000 over their asking price (Davie, 2020). These price increases imply that the house demand in the province continues to exceed supply, even as the world experiences the COVID-19 pandemic. The pandemic seemed to not have any impact on the booming housing market in Nova Scotia especially in the province's capital, Halifax, where after a short halt in the spring the market was jumping by June and had not stooped by the fall, in October; and where the aggregate price of a home went up 11.3 percent year over year in the third quarter, with expectations to keep rising up to 12 percent in the final part of 2020 (Davie, 2020).

Nova Scotia's growing population has been attributed to be responsible for the increasing demand for homes in the province. The government of Nova Scotia estimates a population of 979,449 as of January 1st, 2021, which is the highest population for Nova Scotia on record and an increase of 43,178 from April 1st, 2015 (Government of Nova Scotia – Finance and Treasury Board). And the COVID-19 pandemic might even be a contributor to the province's increasing population over the past year and possibly in the immediate future, as it has been reported to be boosting migration from other parts of Canada into the province. Social distancing caused some people to feel less comfortable being in close proximity to others due to the risk of exposure to the virus, hence for large metropolitan hubs where condo lifestyles are common and require the use of shared spaces like elevators and lobbies, this meant some people were incentivized to move from densely populated provinces like Ontario to the east coast. The shift to remote working arrangements has afforded homeowners more freedom to choose where they would like to live, no longer constrained by their office commute; and with a recent survey by RE/MAX Canada showing that 48 percent of Canadians want to live closer to green spaces and 33 percent realizing that they would like more square footage in their home, the pandemic appears to have caused locals and those from other provinces to seek larger floor plans and more green space, both of which are plentiful in Nova Scotia (Re/max Canada, 2020). The growing demand and consequently growing house prices in the Nova Scotian housing market should be a concern because if it needs management and is not managed, it could negatively impact the general welfare of the immediate consumers of Nova Scotia homes.

From the results of this study, the main factors that affected the real price of houses in Nova Scotia during 2010 to 2020 were: location; sale date; building size; the number of bathrooms in a house; availability of a garage; availability of a finished basement; the construction quality of a house; if the house is detached, multi-unit, or multi-parcel; population; unemployment rate; housing supply; the percentage of the housing supply that is occupied; and

the percentage of tenants living in subsidized housing. The number of bedrooms in a house and the percentage of the province's population that is Aboriginal were other factors that were revealed to have affected the real price of houses in Nova Scotia during the past decade.

The body of this thesis is structured into the introduction to the study and literature review, which is followed by a data and methodology section that describes the data that is used and modelling approach that was taken. Finally, the model results and policy implications are discussed.

2. LITERATURE REVIEW

There have been numerous studies done on the factors that influence the price and demand for housing in various real estate markets of the world. After examining a few of these numerous studies for guidance on this thesis, some of the factors that have been found to influence house prices and demand include; interest rates, unemployment rates, population, population age, income, loan demand, household or family size, the house or property's location, marital status, and immigration. This section reviews some relevant existing literatures to this study.

2.1 Review of Theoretical Literature

Traditional demand theory, rational choice theory, utility theory, and the hedonic pricing method theory are four theories appropriate for the thrust of this thesis. These theories establish the relationship between the demand for housing, housing prices, housing markets and the factors affecting them. These theories are based on justifiable reasoning of rationality and they are examined briefly as they are related to this study in the following sub-sections.

2.1.1 Traditional Demand Theory

This is one of the oldest and most well developed theories in the history of economic theory. This theory assumes that the key factors that drive the demand for any goods or services are price and income. Demand is related to housing prices because the quantity demanded of houses and real estate is largely determined by the price of real estate. Time element is included to ensure analytical precision since demand is a stock variable. It is this concept of effective demand as compared to wants or needs that yields the relevant market information for the economist to analyze. The relationship with respect to price is theoretically known to be inverse or negative while that of income is inverse or direct depending on the category of goods whether it is inferior or normal. This inverse relationship explains reasons why demand curve

slopes downward from left to right, thereby reflecting the law of demand that says all things being equal; the higher the price, the lower the quantity demanded when all things are being equal. Nevertheless, outside price and household income, there are other factors that affect demand which are prices of other goods (substitutes or complements), taste of the consumer, changes in population, government policy, weather, expectation of future price changes, and advertisement among others.

2.1.2 The Rational Choice Theory

This theory was propounded by Gary Stanley Becker in the 19th century. This theory helps to provide useful insights on the choice or selection behaviour of consumers. It is a framework of modelling social and economic behaviour of consumers in a formal way in economics. The theory posits that patterns of behaviour in societies reflect the choices made by individuals as they try to maximize their benefits and minimize their costs. This implies that people make decisions about how they should act by comparing the costs and benefits of different courses of actions, that is, rational decision making entails choosing an action given one's preferences, the actions one could take and expectations about the outcomes of those actions. The validity of rational decision making according to this theory is rooted in completeness and transitivity assumption. Completeness assumption requires that all actions of consumers can be ranked in order of preference (indifference between two or more is possible), while transitivity is a condition that if choice A is preferred to B and action B is preferred to C, then it implies that, A is preferred to C. This reflects that preferences are consistent.

2.1.3 The Utility Theory

This is another theory of demand that focuses on utility and consumer satisfaction. It emphasises that people demand for goods and services in an economy to satisfy their wants

and desires. All goods and services have a satisfying capacity known as utility. Several schools of thoughts arose due to this theory; the cardinalist school theory spearheaded by Alfred Marshal, ordinalist theory (indifference curve approach) and the revealed preference theory by Paul Samuelson. The proposition of this theory irrespective of the assumptions of the three schools of thoughts is that demand for goods and services is dependent upon two factors which are the ability to satisfy wants or desires and the capability of the prospective consumer to pay for the goods and services they demand for from suppliers and producers in the market. This theory is based on the assumptions of completeness (possibility of consumers to compare any bundle and rank them), monotonicity (meaning that more is better than one bundle set), and transitivity (implying consistency in ranking preferences).

2.1.4 Hedonic Demand Theory

This is a revealed preference method of estimating the demand for a good or its values to consumers. It breaks down the items being researched into its constituent characteristics and obtains estimates of the contributory value of each characteristic. It can accommodate non linearity, variable interaction, or other complex valuation situations. This theory is commonly used in real estate appraisal and real estate economics, as houses have a variety of easily measured traits such as the number of bedrooms, overall size or distance from certain amenities among others. The hedonic price model therefore assumes that the price of a product reflects embodied characteristics valued by some implicit or shadow prices. It involves price regression models where estimations are made using secondary data on prices and attributes of different products or service alternatives. It is based on the fact that prices of goods in the market are affected by their characteristics. The hedonic price method therefore helps us to estimate the value of a commodity based on people's willingness to pay for the commodity and when its characteristics change.

2.2 Summary of the Theoretical Literature Review

There are lots of theoretical studies in the literature supporting this research work but the ones made use of include; the traditional demand theory, rational choice theory by Becker, hedonic demand theory and the utility theory. These theories are useful because they support and analyze the factors affecting the demand for products, goods and services in the economic and social environment.

The traditional theory model is an economic demand model of long-run determinants of demand set within the framework of classical and neoclassical economics in microeconomics. Utility theory is one of the historical models of demand growth. The theory postulates that people demand for goods and services in an economy to satisfy their wants and desires. And that all goods and services have wants satisfying capacity. In other words, demand for goods and services is dependent upon on two main factors and determinants which are the ability to satisfy wants or desires, and the capability of the prospective consumer to pay for the goods and services demanded for by them.

The rational choice theory provides useful insights on the choice or selection behaviour of consumers in demand. It is a framework of modelling social and economic behaviour of consumers in a formal way in economics. This theory posits that patterns of behaviour in societies reflect the choices made by individuals as they try to maximize their benefits and minimize their costs. This implies that people make decisions about how they should act by comparing the costs and benefits of different courses of actions, that is, rational decision making entails choosing an action given one's preferences, the actions one could take and expectations about the outcomes of those actions.

And the hedonic price model theory assumes that the price of a product reflects embodied characteristics valued by some implicit or shadow prices. It involves price regression models where estimations are made using secondary data on prices and attributes of different

products or service alternatives. It is based on the fact that prices of goods in the market are affected by their characteristics.

2.3 Review of Empirical and Methodological Literatures

Several studies have been conducted to observe the main determinants of house prices, housing demand, and growth of real estate markets in the world because of their essentiality in the economic growth of nations. In various nations, significant research efforts such as Nistor and Reianu (2018), Wang, Yang, et al (2017), Oktay et al. (2014), Ermisch and Di Salvo (1997), Égert and Mihaljek (2007), Al Obaid (2020), Wilkins (2020), and Zhang et al. (2020) which were examined for guidance for this thesis have been given for comprehension of economic variables links to housing prices and demand.

Nistor and Reianu (2018) presents a panel data econometric model of the main determinants of house prices in the ten largest census metropolitan areas (CMA) in Ontario, Canada for the years 2001, 2006, and 2011, while applying hedonic pricing model theory. In their study, in a bid to justify earlier studies, they also investigated the impact of the top three leading categories of immigrants to Canada, namely, Chinese, Indian, and Filipino, on the housing prices in Ontario's largest cities. And their results showed that main factors that influenced Ontario home prices over time were interest rate, immigration, unemployment, household size and income.

Wang, Yang, et al (2017) analyzed the direction and strength of the association between housing prices and their determinants in China using the proportion of renters, living space, floating population, wage level, cost of land, housing market, and city service level as independent variables. Spatial regression and geographical detector technique estimates were used for their study. They argued that regression remains the favoured method for exploring the impact factors of housing prices in existing literatures, with ordinary least squares (OLS)

regression analysis frequently used. However, OLS regression would not be able to account for spatial interaction or spill-over effects between study units, and in comparison to OLS regression, spatial regression (both lag and error models) can reveal spatial autocorrelation. Hence, they undertook spatial regression analysis to investigate the potential influencing factors of housing prices while also carrying out OLS regression for comparison. Goodness-of-fit statistics such as Akaike information criteria (AICs) and log-likelihoods were used to estimate the fitting degree of regressions and the results indicated that their data were better fit using spatial analysis techniques than an OLS regression. Their results indicated that house prices in Chinese counties were heavily influenced by the administrative level of the county in question. They found strong positive spatial autocorrelation in their data using global Moran's I index. In addition, using spatial regression their study identified positive effects of the proportion of renters, the floating population, wage level, the cost of land, the housing market and the city level prices on house prices, and the negative effect of living space. While the geographical detector technique estimate revealed marked differences in the relative influence and the strength of association of their independent variables in relation to house prices. The cost of land had the greatest influence on housing prices of all the independent variables in their study. In their conclusions, they presented their study as an indication of the promise of spatial analysis techniques and the geographical detector techniques in creating further knowledge and understanding of the factors influencing housing prices in the future.

Oktay et al. (2014) used binary logistic regression analysis to study the factors that influence the housing demand of households in Erzurum, North-eastern Turkey using a questionnaire-based cross-sectional survey in which the outcome variable had binary responses such as whether to invest in housing or not. Their results showed that the demographic or socio-economic factors that may possibly influence housing demand of their questionnaire

respondents were the household head's and spouse's occupations, monthly income, the family size, and car ownership.

Ermisch and Di Salvo (1997) examined the impact of the price of housing, young adult's income and parental income on the probability that young adults live apart from their parents. They estimated dynamic models of the home-leaving process and modelled the impact of individual characteristics, regional housing, and labour market circumstances on the first departure of young adults from the parental home, in the context of competing risk hazard models. Their results predicted that when the price elasticity of housing demand is less than unity, an increase in the price of housing would lead to a decrease in the probability that young adults leave their parental home, but the probability would rise when housing demand is price-elastic. Part of the results of their study included that the probability that a young adult leaves home increases when their income increases and decreases when their parents' income increases.

Égert and Mihaljek (2007) took a comparative approach to study the determinants of house prices in eight transition economies of Central and Eastern Europe (CEE) and 19 OECD countries with emphasis on whether the conventional fundamental determinants of house prices and some transition-specific factors have driven the observed house prices in Central Eastern Europe. They used the mean group panel dynamic ordinary least squares (DOLS) estimator and found that per capita GDP, real interest rates, and housing or private sector credit had strong relationships with house prices in both transition economies and OECD countries. And that while a fall in the real interest rate caused house prices in CEE to increase twice as fast as OECD countries prices, house prices in OECD countries appear to respond about twice as much to credit growth when compared to CEE economies. Their study also showed that demographic factors and labour market developments also play an important role in house price dynamics, and they appear to affect house prices in CEE countries more significantly than in OECD

countries. Furthermore, transition-specific factors like improvements in housing quality (which they used the growth in real wages as a proxy for) and the development of housing markets and financial institutions (proxied by the European bank for Reconstruction and Development (EBRD) indicators of bank and non-bank financial institutions' reform) were also showed to have strong impacts on real house prices in CEE.

Al Obaid (2020) estimated housing demand in Saudi Arabia using time-series analysis from 1987 to 2016 to examine the main factors that determine housing demand in Saudi Arabia. The real income level per capita, housing prices, consumer price index (CPI), loans demand (free interest rate loans) paid for financing houses, and population growth rates were used as independent variables for their study. After their analysis of their estimations and results, the population growth rate, CPI, and demand for housing loans were found to be the most significant factors determining housing demand in Saudi Arabia. Their study also showed that in Saudi Arabia, changes in income also affected housing demand, and that housing price and population increments had a positive effect on housing demand.

Zhang et al. (2020) examined the role of divorce in the nexus between aging and housing demands in China based on China's provincial panel data from 2005 to 2017. They constructed a dynamic panel model from the perspective of family and used the generalized method of moments (GMM) estimation method for their regression analysis to investigate the impact of aging population and divorce on housing demand. They used the logarithm of the number of household sales per household and the logarithm of the average residential transaction area per household as dependent variables, while old-age ratio, young dependency ratio, divorce rate, average house price level, urbanization level, unemployed population, interest rate, and GDP per household were the independent variables in their study. Their study showed that in their sample period, accounting for the effect of divorce rates, the aging population had a significant inhibiting effect on housing demands. After accounting for divorce

rates, the old-age dependency ratio promotes housing demand but this positive effect diminished as divorce rates increased. Also, the positive effect of the young dependency ratio on housing demand was not obvious after accounting for divorce; however, the interaction between divorce rates was significant, indicating that this effect would gradually appear as divorce rates increase. In the conclusion of results from their study they stated that from their study, ageing eventually curbs demand that has not yet appeared. And that may be due to the diminishing size of families and change in the lifestyle of the elderly as population ages.

In conclusion, the differences in the variables that were found to be significant determinants of housing prices or demand in the various housing markets and countries represented in the reviewed literatures for this study are likely due to differences in the macroeconomic structures of the countries, the unique influences of the factors or included variables across the countries, and the selected methodologies and framework of analysis for the literatures. This study is however most similar to Nistor and Reianu (2018) as this study adopts the hedonic price modelling method as the method of housing price evaluation that is used as the framework for its empirical analysis. In the next section, the data and the methodology of analysis that is used for this study will be presented.

3. DATA & METHODOLOGY

3.1. Data

This thesis uses three sources of data: from Statistics Canada, (1) Nova Scotia census data, and from Datazone, (2) Parcel sales history data, and (3) Residential dwelling characteristics data, which provides property and municipal datasets from across Nova Scotia.

Nova Scotia Census Data

Canadian census data on the 18 Nova Scotia census divisions is collected from Statistics Canada for the census years 2011 and 2016 in the decade under consideration, 2010 to 2020. For this study, following the Community of Sector Council of Nova Scotia's region map, the Hants census division is broken down into East Hants and West Hants, making 19 census divisions.

Parcel Sales History Data

The parcel sales history data which was obtained from Datazone provides the geographical location, civic address, sales date, and sales price for all property sales in Nova Scotia from July 2010 onwards. From this data only 2011 and 2016 sales were used in order to combine the parcel sales history data with the census data, which is only available for these two years. For this study's analysis, these property sales are classified into the Nova Scotia Census Divisions where they took place in.

Residential Dwelling Characteristics Data

The residential dwelling characteristics data which was obtained from Datazone provides the geographical location, civic address, and property characteristics or features for residential properties in Nova Scotia. From this data, only observations in 2011 and 2016 are used in this study, in order to combine the residential dwelling characteristics data with the parcel sales history data and the census data. As with the case of the parcel sales history data, properties are classified into the Nova Scotia Census Divisions were they are located in.

3.2. Methodology

The framework for the empirical analysis applies the hedonic pricing model theory to Nova Scotia's housing sales prices over the years 2010 to 2020. The model used in this study follows a linear specification where both the dependent and independent variables enter the regression with a linear form, and following Nistor and Reianu (2018), the hedonic housing price OLS regression model followed takes the following specification functional form:

$$p = \beta_0 + \sum_{n=1}^{N} \beta_n x_n + \varepsilon$$

Where:

p denotes the housing price;

ε is the random error term; and

$\beta_n (n = 1, \dots, N)$ is the marginal change of the unit price of the nth characteristic x_n of the good.

Following the framework of the model and the independent variables collected from the data, the estimated model is presented in the following model:

$$logrealprice = C + \beta_1 * valley + \beta_2 * sshore + \beta_3 * northern + \beta_4 * highlands + \beta_5 * cbreton + \beta_6 * q2 + \beta_7 * q3 + \beta_8 * q4 + \beta_9 * yeardummy + \beta_{10} * houseage + \beta_{11} * logbuildingsize + \beta_{12} * bed + \beta_{13} * bath + \beta_{14} * bath^2 + \beta_{15} * garage + \beta_{16} * basement + \beta_{17} * quality1 + \beta_{18} * quality2 + \beta_{19} * detached + \beta_{20} * multiunit + \beta_{21} * multiparcel + \beta_{22} * logcurrentpop + \beta_{23} * minority + \beta_{24} * aboriginal + \beta_{25} * logrealincome + \beta_{26} * unemprate + \beta_{27} * logdwellings + \beta_{28} * occupancyrate + \beta_{29} * newdwellingpct + \beta_{30} * dwellingrepairpct + \beta_{31} * ownerpct + \beta_{32} * subsidizedhousing + E_t$$

From the estimated model, Logrealprice is the dependent variable in the model and the logarithm of the sales price of properties in the dataset after adjusting 2011 sales price values

to their 2016 dollar values for the purpose of comparison, using the Bank of Canada's inflation calculator.[1]

The Valley, sshore, northern, highlands, and cbreton variables are dummy variables representing groupings of Nova Scotia census divisions. Following the Community of Sector Council of Nova Scotia's region map, the census divisions are grouped into six regions. (1) The Cape Breton region (Cbreton in model), which consists of the census divisions: Cape Breton, Inverness, Richmond, and Victoria. (2) The Highlands region (Highlands in model), which consists of the census divisions: Antigonish, Guysborough, and Pictou. (3) The Northern region (Northern in model), which consists of the census divisions: Colchester, Cumberland, and East Hants. (4) The Valley region (Valley in model), which consists of the census divisions: Annapolis, Digby, Kings, and West Hants. (5) The South Shore region (SShore in model), which consists of the census divisions: Lunenburg, Queens, Shelbourne, and Yarmouth. (6) The Central region, which is the Halifax census division. Halifax is the base or reference group for the census division dummy variables in the model.

Variables Q2, Q3, Q4, and Yeardummy are dummy variables representing the quarters of a year in which a sale was recorded. The first quarter is the base or reference group, Q2 is the 2nd quarter of the year, Q3 is the 3rd quarter, and Q4 is the 4th quarter. While Yeardummy is a dummy variable representing sales in 2016, 2011 sales are the reference dummy variable group for this dummy variable.

The Houseage variable represents the property's age with respect to the year it was built, using the year 2020 as the current year. The Logbuildingsize variable is the logarithm of the square foot living area of properties in the data. The Bed variable represents the number of bedrooms in the properties in the data. The Bath variable represents the number of bathrooms

[1] According to the Bank of Canada's inflation calculator, the consumer price index (CPI) from 2011 to 2016 is 107.64. This means that there was a rise in inflation level of 7.64 percent from 2011 to 2016.

in the properties in the data. The $Bath^2$ variable is used in the model to test if the effect of an additional bathroom in properties in Nova Scotia would increase or diminish, as the number of bathrooms increases. The Garage variable is a dummy variable that holds the value of 1 if a property in the dataset has a garage, and a value of 0 otherwise. The Basement is a dummy variable that holds the value of 1 if a property in the dataset has a finished basement, and a value of 0 otherwise.

The Quality1 and Quality2 variables are dummy variables representing the construction grade of properties in the dataset according to the Datazone residential characteristics data. Quality1 represents an average construction grade in comparison to a fair or good one and takes the value of 1 if the construction grade is average. Quality2 represents a good construction grade in comparison to a fair or average one and takes the value of 1 if the construction grade is good. In the case of these construction grade dummy variables, good is better than average and average is better than fair. The reference dummy variable group for these two dummy variables is the fair construction grade.

The Detached variable is a dummy variable that takes the value of 1 if a property in the dataset is a detached building, and 0 otherwise. The Multiunit variable is a dummy variable that takes the value of 1 if a property in the dataset has more than one living unit, and 0 otherwise. And the Multiparcel is a dummy variable that takes the value of 1 if a property in the dataset had more than one parcel in the sale, and 0 otherwise.

The Logcurrentpop variable is the logarithm of the value of the population in Nova Scotia census divisions, in the census years 2011 and 2016 that are used in this study. The Minority variable represents the percentage of the population in the census divisions that are a visible minority. The Aboriginal variable represents the percentage of the population in the census divisions that is Aboriginal. The Logrealincome variable is the logarithm of the median after-tax household income of households in the census divisions, after adjusting 2011 values

for inflation and converting them to their 2016 dollar values. The Unemprate variable represents the percentage of the population that is unemployed in the census divisions. The Logdwellings variable is the logarithm of the total number of private dwellings in the census divisions. The Occupancyrate variable represents the percentage of private dwellings that are occupied in the census divisions. The Newdwellingspct variable represents the percentage of occupied dwellings that were built within the last five years, in the census divisions. The Dwellingrepairpct variable represents the percentage of occupied dwellings that need major repairs in the census divisions. The Ownerpct variable represents the percentage of private households that are owners of their dwellings, as opposed to private households that are renters, or band housing; shelter occupancy on Indian reserves or settlements. And the Subsidizedhousing variable represents the percentage of tenant households in subsidized housing in the census divisions. In addition, the C and E_t variables are variables representing the intercept and error term of the model respectively. Table 1 shows the summary statistics of the variables used in this study's analysis.

Table 1: Summary of the independent variables used in the regression

Variables	Obs	Mean	Median	Std. Dev.	Min	Max
LOGREALPRICE	29804	12.19	12.21	0.84	10.60	17.46
C	29804	1	1	0	1	1
VALLEY	29804	0.13	0	0.33	0	1
SSHORE	29804	0.08	0	0.27	0	1
NORTHERN	29804	0.11	0	0.31	0	1
HIGHLANDS	29804	0.05	0	0.22	0	1
CBRETON	29804	0.12	0	0.33	0	1
Q2	29804	0.27	0	0.44	0	1
Q3	29804	0.31	0	0.46	0	1
Q4	29804	0.25	0	0.43	0	1
YEARDUMMY	29804	0.49	0	0.50	0	1
HOUSEAGE	22059	36.69	32	28.13	1	465
LOGBUILDINGSIZE	22150	7.38	7.41	0.43	5.70	9.35
BED	21744	3.11	3	0.98	0	13
BATH	24153	2.09	2	1.04	0	12

BATH^2	24153	5.44	4	5.40	0	144
GARAGE	24153	0.42	0	0.49	0	1
BASEMENT	24153	0.52	1	0.50	0	1
QUALITY1	22176	0.75	1	0.43	0	1
QUALITY2	22176	0.11	0	0.31	0	1
DETACHED	22234	0.87	1	0.33	0	1
MULTIUNIT	24153	0.05	0	0.22	0	1
MULTIPARCEL	29788	0.20	0	0.40	0	1
LOGCURRENTPOP	29804	11.74	12.87	1.28	8.87	12.91
MINORITY	29804	6.35	9.11	4.00	0.57	11.39
ABORIGINAL	29804	4.42	3.98	2.73	1.50	20.07
LOGREALINCOME	29804	10.88	10.96	0.11	10.64	10.99
UNEMPRATE	29804	9.82	7.30	3.53	7.20	26.70
LOGDWELLINGS	29804	11.01	12.09	1.21	8.40	12.14
OCCUPANCYRATE	29804	88.89	92.52	6.04	68.40	93.15
NEWDWELLINGSPCT	29804	5.58	6.40	1.64	1.72	8.97
DWELLINGREPAIRPCT	29804	9.98	8.02	3.00	7.08	20.15
OWNERPCT	29804	68.72	62.77	8.08	60.10	88.06
SUBSIDIZEDHOUSING	29804	13.38	9.20	6.56	8.30	33.30

4. RESULTS

In this section, the results from the analysis that was run in this study will be presented.

From Table 2, which shows the regression results of the estimated model, all of the estimated coefficients were statistically significant at the 5 percent level, except houseage, minority, logrealincome, newdwellingpct, dwellingrepairpct, and ownerpct. And the estimated model explains about 48 percent of the variation in the logarithm of the real price of the properties that were sold in Nova Scotia within the decade (in 2011 and 2016).

Using Halifax as the reference group, the results of the census division dummy variable coefficients show that on average, compared to Halifax, housing property real prices in the Valley, South Shore, Northern, Highlands, and Cape Breton regions were all lower than Halifax prices during the decade (2010 to 2020) by 31.7, 21.3, 31.4, 31.2, and 46.5 percents respectively. With Q1, the first quarter of the year as the reference group of the dummy variables representing quarters of the year, on average, the real prices of houses sold in the second quarter of the year during the decade were 7.2 percent higher than those sold in the first. The real prices of third quarter sales were 10.4 percent higher than first quarter sale prices, and fourth quarter sales were 6.4 percent higher than first quarter sales. These results of the year quarterly dummies are in line with what should be expected as house sales historically tend be higher in the warmer quarters of the year. The magnitude of the Yeardummy variable is 0.063697 and implies that the real price of properties that were sold in 2016 were 6.4 percent higher than 2011 property sales on average. According to this result, the value of Nova Scotia houses grew by 6.4 percent on average from 2011 to 2016.

Table 2: Estimated Model Regression Results

Dependent Variable: LOGREALPRICE
Method: Least Squares
Included observations: 18155 after adjustments

Huber-White-Hinkley (HC1) heteroskedasticity consistent standard errors and covariance

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	9.9653	3.7392	2.6650	0.0077
VALLEY	-0.3179	0.1108	-2.8702	0.0041
SSHORE	-0.2134	0.1013	-2.1064	0.0352
NORTHERN	-0.3144	0.1075	-2.9258	0.0034
HIGHLANDS	-0.3111	0.1024	-3.0379	0.0024
CBRETON	-0.4647	0.1328	-3.4994	0.0005
Q2	0.0721	0.0120	5.9911	0.0000
Q3	0.1043	0.0114	9.1157	0.0000
Q4	0.0637	0.0125	5.0798	0.0000
YEARDUMMY	0.0659	0.0342	1.9243	0.0543
HOUSEAGE	0.0002	0.0002	0.7726	0.4398
LOGBUILDINGSIZE	0.3046	0.0193	15.7724	0.0000
BED	-0.0122	0.0058	-2.1056	0.0353
BATH	0.1257	0.0185	6.7776	0.0000
BATH^2	-0.0087	0.0035	-2.4890	0.0128
GARAGE	0.0850	0.0078	10.8695	0.0000
BASEMENT	0.0777	0.0103	7.5641	0.0000
QUALITY1	0.2578	0.0123	20.9766	0.0000
QUALITY2	0.5194	0.0207	25.0787	0.0000
DETACHED	0.0901	0.0106	8.4993	0.0000
MULTIUNIT	0.0999	0.0221	4.5111	0.0000
MULTIPARCEL	0.3407	0.0216	15.8039	0.0000
LOGCURRENTPOP	2.7696	0.7295	3.7967	0.0001
MINORITY	-0.0118	0.0093	-1.2766	0.2017
ABORIGINAL	-0.0072	0.0036	-1.9731	0.0485
LOGREALINCOME	0.0676	0.3225	0.2095	0.8340
UNEMPRATE	0.0186	0.0057	3.2412	0.0012
LOGDWELLINGS	-2.7273	0.7267	-3.7530	0.0002
OCCUPANCYRATE	-0.0389	0.0102	-3.8256	0.0001
NEWDWELLINGSPCT	-0.0153	0.0120	-1.2700	0.2041
DWELLINGREPAIRPCT	-0.0062	0.0051	-1.2130	0.2252
OWNERPCT	-0.0013	0.0028	-0.4827	0.6293
SUBSIDIZEDHOUSING	-0.0156	0.0032	-4.9306	0.0000

R-squared	0.4765	Mean dependent var	12.2117
Adjusted R-squared	0.4756	S.D. dependent var	0.6750

S.E. of regression	0.4888	Akaike info criterion	1.4081
Sum squared resid	4329.8360	Schwarz criterion	1.4223
Log likelihood	-12748.9900	Hannan-Quinn criter.	1.4128
F-statistic	515.5194	Durbin-Watson stat	1.9996
Prob(F-statistic)	0	Wald F-statistic	466.5950
Prob(Wald F-statistic)	0		

From the results, considering that all other variables or factors affecting the real prices of homes in Nova Scotia during the years 2010 to 2020 are held constant, a 10 percent increase in the size of the living area of a property should induce a 3 percent increase in the real price of the property. An additional bedroom in a house is associated with a 1.2 percent decrease in its real price. The bedroom variable's negative impact is reasonable because if the size of the house remains the same as the additional bedroom is created within it, the size other rooms in the house should be negatively affected and it is possible that this makes the house less attractive to buyers. The Bath variable's coefficient implies that an additional bathroom in a house during the decade would have caused a 12.6 percent increase in the real price of the house, however, from the $bath^2$ variable coefficient's sign; there are diminishing returns to adding each additional bathroom to a house.

The average real price of houses with a garage was 8.9 percent higher than that of houses that did not have a garage. If a house had a finished basement in Nova Scotia between 2010 and 2020, its real price would have been 8.1 percent higher than it would be if it did not have a basement. The Quality1 variable coefficient is 0.257752 and implies that the real price of houses that had an average construction grade according to Datazone were 25.8 percent higher than the real price of those that had a fair construction grade, on average. The Quality2 variable coefficient's magnitude of 0.519441 implies that houses that had a good construction grade according to Datazone had a real price that was 51.9 percent higher than those of fair construction grade, on average. On average, detached houses were 9.4 percent more expensive than non-detached houses, multi-units were 10.5 percent more expensive than single-unit

housing properties, and multi-parcel properties were 40.6 percent more expensive than single-parcel properties during the decade.

A 10 percent increase in the current population during the decade is associated with a 27.7 percent increase in the real price of houses in Nova Scotia. This is effect of population on housing price is in line with economic theory, because demand for housing is positively correlated with population. From the Aboriginal variable coefficient of -0.007154, a 10 percent increase in the percentage of the population that is Aboriginal within 2010 and 2020 in the province is related with a 0.07 percent decrease in the real price of houses in the province. This negative effect of Aboriginal variable was expected, due to the socio-economic challenges Aboriginals face in Canada compared to the general population, hence, it is likely that Aboriginals find it more difficult to purchase houses in Canada. An increase in the Nova Scotia's unemployment rate by 10 percent is related with a 0.2 percent increase in the real price of houses in the province. The unemployment rate's positive effect on real housing price was unexpected; however, this could be due to correlation between explanatory variables, especially since a lot of explanatory variables are incorporated in the regression analysis of this study. If the total number of private dwellings in the province increased by 10 percent, the resulting effect on the real price of houses in the province would be a 27.3 percent decline. Private dwellings effect on real housing price is in line with economic theory, because supply is negatively correlated with price. A 10 percent increase in the percentage of the total private dwellings that were occupied would decrease the real price of houses by 0.4 percent. This negative effect of the percentage of the total private dwellings that are occupied was expected, because people that already have a home or already occupy a dwelling should have less need for a home or dwelling that is on the market than people who do not, on average. Furthermore, an increase of 10 percent in the percentage of Nova Scotian tenant households that lived in subsidized housing would have induced a 0.2 percent decrease in the average real price of Nova

Scotian houses. This negative effect of subsidized housing on real housing price was expected because subsidies reduce the price consumers pay for a good or service.

During the decade, household income, the age of houses, the percentage of the population that are visible minorities, the percentage of newly built (within the last five years) occupied private dwellings, the percentage of occupied dwellings needing major repairs, and whether private dwelling occupants were owners of their dwellings or not did not have significant effects on the real price of housing in the province. In the case of the unusual insignificance of household income, the estimated model result is reasonable when the growth in the median after-tax household income from 2011 to 2016 in census divisions is considered from Table 3. Table 3 shows the average real house prices of sold properties, median after-tax household incomes, and price/income ration in Nova Scotia's census divisions in 2011 and 2016. And from Table 3, the median after-tax household income in census divisions had an average growth of 3.7 percent from 2011 to 2016, while the real sales price of houses in the province had an average growth of 117.1 percent from 2011 to 2016. Hence, household income in the province grew little between 2011 and 2016, compared to the real price of houses.

Table 3: Average Real House Prices of Sold Properties, Median after-tax Household Incomes, and Price/Income Ratio in Nova Scotia Census Divisions in 2011 and 2016

Census Divisions	2011 Avg Real Sale Price (2016 CA$)	2016 Avg Real Sale Price (2016 CA$)	Growth in the Real Sale Price (%)	2011 Median after-tax Household Income (in 2016 CA$)	2016 Median after-tax Household Income (in 2016 CA$)	Median after-tax Household Income growth from 2011 to 2016	2011 Price/Income Ratio	2016 Price/Income Ratio	% Price-to-Income Ratio Growth
Cape Breton	210,301.62	162,155.03	-22.89	46,033.32	47624	3.46	4.57	3.40	-25.47
Halifax	427,735.00	471,130.86	10.15	57,461.46	59240	3.10	7.44	7.95	6.84
Guysborough	197,663.70	550,839.17	178.67	41,616.85	44978	8.08	4.75	12.25	157.85
Lunenburg	202,901.02	195,854.05	-3.47	46,015.02	48915	6.30	4.41	4.00	-9.20
Shelburne	132,433.90	142,726.04	7.77	43,874.06	50251	14.53	3.02	2.84	-5.90
Yarmouth	137,919.39	151,260.33	9.67	47,100.03	48276	2.50	2.93	3.13	7.00
East Hants	198,128.95	206,999.40	4.48	56,620.79	56174	-0.79	3.50	3.68	5.31
West Hants	168,294.32	158,694.79	-5.70	56,620.79	56174	-0.79	2.97	2.83	-4.95

Annapolis	134,289.11	169,093.04	25.92	43,114.13	43746	1.47	3.11	3.87	24.10
Antigonish	165,226.18	188,451.30	14.06	55,448.59	56192	1.34	2.98	3.35	12.55
Colchester	170,587.88	203,474.73	19.28	47,940.70	49022	2.26	3.56	4.15	16.65
Cumberland	159,446.44	203,623.46	27.71	42,773.98	45168	5.60	3.73	4.51	20.94
Inverness	150,119.10	163,214.51	8.72	51,064.42	51584	1.02	2.94	3.16	7.63
Kings	195,320.17	243,944.51	24.89	49,702.77	50936	2.48	3.93	4.79	21.87
Pictou	148,446.32	178,724.16	20.40	48,523.04	49544	2.10	3.06	3.61	17.92
Richmond	130,232.53	140,813.95	8.13	48,801.82	47733	-2.19	2.67	2.95	10.55
Victoria	140,736.60	176,473.57	25.39	47,384.20	50778	7.16	2.97	3.48	17.01
Digby	195,888.20	126,552.34	-35.40	41,685.74	43676	4.77	4.70	2.90	-38.34
Queens	140,979.50	375,654.39	166.46	43,258.36	43520	0.60	3.26	8.63	164.86

5. CONCLUSIONS

While the magnitudes of the various coefficients are difficult to compare across variables, the overall result paints a useful picture that provides a sense of the impact of the various factors on property prices in the province during the years in consideration. Following the results of this study, the main factors that affected the real price of houses in Nova Scotia during 2010 to 2020 were; location, sale date, building size, the number of bathrooms in a house, availability of a garage, availability of a finished basement, the construction quality of a house, if the house is detached, multi-unit, or multi-parcel, population, unemployment rate, housing supply, the percentage of the housing supply that is occupied, and the percentage of tenants living in subsidized housing. The number of bedrooms in a house and the percentage of the province's population that is Aboriginal were other factors that were shown to affect the real price of houses in Nova Scotia.

Population growth increases housing demand, housing prices, and induce public concerns that housing demand and prices would continue to rise; however, an interesting result from this thesis is that the housing can be kept affordable if housing supply grows at the same pace with the population. The coefficients of the logarithm of the current population and logarithm of dwellings variables imply that a 10 percent increase in population and a 10 percent increase in housing supply would cancel out and keep prices steady. Hence, for policy purposes it would be important for authorities to monitor population growth and building supply as a mean to control house prices in the province.

While creating the model some variables were considered but dropped from the model due to multi-collinearity problems that arose from their inclusion. These variables were: single municipal dummy variables representing the nineteen municipalities in the province, the logarithm of the median age of the population variable, and migration variables to represent interprovincial, interprovincial, and external migrants in the past year and past five year

periods. The single municipal dummy variables were initially included to compare the real price of properties in Nova Scotia municipalities and examine if there were significant differences in price from municipality to municipality. However, when the municipality dummy variables were included, multi-collinearity problems arose as they were correlated with a lot of the other independent variables in the model, and their coefficients were all statistically insignificant. Multi-collinearity was also induced when the logarithm of the median age of the population, and the migration variables which were included to measure the impact of the province's population age and the migrants into and within it on the real price of its housing during the decade under consideration. Hence, in any future analysis, I would like to examine the impacts of interprovincial, interprovincial, and external migration on house prices in Nova Scotia, along with population age, and some additional variables to representing more structural, locality, and environmental characteristics of the Nova Scotian housing good. In addition, expanding this study's analysis by incorporating transactions in the other years of the decade along with the transactions in 2011 and 2016 should be beneficial in future analysis.

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