The Effects of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the Supply of New Residential Housing in Vancouver

by Jingting Hu

(8863394)

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Supervisor: Professor Gamal Atallah

ECO 6999

Ottawa, Ontario

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Abstract

On Aug 2, 2016, the government of British Columbia introduced the Vacancy Tax and Foreign-buyer Tax Act. This tax act was introduced in a surprise move by the provincial Liberal government. Based on early preliminary data (Bloomberg, 2017), it is reasonable to conclude that from a market demand perspective, the new tax acts have been quite successful in controlling residential housing prices in Vancouver. However, the effect of the tax acts on the supply side of Vancouver's housing market remains mixed and unclear. This is especially true in regards to the supply of new residential buildings, which is a key element of the total housing supply. The main goal of this paper is to investigate the effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the supply of new residential housing in Vancouver, which is measured by the number of new builds (housing starts) and the associated value of these properties (value of residential housing building permits). The conceptual framework of this study exhibits a fixed effects model and DID design based on a panel dataset that is constructed from customized tabulations from Bloomberg and Thomson Reuters DataStream. Unlike most of the relevant literature (such as Gyourko and Saiz (2006) and Quigley and Raphael (2005)) suggests, the empirical results of this study indicate that British Columbia's Vacancy Tax and Foreign-buyer Tax Act have a positive impact on the supply of new residential housing in Vancouver. More specifically, the tax act has a strong positive causal impact on the number of new residential builds (housing starts) and a weak positive causal relationship on the total book value of these properties (value of residential housing building permits). This outcome is favourable to the policymaker as the tax act did not suppress the supply of new residential housing; in fact, the act seems to encourage builders to commit to constructing more residential houses with no significant increase in the value of the property building permit, which is a positive step towards creating more affordable housing.

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Introduction

Vancouver's housing crisis goes back decades. In fact, economist Gordon Soules wrote a book on the subject in the late 1970s. At that time, Vancouver's ratio of real estate prices to local earnings was about 3 to 1. In 2016, Vancouver's housing was the third most unaffordable in the English-speaking world, with a ratio of real estate prices to local earnings of 13 to 1 (Todd, 2017). In addition to the issue of unaffordable housing, locals also expressed concern that housing that was purchased by foreigners tended to stay vacant. On August 2, 2016, the government of British Columbia introduced Bill 28. It was announced and put through a first reading on July 25, 2016 without any advance notice, and it officially became law on August 2, 2016. The amendments relating to the Property Transfer Tax Act became effective on August 2, 2016.

The act has four parts: i) vacancy tax, ii) foreign-buyer tax, iii) amendments to the Real Estate Services Act discontinuing industry self-regulation of the real estate industry, and iv) creating a new Housing Priority Initiatives special account to fund initiatives in respect to housing, rental, access, and support programs with the new tax revenues resulting from this law. For this study we will mainly focus on the effect of the vacancy tax and the foreign-buyer tax. The vacancy tax was amended to enable the City of Vancouver to impose a municipal vacancy tax on vacant residential properties. The foreign-buyer tax, on the other hand, was a new 15% tax which is added to the Property Transfer Tax when a purchaser who is not a Canadian citizen or permanent resident purchases a residential real estate property in Metro Vancouver. The tax was expected to add a large cost to foreign buyers of homes in Vancouver and to increase tax revenue for the provincial government.

According to the Business News Network, Vancouver area sales dropped nearly 40 percent in October 2016 after the tax act was introduced (BNN, 2016). In addition, Bloomberg News reported that the Chinese international property portal Juwai saw Chinese buying inquiries in Vancouver drop by at least 25% (Bloomberg, 2017). Based on these early preliminary results and data, it is reasonable to conclude that from a market demand perspective, these new acts were quite successful in controlling residential housing prices in Vancouver, at least in the short term. However, the effect of these new tax acts on the supply side of Vancouver's housing market remains mixed and ambiguous, especially on the supply of new residential buildings, which is a key element of the total housing supply.

The main goal of this paper is to investigate the effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the supply of new residential housing in Vancouver. In other words, in this paper we will try to determine if the tax act has had any negative or suppression effects from the home-builder's perspective. The conceptual framework exhibits a fixed effects model and a differences in differences (DID) design based on a panel dataset which is constructed from customized tabulations from Bloomberg and DataStream. The original source data are based on CANISM tables and other macroeconomic indices released by Statistics Canada. Variables are first collected from different tables/data sources and then combined into one master panel dataset based on provinces/cities on a monthly basis. The final analysis dataset contains residential housing market information between January 1997 and January 2018 for Vancouver and Toronto. For this study, Toronto is chosen as the control group since it is similar in size, economic condition and population size to Vancouver.

The identification strategy exhibits a fixed effects model and DID design with two

different model specifications. The first model specification estimates the pure impact of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the supply of new residential housing in Vancouver with no other control variables. The second model specification estimates the impact of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the supply of new residential housing in Vancouver, controlling for demographic factors and macroeconomic conditions, including the effect of the 2008 financial crisis, the new housing price index, the GDP of the real estate rental and leasing sector, the 10-year government bond yield (interest rate), the provincial unemployment rate and the provincial population.

The regression results of both fixed effects and DID suggest that, holding other factors constant, British Columbia's Vacancy Tax and Foreign-buyer Tax Act had a significant positive impact on units of new residential builds (housing starts) in Vancouver. On the other hand, we find that there is no significant impact on the value of new residential housing building permits as a result of the tax act. This outcome is favourable to the policymaker as the tax act did not suppress the supply of new residential housing; in fact, the act seems to encourage builders to commit to constructing more residential houses with no significant increase in the value of the property building permit, which is a step towards building more affordable housing.

This paper contains nine sections in total. Section 2 provides the literature review. Section 3 discusses the key conceptual framework. Section 4 provides a summary of the datasets and descriptive statistics. Section 5 discusses the identification strategy. Section 6 presents the empirical results in detail. Section 7 presents a robustness check of the empirical results. Section 8 discusses the main results and Section 9 concludes.

Literature Review

When studying the housing market as a whole, the housing supply should be taken into consideration. Glaeser et al. (2008) present a model to incorporate housing supply in order to better understand boom-bust housing cycles. Based on their model, they predict that places with a more elastic housing supply will have fewer and shorter bubbles, along with smaller price increases. At the same time, they predict that the welfare consequences of bubbles may actually be higher in more elastic places due to "overbuild" in response to the bubble. They state that, given that the supply of housing is not fixed, the possibility of an oversupply of housing during a boom is one of the primary ways in which housing bubbles may create substantial welfare losses. From the policymaker's perspective, understanding the interaction between proposed policy and housing supply is also very important.

Barker (2008) discusses the issues raised by a plan-led system and the uncertainties of household projections related to the housing supply in England. She concludes that evidence of the relationship between house prices and the housing supply, as well as of a house-builder's landbanks, suggests that policy planning constraints[1] are a key factor behind the long-term upward trend in house prices. At the same time, environmental constraints on additional housing supply are important but can nevertheless be overstated. The key takeaway from this paper is that any policy based on a plan-led system of the housing market, especially related to housing supply such as British Columbia's Vacancy Tax and Foreign-buyer Tax Act, would be subject to planning and environmental constraints.

[1] According to Barker (2008) and Pennington (2000), planning constraints refer to institutional incentives within the 'political market' that have frequently led to policies which favor special interest groups and public-sector bureaucracy. These constraints usually have an upward impact on land (and therefore house) prices. For example, Glaeser and Gyourko (2003) conclude that, while affordability differs significantly across locations in the USA, 'measures of zoning strictness are highly correlated with high house prices' (p. 21).

In addition to housing supply, other factors such as the interest rate and the condition of the financial and banking sector could also significantly impact the overall housing market. Bordo and Jeanne (2002) study the boom and bust cycle of the U.S. housing market and find that a boom or bust in asset price series occurs when the housing market's three-year moving average of the growth rate is outside a confidence interval, which is defined by references to the historical first and second order derivatives of the series. Most importantly, they show that a regular feature of boom to bust episodes is that the fall in asset prices is strongly correlated with a slowdown in economic activity, as well as the financial and banking industry as a whole.

Like Bordo and Jeanne (2002), there have been a few recent empirical studies that examine the role of fundamental factors in explaining significant changes in housing prices under different market conditions. Gerdesmeier et al. (2009) focus their attention on the causes of asset prices bust episodes using a sample of 17 OECD countries between 1969 and 2008. Using a Pooled Probit model, they show that domestic credit aggregates, nominal long-term interest rate and investment are the three best indicators to forecast busts up to about eight quarters ahead. Similarly, using real housing prices data provided by the Bank for International Settlements (BIS) for 18 industrialized countries between 1970 and 2007,[2] Agnello and Schuknecht (2011) look at the characteristics and determinants of booms and busts in housing markets. They find that over the period between 1870 and 2007, the housing booms in the past four decades have been amongst the longest. Using a Multinomial Probit Model, they find that domestic credit and interest rates have a significant influence on the probability of booms and busts occurring. In addition, Agnello and Schuknecht (2011) argue that international liquidity

[2] The 18 industrialised countries are: United Kingdom, United States, Japan, Canada, Australia, New Zealand, Switzerland, Norway, Denmark, Finland, Ireland, Netherlands, Germany, France, Italy, Spain, Belgium and Sweden.

plays a significant role for the occurrence of a housing boom and in conjunction with banking crises for busts. They also find that the deregulation of financial markets has strongly magnified the impact of the domestic financial sector on the chances and occurrences of booms. Moreover, financial variables such as interest rate, money and credit supply have been found to be related to housing price developments (Kennedy and Andersen (1994), Kasparova and White (2001)).

Apart from these studies that focus on the relationship between financial market conditions and the overall housing market, some studies instead look into the link between the macroeconomy and housing markets. Single and cross-country studies generally find that housing markets and the macroeconomy are strongly interrelated at the country-level as well as being internationally correlated. Such studies show that, at the national and regional levels, housing prices are strongly influenced by the business cycles and therefore are driven by fundamentals like income growth, industrial production and employment rate (Hwang and Quigley (2006)). Differences in real estate price dynamics across countries can also be traced back to differences in regulatory settings and mortgage market features, as Adams and Füss (2010) suggest. In terms of non-economic domestic indicators, Parker (2000) and Jud and Winkler (2002) conclude that real housing price appreciation is strongly influenced by population growth.

All these findings from the existing literature demonstrate the important roles that the financial market condition and the macroeconomy could play in determining the overall housing market condition including the price, demand and to some extent the supply of new residential housing, all of which are important and relevant to our study. To estimate the true policy effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act, the empirical

model in this study should take into consideration the interest rate and overall financial market condition. This might include occurrences such as the 2008 financial crisis, which is a major bust in recent housing market history. In addition, unemployment rate and population growth should also be examined.

At the time of this study, there are no other existing analyses that directly examine the effect British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the supply of new residential housing in Vancouver. Most of the existing literature focuses on discussing housing supply from a fundamental and theoretical perspective, which are nevertheless important in order to better understand the role of housing supply in a dynamic housing market setting. Gyourko (2009) provides a comprehensive look at the role of housing supply in a dynamic housing market, especially in the context of heightened interest in policies such as local land use regulations. Gyourko (2009) points out that heterogeneity in supply conditions across markets is shown to be essential to understanding the growing price dispersion across metropolitan areas, as well as to understanding whether positive growth shocks to a metropolitan area manifest themselves more in terms of expanding population and homebuilding, or in terms of higher wages and house prices.

In an earlier study, Gyourko and Saiz (2006) examine the link between construction costs and housing supply, finding that there are economically large differences in construction costs across U.S. housing markets. More importantly, they estimate a very elastic supply for physical structures and conclude that differences in construction activity across markets do not fully explain the variation in costs. Rather, they find that supply shifters that collectively do account for differences in building costs include the extent of unionization within the

construction sector, local wage, local topography and the local regulatory environment.

In addition to studies which focus on the theories and fundamentals of housing supply, some studies also examine relevant policies such as land use regulations that share similar mechanisms and implementations with regard to housing supply as the Vacancy Tax and Foreign-buyer Tax Act. Quigley and Raphael (2005) explore the linkages between land-use regulations, growth in the housing stock and housing prices in California. Based on a city-level index of regulatory stringency and index of regulation to local housing prices in 1990 and 2000, they find that land-use regulation increases housing costs. This relationship is evident in both the 1990 and 2000 cross sections, as well as in the changes in housing prices and rents over the decade. More importantly, they find evidence that new housing construction is lower in more regulated cities relative to less regulated cities. For instance, they find that changes in the housing stock arising from new construction (housing starts) are smaller in more regulated cities, while holding the change in the price indexes constant. However, this relationship may be subject to omitted variable bias such as the unobserved differences in the changes in housing demand over the decade. To solve this issue, we will attempt to control for these unobserved differences in the changes in housing demand through a fixed effects model and DID design.

On a global scale, Caldera and Johansson (2011) estimate the elasticity of the new build housing supply for 21 OECD countries with different supply conditions. Their empirical results suggest that supply responsiveness (supply shocks or an increase in demand) is strongest in North America compared to other OECD countries. In addition, they highlight the importance of a responsive housing supply, which is important in avoiding bottlenecks in different segments of the market in response to an increase in housing demand. In this paper, they also

include some interesting discussion regarding housing supply from a taxation and policy perspective. For example, a well-designed tax on under-used or vacant land can be adapted to increase the responsiveness of the housing supply. Similarly, if British Columbia's Vacancy Tax and Foreign-buyer Tax Act suppress the supply of new residential housing, which would reduce the responsiveness of the total housing supply, then they could have a negative implication for welfare.

Conceptual Framework

According to Gyourko and Saiz (2006) and Quigley and Raphael (2005), it is suggested that a similar policy to British Columbia's Vacancy Tax and Foreign-buyer Tax Act would supress the local housing supply, especially for new builds. Therefore, in this study we assume that British Columbia's Vacancy Tax and Foreign-buyer Tax Act would have a negative impact on the supply of new residential housing in Vancouver. More specifically, the tax act is assumed to have a negative impact on the number of new residential builds (housing starts) as well as the total book value of these properties (value of residential housing building permits). To test this hypothesis and estimate the policy effect, both a fixed effects model and DID design are proposed here. The fixed effects model is one of the most commonly used methods in time-series and panel data analysis, where unobserved factors across two groups or demographic regions that are fixed over time would be captured in the model and potentially solve the issue of endogeneity. The advantage of DID design is that, unlike standard cross-sectional and time-series studies which in most cases can only provide an average correlation, DID design provides a direct estimation of the causal effect of a certain policy on outcomes of interest; in

this case, we are interested in the supply of new residential builds. The main idea of DID design is to calculate the differences in differences between the treatment group and control group across time after the policy intervention, and therefore provide a direct measure of the policy effects. In this case, the first differences are the pre- and post-differences observed in the outcomes of the supply of new residential housing (housing starts, value of residential housing building permit) within the treated group and control group between January 1997 and January 2018. The second differences are calculated by taking the differences between the first differences among the treated group and control group. As an alternative to calculating each stages of differences manually, this paper uses the regression approach to estimate the DID coefficients. The regression approach has several advantages over manual imputation. First it imputes the standard error, which is critical for standard testing, such as the t- or F-test. Second, the regression approach is more flexible, which allows us to add in other co-variates to improve the precision of the estimates. And lastly, it provides the possibility to add in multiple treatment indicators if needed.

Identification Strategy

In this study, two different identification strategies are considered. The first econometric model takes the following form:

$$Y_{it} = \beta_i + \beta_1 Post_t + \beta_2 Treatment_i * Post_t + \gamma_{it} + \varepsilon_{it} \text{ eq.(1.0)}$$

$$Log\ (Housing\ Starts)_{it} = \beta_i + \beta_1 Post_t + \beta_2 Treatment_i * Post_t + \gamma_{it} + \varepsilon_{it} \text{ eq.(1.1)}$$

$$Log\ (Value\ of\ Residential\ Building\ Permit)_{it} = \beta_i + \beta_1 Post_t + \beta_2 Treatment_i * Post_t + \gamma_{it} + \varepsilon_{it} \text{ eq.(1.2)}$$

The second econometric model takes the following form:

$$Y_{it} = \beta_0 + \beta_1 Treatment_i + \beta_2 Post_t + \beta_3 Treatment_i * Post_t + \gamma_{it} + \varepsilon_{it} \text{ eq.(2.0)}$$

$$Log\ (Housing\ Starts)_{it} = \beta_0 + \beta_1 Treatment_i + \beta_2 Post_t + \beta_3 Treatment_i * Post_t + \gamma_{it} + \varepsilon_{it} \text{ eq.(2.1)}$$

$$Log\ (Value\ of\ Residential\ Building\ Permit)_{it} = \beta_0 + \beta_1 Treatment_i + \beta_2 Post_t + \beta_3 Treatment_i * Post_t + \gamma_{it} + \varepsilon_{it} \text{ eq.(2.2)}$$

Where eq.(1.0) is the base fixed effect model and eq.(2.0) is the base model for DID design. In this paper, Y_{it} represents the supply side housing market outcome variable for each major city *i* in Canada at time *t*. In eq.(1.0), β_i is the fixed effect intercept for each city *i*, which captures the unobserved variable that does not change over time.

Treatment is a binary variable equal to 1 if the data point is from Vancouver and 0 otherwise. *Treatment* equal to 0 is referencing the control group where the data points are observed from other cities/provinces where similar tax acts do not exist. *Treatment* in this case captures the average differences between the treatment group (Vancouver) and control group (Toronto) on the supply outcomes of the residential housing market. *Post* is a binary variable equal to 1 if the date is August 2016 onward and 0 otherwise. *Post* in this case captures the pre- and post-differences on the supply outcomes of the residential housing market within the two groups between August 2016 and the present (or the latest data point available).

*Treatment*Post* is the interaction term of the binary variables *Treatment* and *Post* where it is equal to 1 when both *Treatment* and *Post* are equal to 1. This interaction term represents the implementation of British Columbia's Vacancy Tax and Foreign-buyer Tax Act in the model.

In eq.(1.0), *Treatment*Post* captures the overall effect of the tax acts on the supply outcomes of the new residential housing market in Vancouver. The key assumption here is that any unobservable factors that do not change over time are captured in the fixed effect term (including the treatment itself based on geographic location), thus controlling for endogeneity. In eq.(2.0) however, *Treatment*Post* captures the differences in differences on supply outcomes of the new residential housing markets between the treatment group (Vancouver) and the control group (Toronto) before and after the introduction of the tax acts. The DID design shares the same mechanisms to a randomized experimental design, which (in theory) is free of endogeneity issues. In reality however, the treatment group (Vancouver) and the control group (Toronto) in this case are not identical in many aspects; therefore, it is still necessary to include additional control variables in the model to control for omitted variables bias.

γ_{it} is a vector which contains several control variables for each of these major cities or provinces *i* at time *t.* These control variables are selected based on the relevant studies discussed above, such as Agnello and Schuknecht (2011), Bordo and Jeanne (2002), Gerdesmeier et al. (2009) and Gyourko (2009); the variables include the new housing price index, the GDP of the Canadian real estate rental & leasing sector, the 10-year government bond yield, the local unemployment rate and the size of local population. In this study, two main outcome variables are chosen for empirical analysis. The first outcome variable is the housing starts, which is an economic indicator that reflects the number of privately-owned new houses (technically housing units) on which construction has been started in a given period. The second outcome variable is the value of a residential housing building permit, which measures the total value of new residential building permits approved by the city in a given period. To make the

interpretation more relevant and clearer, the log value of the two outcome variables are calculated and used in the empirical estimation instead.

Data and Descriptive Statistics

All data are collected from customized tabulations from Bloomberg and DataStream. The original source data are based on CANISM tables and other macroeconomic indices released by Statistics Canada. Variables are first collected from different tables/data sources and then combined into one master panel dataset based on provinces/cities on a monthly basis. In total, 1,482 observations are collected from January 1977 to February 2018; after adjusting for missing values however, 759 observations (3 panels) are left in the working dataset, where 506 observations (2 panels) are used to construct the treatment group and control group in the analysis dataset. For this study, Toronto is chosen as the control group since it is similar in size, economic condition and population size to Vancouver.

The analysis dataset contains measurements on housing starts, the value of building permits, the new housing price index, the GDP of real estate rental & leasing, the 10-year government bond yield, the unemployment rate and the size of population between January 1997 and January 2018 for Vancouver and Toronto. The main variables of interest “Treatment” and “Post” as well as the interaction term between the two (“Treatment*Post”), which captures the implementation of British Columbia’s Vacancy Tax and Foreign-buyer Tax Act, are generated based on monthly date and geographic location. In addition, to account for the effect of the 2008 Financial Crisis, a dummy variable is generated which equals “true” when the monthly date is between January 2007 and December 2009 and “false” otherwise.

One important pre-analysis test on panel/time-series data is the unit root test, which is used to determine whether there are serial autocorrelations within the panels based on time. According to the Levin-Lin-Chu unit-root test, we reject the null hypothesis that the panels contain unit roots (Appendix, Tables 1 and 2). The same conclusion is made based on the Fisher-type unit-root test, which indicates that at least one panel is stationary (Appendix, Tables 1 and 2). Therefore, there is no need to add in lag terms such Autoregressive term (AR) or Moving Average term (MA) to control for serial autocorrelation.

Table 3 in the Appendix shows the summary statistics of the working dataset, which contains 759 observations consisting of three balanced panels. The average housing starts of the three cities is 22,054 units and the average value of residential housing building permits is around $618,429,200. In a perfect setting, the identification strategy prefers minimum differences between the treatment and control groups except on the main outcome variables. According to Table 4 in the Appendix, which shows the absolute differences between the two groups, there are some significant pre-existing differences on some of the control variables such as population size and new residential housing price index. However, these differences should be controlled with the fixed effect and DID identification strategy, which focuses on the true differences observed on the outcome variables as a result of the policy treatment.

Table 5 in the Appendix provides a summary of the main outcome variables across time before and after British Columbia's Vacancy Tax and Foreign-buyer Tax Act, which was implemented in August 2016. For the number of housing starts, the differences between the treatment and control groups gradually decrease as time goes by, from 20,667 units to 12,056 units respectively, with the control group dominating in numbers. At the same time, the number

of housing starts within both groups increased by 10,293 units and 1,682 units respectively after the policy treatment. This indicates that British Columbia's Vacancy Tax and Foreign-buyer Tax Act could have had a very minimum suppression effect or even a positive effect on the building/supply of new residential housing in Vancouver (as shown by the decreased differences between the two groups post treatment).

In terms of the value of residential housing building permits, the differences between the treatment and control groups gradually increase as time goes by, which is the opposite of the number of housing starts. Before the treatment, the average difference between the two groups was $564,693,200; after the treatment, this difference increased to $873,359,400, with the control group dominating in numbers. At the same time, within both groups, the value of residential housing building permits increased by $327,589 and $616,255,200 respectively, with the control group dominating in numbers. This suggest that British Columbia's Vacancy Tax and Foreign-buyer Tax Act could have had some suppression effect on the total value of new residential housing permits in Vancouver (as shown by the increased differences between the two groups post treatment).

Combining the results shown above leads to an interesting preliminary conclusion, where British Columbia's Vacancy Tax and Foreign-buyer Tax Act seem to have positive effects on the number of new residential builds (housing starts) in Vancouver, while simultaneously having small positive effects on the total value of these new builds. This outcome is favourable to the policymaker as the tax act did not suppress the supply or building of new residential housing. In fact, the act seems to encourage builders to commit to building lower value residential housing properties, which is a step towards creating more affordable

housing. However, in order to have a more comprehensive understanding of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the supply of new residential housing in Vancouver, a better identification strategy such as a fixed effect model and DID regression is needed.

Empirical Results

Table 6 in the Appendix contains the estimated treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's housing starts using the fixed effect model identification strategy (eq.1.1). Among both specifications, the treatment effects of the tax act on Vancouver's housing starts have positive signs, which is opposite from the initial hypothesis. In the first specification where there are no other control variables, the number of housing starts (number of new residential builds) in Vancouver (treatment group) is 46.4% more on average than Toronto (control group) as a result of the tax act. This result is statistically significant at a 1% level. This indicates that for Vancouver, even with the implementation of British Columbia's Vacancy Tax and Foreign-buyer Tax Act, the number of new residential builds is still significantly greater compared with Toronto, where a similar tax act does not exist.

In the second specification with demographic and macroeconomic control variables, the housing starts number in Vancouver (treatment group) is 37.3% greater on average compared to Toronto (control group) after implementing the tax act. Similar to the results from the first specification, the result in the second specification is statistically significant at a 1% level. Note that in this case, the coefficients of the 2008 financial crisis dummy variable and the local unemployment rate are also economically and statistically significant at a 1% level. For instance, the estimates suggest that during the financial crisis of 2008, the number of housing starts in Vancouver and Toronto decreased by an average of 22.1%. Similarly, a 1%

increase in the local unemployment rate is associated with an average 9.0% decrease in housing starts. This suggests that, in addition to British Columbia's Vacancy Tax and Foreign-buyer Tax Act, there are other factors/channels that could impact the number of housing starts which should also be considered in the model.

Table 7 in the Appendix contains the estimated treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's value of residential housing building permits using the fixed effect model identification strategy (eq.(1.2)). Among both specifications, the treatment effects of the tax act on Vancouver's value of residential housing building permits have positive signs, which is opposite from the initial hypothesis. In the first specification where there are no other control variables, the dollar value of residential housing building permits (new builds) in Vancouver (treatment group) is 10.7% more on average than in Toronto (control group) after the introduction of the tax act. However, this result is not statistically significant. This indicates that for Vancouver, there is a weak positive correlation between British Columbia's Vacancy Tax and Foreign-buyer Tax Act and the value of residential housing building permits.

In the second specification with demographic and macroeconomic control variables, the value of a residential housing building permit in Vancouver (treatment group) is 13.8% more on average compared to Toronto (control group) as a result of the tax act. Similar to the results from the first specification, the result in the second specification is also not statistically significant. Note that in this case, the coefficients of the 2008 financial crisis dummy variable and the local unemployment rate are also economically and statistically significant at a 1% level. This is consistent with the results from eq.(1.1) on housing starts. For instance, the

estimates suggest that during the financial crisis of 2008, the value of residential housing building permits in Vancouver and Toronto decreased by an average of 13.0%. Similarly, a 1% increase in the local unemployment rate is associated with an average of 6.2% decrease in the value of residential housing building permits. Like the housing starts, this suggests that, in addition to British Columbia's Vacancy Tax and Foreign-buyer Tax Act, there are other factors/channels that could impact the value of residential housing building permits that should be considered in the model. And in this case, these factors seem to be more strongly correlated with the value of residential housing building permits than the tax act.

Overall, the results from the fixed effects identification strategy in eq.(1.1) and eq.(1.2) confirm the preliminary findings from the summary statistics in the previous section. The estimated treatment effect from the fixed effect model suggests a positive relationship between British Columbia's Vacancy Tax and Foreign-buyer Tax Act and the number of new residential builds (housing starts) in Vancouver. On the other hand, the results find no significant impact on the value of residential housing building permits as a result of the tax act. This outcome is favourable to the policymaker as the tax act did not suppress the supply or building of new residential housing; in fact, the act seems to encourage builders to commit to constructing more residential houses with no significant increase in the value of the property building permit, which is a step towards building more affordable housing.

Table 8 in the Appendix contains the estimated treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's housing starts using the DID (eq.(2.1)) identification strategy. Among both specifications, the treatment effects of the tax act on Vancouver's housing starts have positive signs, which is opposite from the initial hypothesis.

In the first specification where there are no other control variables, the number of housing starts (number of new residential builds) in Vancouver (treatment group) is 46.3% higher on average compared to Toronto (control group) after implementing the tax act. This result is consistent with the fixed effects model and it is also statistically significant at a 1% level. This indicates that for Vancouver, with the implementation of British Columbia's Vacancy Tax and Foreign-buyer Tax Act, the number of new residential builds is still significantly greater compared to Toronto where a similar tax act does not exist.

In the second specification with demographic and macroeconomic control variables, the housing starts in Vancouver (treatment group) number 37.3% more on average compared to Toronto (control group) after implementing the tax act. Similar to the results from the first specification, the result in the second specification is statistically significant at a 1% level. In this case, the estimated coefficient of the main DID indictor (Treatment*Post) is almost identical to the estimated coefficient from the fixed effects model with smaller standard errors (0.111 vs. 0.121), which further reinforces the preliminary results found previously from the summary statistics and fixed effects model. Similar to the results from the fixed effects model, the coefficients of the 2008 financial crisis dummy variable and local unemployment rate are also economically significant and statistically significant at a 1% level. For instance, the estimates suggest that during the financial crisis of 2008, the number of housing starts in Vancouver and Toronto decreased by an average of 22.1%. Similarly, a 1% increase in the local unemployment rate is associated with an average of 9.0% decrease in the housing starts. Again, this suggests that in addition to British Columbia's Vacancy Tax and Foreign-buyer Tax Act,

there are other factors/channels that could impact the number of housing starts that should be considered in the model.

Table 9 in the Appendix contains the estimated treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the value of Vancouver's residential housing building permits using the DID identification strategy (eq.(2.2)). Within both specifications, the treatment effects of the tax act on Vancouver's value of residential housing building permits show positive signs, which is the opposite of the initial hypothesis. In the first specification where there are no other control variables, the dollar value of a residential housing building permit (new builds) in Vancouver (treatment group) is 10.7% higher on average than in Toronto (control group) after the introduction of the tax act. Unlike the fixed effects model, this result is statistically significant at a 10% level. This indicates that for Vancouver, there is a weak positive correlation between British Columbia's Vacancy Tax and Foreign-buyer Tax Act and the value of a residential housing building permit; however, this relationship is only weakly statistically significant.

In the second specification with demographic and macroeconomic control variables, the value of a residential housing building permit in Vancouver (treatment group) is 13.8% higher on average compared to Toronto (control group) as a result of the tax act. Unlike the results from the second specification in the fixed effects model, the result here is statistically significant at a 5% level. This indicates that for Vancouver, there is a weak to medium strong positive correlation between British Columbia's Vacancy Tax and Foreign-buyer Tax Act and the value of residential housing building permits. Note that in this case, the coefficients of the 2008 financial crisis dummy variable and the local unemployment rate are also economically

significant and statistically significant at a 1% level. This is consistent with the results from eq.(2.1) on housing starts. For instance, the estimates suggest that during the financial crisis of 2008, the value of residential housing building permits in Vancouver and Toronto decreased by an average of 13.0%. Similarly, a 1% increase in the local unemployment rate is associated with an average of 6.2% decrease in the value of residential housing building permits. Like the housing starts, this suggests that in addition to British Columbia's Vacancy Tax and Foreign-buyer Tax Act, there are other factors/channels that could impact the value of residential housing building permits that should be considered in the model. Additionally, in this case, these factors seem to be more strongly correlated with the value of residential housing building permits than the tax act.

Overall, the results from both equations using the DID identification strategy (eq.2.1, eq.2.2) reinforce the results from the fixed effects model, which confirms the preliminary findings from the summary statistics in the previous section. The estimated treatment effect from the fixed effect model suggests a positive relationship between British Columbia's Vacancy Tax and Foreign-buyer Tax Act and the number of new residential builds (housing starts) in Vancouver. On the other hand, there is no significant impact on the value of residential housing building permits as a result of the tax act. This outcome is favourable to the policymaker as the tax act does not suppress the supply or building of new residential housing and in fact, the act seems to encourage builders to commit to constructing more residential houses with no significant increase in the value of the property building permit. This is a step forward in building more affordable housing.

Robustness Check

As a robustness check, eq.(1.1), eq.(1.2), eq.(2.1) and eq.(2.2) are re-estimated to include Calgary in the control group. The goal is to see if the main results would change significantly if we expand the sample size to include an additional city in the control group for comparison.[3] More specifically, we want to test the external validity of the main results to see if the estimated local causal effects based on Vancouver and Toronto would remain consistent when the sample size is expanded. Overall, the results obtained in Tables 10 to 13 in the Appendix are consistent with the main results estimated using only Toronto as the control group. However, there are some differences, especially on the outcomes of the fixed effects identification strategy where the treatment effects estimates are much less statistically significant than the main results.

Table 10 in the Appendix contains the re-estimated robustness check treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's housing starts using the fixed effect model identification strategy (eq.(1.1)). Within both specifications, the treatment effects of the tax act on Vancouver's housing starts have positive signs, which are consistent with the main results. In the first specification where there are no other control variables, the number of housing starts (number of new residential builds) in Vancouver (treatment group) is 54.7% more on average than in Toronto and Calgary (control group) as a result of the tax act. This result is statistically significant at a 1% level. This indicates that for Vancouver, even with the implementation of British Columbia's Vacancy Tax and Foreign-

[3] In empirical analysis, one common practice for robustness check is to test the model on a different or larger sample population. In this paper, the main goal of the robustness check is to test the external validity of the estimates (ability/feasibility of generalizing the results to a larger scale), therefore we add Calgary to the control group instead of running a parallel estimation by just using Calgary instead of Toronto.

buyer Tax Act, the number of new residential builds is still significantly greater when compared to Toronto and Calgary where a similar tax act does not exist.

In the second specification with demographic and macroeconomic control variables, housing starts for Vancouver (treatment group) are 12.5% higher on average compared with Toronto and Calgary (control group) after implementing the tax act. Unlike the main result from Table 6 in the Appendix, the result in the second specification is not statistically significant. Note that in this case, the coefficients of the 2008 financial crisis dummy variable and local unemployment rate are also economically significant and statistically significant at a 1% level. For instance, the estimates suggest that during the financial crisis of 2008, housing starts in Vancouver and Toronto decreased by an average of 22.4%. Similarly, a 1% increase in the local unemployment rate is associated with an average of 12.0% decrease in housing starts.

Table 11 in the Appendix contains the re-estimated robustness check treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's value of residential housing building permit using the fixed effect model identification strategy (eq.(1.2)). Within both specifications, the treatment effects of the tax act on Vancouver's value of residential housing building permits have positive signs, which are consistent with the main results. In the first specification where there are no other control variables, the dollar value of residential housing building permits (new builds) in Vancouver (treatment group) is 19.7% more on average than in Toronto and Calgary (control group) after the introduction of the tax act. However, this result is not statistically significant. This indicates that for Vancouver, there is a weak positive correlation between British Columbia's Vacancy Tax and Foreign-buyer Tax Act and the value of residential housing building permits.

In the second specification with demographic and macroeconomic control variables, the value of residential housing building permits in Vancouver (treatment group) is 15.6% higher on average compared with Toronto and Calgary (control group) as a result of the tax act. The result in the second specification is at a 10% level, which is slightly more significant than the main result in Table 7. Note that in this case, the coefficients of the 2008 financial crisis dummy variable and the local unemployment rate are also economically significant and statistically significant at a 1% level. This again is consistent with the main results. For instance, the estimates suggest that during the financial crisis of 2008, the value of residential housing building permits in Vancouver and Toronto decreased by an average of 10.0%. Similarly, a 1% increase in the local unemployment rate is associated with an average 7.9% decrease in the value of residential housing building permits.

As we can see from the results discussed above, the treatment effect of the tax act on Vancouver's housing starts is only statistically significant in the first specification where there are no other control variables (Appendix, Table 10). On the other hand, the treatment effects of the tax act on Vancouver's value of residential housing building permits are only statistically significant in the second specification at a 10% level, which is fairly weak (Appendix, Table 11). The exact reason for these differences is unclear, however. In general, when including additional observations in the control group, there is also the possibility of introducing noise, which could distort the treatment effects. At the same time, by introducing additional observations in the control group, it is possible that the overstated treatment effects are smoothed, which is a better estimate of the true treatment effects. In this case, it is hard to tell which scenario applies, and it may be a mix of both. Nonetheless, the overall direction and

correlation indicated by the robustness check estimates from the fixed effects identification strategy are still consistent with the main results.

Table 12 in the Appendix contains the re-estimated robustness check treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's housing starts using the DID (eq.(2.1)) identification strategy. Within both specifications, the treatment effects of the tax act on Vancouver's housing starts have positive signs, which are consistent with the main results. In the first specification where there are no other control variables, the number of housing starts (number of new residential builds) in Vancouver (treatment group) is 54.7% higher on average compared with Toronto and Calgary (control group) after implementing the tax act. This result is consistent with the main results from Table 8 in the Appendix where it is also statistically significant at a 1% level. This indicates that for Vancouver, with the implementation of British Columbia's Vacancy Tax and Foreign-buyer Tax Act, the number of new residential builds is still significantly greater when compared to Toronto and Calgary where a similar tax act does not exist.

In the second specification with demographic and macroeconomic control variables, the housing starts number for Vancouver (treatment group) is 22.6% greater on average compared to Toronto (control group) after implementing the tax act. The result here in the second specification is statistically significant at a 5% level, which is a little less significant compared to the main results. Again, similar to the main results from Table 8 in the Appendix, the coefficients of the 2008 financial crisis dummy variable and the local unemployment rate are also economically significant and statistically significant at a 1% level. For instance, the estimates suggest that during the financial crisis of 2008, the number of housing starts in

Vancouver, Toronto and Calgary decreased by an average of 22.5%. Similarly, a 1% increase in the local unemployment rate is associated with an average of 12.5% decrease in the housing starts.

Table 13 in the Appendix contains the re-estimated robustness check treatment effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the value of Vancouver's residential housing building permits using the DID identification strategy (eq.(2.2)). Within both specifications, the treatment effects of the tax act on Vancouver's value of residential housing building permits have positive signs, which are consistent with the main results.

In the first specification where there are no other control variables, the dollar value of residential housing building permits (new builds) in Vancouver (treatment group) is 19.7% more on average than in Toronto and Calgary (control group) after the introduction of the tax act. Unlike the main results from Table 9 in the Appendix, this result is not statistically significant.

In the second specification with demographic and macroeconomic control variables, the value of residential housing building permits in Vancouver (treatment group) is 28.2% more on average than in Toronto and Calgary (control group) as a result of the tax act; this is more significant than the main result in Table 9 in the Appendix. This indicates that for Vancouver, there is a weak to medium strong positive correlation between British Columbia's Vacancy Tax and Foreign-buyer Tax Act and the value of residential housing building permits. Note that in this case, the coefficients of the 2008 financial crisis dummy variable and the local unemployment rate are also economically significant and statistically significant at a 1% level. This again is consistent with the main results. For instance, the estimates suggest that during

the financial crisis of 2008, the value of residential housing building permits in Vancouver, Toronto and Calgary decreased by an average of 10.2%. Similarly, a 1% increase in the local unemployment rate is associated with an average 8.5% decrease in the value of residential housing building permits.

Overall, compared to the main results, the estimate from the DID robustness check is larger and more statistically significant compared to the main result (28.2% at 1% vs. 13.8% at 5%). Generally speaking, the DID design is usually considered to be a better identification strategy than the fixed effects model for policy evaluation. As we can see from the robustness check results here, with expanded sample size the estimates of the DID indictor remain relatively stable and are consistent with the main DID results in Tables 8 and 9. In conclusion, the results from the robustness check support the conclusion from the main results, which suggests that the implementation of British Columbia's Vacancy Tax and Foreign-buyer Tax Act does not have any negative impact on the residential market supply in Vancouver. In fact, it appears that the tax act has a positive impact on both housing starts and the value of residential housing building permits in Vancouver compared to Toronto and Calgary.

Discussion

Unlike most of the existing literature suggests (such as Gyourko and Saiz (2006) and Quigley and Raphael (2005)), the empirical results from this study indicate that British Columbia's Vacancy Tax and Foreign-buyer Tax Act have a positive impact on the supply of new residential housing in Vancouver. More specifically, the tax act has a strong positive causal impact on the number of new residential builds (housing starts) and a weak positive causal

relationship on the total book value of these properties (value of residential housing building permits).

There are a few possible theories that might be able to explain these observed phenomena. First, although this study mainly focuses on the effect of the tax act on the residential housing market from the supply side, there is much more discussion and research interest which focus on the demand instead. According to data from Bloomberg (Bloomberg, 2017), the increase in the average price of residential housing in Vancouver became much more stable upon the introduction of British Columbia's Vacancy Tax and Foreign-buyer Tax Act in 2016 when compared to 2015. Perhaps the tax act had a negative effect on the demand from foreign buyers (which lead to a temporary decrease in residential housing prices) but was substituted by demand from local buyers instead which increased the total demand overall (assuming the price elasticity of the housing demand is elastic). This then could indirectly lead to an increase in the supply of residential housing through more homebuilding, which ultimately lead to higher total value of building permits. This view is supported by the traditional supply and demand market model, where supply matches the change in demand to a new equilibrium.

Second, in recent years, there has been an upward trend in demand for residential housing and the overall price in Canada, especially in the areas of Vancouver and Toronto. Although unlikely (since the data are already de-trended with no unit roots), it is still possible that the positive effects of the tax acts on housing starts and the value of residential housing building permits we captured in this study are simply a reflection of this overall trend in Canada, instead of the true treatment effect of the tax acts.

Third, even though both the fixed effects model and DID design identification strategies should be able to control endogeneity to some extent, the results in this study could still be subjected to endogeneity issue due to the complexity and nature of the subject. More specifically, the results in this study could be subjected to omitted variable bias where unobserved factors are not considered in the model, which could cause biased estimates. One example is construction costs, which are not directly observed in the dataset of this study. A change in construction costs, including labour and raw materials costs, could have significant impact on the supply of new residential housing. In addition, although there were no similar tax acts in place at the time of this study in Ontario and Alberta, it is still possible that other relevant policies such as minimum wage adjustment could indirectly impact the residential housing market through other channels that are not directly observed in the data. However, despite these potential issues, we are confident in concluding that British Columbia's Vacancy Tax and Foreign-buyer Tax Act do not have any negative or suppression effects on the supply of new residential housing in Vancouver.

Conclusion

This paper investigates the effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on the supply of new residential housing in Vancouver. Using a panel dataset constructed from customized tables and various data sources for Vancouver and Toronto between January 1997 and January 2018, this paper estimates a fixed effects model and DID design using differences before and after the implementation of British Columbia's Vacancy

Tax and Foreign-buyer Tax Act between Vancouver and Toronto on housing starts and value of residential housing permits.

Unlike most of the existing literature suggests, the empirical results from this study indicate that British Columbia's Vacancy Tax and Foreign-buyer Tax Act have a positive impact on the supply of new residential housing in Vancouver. For instance, the regression results of both fixed effects and DID design suggest that holding other factors constant, British Columbia's Vacancy Tax and Foreign-buyer Tax Act have a significant positive impact on new residential builds (housing starts) in Vancouver. On the other hand, we find no evidence that suggests a significant impact of the tax acts on the value of residential housing building permits. There are few possible theories which might be able to explain these observed phenomena, including the traditional supply and demand equilibrium mechanism, endogeneity issued due to the complexity and nature of the subject and other possible causes such as the positive overall trend in the recent Canadian housing market. However, despite these potential issues, we are confident in concluding that British Columbia's Vacancy Tax and Foreign-buyer Tax Act do not have any negative or suppression effect on the supply of new residential housing in Vancouver. This outcome is favourable to the policymaker as the tax act did not suppress the supply of new residential housing, and in fact, the act seems to encourage builders to commit to building more residential houses with no significant increase in the value of the property building permits, which is a step forward in building more affordable housing.

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Appendix

Table 1 Unit Root Test: Housing starts

Ho: Panels contain unit roots *Ha: Panels are stationary*	Statistics	P-value
A. Levin-Lin-Chu unit-root test		
Unadjusted t	-10.975	N/A
Adjusted t	-6.977	0.000
Ho: All panels contain unit roots *Ha: At least one panel is stationary*	Statistics	P-value
B. Fisher-type unit-root test		
Inverse chi-squared	188.386	0.000
Inverse normal	-12.973	0.000
Inverse logit t	-30.852	0.000
Modified inv. chi-squared	52.650	0.000

Notes: The working sample contains data collected from Vancouver, Calgary and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto.

Table 2 Unit Root Test: Value of residential housing building permits

Ho: Panels contain unit roots *Ha: Panels are stationary*	Statistics	P-value
A. Levin-Lin-Chu unit-root test		
Unadjusted t	-4.884	N/A
Adjusted t	-1.862	0.031
Ho: All panels contain unit roots *Ha: At least one panel is stationary*	Statistics	P-value
B. Fisher-type unit-root test		
Inverse chi-squared	83.762	0.000
Inverse normal	-8.160	0.000
Inverse logit t	-13.718	0.000
Modified inv. chi-squared	22.448	0.000

Notes: The working sample contains data collected from Vancouver, Calgary and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto.

Table 3 Summary Statistics

	Overall (mean)
A. Supply of New Residential Housing	
Housing starts (in 000s)	22.054
Value of residential housing building permits (in 000s)	618429.200
B. Control Variables	
New residential housing price index	81.120
GDP real estate rental and leasing (National) (in 000s)	170165.200
Population (in 000s)	5524.835
10 years government bond yield (National)	3.772%
Unemployment rate	6.386%
Observations	759

Notes: The working sample contains data collected from Vancouver, Calgary and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto.

Table 4 Summary Statistics: Treatment Group vs. Control Group

	Treatment Group (mean)	Control Group (mean)	Differences (absolute)
A. Supply of New Residential Housing			
Housing starts (in 000s)	16.969	32.024	15.055
Value of residential housing building permits (in 000s)	454500.400	1041154.000	586653.6
B. Control Variables			
Population (in 000s)	3517.101	10279.350	6762.249
New residential housing price index	98.913	72.450	26.463
Unemployment rate	6.809%	7.065%	0.256%
Observations	253	253	0

Notes: The analysis sample contains data collected from Vancouver and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto.

Table 5 Summary Statistics of Main Outcomes: Treatment Group vs. Control Group Before and After Treatment

Housing starts	Treatment Group (mean)	Control Group (mean)	Differences (absolute)
Year, Month			
199701-201607 (in 000s) (before)	16.237	36.904	20.667
201608-201801 (in 000s) (after)	26.530	38.586	12.056
Differences (absolute)	10.293	1.682	8.611
Observations (before vs. after)	235 vs. 18	235 vs. 18	N/A
Value of residential housing building permits	**Treatment Group (mean)**	**Control Group (mean)**	**Differences (absolute)**
Year, Month			
199701-201607 (in 000s) (before)	431193.600	995886.800	564693.200
201608-201801 (in 000s) (after)	758782.600	1632142.000	873359.400
Differences (absolute)	327589	636255.200	308666.200
Observations (before vs. after)	235 vs. 18	235 vs. 18	N/A

Notes: The analysis sample contains data collected from Vancouver and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto.

Table 6 Fix Effect Model Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's Housing Starts (Eq.1.1)

Variable	*Specification (1)*	*Specification (2)*
Post	0.064 (0.088)	-0.303 (0.090)***
Treatment*Post	**0.463 (0.124)*** **	**0.373 (0.121)*** **
2008 financial crisis		-0.221 (0.043)***
New housing price index		0.008 (0.003)***
GDP real estate rental and leasing		0.000 (0.000)***
10 years government bond yield		0.022 (0.035)
Unemployment rate		-0.090 (0.017)***
Population		-0.000 (0.000)***
Constant	3.136 (0.017)***	3.688 (0.477)***
R^2	0.002	0.424
N	506	506

Notes: The analysis sample contains data collected from Vancouver and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 7 Fix Effect Model Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's Value of Residential Housing Building Permit (Eq.1.2)

Variable	*Specification (1)*	*Specification (2)*
Post	0.536 (0.091)***	-0.213 (0.063)***
Treatment*Post	**0.107 (0.129)**	**0.138 (0.085)**
2008 financial crisis		-0.130 (0.030)***
New housing price index		0.008 (0.002)***
GDP real estate rental and leasing		0.000 (0.000)***
10 years government bond yield		0.042 (0.024)*
Unemployment rate		-0.062 (0.012)***
Population		-0.000 (0.000)***
Constant	13.322 (0.017)***	12.002 (0.334)***
R^2	0.056	0.189
N	506	506

Notes: The analysis sample contains data collected from Vancouver and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 8 DID Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's Housing Starts (Eq.2.1)

Variable	*Specification (1)*	*Specification (2)*
Treatment	-0.848 (0.034)***	-2.977 (0.671)***
Post	0.064 (0.062)	-0.303 (0.084)***
Treatment*Post	**0.463 (0.096)*** **	**0.373 (0.111)*** **
2008 financial crisis		-0.221 (0.049)***
New housing price index		0.008 (0.003)***
GDP real estate rental and leasing		0.000 (0.000)***
10 years government bond yield		0.022 (0.036)
Unemployment rate		-0.090 (0.017)***
Population		-0.000 (0.000)***
Constant	3.560 (0.021)***	5.176 (0.640)***
R^2	0.577	0.695
N	506	506

Notes: The analysis sample contains data collected from Vancouver and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 9 DID Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's Value of Residential Housing Building Permit (Eq.2.2)

Variable	*Specifications (1)*	*Specifications (2)*
Treatment	-0.884 (0.035)***	-2.371 (0.442)***
Post	0.536 (0.032)***	-0.213 (0.050)***
Treatment*Post	**0.107 (0.061)***	**0.138 (0.067)** **
2008 financial crisis		-0.130 (0.039)***
New housing price index		0.008 (0.002)***
GDP real estate rental and leasing		0.000 (0.000)***
10 years government bond yield		0.042 (0.027)
Unemployment rate		-0.062 (0.012)***
Population		-0.000 (0.000)***
Constant	13.764 (0.020)***	13.188 (0.452)***
R^2	0.610	0.871
N	506	506

Notes: The analysis sample contains data collected from Vancouver and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and the control group is Toronto. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 10 Robustness Check Fix Effect Model Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's Housing Starts (Eq.1.1)

Variable	*Specification (1)*	*Specification (2)*
Post	-0.020 (0.061)	-0.070 (0.064)
Treatment*Post	**0.547 (0.106)*** **	**0.125 (0.014)**
2008 financial crisis		-0.224 (0.036)***
New housing price index		-0.003 (0.001)**
GDP real estate rental and leasing		0.000 (0.000)***
10 years government bond yield		0.025 (0.029)
Unemployment rate		-0.120 (0.010)***
Population		-0.000 (0.000)
Constant	2.907 (0.013)***	3.215 (0.382)***
R^2	0.007	0.236
N	759	759

Notes: The working sample contains data collected from Vancouver, Calgary and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and for the purpose of robustness check, the control group here is expanded to include both Toronto and Calgary. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 11 Robustness Check Fix Effect Model Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's Value of Residential Housing Building Permit (Eq.1.2)

Variable	*Specification (1)*	*Specification (2)*
Post	0.446 (0.072)***	-0.201 (0.047)***
Treatment*Post	**0.197 (0.124)**	**0.156 (0.077)***
2008 financial crisis		-0.100 (0.027)***
New housing price index		0.009 (0.001)***
GDP real estate rental and leasing		0.000 (0.000)***
10 years government bond yield		0.031 (0.021)
Unemployment rate		-0.079 (0.007)***
Population		-0.000 (0.000)***
Constant	13.098 (0.016)***	11.744 (0.284)***
R^2	0.038	0.115
N	759	759

Notes: The working sample contains data collected from Vancouver, Calgary and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and for the purpose of robustness check, the control group here is expanded to include both Toronto and Calgary. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 12 Robustness Check DID Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Vancouver's Housing Starts (Eq.2.1)

Variable	*Specification (1)*	*Specification (2)*
Treatment	-0.293 (0.040)***	0.443 (0.047)***
Post	-0.020 (0.120)	-0.084 (0.069)
Treatment*Post	**0.547 (0.141)*** **	**0.226 (0.100)** **
2008 financial crisis		-0.225 (0.042)***
New housing price index		-0.004 (0.001)***
GDP real estate rental and leasing		0.000 (0.000)
10 years government bond yield		0.024 (0.030)
Unemployment rate		-0.125 (0.009)***
Population		0.000 (0.000)***
Constant	3.005 (0.030)***	2.468 (0.372)***
R^2	0.058	0.721
N	759	759

Notes: The working sample contains data collected from Vancouver, Calgary and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and for the purpose of robustness check, the control group here is expanded to include both Toronto and Calgary. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.

Table 13 Robustness Check DID Result: Estimated Treatment Effect of British Columbia's Vacancy Tax and Foreign-buyer Tax Act on Value of Residential Housing Building Permit (Eq.2.2)

Variable	*Specifications (1)*	*Specifications (2)*
Treatment	-0.326 (0.043)***	0.043 (0.038)
Post	0.446 (0.119)***	-0.220 (0.056)***
Treatment*Post	**0.197 (0.130)**	**0.282 (0.070)*** **
2008 financial crisis		-0.102 (0.035)***
New housing price index		0.007 (0.001)***
GDP real estate rental and leasing		0.000 (0.000)***
10 years government bond yield		0.030 (0.024)
Unemployment rate		-0.085 (0.008)***
Population		0.000 (0.000)***
Constant	13.206 (0.032)***	10.928 (0.301)***
R^2	0.093	0.860
N	759	759

Notes: The working sample contains data collected from Vancouver, Calgary and Toronto between January 1997 and January 2018. The treatment group is Vancouver. and for the purpose of robustness check, the control group here is expanded to include both Toronto and Calgary. Robust standard errors are shown in parentheses. * significant at 10%; ** significant at 5%; *** significant at 1%.