VACANCY TAX AND HOUSING PRICE – DIFFERENCE IN DIFFERENCE MODEL IN REAL ESTATE MARKET

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PROJECT SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE IN FINANCE

In the Master of Science in Finance Program
of the
Faculty
of
Business Administration

SIMON FRASER UNIVERSITY

Fall 2019

Approval

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Degree:	**Master of Science in Finance**
Title of Project:	**Vacancy Tax and Housing Price – Difference in Difference Method in Real Estate Market**

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Abstract

With the purpose of addressing housing affordability in British Columbia, provincial government announced the Vacancy and Speculation Act in February 2016. Previous research on property tax and real estate has found that property tax was expected to curtail housing price in British Columbia. In this article, we study the effect of vacancy tax on residential housing price. We conducted a five-year difference-in-difference analysis of the impact of vacancy tax particularly on Census Metropolitan Area with regard to different property types and neighborhoods. Unexpectedly, we cannot detect that vacancy tax trigger consequential price change in the composite real estate market taking three major property types into consideration. However, we detect that this policy does have a negative impact on condo price of approximate 2.3% in expensive area neighborhoods. Our research examines the effectiveness of the vacancy tax applying a quantitative approach.

Keyword: vacancy and speculation tax; difference-in-difference model;

Executive Summary

Vacancy and Speculation Tax Act was announced in February 2016 and came into force since January 2017 to intervene in housing market. Specifically, the tax aims to reduce the vacant houses in Vancouver and place them back to rental or resale housing market by punishing vacant properties. 1% of the property assessed value will be charged as punishment. However, whether the vacancy tax decisively solve the housing affordability has become a controversial issue.

This research paper provides a quantitative analysis and evaluation of the influence of this recent tax policy on Vancouver housing price. To accurately capture the detailed impact of the policy, we collected housing prices based on representative property categories and neighborhood. After verifying necessary assumption prior to model building, we applied difference-in-difference methodology to detect the policy effect in Vancouver housing price against Toronto housing price, which was not affected by vacancy tax before and after policy announcement. The results do not indicate that Vancouver housing affordability overall improved with the introduction of the vacancy tax. Nevertheless, condo housing price in wealthy region experienced a fluctuation. To further improve our model and validate our results, we conducted several robustness checks. And it turns out that our results passed both tests so have certain accuracy and explainable power.

The value of our investigation is that we scrutinize the effectiveness of the vacancy tax and explores the potential practical reasons behind the facts.

Dedication

This project is dedicated to our beloved families who continually provide moral, spiritual and emotional support.

Acknowledgement

We would like to express our deepest gratitude to our supervisor Dr. Andrey Pavlov for his guidance and support on this project. We appreciate his insightful ideas, aspiring guidance and constructive comments during the project work. Without him it is not possible to finish our project in such an efficient way.

We would like to convey our thanks to Dr. Phil Goddard, who kindly evaluates our project and provide valuable suggestion for improvement as second reader.

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Introduction

Vancouver's housing prices have risen sharply during the last 20 years. Housing prices in 2019 tripled compared to prices in 2000. In 2019, Vancouver's housing unaffordability ranked the second in North America after those of San Francisco, with a ratio of 12.6 to one on real estate prices to local earnings (Todd, 2019). In addition to the unaffordability issue, locals also expressed concerns about housing purchased by speculators, foreign buyers and satellite families. In 2016, British Columbia Government introduced Vacancy and Speculation Tax Act, which required residential property owners must file an annual declaration. After imposing the new property tax, properties deemed unoccupied for more than six months during the vacancy reference period are subject to a tax of 5% of the property's assessed taxable value. Failure to declare the property status by the deadline results in the property being deemed vacant and subject to a tax of 5% of its assessed value, a penalty of 5% and a $250 of fine. The objective of this tax act is to prevent housing speculation, to put empty homes back into housing market for people living and working in British Columbia. This act is targeting domestic and foreign speculators who own residential property in Columbia, but don't pay taxes here. The net revenue of this empty home tax will be reinvested into affordable housing initiative.

People who support this act criticize that the tax system in Canada is not well designed to tax people. They are using foreign income and wealth to purchase houses, to come, to reside in British Columbia. Besides, they are using social services and amenities that British Columbia society provides but they don't often contribute to that because

foreign income or wealth are not taxable in Canada. Supporters also presume that British Columbia is becoming more attractive to those who are wealthy and don't have to pay tax locally. This separates the housing price from local income. They claim that the speculation component of the tax is to address this dynamic so that income comes more in line with the housing market.

People who object this tax suspect that it is costly to collect the tax, along with the extra costs setting up a new tax administration system. However, the net revenue of this tax is not considerable compared to its expenses as most homeowners will be exempted. The burden from payment of all those costs would be transferred back to taxpayers furthermore decreasing their disposable income and purchasing power. The second concern of this act is that it may have collateral damage on high net worth people in Canada. Some lawyers argue that the jurisdiction of the vacancy tax is to tax people who benefit from Canadian society but not financially contribute to it[1]. However, during the implementation process of vacancy tax, people from other provinces who plan to move here in one or two years, purchased their property in advance and levied taxes. All those people are contributing to Canadian society and paying tax in Canada yet deemed to be speculators worthy of punishment. Last but not least, some economists assume that the number of houses, entered back into market due to vacancy tax, is not significant to satisfy the fast-growing demand for residential properties. They also assume that increases in the supply of housing market, such as more permits for construction, are the appropriate approach to address housing affordability.

[1] See "City of Vancouver facing multiple lawsuits over empty homes tax" Global News, July 7, 2019.

Therefore, our purpose of this study was to explore the effectiveness of the implementation of speculation and vacancy tax on housing affordability.

Our paper replicates the difference-in-difference methodology in Pavlov and Sommerville (2018) to examine the housing price change in post-policy period.

In terms of the effect for monthly housing price from 2013 to 2019, our empirical results show that the vacancy tax does not have significant influence on stabilizing housing price and improving affordability for people who residing and working in B.C. Surprisingly, prices of condos in expensive area are indeed reduced due to vacancy tax. This result indicates that the vacancy tax may have the largest policy power on some particular housing types in Vancouver sub-market instead of the housing market on the whole.

Literature review

Researchers explored the link between immigration and housing prices increase. In Pavlov and Somerville's article 'Immigration, capital flow and housing prices' in 2018, they applied a difference-in-difference identification strategy to evaluate the impact of wealthy immigrants on the housing price of Vancouver. Their empirical evidence illustrates that wealthy immigrants from investor immigrants program boost neighborhood house prices through three channels: an increase in market- wide demand, increases in expected future rents from faster productivity growth and preferences for specific locations. The conclusion is consistent with that in Sa, Tobin and Wieladek's article 'capital inflows, Financial Structure and Housing Booms'(2014). In that paper, researchers estimated Vector Auto-regressive (VAR) approach on a panel of 18 Organisation for Economic Co-operation and Development (OECD) countries and found that capital-inflow shocks have a significant and positive effects on real housing prices and real residential investment.

In August 2016, Province of BC introduced foreign buyer tax to cool down the housing market and to tackle housing affordability problems in BC. In Pavlov and Wetzel's Expert Report in 2018, they used a difference-in-difference model to assess the effectiveness of the implementation of foreign buyer and transferee tax. They used semi-log regression model with multiple variables to estimate time period dummy variable. Their empirical result exhibits that foreign buyer transferee tax had a significant and substantial impact on the Greater Vancouver Regional District real estate market and improved housing affordability in those markets.

Apart from studies that focus on the relationship between tax instrument and the overall housing market, some researchers instead look into the impact of tax on supply side of housing market, Hu's (2018) identified the effects of British Columbia's Vacancy tax and foreign-buyer tax act on the supply of new residential housing in Vancouver. The author used a fixed effect model and a difference-in-difference design based on a panel dataset to estimate time period dummy variable. The author interpreted the variation in housing starts as the indicators of housing supply. The empirical result suggests that British Columbia's Vacancy Tax and Foreign-Buyer Tax Act have a positive impact on new residential builds in Vancouver.

Data selection

In February 2016, Provincial government has imposed the Vacancy and Speculation Tax Act targeting foreign and domestic speculators who are dwelling in B.C. but don't pay tax here. Vancouver City before the tax policy is a natural experiment, in which the cluster of individuals is exposed to the experimental conditions that are determined by the nature. If an experiment can be considered as a natural experiment, then the effects of this policy can be captured by comparing the social group affected by this policy (Treatment group) and that not affected by this policy (Control group). In our research, the treatment group is Vancouver's housing market and the control group is Toronto's housing market. We applied approximately 5-year time horizon and selected 160 monthly data from January 2013 to September 2019. We use "Treat" to indicate treatment group. "Treat = 1" if the group is exposed to the policy, otherwise "Treat = 0". We use "Time" to indicate reform process. "Time = 1" if the year is in or after year 2016, otherwise "Time = 0". To inspect the effect of the reform, we set up an interaction term "Treat*Time", which is the product term of "Treat" and "Time". Therefore, we divide our data into 4 groups: treatment group before the policy (Treat = 1, Time = 0), treatment group after the policy (Treat = 1, Time = 1), control group before the policy (Treat = 0, Time = 0) and control group after the policy (Treat = 0, Time = 1).

We selected housing price index (HPI) as the measure of dependent variable. HPI is based on the value home buyers distribute to assorted housing characteristics, which would evolve over time. We consider the benchmark tracked across Canadian different types of houses and neighborhood can be the ideal price indicator of Canadian housing

market. In addition to composite HPI in both cities, we also obtained HPI on such major property categories as single family, condo, and attached[2] to dig out the potential influence of the tax policy on housing price of different types.

Table 1 provided a summary of the major results across time pre- and post- Vacancy and Speculation Tax Act, which was announced in February 2016. The differences between Vancouver and Toronto gradually increase during pre-tax to post-tax period, from 20.75.11 to 35.77. Simultaneously, the housing price within both groups increased by 84.35.9 and 69.33 after policy enacted. This might imply that Empty Home Tax could have had a very limited effect or even a positive effect on the residential housing price in Vancouver.

HPI	Treatment Group	Control Group	Differences
201301-201601 (before)	182.66	161.91	20.75
201602-201909 (after)	267.00	231.24	35.77
Differences(absolute)	84.35	69.33	15.02
Observations (before vs. after)	37 vs.44	37 vs.44	N/A

Table 1 *Summary statistics: Treatment Group vs. Control Group before and after Vacancy and Speculation Tax Act*

Following that, we continued to break it down based on geography and selected expensive area according to historical record for both groups in order to exploit the power of vacancy tax on price sensitive area. Finally, we combined different types and

[2] Single family, also called detached house, is a free-standing residence building. Condo is a type of living space similar to an apartment. Attached home is a structure which shares a common wall or walls with another unit, e.g. townhouses.

neighborhoods together and further analyzed aggregated results.

Methodology

Difference-in-Difference model application

Due to the difficulty of measuring the dynamic causality between announcement of policy variables and corresponding economic effects, since 1980s, the difference-in-difference methodology, a special quantitative method of policy effect analysis, has been developed and broadly applied in academic econometrics field. This research approach regards policy transformation and enforcement as a “natural experiment”, which is an exogenous shock to the economic system. At the same time, it effectively controls the influence of other factors other than the interventional factors to some extent. It is becoming more and more mature and widely used by many domestic and international scholars. Therefore, from our perspective, difference-in-difference model would be the most suitable model for our research purposes.

Firstly, to investigate the impact of vacancy tax, we compared the composite price index evolution in Greater Vancouver, an area that applied vacancy tax with Greater Toronto Area, an area that doesn’t have similar tax act around the time the tax was introduced. If the tax had no impact on prices, then the difference between Greater Vancouver and Greater Toronto Area would be considered the same before and after the introduction of the tax. In Contrast, if the tax had a substantial and negative impact on the housing market, the impact would be most conspicuous in the policy affected area, which is Vancouver. The Composite Housing Price Index in Toronto and Vancouver could go up, go down or remain the same, we are only focusing on the relative change between the price difference in Vancouver and Toronto.

Secondly, to evaluate the impact of vacancy tax on properties with different characteristics, we categorized all housing into single family, condo and attached three different subgroups. We collected data within three different subgroups in Vancouver and Toronto and compared the difference before and after the policy release. We would like to observe whether the prices of single family, condo and attached homes respond differently to this policy and which one experiences the most price change after the policy published.

Last but not least, this policy targets speculators and satellite families which are wealthy. Therefore, it is important to detect whether the vacancy tax impacts wealthy opeople more. As researchers found that the housing price are associates with capital inflow and well-off immigrants, we are using areas with the highest housing price index to represent the influence on wealthy people. We compared the price index of the most expensive area in Vancouver and Toronto to check if the policy is on its right track. If the tax reduced the housing price in expensive area the most, then the wealthy individuals are the most pronounced affected by the policy publish.

Exogeneity check

Vancouver is the first city that implemented vacancy tax in North America. Figure1 listed below depicts the searching trend for keyword 'Vacancy and Speculation Tax' in British Columbia from 2014 till present. As can be seen from the figure, no one started searching this phrase since very beginning of year 2016, which is about the announcement date of Vacancy and Speculation Tax Act. The first peak in the graph is around November 30th, which is constant with the time council enacted it. The huge

increase in searching trend after the announcement and passage of tax act can be interpreted that the empty home tax is an unexpected event to people who are working and living in British Columbia.

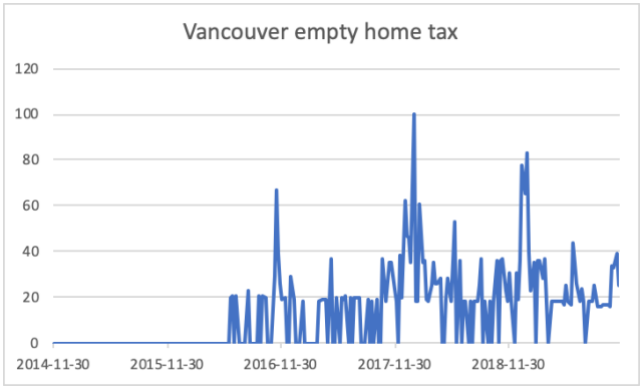

Figure 1 *Searching Trend for " Vacancy and Speculation Tax "*

Assumption test for difference-in-difference model

The main principle of difference-in-difference methodology is to investigate the actual effect by obtaining both cross sectional difference and time series difference on a specific public policy. The most important assumption before applying this model is called parallel trend assumption, which is to ensure that control group and treatment group must share common trend before the policy is released. In our case, prior to the establishment of difference-in-difference model, we need to prove that before enforcing the vacancy tax policy, the housing price in both Vancouver (treatment group) and Toronto (control group) should present a common tendency. To avoid causing any biases, our experiment requires both groups carry similar features such as development speed of society, cost of living, income distribution, etc. We adopted two ways to prove this assumption.

Firstly, we generated the following figure displaying the housing price trend of two cities respectively.

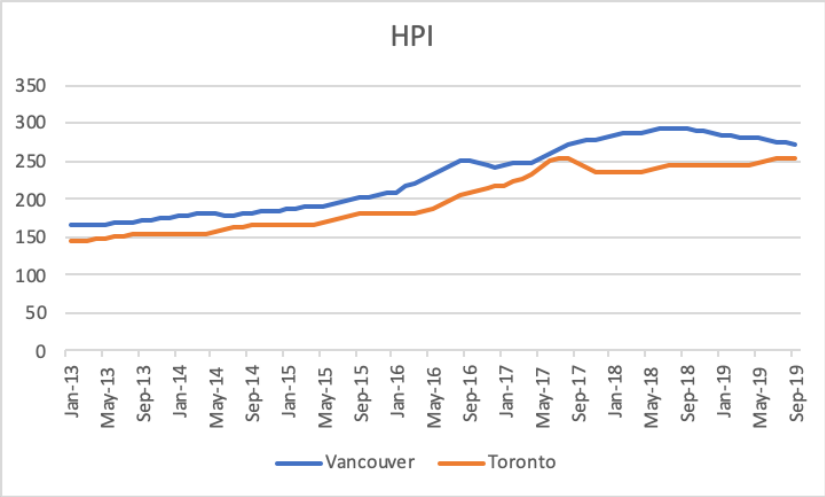

Figure 1 *Housing price trend of Vancouver and Toronto*

We could find from Figure 2 that these two cities almost had a same trend before the tax policy announcement (February 2016). This gives us a general idea that our groups should satisfy the parallel trend assumption.

We then conducted a more formal parallel trend assumption by constructing the following regression model:

$$Log(PI_t) = \beta_0 + \beta_1 \times Treat + \beta_2 \times \sum_{2013}^{2015} Time + \beta_3 \times \sum_{2013}^{2015} Treat * Time + \varepsilon_t \quad (1)$$

Where PI is a basket of housing price in the unique month t; Treat is group dummy variable depicting either 1 when it is Vancouver housing price or 0 when it is Toronto housing price; Time is time series dummy variable, it shows 1 when it is in year 2013, 2014 or 2015 respectively and 0 otherwise; Treat*Time is the intersect term. Hence, we have three-year dummies and three intersections. The coefficient of intersect term reflects the difference between housing price in Vancouver and that in Toronto in a specific year prior to policy announcement. If regression results on all three intersect terms are not statistically significant, we could conclude that there is no obvious distinction between two groups before 2016. Our regression result can be seen from

Table 2:

Log price	Coef	Std.Err.	t	P > |t|
Treat	-.0018657	.0023308	-0.80	0.425
Time_2013	-.0031407	.0035604	-0.88	0.379
Time_2014	-.0019412	.0035604	-0.55	0.586
Time_2015	-.0009598	.0035604	-0.27	0.788
Treat*Time_2013	.0032035	.050351	0.64	0.526
Treat*Time_2014	.0000887	.0050351	0.02	0.986
Treat*Time_2015	.0047831	.0050351	0.95	0.344
_Cons	.0078526	.0016481	4.76	0.000

Table 2 *The result of parallel trend assumption test*

As it shows from the Table 2, the coefficients of intersect terms are not statistically significant at 1%, 5% even 10% confidence interval. We could then prove that housing price in both Vancouver and Toronto has common trend, satisfying the assumption.

Identification Strategy

Once we completed common trend assumption, we started to construct our difference-in-difference model to test for a post-policy difference in housing price between Vancouver and Toronto. Assuming log price is the dependent variable that we care about, Treat*Time or 0 represent whether or not the group data has been "treated" respectively, the real causal effect should be reflected by E(log price | Treat*Time=1) - E(log price | Treat*Time=0). We also assume that dependent variable and interaction term has linear relationship, as an individual data i at time t, we could construct the

model:

$$Log(PI_{i,t}) = \beta_0 + \beta_1 \times Treat_{i,t} + \beta_2 \times Time_{i,t} + \beta_3 Treat * Time_{i,t} + \varepsilon_{i,t} \quad (2)$$

Where Treat * Time is the dummy variable showing whether the individual data i is "treated" at time t. It reflects the overall effect of the Vacancy Tax policy on the housing price in Vancouver. β_1 is the difference between "control group" and "treatment group", β_2 is the difference between pre-policy and post-policy, and β_3, the actual effect of the vacancy tax, is the core variable in our research.

Testing and Results

The first difference-in-difference regression we ran is based on composite housing price in Vancouver and Toronto, which shows the trend in overall housing market of these two cities. We collected the following results:

Logprice_composite	Coef	Std.Err.	t	P > |t|
Treat	.0016031	.0025187	0.64	0.525
Time	.0022375	.0024293	0.92	0.358
Treat*Time	-.0041999	.0034355	-1.22	0.223
_Cons	.0057438	.001781	3.23	0.002
Adj R Square	0.0104			
# of Observation	160			

Table 3 *The results of difference-in-difference model of log prices using both Vancouver and Toronto composite housing index data*

As we can see from Table 3, the only term that we are interested in interaction "Treat*Time". Among 1%, 5%, and 10% confidence interval, the interaction term is not statistically significant with t-stat=-1.22. In general, this result does not present that the vacancy tax declared in Vancouver has significant effect on housing price within Vancouver housing market.

We then conducted our second difference-in-difference analysis based on the subgroups we separated in the overall housing market: single family, condominium and attached homes in Vancouver and Toronto. We gathered the following results:

Logprice_SF	Coef	Std.Err.	t	P > |t|
Treat*Time	-.0067232	.0827605	-0.08	0.935

Table 4 *The results of difference-in-difference model of log prices using both Vancouver and Toronto simple family housing index data*

Logprice_condo	Coef	Std.Err.	t	P > |t|
Treat*Time	-.0065146	.0828497	-0.08	0.937

Table 5 *The results of difference-in-difference model of log prices using both Vancouver and Toronto condominium housing index data*

Logprice_attached	Coef	Std.Err.	t	P > |t|
Treat*Time	-.0027907	.0049067	-0.57	0.570

Table 6 *The results of difference-in-difference model of log prices using both Vancouver and Toronto attached housing index data*

As can be seen from Table 4, 5, 6, the t-stats of those three coefficients are -0.08, -0.08 and -0.57 for single family, condominium and attached homes correspondingly. The t-stats are not significant at the 90% and 95% level and not high enough to explain the decrease in housing price is caused by the introduction of vacancy tax.

We conducted the third difference-in-difference analysis based on the most expensive area in Vancouver and Toronto, which shows the trend in certain area after the introduction of this tax. The collected data are listed as follows:

Logprice_EN	Coef	Std.Err.	t	P > |t|
Treat*Time	-.0087466**	.00486661	-1.8	0.074

Table 7 *The results of difference-in-difference model of log prices using both Vancouver and Toronto expensive neighborhood housing index data*

From Table 7, the t-stat of the interaction term of -1.8 is not statistically significant at

99% and 95% confident intervals but is statistically significant at 90% confident interval. Then we could say that there exists 90 percent possibility that Vacancy Tax Act would lead to a negative impact on Vancouver housing price of expensive area. In another words, we have 90% confidence that Vacancy Tax Act is negatively related to housing price in expensive area in Vancouver.

To further examine which type of houses in wealthy regions contribute more to housing price, we did our fourth difference-in-difference analysis based on three different subgroups in expensive area trying to find out which subgroup in expensive area being impacted the most by this tax. The collected data are listed as follows:

Logprice_EN_SF	Coef	Std.Err.	t	P > |t|
Treat*Time	-.0115008	.0198713	-0.58	0.564

Table 8 *The results of difference-in-difference model of log prices using single family housing index data in expensive neighborhood*

Logprice_EN_attached	Coef	Std.Err.	t	P > |t|
Treat*Time	-.0154603	.0840565	-0.18	0.584

Table 9 *The results of difference-in-difference model of log prices using attached housing index data in expensive neighborhood*

Logprice_EN_condo	Coef	Std.Err.	t	P > |t|
Treat	.0040858	.005325	0.77	0.444
Time	.0089735	.00513559	1.75	0.083
Treat*Time	-.0130458**	.072633	-1.80	0.074
_Cons	.0042474	.0037654	1.13	0.261
Adj R Square	0.0083			

# of Observation	160

Table 10 *The results of difference-in-difference model of log prices using condominium housing index data in expensive neighborhood*

From Table 8, 9 and 10, t-stats of the interaction between time and treatment group coefficient is -0.58, -0.18 and -1.8 for single family, attached homes and condominium respectively. The t-stat of condominium in expensive area is significant at 90% confidence levels and the coefficient of the interaction term is -1.304%. The estimated negative coefficient and their statistically significance t-stat indicate that the introduction of the vacancy tax substantially reduced price of condominiums in expensive area in Vancouver relative to those in Toronto. For instance, the coefficient of -1.304% means that after the announcement of vacancy tax, the price of condominiums in expensive area in Vancouver experienced a 1.304% curtailment compared to the price of condominiums in expensive area in Toronto.

Robust test

Placebo test

Placebo test is placed to demonstrate that a significant effect should not exist when no intervention occurred. Specifically, to ensure our analysis results on condo housing price of expensive area are not coincident, we reperformed our experiment by choosing a dataset of same housing type but different time horizon from 2012 to 2014, in which no intervention was undertaken. If the result is still significant, other factors in the equation might have significant influence on the dependent variable instead of the empty home tax does. That means the empty home tax is a placebo and our previous estimation might be biased. If the result is not significant, then it is highly likely that our results are robust. Hypothetically, the policy intervention occurred on June 2013, which is in the middle of our selected testing period, so we collected the following data:

Logprice_EN_condo	Coef	Std.Err.	T	P > |t|
Treat	.0052601	.0063185	0.83	0.408
Time	.0084494	.0063185	1.34	0.186
Treat*Time	-.0021836	.0089357	-0.24	0.808
_Cons	-.0051458	.0044679	-1.15	0.254
Adj R Square	0.0095			
# of Observation	68			

Table 11 *The results of difference-in-difference model of log prices using condominium housing index data in expensive neighborhood during different time horizon.*

Based on the Table 11, t-stats of our focused term “Treat*Time” was no longer

significant compared to our actual result. The insignificance of t-stats tells us that when we change time interval, the placebo doesn't have a causal effect on house prices. Instead it is the introduction of the empty home tax that caused the price change in the expensive area in Vancouver. Therefore, the placebo test proves that our results are powerful to some extent.

Adding explainable variables

In order to make our results more robust, we attempted to include other driven factors of economic activities varied with different cities. We constructed the following two models:

$$Log(PI_{i,t}) = \beta_0 + \beta_1 \times Treat_{i,t} + \beta_2 \times Time_{i,t} + \beta_3 Treat * Time_{i,t} + \beta_4 \times UR + \varepsilon_{i,t} \quad (3)$$

$$Log(PI_{i,t}) = \beta_0 + \beta_1 \times Treat_{i,t} + \beta_2 \times Time_{i,t} + \beta_3 Treat * Time_{i,t} + \beta_4 \times UR + \beta_5 \times DI + \varepsilon_{i,t} \quad (4)$$

Where first three terms and their associated coefficient are same as that in the second model, UR represents unemployment rate (annualized), DI stands for disposable income, and dependent variables are housing price index.

Treat* Time	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Simple	-.0042	-.0067	-.0065	-.0030	-.0087	-.0115	-.0155	-.0130**
	(-1.22)	(-0.08)	(-0.08)	(-0.57)	(-1.8)	(-0.58)	(-0.18)	(-1.8)
Simple + UR	-.0033	-.0079	-.0074	-.0018	-.0078	-.0102	-.0127	-.0126**
	(-1.00)	(-0.09)	(-0.09)	(-	(-	(-	(-0.15)	(-1.72)

				0.37)	1.63)	0.51)		
Simple + UR +DI	-.0031	-.0064	-.0052	-.0016	-.0078	-.0103	-.0134	-.0125**
	(-0.94)	(-0.08)	(-0.06)	(-	(-	(-	(-0.16)	(-1.71)
				0.34)	1.64)	0.51)		
Adj R_2	0.10	0.01	0.01	0.04	0.07	0.02	0.01	0.04

Table 12 *The regression result of each dependent variable on interaction term adding two driven factors.*

Note: number (1) to (8) represents composite, single family, condo, attached, expensive neighborhood, single family in expensive neighborhood, attached in expensive neighborhood, and condo in expensive neighborhood respectively.

Essentially, we run the regression model three times. As it shows in Table 12, the first and second row are the coefficient and t-stats of interaction term when we run regression using Equation (2). The third and fourth row are the coefficient and t-stats of interaction term when we run regression using Equation (3) with unemployment rate as independent variable, keeping all other variables in Equation unchanged. The fifth and sixth row are the coefficient and t-stats of interaction term when we run regression using Equation (3) with unemployment rate and disposable income as independent variables. The results in the last row are the adjusted R square including all independent variables. We found that adjusted R square increases compared with previous simple model since more explainable variables were added. Most importantly, although we modified our regression model controlling more factors and run them individually, Treat*Time term, as the tax policy variable, didn't change too much. This indicates that using difference-in-difference in our research could return a robust result.

Discussion

Difference-in-difference model estimates an average effect of policy announcement. This means for certain policies, the associated impacts tend to be revealed after a period of time has elapsed. Thus, it is imperative to take potential lag effect into consideration for better evaluation. Our research might involve the lag effect since we find that the announcement time, which is in February 2016, and the actual implementation time, which is in January 2017, are inconsistent. So, we also conduct a difference-in-difference with regards to the implementation time to observe possible lag effect. As you could see from Appendix, which are the results considering January 2017 as cutoff point, we notice that the overall outcomes almost resemble previous outcomes. More specifically, implementation of policy has no significant effect on composite housing price and price of break-down housing types including single-family, condominium, and attached. Noticeably, effect on wealthy area is more significant in actual results than the one with potential lag effect. However, the results in sub-types of expensive area show the similar effect. Therefore, we would conclude that the lag effect might not affect the final outcomes in our research.

Potential Limitations

- In our research paper, we chose Toronto as our control group as it has not carried out vacancy tax till now. In fact, we should have taken all cities without the implementation of vacancy tax into consideration. It is likely to have selection bias in data selection process. To eliminate this potential bias, we could search for more data groups from other cities such as Calgary, Montreal, or Halifax, which should have similar development trend as Vancouver has before tax imposed. By expanding our dataset observations and incorporating more data groups into our existing control group, we might be capable of presenting a more accurate regression model and reaching a much more thorough conclusion.
- When we were searching for housing price data, we initially attempted to use transactional data because it is conspicuous that transactional data reflect the actual market data in the real estate market. However, it is not readily available for us. Therefore, we selected housing price index data that we have access to as our second-best choice.
- Even though difference-in-difference identification strategies should be capable of controlling endogeneity at a certain level, it is still possible that our results are prone to endogeneity problems due to the sophistication and the nature of the topic. For instance, potential omitted variable bias that caused by unintendedly neglection. One expected solution is to include those unobservable factors in the model in order to avoid biased estimates.

Conclusion

Our paper explores the effect of Vacancy and Speculation Tax on the residential housing price in British Columbia. Using price index data for Vancouver and Toronto between January 2013 and September 2019, this article estimates a difference-in-difference model using differences pre- and post- the announcement of tax policy between Vancouver and Toronto on the housing price in overall housing market and sub-markets.

Most literatures suggest an either positive or negative relationship between a tax policy announcement and housing price. Unlike the majority of existing academic article, the empirical results from our study do not detect statistically significant impacts of Vacancy and Speculation Tax on the overall composite residential housing market. More specifically, this result is unfavorable to the policy maker as the tax act might not place effects or the effects were too small to be detected on the residential housing market. One exception based on our result is that we do detect there is a negative effect that the tax policy raised on condominium price in wealthy area. The possible explanation of this observed phenomena is that the assessed value of properties in expensive area are normally more costly in those in other areas, hence, yearly vacancy tax for those speculators who have properties in expensive area would drag down their return of properties price appreciation, therefore they may consider sell their properties and realize their return immediately. For those satellite families in expensive area, as the one percent empty home tax increases their yearly expense to preserve a house and therefore may consider

moving out to a region where empty home tax is not applied to avoid this expense. Therefore, our research indeed validates the effectiveness of the Vacancy and Speculation Tax Act to some extent.

Appendixes

Table: Implementation date as cutoff

	(1)	(2)	(3)	(4)
	logprice	logsingle	logcondo	logattached
post	0.00224	-0.00193	0.00758	0.00300
	(0.92)	(-0.03)	(0.13)	(0.87)
treat_Van	0.00160	0.00231	0.00250	0.000123
	(0.64)	(0.04)	(0.04)	(0.03)
posttreat	-0.00420	-0.00672	-0.00651	-0.00279
	(-1.22)	(-0.08)	(-0.08)	(-0.57)
_cons	0.00574**	0.00788	0.00398	0.00607*
	(3.23)	(0.18)	(0.09)	(2.39)
N	160	160	160	160

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

	(1)	(2)	(3)	(4)
	logEA	logEAsingle	logEAattach	logEAcondo
post	0.00164	-0.000334	0.0119	0.00897
	(0.48)	(-0.02)	(0.20)	(1.75)
treat_Van	0.00128	0.00208	0.00542	0.00409
	(0.36)	(0.14)	(0.09)	(0.77)
posttreat	-0.00875	-0.0115	-0.0155	-0.0130
	(-1.80)	(-0.58)	(-0.18)	(-1.80)
_cons	0.00804**	0.00894	0.00274	0.00425
	(3.19)	(0.87)	(0.06)	(1.13)
N	160	160	160	160

t statistics in parentheses
* p<0.05, ** p<0.01, *** p<0.001

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