Are Foreign Buyers Making Housing Unaffordable? Results from a Natural Experiment in Vancouver*

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Abstract

Are out-of-town buyers contributing to a housing affordability crisis in major global cities? If so, can targeted policy interventions successfully alleviate this problem? A lack of data on foreign investment flows into real estate has made these questions hard to answer. This paper exploits three exogenous shocks to foreign investor demand in Metro Vancouver, B.C., and uses a "home-bias abroad" strategy to identify the causal effect of foreign buyer demand. To the first question: we find that out-of-town buyers significantly raise local house price growth. To the second: the imposition of a Foreign Buyers Tax had an immediate but limited impact on affordability. This is because some foreign buyers substituted into renting: rental vacancy rates fell by more than one-half following the tax's implementation. Moreover, we observe a dynamic supply response—new owner-occupied housing construction fell in foreign-buyer "destination" neighborhoods—so the long-run impact of the tax on affordability is likely to be attenuated.

Keywords: housing prices, foreign investors, buyers tax.
JEL Classifications: G11, H70, R21, R31, R51.

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1 Introduction

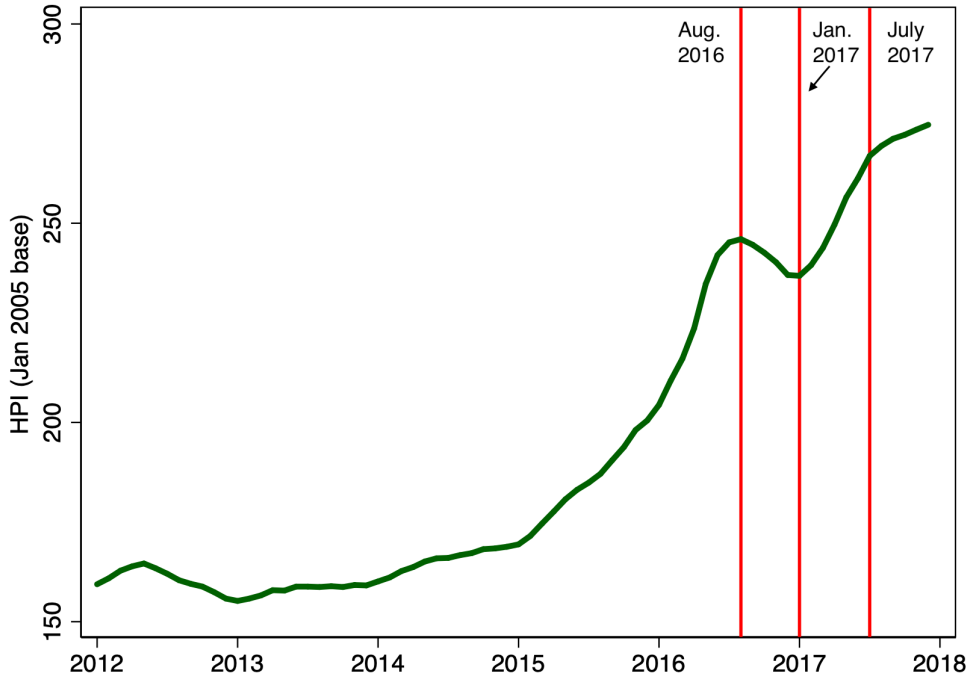
Globalization has produced drastic structural changes across the world. Since the turn of the 21st Century, major cities including New York, London, Sydney, and Vancouver have experienced massive inflows of wealthy immigrants and foreign capital, much of which is invested in real estate (Ley and Tutchener 2001). Debates about the influence of foreign buyers on local housing affordability have consequently come to the forefront of policy discourse in many global cities, and local leaders have responded by enacting policies to limit foreign real estate investment in: Hong Kong (2012), Singapore (2013 and 2018), Australia (2015 and 2016), Canada (2016 and 2018), Israel (2017), and New Zealand (2018).[1] However, relatively little research has been done to quantify the effects of foreign direct investment on real estate markets in destination cities. A lack of detailed data on foreign capital flows into real estate, and the relatively recent introduction of these policies, has made this question hard to answer.

Metro Vancouver, British Columbia, provides an ideal case in which to examine these issues. Between 2012 and 2016, Vancouver experienced a dramatic acceleration in residential house price growth (Figure 1). Given its desirable location on the Pacific coast, Canada's strong protections for private property rights, and a significant pre-existing foreign-born population, Vancouver is an attractive destination for foreign buyers—particularly from China. In August 2016, policymakers responded to the perceived link between rising foreign demand and a local housing affordability crisis by enacting a surprise 15% Foreign Buyers Tax (FBT) on all residential property sales. The time-series evidence suggests that this policy was highly effective: house prices rose 22% over the first seven months of 2016, but fell by 3.3% over the remaining five. Of course, without a counterfactual, one cannot rule out alternative stories such as a slowdown in local resident housing demand or a general

[1] See Favilukis and Van Nieuwerburgh (2018) for a description of each country's intervention.

downturn in Canadian real estate. Even more worrisome for advocates of the FBT, house price growth re-accelerated beginning in January 2017. As we discuss below and exploit in our empirical strategy, the Vancouver real estate market was subject to multiple shocks over this time period. In order to make causal claims about the role of foreign buyer demand and the efficacy of the FBT, an analysis must take care to account for all of these shocks.

Figure 1: Metro Vancouver House Price Growth



Notes: This graph illustrates the rise in aggregate house prices that have occurred in the Metro Vancouver area between 2012 and 2017. The vertical axis plots the composite Metro Vancouver HPI measure obtained from the Real Estate Board of Greater Vancouver, which has 2005 as its base year. The vertical bars correspond to the three events of interest: the August 2016 FBT implementation, January 2017 after the Chinese capital controls announcement, and July 2017 when the capital controls went into effect.

We overcome the lack of transaction-level ownership data for the Vancouver housing market using a "home-bias abroad" strategy. First introduced by Badarinza and Ramadorai (2018), this methodology relies on the observation that foreign investors have heterogeneous

preferences for real estate within a given city. Foreign capital is more likely to flow into neighborhoods with a high existing concentration of source-country-origin residents. In the context of Vancouver, we expect that wealthy Chinese investors seeking a safe haven for their capital are more likely to purchase homes in subdivisions with a high pre-existing concentration of ethnic Chinese residents. We can thus identify the effect of foreign demand shocks on the Vancouver housing market by examining the differential between high- and low-Chinese origin subdivisions, which we refer to as "destination" versus "non-destination" neighborhoods. Crucially, this methodology does not require access to detailed asset ownership data, which was not collected in Vancouver until after passage of the FBT.[2]

A major strength of our empirical strategy is that it utilizes both cross-sectional and time-series variation in foreign demand. In the cross-section, we focus on Chinese buying activity (which made up 76.6% of all foreign buying activity in the month before the enactment of the FBT) and sort Vancouver subdivisions by their fraction of ethnic Chinese residents into Chinese destination versus non-destination areas.[3] In the time-series, we additionally exploit three exogenous shocks to foreign demand in 2016 and 2017. First, as previously discussed, Vancouver unexpectedly announced and implemented the FBT in August 2016. Second, the People's Republic of China announced heightened capital controls on its own citizens in January 2017; and third, it implemented the new controls in July 2017. The aggregate time-series data in Figure 1 is suggestive that these three shocks had a powerful impact on house prices in Vancouver: house price growth turns negative during the latter half of 2016, accelerates and turns positive in January 2017 (suggesting that Chinese investors "rushed to buy" before the implementation of the new controls), and decelerates in August

[2]However, we do use the later ownership data to confirm the validity of our identification strategy.
[3]For comparison, the second largest source country of buyers was the United States, at 6.8% (B.C. Ministry of Finance 2016).

2017. Our empirical strategy strengthens this graphical observation by additionally exploiting cross-sectional, geographic variation in the destination of Chinese capital flows. This allows us to credibly identify the causal role of foreign buyers on Vancouver's residential real estate market, separately from any shocks that might have homogenously affected the entire metro area during this time period.

We present three major sets of results. First, we find that foreign (Chinese) buyers have significantly influenced housing affordability in Vancouver. All three foreign demand shocks are associated with differential house price movements in Chinese destination subdivisions in the hypothesized directions. The estimates are largest and most robust post-June 2017, after the new Chinese capital controls went into effect: we find that house price growth in destination subdivisions immediately declined by 7.9 percentage points per annum as compared to non-destination subdivisions. This decline in growth rates is persistent, lasting through the end of our sample at year-end 2017. Our estimates suggest that the FBT had a slightly smaller impact—house price growth slowed by 7.1 percentage points in destination subdivisions during the five months post-tax, differentially—but the effect is estimated less precisely. However, the FBT effect size is almost twice as big on detached houses (-13.1 p.p.), the most expensive housing category and the preferred investment vehicle of non-resident foreign buyers in Vancouver.

Second, we investigate the impact of these three shocks to foreign buyer demand on the rental market. Housing affordability encompasses multiple dimensions, and what is good for prospective owners may be bad for renters. To the extent that some non-resident foreign buyers were purchasing with the intent of eventually immigrating, buying and renting are close substitutes, so we expect that these negative shocks to purchaser demand might cause an increase in rental demand. Indeed, the rental vacancy rate differentially fell by more

than half, 59%, in 2017 versus 2015 in destination subdivisions, in an already tight rental market (the mean vacancy rate was 0.89% in 2015). Because of the annual frequency of our rental data, we cannot disentangle the effects of the FBT from those of the Chinese capital controls, but this is powerful evidence that the effect on "affordability," for many Vancouver residents, is ambiguous.

Third, we hypothesize that a negative foreign demand shock will reduce developer profits and might discourage new construction in destination neighborhoods, attenuating the fall in home purchase prices. In Econ 101 terms, the short-run housing supply curve is highly inelastic but the long-run housing supply curve is highly elastic. We observe exactly such a dynamic adverse supply response in Vancouver. Using annual data on construction starts, we find that the supply of new detached housing and of units intended for homeownership decreased dramatically in destination neighborhoods post-2016. Although we cannot disentagle the effect of the FBT from the Chinese capital controls due to the low frequency of the construction data, this is suggestive evidence that any improvements to home purchase affordability associated with the FBT are likely to be attenuated in the long run.

Perhaps most directly, this paper builds on a new and growing literature in urban economics that studies the role of out-of-town buyers in driving local house price dynamics.[4] During the housing boom of the mid-2000s, second-house buyers accounted for a significant fraction of mortgage originations in the U.S. (Haughwout et al. 2011). Chinco and Mayer (2016) argue that distant, out-of-town investors exacerbated mispricing in boom cities. A number of recent theory papers have investigated the role played by foreign buyers in driving house price increases since the financial crisis, including Favilukis and Van Nieuwerburgh

[4]An older, well-established literature looks at the effect of immigrants on local house prices: e.g., Saiz (2003), Saiz (2007), Cvijanovic, Favilukis, and Polk (2010), Saiz and Wachter (2011), Gonzalez and Ortega (2013), and Sá (2014). See Pavlov and Somerville (2018) for a review. The out-of-town buyer literature differs in its focus on real estate as an *investment* vehicle for nonresident foreign purchasers.

(2018), Hilber and Schöni (2018), and Flores (2018).

The main empirical challenge is isolating exogenous variation in foreign demand so as to rule out reverse causality (i.e., rising house prices in a major city might attract a foreign capital inflow). Previous empirical work has employed two main sources of variation: source country shocks and destination country policy interventions. The first approach builds upon the insight of Badarinza and Ramadorai (2018) that investors exhibit "home-bias abroad," generating predictable geographic variation in the destination of capital flows following a source country shock. Several recent papers rely upon this strategy. Sá (2016) runs regressions of house prices on foreign investment flows into localities in England and Wales, using a home-bias abroad instrument. She finds that foreign investors have a positive impact on house price growth, not just for the most expensive houses, but across the house price distribution. However, she finds no significant effect either on new housing construction or on the vacancy rate, two claims often advanced by proponents and detractors of foreign real estate investment, respectively. Cvijanovic and Spaenjers (2018) have access to an extensive dataset that allows them to explicitly identify foreign buyers in Paris. They find that foreign buyers follow the recent settlement patterns of people from the same origin country, supporting the home-bias abroad notion. However, unlike the previous two papers, they find no causal evidence that foreign demand affects the price of the average house. Li, Shen, and Zhang (2019) find that Chinese foreign buyers had a significant impact on house price growth in California post-2007, using the pre-existing ethnic Chinese population share as an instrument.[5]

The second main empirical approach uses destination-country policy interventions as quasi-natural experiments. Suher (2016) exploits a 2013 property tax change in New York

[5]A number of papers in the immigration literature use a similar strategy to predict location choice: see, e.g., Bartel (1989), Card and DiNardo (2000), Card (2001), Cortes (2008), Saiz and Wachter (2011), and Sá (2014).

City to estimate the impact of non-resident buyers on residential real estate. His results suggest that non-residents significantly raise house prices in a small subset of highly desirable neighborhoods, but he finds no impact extending outside of these concentrated areas, which results in insignificant effects on aggregate. Hilber and Schöni (2018) assess the effects of a 2012 Swiss policy that restricted the construction of second homes in desirable tourist locations. They find that the policy increased price growth of second homes and lowered price growth of primary homes. Pavlov and Somerville (2018) study the impact of wealthy Chinese buyers who are also immigrants on house prices in Vancouver following the suspension of a Canadian visa program in 2012, and find that wealthy immigration raises prices in destination neighborhoods, proxied for by the fraction of recent immigrants from China. Finally, Somerville, Wang, and Yang (2018) examine the impact of a 2010 restriction in China on apartment purchases for investment purposes. They find that, while the policy had a negative effect on the volume of buying activity, it did not significantly attenuate house price growth.

In sum, prior research is inconclusive on whether foreign buying activity significantly affects house prices. This paper extends the literature on three primary fronts. First, it bridges the gap between papers that exploit source country shocks and others that exploit destination country policy interventions. By combining these two types of shocks, we are uniquely able to compare their relative impacts. Second, our paper is one of the few that investigates the potential for a dynamic supply response in the construction market. This type of comprehensive analysis is required to better understand the aggregate impact of foreign buyers on a city's welfare. Finally, this paper is one of the first to look specifically at Chinese buyers and the impact of Chinese governmental regulations on controlling the global flow of capital.

The rest of the paper proceeds as follows. Section 2 provides background information on Vancouver's Foreign Buyers Tax and China's capital controls. Section 3 discusses our identification strategy, empirical methodology, and theoretical predictions. Section 4 describes the data. Section 5 is the heart of paper, presenting our analysis of the impact of foreign buying activity on house price growth in Vancouver. We also run standard robustness checks, such as testing for parallel pre-trends, and perform two placebo tests to verify the home-bias abroad strategy. We further sharpen our analysis of FBT by utilizing Chinese-destination subdivisions of Toronto, a city that did not enact a tax at the time, as an alternative control group. Section 6 contains our analysis of Vancouver's rental and construction markets. Section 7 considers policy implications, and Section 8 concludes.

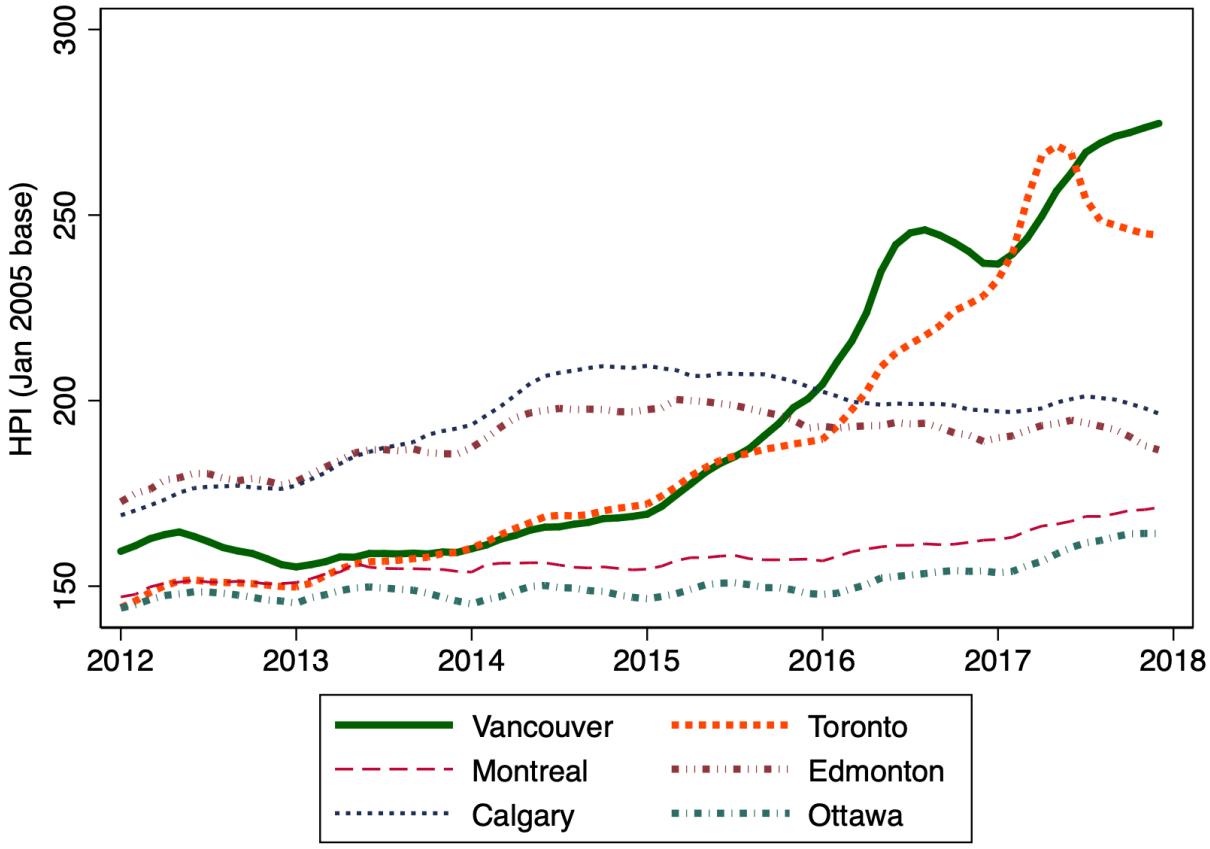
2 Background

The rise of foreign direct investment into cities around the world has brought with it large structural changes that have permanently altered the landscape of many urban communities. The economic success of China is one of the primary drivers of this global shift. Rapid GDP growth, a high saving rate, and severe income inequality have combined to create a new class of millionaires and billionaires who wish to protect their wealth from the risks brought about by domestic political uncertainty. This protection often takes the form of moving wealth abroad and acquiring foreign financial assets.

In the menu of investment choices, large-scale property acquisition in major global cities is a particularly popular strategy, and the United States and Canada are the two most popular destinations (Simons et al. 2016). According to Juwai, a website that helps Chinese buyers purchase overseas properties, total Chinese outbound real estate investment has risen from 5

billion USD in 2005 to over 100 USD billion in 2016 (Juwai 2018). Moreover, a report released by the People's Bank of China documents that 50% of high net-worth Chinese individuals who are investing overseas are pursuing quality education for their children, and 60% are considering physically immigrating to the foreign country in which they are investing.

Figure 2: House Price Growth in Major Canadian Cities



Notes: This graph illustrates the differential rise in house prices across six major Canadian cities. The vertical axis plots the composite MLS HPI measure for each city, with 2005 as the base year.

Some speculate that Canada has experienced increased immigration and dramatic house price growth over the past couple decades as a result (e.g., Moos and Skaburskis 2010).

However, this acceleration in house prices has not been uniformly distributed across Canada's major cities. As shown in Figure 2, while Canada overall has experienced around a 50% increase in overall house prices since 2012, both Vancouver and Toronto have seen increases of around 70%. In response, both cities have introduced policies to reduce foreign investment in residential real estate. Vancouver implemented a tax on foreign buyers in August 2016 and Toronto followed suit nine months later, in April 2017. Our analysis focuses on Vancouver both because this was the first Canadian city to enact an FBT and because it has a much larger ethnic Chinese population, which makes it a greater target for non-resident Chinese foreign buyers.

2.1 The 2016 Vancouver Foreign Buyers Tax

Taxes are typically imposed either to raise revenues or to deter the underlying activity. A foreign buyers tax can be interpreted with the second objective in mind, but its main objective is really to reduce the price of the good for local residents. Whether or not it achieves this objective depends on a number of factors that we will discuss in Section 3.

On July 25th, 2016, the B.C. Provincial Government announced their proposal for a 15% Foreign Buyers Tax (FBT) to improve housing affordability in the Greater Vancouver Regional District ("Metro Vancouver"), a political unit encompassing the city of Vancouver and neighboring municipalities.[6] The FBT was quickly passed into law and went into effect the following week, on August 2nd. The legislative details of the FBT (Bill 28) are quite straightforward. Residential property purchased by a foreign entity (either a foreign national[7] or a foreign corporation[8]) in Metro Vancouver became subject to a tax equal to 15% of the

[6]The regional district's official name changed to Metro Vancouver Regional District in 2017.
[7]A foreign national is a person who is not a Canadian citizen or a permanent resident.
[8]A foreign corporation is either (a) a corporation not incorporated in Canada or (b) a corporation that is not

"fair market value" (i.e. sale price) of the property. This amount was in addition to a baseline Property Transfer Tax (PPT) that already existed for all real estate transactions.

Policymakers implemented the FBT with the explicit goal of addressing housing affordability for local residents. Premier Christy Clark, the head of the Provincial Government, clearly conveyed that message, stating, "We need to make sure we do everything we can to try and keep housing affordable," and that the tax could accomplish that goal "by making sure it's maybe a little tougher for foreign buyers to find their way into our market" (quoted in Kassam 2016). At the time the FBT was implemented, Vancouver ranked third worst for housing affordability among all major metropolitan areas in the world, with a median house price-to-income ratio of 10.8 (Demographia 2017). To put this in perspective, in the 1970s the house price-to-income ratio in Vancouver was about 3 (Douglas 2017).

As early as 2004, newspaper accounts indicate a growing public belief that foreign buyers might be contributing to housing unaffordability:

> Like London, Paris or New York, Vancouver has become a place where the well-to-do like to have pieds-a-terre. These aren't properties that are bought as an investment and rented out. They may well be good investments, but in many cases, they sit empty when their owners are away, which is most of the time. (Mackie 2004)

A decade later, worries among local Vancouver residents of a full fledged housing crisis appeared to have surfaced:

> On our block, there are three empty million-dollar [...]. The house behind mine sits empty for 90 per cent of the year. This is having a devastating effect on our neighborhood. People no longer are doing upgrades on their houses because they know they will be torn down if sold. Merchants and schools are suffering because people don't live in the houses. Property values are skyrocketing. It is a disaster for people who want to live in Vancouver. (Yaffe 2014)

listed on a Canadian Exchange that is controlled by a foreign national or by a corporation not incorporated in Canada.

As such, the citizens of Vancouver and foreign investors around the world might have been anticipating a policy intervention similar to the eventual FBT. If this were the case, any shock caused by the introduction of the actual tax would be severely limited, as foreign buyers would have already adjusted their buying behavior. However, the evidence suggest that the July 25th, 2016, announcement was indeed an unexpected shock to the citizens of Vancouver and to prospective foreign buyers as well. We come to this conclusion after conducting a thorough review of the provincial government's position regarding foreign buyers and the public's awareness of that position in the years and months leading up to the July 25th announcement. Appendix C provides detailed, narrative evidence.

2.2 The 2017 Chinese Capital Controls

Capital controls have been a major part of China's growth strategy since the beginning of economic liberalization.[9] The main tool used to target capital outflows is a foreign exchange quota. Since 2008, China has restricted the amount of money Chinese citizens can move out of the country to the equivalent of 50,000 USD per person, per year. Although this dollar constraint would seemingly impede the purchase of a multi-million dollar house in a city like Vancouver, prospective Chinese buyers have invented creative ways to achieve their foreign real estate ambitions.[10] Furthermore, Chinese citizens are technically barred from using their exchanged foreign currency to purchase property outside of China.

Initially, these regulations were not enforced very rigorously (Vanderklippe 2017). All of this changed on December 30th, 2016. The People's Bank of China (PBOC), jointly with

[9] On China's growth strategy, see Prasad and Rajan (2006). For detailed discussions of capital flows in China, see Gunter (2004), Prasad and Wei (2005) and Hung (2008).

[10] For example, one of the most popular techniques is known as "smurfing". Smurfing consists of a group of people (family, friends, neighbors) agreeing to lend their foreign currency quotas to a single individual (or family) by all wiring money to the same overseas bank account. Once enough foreign currency has accumulated in this account, an overseas purchase can be made.

the State Administration of Foreign Exchange, released an official statement titled *"Administrative Measures for the Reporting of Large-value and Suspicious Transactions by Financial Institutions"*. The measures outlined, the first of their kind since 2008, were specifically designed to remove the significant loopholes in China's outbound capital regulations, and to better enforce the regulations already in place (i.e., the ban on purchasing foreign real estate). The new measures required that Chinese banks and other financial institutions report to the Chinese Anti-Money Laundering Monitoring and Analysis Centre the following activities: cash transactions made by individuals that exceed 50,000 yuan, or the equivalent of 10,000 USD; single-day domestic currency transfers exceeding 500,000 yuan, or the equivalent of 100,000 USD; and single-day cross-border fund transfers exceeding 200,000 yuan, or the equivalent of 10,000 USD (People's Bank of China 2016). In addition to the above cutoffs, the new measures mandated that banks file a report within five days for any transaction, no matter the amount, if there was a reasonable suspicion of illegal behavior (KPMG 2017). People who are caught withdrawing money for non-approved uses face a three-year ban and could be subject to a full-scale money laundering investigation.

The critical detail that we have left out, which allows us to make use of this shock twice, is the clear statement that all of the above measures would not go into effect until July 1st 2017, six months and two days after the announcement.[11] Although the regulations themselves represent a clear negative demand shock to foreign buyers of real estate, their announcement may have had the opposite effect. If prospective buyers were aware that things would be made much more difficult starting in July 2017, they were likely to move their money out as quickly as possible. Hence, the December 30th announcement date might lead to a large

[11] The only changes that were enacted immediately required people making foreign exchange transactions to sign a form stating their intended use. However, without banks having to start reporting until July, plus the simple fact that people could easily claim false uses, this stipulation seems fairly non-restrictive.

influx of foreign capital in destination cities like Vancouver, causing a positive demand shock in the residential real estate market. Furthermore, the announcement of the shock might signal greater economic instability, causing potential investors to seek safety overseas as soon as possible. On the other hand, it might be the case that there was sufficient scrutiny during this intermittent period so as to make pre-emptive moves too difficult and dangerous. Nevertheless, when the controls eventually went into effect on July 1st 2017, Vancouver likely experienced a negative demand shock.

A valid concern is that these regulations might have little to no effect on ultra-wealthy Chinese buyers. These individuals possess a vast network of financial resources and connections, enabling them to evade regulatory check points by using shell companies, insiders, or other methods. However, for the majority of wealthy Chinese individuals looking to safeguard their assets outside of China, the new 2017 capital controls likely make such transactions much more difficult (Vanderklippe 2017; Nonko 2017). Initial reports suggested that the 2017 capital controls were very effective. According to Juwai (2018), residential purchases in Canada dropped from $2 billion in 2016 to $900 million in 2017, a decline of 55%.

3 Methodology

3.1 Identification

Identifying the effects of foreign buyers on the Vancouver real estate is challenging for a number of reasons. First, an empirical analysis seemingly would require detailed, transaction-level data on the nationalities of buyers and sellers in the Vancouver housing market. But foreign purchasers often attempt to conceal their identities (e.g., because they are trying to evade home country capital outflow restrictions), which makes the task of measuring

the impact of foreign buying activity very difficult. Second, the city of Vancouver only started collecting and releasing data on foreign purchases starting in June 2016, a month before the FBT was announced, and with low geographic disaggregation. Hence, because of poor cross-sectional variation and a lack of data in the pre-FBT period, foreign-purchase data cannot be used in relation to the August 2016 FBT. Data with improved geographic granularity became available in January 2017. Similarly, the improved data do not exist before the December 30th 2016 capital controls announcement, so are also not very useful. We do, however, use these data to confirm the validity of our identification strategy.

To overcome these challenges, we exploit the "home-bias abroad" strategy of Badarinza and Ramadorai (2018). Drawing inspiration from preferred-habitat explanations to the home-bias puzzle in financial economics, Badarinza and Ramadorai theorize that foreign investors' demand for real estate in a city will be heterogeneous: they will prefer to buy in specific "destination" neighborhoods that contain a high concentration of source-country origin residents.[12] They suggest three explanations for this behavior. First, since at least a portion of demand is likely to be driven by intended future immigration (Simons et al. 2016), a foreign buyer who eventually plans on moving into his or her newly acquired property would likely target an area that contains a high density of people sharing their language and culture. This explains the presence of ethnically homogeneous neighborhoods, e.g. Chinatowns and Little Italies, in cities all around the world. Second, even if a wealthy foreign buyer never plans on moving, foreign buyers are faced with additional transaction costs when attempting to purchase property in an overseas market (Cvijanovic and Spaenjers 2018). In ethnically similar locations, social network effects help to reduce information asymmetries and thus

[12]The puzzle is that investors fail to optimally diversify their portfolios by holding too many domestic stocks. E.g., French and Poterba (1991) document home bias in the world's five largest stock markets. See Lewis (1999) for a survey of the literature.

lower transaction costs. This "soft infrastructure" includes speciality realty firms and local legal firms that are specifically dedicated to financing and assisting in the acquisition process, as well as informal information flows. Third, unlike financial assets, regular maintenance and upkeep of the physical investment after the purchase is required, especially if the property is going to be rented out. This type of monitoring will likely be less expensive and more effective in ethnically-similar neighborhoods because of the same sort of soft infrastructure described above. For example, some property management companies might cater specifically to foreign buyers, and a network of local friends and family can provide regular reports to the foreign owner on the condition of the property.

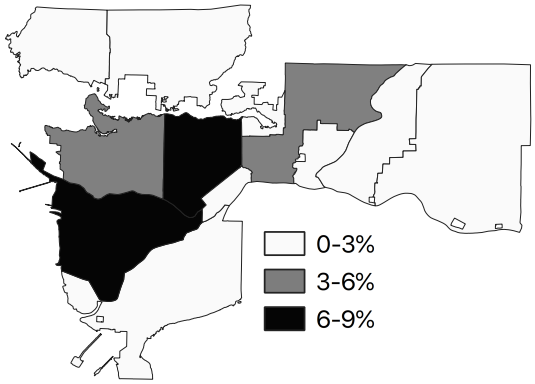
Using the data on foreign buying activity that was collected by the B.C. government after the implementation of the FBT, we compare the geographic pattern of foreign buying activity within Metro Vancouver to the concentration of Chinese origin residents in Figure 3, panels A and B. This shows that foreign buying patterns largely align with the concentration of Chinese origin residents. The foreign purchases variable is 95% correlated with the Chinese ethnic origin measure, strong evidence in support of our identification strategy. The three subdivisions with the highest percentage of foreign purchases— Richmond, Burnaby, and Coquitlam—correspond exactly to the three subdivisions with the highest fraction of Chinese origin residents. This is strong evidence that the "home-bias abroad" theory applies to foreign purchasing dynamics across Vancouver subdivisions.

Figure 3 additionally illustrates the variation in house price growth in the 30 months leading up to passage of the FBT for all housing categories (panel C) and separately for detached homes (panel D).[13] Foreign purchases are not correlated with overall HPI growth in

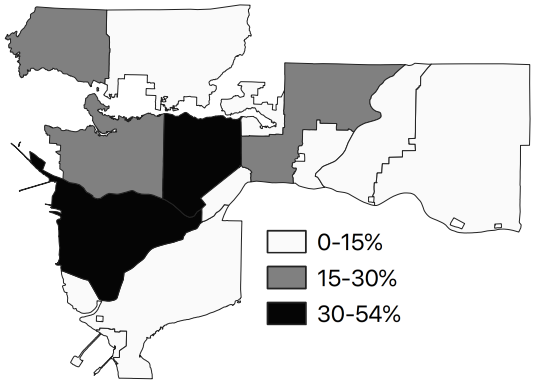
[13]Detached homes are defined as independent structures (typically one or two story single-family homes) built on land that exceeds the footprint of the structure on all sides. In Vancouver, detached homes are much more expensive, on average, than properties in other housing categories.

Figure 3: Geographic Comparison of Vancouver Foreign Buying Activity, Chinese Population, and HPI Growth

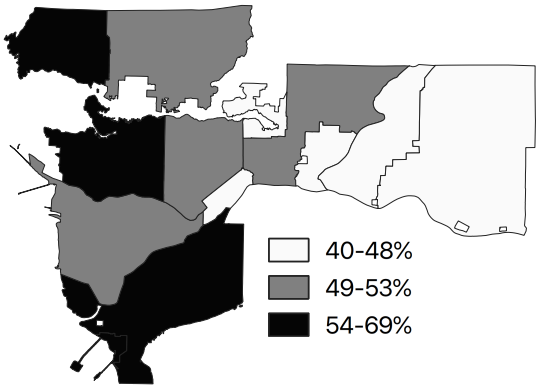
(a) Fraction of Purchases Made by Foreign Buyers (2017)



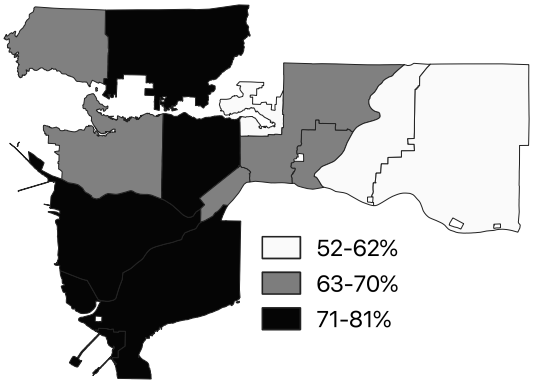
(b) Fraction Chinese Origin



(c) HPI Growth (2014 - 2016)



(d) Detached HPI Growth (2014 - 2016)



Notes: Each panel breaks Metro Vancouver into its Census subdivisions. Since our analysis uses a few custom built regions (see Appendix D) these maps do not directly correspond to the 17 regions used in our analysis. Panel A illustrates the geographic variation of foreign buying activity in 2017. This is measured as the fraction of total residential real estates purchases in each subdivision that were made by foreigners. As we mention in our methodology section, this data only became available after the 2016 FBT. Further, data that sufficiently disaggregates the Metro Vancouver region, as presented here, was only collected starting in 2017. Panel B illustrates the geographical variation of our baseline Chinese ethnicity variable that we use to designate destination/non-destination subdivisions. Panels C and D are constructed by calculating a simple percentage change in the HPI from January 2014 to June 2016, one month before the FBT was announced.

the pre tax period, although they are positively correlated with detached HPI growth, the most expensive housing category and the preferred investment vehicle of non-resident foreign buyers in Vancouver. We investigate these dynamics further in Appendix Table B.1. Foreign buying activity is positively correlated with education levels, access to public transportation, and areas with a higher share of condominiums, all positive amenities that might predict where a person would want to live. Interestingly, foreign buying activity is negatively correlated with average income. This aligns with the observation that foreign buying activity is concentrated in select ethnic suburbs, instead of the wealthier downtown locations.

A major strength of our empirical strategy is that it utilizes both cross-sectional and time-series variation in foreign demand. In the cross-section, we rely upon heterogeneity in non-resident Chinese investor across subdivisions with high versus low fractions of the resident population who are ethnically Chinese. In the time-series, we additionally exploit three exogenous shocks to foreign investor demand due to the passage of Vancouver's FBT in 2016 and the strengthened Chinese capital controls in 2017, discussed in Section 2. Previous papers (reviewed in Section 1) have used one or two of these sources of variation: e.g., geographic heterogeneity in investors' or immigrants' preferred destinations combined with either source country shocks or destination country policy interventions. We are the first to combine all three sources of variation, in order to credibly identify the causal role of foreign buyers on housing affordability in a major global destination city.

3.2 Empirical Specification

The home-bias abroad strategy requires that we identify specific regions in Vancouver that are the preferred destinations of foreign buyers. In July 2016, the month immediately before the FBT was announced, Chinese buying activity made up 76.6% of all foreign buying activity

(the second largest group was the United States at 6.8%) (B.C. Ministry of Finance 2016). Given that the overwhelming proportion of foreign buying activity comes from mainland China, our analysis focuses on comparing housing market outcomes in Chinese destination areas versus Chinese non-destination areas, before and after the three exogenous shocks.

Using data from the 2016 Canadian Census, we calculate the fraction of the population residing in each subdivision i who are of Chinese ethnic origin, $fractChinese_i$. We label subdivision i as a "destination" subdivision for non-resident Chinese investors as follows:

$$chinDest_i = \begin{cases} 1 & \text{if } fractChinese_i > median(fractChinese) \\ 0 & \text{if } fractChinese_i \leq median(fractChinese), \end{cases} \tag{1}$$

where $median(fractChinese) = 12.1\%$, the median level of $fractChinese$ across all Vancouver subdivisions in 2016. There are an odd number of subdivisions, so we categorize the median subdivision (Port Coquitlam) as a non-destination area, since its value more closely resembles this group.[14] We further define three post-event dummies, following the form:

$$postMonthYear_t = \begin{cases} 1 & \text{if data are from Month-Year or later, inclusive} \\ 0 & \text{otherwise.} \end{cases} \tag{2}$$

We define post-event dummies for each of the three time-series shocks: August 2016 (the surprise enactment of Vancouver's FBT), January 2017 (the PBC's announcement of stepped-up capital controls), and July 2017 (the effective date of the controls).

Our home-bias strategy and the natural experiment setting utilize both cross-sectional (due to heterogeneity in non-resident investor preferences) and time-series (due to destination

[14] Resident populations in the two subdivisions just below the median were 11.4 and 11.7% Chinese ethnic origin, and in the two subdivisions just above were 18.2 and 22.1% Chinese ethnic origin.

city and source country policy shocks) variation. This lends itself naturally to a pooled difference-in-difference specification:

$$Y_{it} = \alpha_i + \alpha_t + \beta_1(chinDest_i \times postAug2016_t) + \beta_2(chinDest_i \times postJan2017_t) + \beta_3(chinDest_i \times postJuly2017_t) + \varepsilon_{it}, \quad (3)$$

where Y_{it} is an outcome variable for subdivision i at time t. The β coefficients on the three interaction terms are the standard difference-in-difference coefficients of interest. For example, β_1 captures the change in the average outcome in Chinese destination areas, before vs. after the FBT, minus the change in the average outcomes of non-destination areas, before vs. after the FBT. Without using non-destination areas as a control group, the estimated impact of foreign buyers on real estate outcomes could be biased by some unknown shock that occurred at the same time (e.g., a general slow down in house prices across Canada). We include region fixed effects α_i to control for all the fixed, unobservable characteristics that vary across regions that might influence the dependent variable. The inclusion of time fixed effects α_t eliminates the impact of larger time trends or shocks that might affect multiple regions simultaneously, allowing us to focus on the differential impact surrounding the three events of interest on destination versus non-destination subdivisions.

The main outcome variable Y_{it} of interest in (3) is house price growth, calculated using log differences. In Section 3.3 we develop additional hypotheses concerning the impact of foreign buyers on the cost of renting, the rental vacancy rate, and new construction starts, which we test in additional analyses. Our baseline specification uses log differences to avoid unit root issues associated with time series data that are growing over time (Granger and Newbold 1974; Phillips 1986). However, our main results are robust to using log prices as the

dependent variable. We also estimate a fully-flexible, dynamic model to confirm that the appropriate specification is on growth rates rather levels. We do not take first-differences in the assessment of rental vacancy rates and new construction starts, as these variables are unlikely to contain unit roots.

Causal interpretation of a difference-in-difference model relies on two important assumptions. First, we need there to be no other shocks during this time period, other than the three we have put forth, that differentially would have affected the outcome variables in destination locations. We search news archives of *The Vancouver Sun* to confirm this was indeed the case—see Appendix C. Second, we require that the outcome variables in destination and non-destination locations had similar trends leading up to each shock. That is, there were no pre-existing trends preceding the initial August 2016 shock such as widening or converging. We formally test for and confirm that the parallel trends assumption is valid in Section 5.2.

3.3 Predictions

House Prices. Taking Y to be house price growth, the main outcome of interest, our baseline predictions are as follows. Since the FBT represents a negative demand shock to foreign buyers, β_1 is likely to be negative. A negative sign would suggest that there was a deceleration in house price growth in Chinese destination areas relative to non-destination areas, following the implementation of the tax. The coefficient on Chinese capital controls, β_2, should be positive. This is because the December 2016 announcement should temporarily increase the demand by foreign buyers wishing to move capital out of China before the controls go into effect, thus differentially accelerating price growth in destination areas. (However, β_2 could also be negative if there was sufficient regulatory scrutiny during this in-between period.) We predict that β_3 will be negative because it marks the implementation of the actual controls,

which should lead to a deceleration of price growth in these same destination areas relative to non-destination areas. The sum of β_2 and β_3 represents the net impact of the two capital control events. Theory does not indicate which event will have a greater impact in our time window; but in the long run we expect that the sign of β_3 will dominate. We summarize this as follows:

Hypothesis 1 (Foreign demand effect on prices)**.** *If nonresident foreign investors are the marginal buyers in local housing markets, then reductions in foreign demand will* decrease *house prices:* $\beta_1 < 0$*,* $\beta_2 > 0$*, and* $\beta_3 < 0$*.*

However, there are two additional channels that make the above predictions more ambiguous: a positive local demand response and a dynamic (positive or negative) supply response. Anecdotal observation suggests that foreign buyers can have devastating effects on local neighborhoods via a "disamentity" effect. For example, Favilukis and Van Nieuwerburgh (2018) document that houses purchased by out-of-town investors are often left vacant rather than rented out, creating "ghost neighborhoods." The reduction in foreign buyers due to the FBT might make a previously unattractive neighborhood more attractive to local buyers. That is, the FBT might provoke a positive local demand shock as Vancouver residents substitute into foreign destination neighborhoods because the disamentity has been reduced. This could potentially lead to differentially increased house prices in destination vs. non-destination neighborhoods (which would experience a local negative demand shock) after passage of the FBT, reversing all of our previous sign predictions:

Hypothesis 2 (Local substitution effect on prices)**.** *If foreign ownership creates strong neighborhood disamenities, then reductions in foreign demand will* increase *house prices:* $\beta_1 > 0$*,* $\beta_2 < 0$*, and* $\beta_3 > 0$*.*

The dynamic supply response manifests itself through the construction market. In an equilibrium stock-flow model of real estate, construction activity flows to building projects that have the highest value as determined by the eventual sale price and all the costs involved in the actual construction (DiPasquale and Wheaton 1992). Because the future sale price is determined by future housing demand, projected foreign buying activity plays a significant role in the allocation of construction choices. During periods of high foreign buyer demand (pre-FBT) there might be a large market for expensive mansions since foreign buyers are trying to shift as much capital as possible out of their home countries. This demand could motivate developers to build new mansions or to renovate existing multi-unit buildings into large, single-unit, luxury homes. However, if foreign buyer demand slows down significantly (post-FBT), these single-unit projects likely will not remain the highest value use. Instead, developers might find it more profitable to build small single-family homes, condominiums, or multi-unit apartment buildings. This would increase the overall supply of housing in destination neighborhoods and push house prices down.

On the other hand, developers might simply no longer find it profitable to build in areas where foreign buyers made up such a large portion of the demand for new housing. This would cause construction activity to slow down, the housing supply to shrink, and would put upward pressure on house prices in destination areas relative to non-destination areas. Due to these countervailing forces, we do not make a prediction as to whether the supply response to the FBT will reinforce or mitigate our baseline predictions concerning house prices. However, we do make the following prediction concerning the quantity of new housing:

Hypothesis 3 (Dynamic supply effect)**.** *Reductions in foreign demand will* reduce *new housing construction, particularly of* high-end *properties, in destination neighborhoods. When* Y *in* (3) *is new construction starts,* $\beta_1 < 0$*,* $\beta_2 > 0$*, and* $\beta_3 < 0$*.*

Rental Markets. We next turn to the effect of foreign buying activity on rental markets. House prices P_t should capitalize both present and expected future changes in rents $\{R_t, \mathbb{E}_t R_{t+1}, \ldots\}$ (e.g., Poterba 1984). If an increase in foreign demand raises home purchase prices and effectively reduces the supply of housing available for locals, then some local residents are displaced from owning to renting, driving up rents. So negative shocks to foreign purchaser demand such as the FBT and the Chinese capital controls should cause a decrease in local demand for rental units, as some locals choose to buy instead, lowering rents. That is, when Y is rent growth instead of house price growth, all of the sign predictions are in the same direction as Hypothesis 1.[15]

However, we hasten to add three caveats. First, to the extent that some non-resident foreign buyers were purchasing with the intent of eventually immigrating, buying and renting are close substitutes (Simons et al. 2016; Nonko 2017), so we might expect policy shocks that make purchasing more expensive to cause an increase in foreign rental demand. Second, this discussion assumes that there are no governmental regulations that impede the natural adjustment of rents. However, the city of Vancouver limits the annual increase in rents to the rate of inflation. In the presence of a binding price ceiling, we expect to see decreases (increases) in demand for rental units reflected on the quantity margin, via a rising (falling) vacancy rate. Third, we note that as before, a dynamic supply response could partially or totally offset any change in foreign demand. If the investment effect dominates and rental demand decreases post-FBT, developers might reallocate new construction projects away

[15] The only concrete difference is that one might expect to see different magnitudes for the β coefficients. Theoretically, they might be either larger or smaller. If homeowners expect a decline in foreign buying activity in the future (and thus a decline in future rents), house prices would fall immediately, even if the spot price of housing on today's rental market is unaffected ($|\Delta P_t| > |\Delta R_t|$). On the other hand, a contemporaneous demand shock should move spot prices more than future prices if the shock is expected to be transitory. Favilukis and Van Nieuwerburgh (2018) investigate the theoretical impact of out-of-town buyers and predict that unanticipated demand shocks should affect rents by more than purchase prices ($|\Delta R_t| > |\Delta P_t|$), due to the possibility that the shocks will reverse in the future.

from destination areas, decreasing the supply of rental units and offsetting the decrease in rents. If the consumption effect dominates and rental demand increases post-FBT, developers could decide to build fewer detached houses and more multi-unit apartments in destination areas, offsetting the increase in rents.

To summarize:

Hypothesis 4 (Foreign investment channel in rental markets)**.** *If the marginal foreign buyer is purchasing as an investment vehicle (i.e. not to live in), then policy interventions to reduce foreign purchaser demand will* decrease *rents,* raise *the rental vacancy rate, and* decrease *new apartment construction. When Y is rent growth in (3), $\beta_1 < 0$, $\beta_2 > 0$, and $\beta_3 < 0$. When Y is the rental vacancy rate in (3), $\beta_1 > 0$, $\beta_2 < 0$, and $\beta_3 > 0$. When Y is the new apartment construction starts rate in (3), $\beta_1 < 0$, $\beta_2 > 0$, and $\beta_3 < 0$.*

Hypothesis 5 (Foreign consumption channel in rental markets)**.** *If the marginal foreign buyer is purchasing to consume housing services (i.e. immigrate), then policy interventions to reduce foreign purchaser demand will* increase *rents,* lower *the vacancy rate, and* increase *new apartment construction.. When Y is rent growth in (3), $\beta_1 > 0$, $\beta_2 < 0$, and $\beta_3 > 0$. When Y is the rental vacancy rate in (3), $\beta_1 < 0$, $\beta_2 > 0$, and $\beta_3 < 0$. When Y is the new apartment construction starts rate in (3), $\beta_1 > 0$, $\beta_2 < 0$, and $\beta_3 > 0$.*

All of this is to say, the effect of foreign demand shocks on both home purchase and rental markets is complicated and potentially operates via multiple channels. We test predictions relating to house prices in Section 5, and relating to the rental and construction markets in Section 6.

4 Data

The data set for our main analysis of foreign buying activity and house prices is constructed from two different sources: the Real Estate Board of Greater Vancouver (REBGV) and the 2016 Canadian Census. To capture house price growth we use the monthly MLS Housing Price Index (HPI) published by the REBGV in collaboration with the Canadian Real Estate Association (CREA) for 2016 and 2017. The HPI is published monthly and tracks 17 subdivisions within Metro Vancouver. It is constructed using a hybrid approach that combines the repeat sales method and traditional hedonic modeling. Indices are published in composite and separately for four broad housing categories: detached homes, apartment units, townhouses, and row houses. Due to a very limited number of observations in the row category, our analysis includes only the first three categories. We supplement the HPI data with sociodemographic and housing characteristic data from the 2016 Canadian Census. After merging the two sources, we are left with 17 regions within Metro Vancouver to use for our analysis.[16]

The basic summary statistics for the subdivision data along with the variable definitions are presented in Table 1. As mentioned previously, Chinese people make up the largest ethnic group on average. Furthermore, recent Chinese immigrants make up over 40% of the total recent immigrant population. The average monthly HPI growth (annualized) for all 17 subdivisions over the entire time period of January 2016 to December 2017 was 16.7%. As would be expected there is significant variation from the 10th percentile of -11% to 44% at the 90th percentile.

Table 2 breaks down the basic summary statistics into destination and non-destination

[16]For a more detailed description of these data sources and how we actually constructed our data set, see Appendix D.1.

Table 1: Summary Statistics for Vancouver Subdivisions

	Mean	(SD)	10th Pctl.	90th Pctl.
Population	104,200	(98,505)	3,680	311,116
Area (sq. km)	87.2	(77.1)	8.3	195.5
Population Density	1,755	(1653)	124	4,401
Demographic Characteristics				
Age	42.0	(2.66)	39.0	47.4
Income (Individual Average) in 2015	51,505	(14,954)	38,039	64,670
Percent Female	51.3	(0.87)	50.6	52.3
Percent Canadian Citizen	86.8	(4.80)	79.6	93.3
Percent Chinese Ethnic Origin	18.2	(14.8)	3.2	38.0
Percent South Asian Ethnic Origin	6.14	(5.04)	1.77	15.8
Percent Recent Chinese Immigrants	1.27	(1.29)	0.00	3.24
Percent Recent Other Immigrants	3.49	(1.51)	1.65	5.62
Percent with College Degree	21.1	(6.7)	11.0	26.6
Unemployment Rate	5.5	(0.9)	4.7	6.5
Housing Mkt. Characteristics				
Log HPI Growth, 2016-17 (ann. monthly %)	16.7	(22.1)	-10.7	43.8
Number of Dwellings	45,564	(48,786)	1,915	130,707
Number of Households	42,509	(44,495)	1,495	120,064
Average Year Built	1982.4	(5.8)	1973.8	1989.4
Number of Bedrooms	2.9	(0.4)	2.2	3.3
Percent with Public Transit Access	24.2	(10.9)	13.9	40.6
Home Ownership Rate	69.8	(12.00)	51.7	82.3
Percent Repairs Needed	6.0	(1.2)	4.8	7.7

Notes: This table provides summary statistics for 17 consistently-defined subdivisions of Metro Vancouver, using data from the 2016 Canadian Census and the composite MLS HPI from REBGV. All rows report cross-sectional statistics ($N = 17$), except for Log HPI Growth, which is based on monthly panel data between January 2016 and December 2017 ($N = 17 \times 24 = 408$). "Recent Immigrants" are individuals who immigrated between 2001 and 2016. "Public Transit Access" measures the percentage of employed people who commute via public transit, bicycles, or walking methods

subdivisions, splitting by the median level of *Percent Chinese Ethnic Origin* of 12.1%. The right-most column calculates difference in means between destination versus non-destination subdivisions. Moving down the column, destination subdivisions are both more populous

Table 2: Demographic and Household Characteristics by Destination and Non-destination Subdivisions

$N =$	Destination 8	Non-Destination 9	Difference
Population	157,731	56,617	101,114**
Area (sq. km)	74.5	98.5	-24.0
Population Density	2,617	990	1,627**
Demographic Characteristics			
Age	41.8	42.1	-0.4
Income (Individual Average) in 2015	49,747	53,067	-3,321
Percent Female	51.5	51.1	0.5
Percent Canadian Citizen	82.6	90.6	-8.0***
Percent Chinese Ethnic Origin	30.9	6.9	24.1***
Percent South Asian Ethnic Origin	7.0	5.4	1.6
Percent Recent Chinese Immigrants	2.3	0.3	2.0***
Percent Recent Other Immigrants	4.5	2.6	1.8***
Percent with College Degree	24.6	18.0	6.6**
Unemployment Rate	6.0	5.1	1.0**
Housing Mkt. Characteristics			
Log HPI Growth, 2016-17 (ann. monthly %)	15.5	17.7	-2.3
Number of Dwellings	70,847	23,091	47,756*
Number of Households	65,552	22,026	43,527*
Average Year Built	1981.0	1983.6	-2.6
Number of Bedrooms	2.8	3.0	-0.2
Percent with Public Transit Access	30.1	18.9	11.2**
Home Ownership Rate	63.0	75.9	-13.0**
Percent Repairs Needed	6.1	6.0	0.1

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

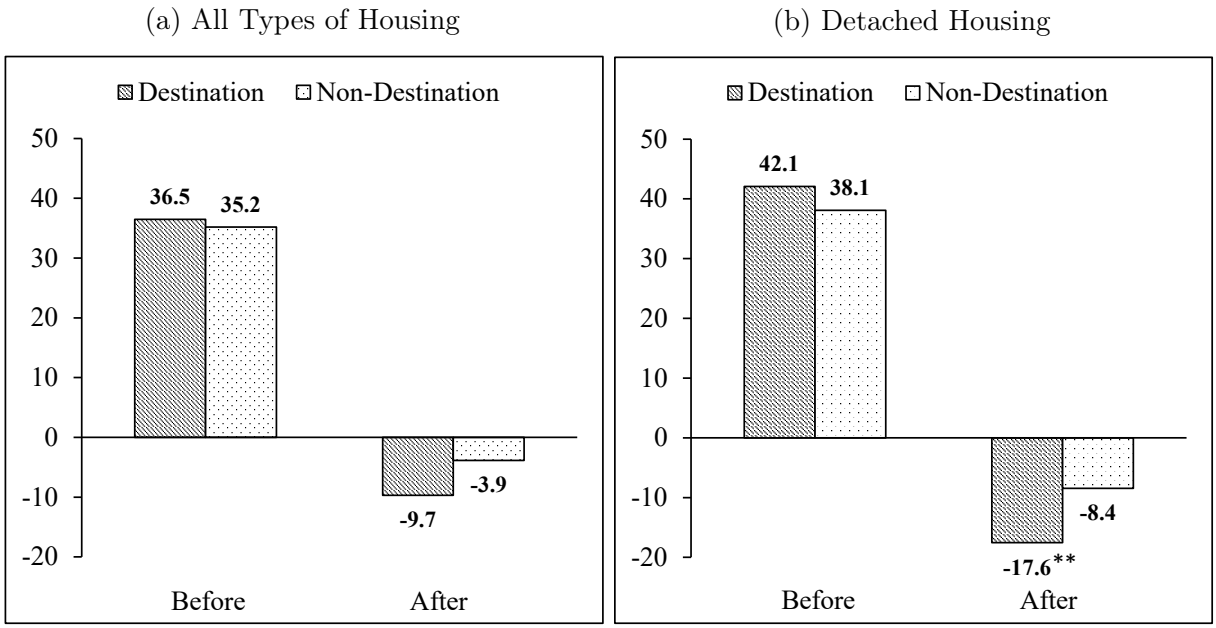
Notes: This table runs tests of equality of means of each variable for destination subdivisions versus non-destination subdivisions. A destination subdivision is defined as having above the median level (12.1%) of ethnically Chinese residents as a fraction of the subdivision's total population. Significance levels are calculuated from small-sample critical values using Satterthwaite's (1946) formula for the approximate degrees of freedom. Differences may not appear exact due to rounding. All variables are defined as in Table 1.

and more densly populated, on average. Compared to non-destination subdivisions, there are on average 8 p.p. fewer Canadian citizens and 24 p.p. more ethnically Chinese residents in destination subdivisions. Additionally, there are more recent immigrants from China and from elsewhere in destination regions. On average, residents of destination areas are more educated, slightly less employed, and have greater access to public transit. These differences correspond to typical urban versus rural trends. Thus, considering that the destination areas are more centrally located, these observed differences make sense.

Looking under the bottom panel, "Housing Variables," there is no significant difference in average HPI growth across groups over the entire time period. This is to be expected considering the multiple shocks, working in different directions, that occur during this period. Breaking down the difference-in-means into pre- and post-implementation of the FBT is more revealing. Figure 4 presents these pre/post means for the composite HPI growth (panel A) and for detached housing (panel B). In both panels, there appear to be no significant differences between destination subdivisions and non-destination subdivisions in the pre-tax period (Jan 2016 - July 2016). After the tax, both growth rates fall below zero and a differential emerges. HPI growth in destination areas is considerably more negative than HPI growth in non-destination areas. Furthermore, the differential in the detached category is considerably more pronounced and statistically significant at the 5% level.

These preliminary comparisons suggest that lower foreign buyer demand had a negative effect on house price growth and that these effects were concentrated in detached housing (consistent with Hypothesis 1). Having established that a differential effect is visible even in the raw data, we turn to a more formal analysis of all three shocks.

Figure 4: Differences in Average HPI Growth in Destination Versus Non-Destination Areas Before and After FBT



Notes: The averages reported in this figure are monthly log growth rates that have been annualized. The data are from a restricted sample that only uses 2016, to focus on the implementation of the FBT alone. Hence, the "Before" averages are based on data from Jan 2016 - July 2016, and the "After" averages are based on Aug 2016 - Dec 2016. ** Indicates that the difference in means for detached housing after the FBT is statistically significant at the 5% level.

5 The Effect of Foreign Demand on Vancouver House Prices

5.1 Main Results

This section presents our main empirical results on the impact of foreign buying activity on house price growth in the greater Vancouver area. Table 3 reports the pooled difference-in-difference estimates, estimated over January 2016 - December 2017. The first column presents the basic difference-in-difference estimator without fixed effects, and the second columnn

controls for time and subdivision fixed effects (thereby absorbing the post and Chinese destination dummy variables). The dependent variable in each column is the annualized month-over-month growth rate of the composite house price index, which includes all the different housing categories.

In the basic DD specification (column 1), we note first that the coefficient on $chinDest_i$ is small (just over 1% per annum) and statistically insignificant. However, this lack of significance is mostly related to our short event window. In Section 5.2 we show the higher pre-FBT growth rate in Chinese destination subdivisions is statistically and economically significant over longer time horizons, e.g. accumuluating to almost 5 p.p. additional house price growth between January 2014 and July 2016. This indicates that destination neighborhoods experienced greater demand pre-tax, an important tenet of our home-bias abroad identification strategy.[17]

Turning to the three exogenous demand shocks, the coefficients on the three *post* dummies are consistent with the visual evidence of an overall decline in the housing market starting in August 2016, a resurgence in January 2017, and a smaller decline in July 2017. Moreover, the difference-in-difference point estimates strongly suggest that the fluctuations in house price growth were stronger in neighborhoods that were targeted by foreign investors. For example, the coefficient on the interaction term $chinDest_i \times postAug2016_t$ suggests there was a differential deceleration in house price growth in destination subdivisions of 7.1 percentage points. In column 2 we add time and subdivision fixed effects. These absorb the single-difference coefficients but buy us greater statistical precision for the double-difference coefficients. The FBT interaction coefficient remains the same and is now statistically

[17] Additionally, Chinese destination subdivisions may contain less desirable housing stock, as suggested by Table 2. In Appendix Table B.2 we augment the basic difference-in-difference with available demographic and housing stock controls. Inclusion of these controls boosts the coefficient on $chinDest_i$ to as large as +13 p.p. per annum over January-July 2016.

Table 3: Impact of Foreign Demand Shocks on Vancouver House Price Growth in Chinese Destination vs. Non-Destination Subdivisions

	(1) No Fixed Effects	(2) Time and Subdivision FE
Chinese Destination Subdivision	0.0130	
	(0.034)	
postAugust2016	-0.390***	
	(0.036)	
postJanuary2017	0.221***	
	(0.035)	
postJuly2017	-0.0333	
	(0.030)	
Destination × postAugust2016	-0.0712	-0.0712*
	(0.050)	(0.040)
Destination × postJanuary2017	0.0693	0.0693*
	(0.047)	(0.037)
Destination × postJuly2017	-0.0790**	-0.0790***
	(0.039)	(0.026)
Constant	0.352***	0.216***
	(0.024)	(0.026)
Observations	408	408
R^2	0.475	0.740

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents results from estimating a pooled difference-in-difference for the time window Jan. 2016 - Dec. 2017, for 17 consistently-defined subdivisions of Metro Vancouver. The dependent variable in every specification is the annualized monthly growth rate (log change) in the composite HPI for all housing types, in decimal units. Independent variables are defined in Section 3.2.

significant at a 10% level, providing moderate evidence that the FBT had a negative influence on foreign buying activity and house prices.

Moving on to the Chinese capital controls, the coefficient on the interaction term $chinDest_i \times postJan2017_t$ is positive and significant at a 10% level in the fixed effects specification. The almost identical magnitude (6.9 percentage points), but opposite direction, of this estimate suggests that there was heightened foreign buyer demand following the December 30th announcement of the Chinese Capital Controls, and that this "rush to buy" almost exactly offset any negative price effect of the tax from five months earlier. The estimated coefficient on the final interaction term $chinDest_i \times postJuly2017_t$ is the most striking. Highly statistically significant in both specifications, these estimates suggest that foreign buyers responded strongly to the enactment of the capital controls, causing a differential decline in house price growth of 7.9% in destination neighborhoods.

Taking the fixed effects model as our baseline, as is standard in the diff-in-diff literature, it appears that the direct foreign demand effect more than offset any local substitution effects following each exogenous demand shock—i.e., the evidence is consistent with Hypothesis 1 rather than Hypothesis 2. The larger magnitude and much greater level of significance of the estimated impact following the implementation of the capital controls suggests that foreign buying activity was ultimately more responsive to Chinese government regulations than to local officials' targeted policy intervention. On the other hand, we have only five months of data between enactment of the FBT and announcement of the capital controls (versus six and seven months for the subsequent shocks), so the lack of precision could be due to the shorter time window.

To investigate further, we look at the effect of these demand shocks on different housing categories. Specifically, we investigate whether the effects are stronger for detached homes

than for apartments or townhouses. The typical value of a detached home is significantly greater than the two other types: in January 2016, the benchmark value for a detached home in Vancouver was almost $1.3 million compared to just $0.45 million and $0.57 million for apartments and townhouses, respectively.[18] Further, the price of detached homes followed a more dramatic trend during this time period, compared to apartments and townhouses (Figure A.1). Given this discrepancy and combined with the fact that foreign investors typically target high-end real estate (Suher 2016; Cvijanovic and Spaenjers 2018), one would expect the effects of foreign buyers to be concentrated in the detached category.

Table 4: Impact of Foreign Buyers on Different Categories of Housing

	(1) All Types	(2) Detached	(3) Apartments	(4) Townhouse
Destination × postAugust2016	-0.0712*	-0.131***	0.00183	0.0877
	(0.040)	(0.045)	(0.068)	(0.071)
Destination × postJanuary2017	0.0693*	0.0733	0.0660	-0.0937
	(0.037)	(0.045)	(0.060)	(0.064)
Destination × postJuly2017	-0.0790***	-0.0533	-0.173***	0.00183
	(0.026)	(0.037)	(0.045)	(0.053)
Time and Subdivision Fixed Effects	Yes	Yes	Yes	Yes
Observations	408	408	384	360
R^2	0.740	0.767	0.368	0.423

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents regression results from estimating the pooled difference-in-difference model for different dependent variables that correspond to the three separate housing categories. The first column reproduces our baseline estimate of the impact on the annualized monthly growth rate (log change) of the composite HPI, from Table 3, column 2, in decimal units. In columns 2-4, the dependent variable is the annualized monthly growth rate (log change) of the HPI for a specific housing category. The sample is 17 consistently-defined subdivisions of Vancouver, over Jan 2016 - Dec 2017. Columns 3 and 4 are missing price data in two subdivisions: Bowen Island (apartments and townhouses) and West Vancouver (townhouses).

[18]These benchmark values are published by the REBGV and the CREA in combination with the MLS HPI.

Table 4 reports the estimated impact of the three foreign demand shocks on different categories of housing in Vancouver. The dependent variable in columns 2, 3, and 4 are the %ΔHPI of detached homes, apartments, and townhouses, respectively. For reference, column 1 reproduces our baseline estimates using the composite HPI. Looking at the post-August 2016 interaction variable in the top row, we see that the decrease in overall house price growth following passage of Vancouver's FBT is driven entirely by detached housing. Declining foreign buyer demand led to a differential decline in detached home price growth of 13.1 percentages points in destination subdivisions, almost twice our baseline estimate for overall house price growth. Moreover, the estimate is highly significant ($p < 0.005$). As outlined above, Vancouver's high-end real estate market is largely made up of detached homes rather than luxury condos, so this result also provides strong support to the narrative that wealthy foreign buyers tend to focus on luxury real estate.

The estimates in the rest of the table complicate the story somewhat. First, we find weak evidence of differential changes in detached house price growth following the announcement (+7 p.p.) and enactment (-5 p.p.) of Chinese capital controls in January and July 2017, respectively. Although neither is statistically different from zero, the estimates are similar in magnitude to our baseline findings for the composite HPI in column 1. Second, apartment price growth appears not to have been affected by the FBT—the estimated coefficient on $chinDest_i \times postAug2016_t$ in column 3 is statistically and economically insignificant. However, apartment price growth rose post-January 2017 by nearly 7 p.p., although this difference is not significant ($p = 0.25$), and fell by more than 17 p.p. post-July 2017 ($p < 0.0002$). Finally, we find no significant movements in townhouse price growth following any of the demand shocks (column 4).

One possibility to reconcile these results is that the capital controls impeded the ability

of Chinese foreign buyers to purchase Vancouver apartments, but not necessarily detached houses. This aligns with our earlier suggestion that the capital controls might not affect the small minority of ultra-wealthy Chinese buyers, who are likely to find ways to maneuver around regulations. Instead, if the controls only affected the majority of wealthy rather than ultra-wealthy Chinese buyers—who might not be able to afford, or assemble the capital necessary to purchase luxury detached properties—then one might expect to see price effects concentrated in apartments, the relatively more affordable option in Vancouver. Alternatively, as discussed in Section 3.3, the weaker movements in columns 3 and 4 could be evidence of an offsetting positive demand shock as local buyers substituted into apartments and townhouses in destination neighborhoods post-FBT (Hypothesis 2).

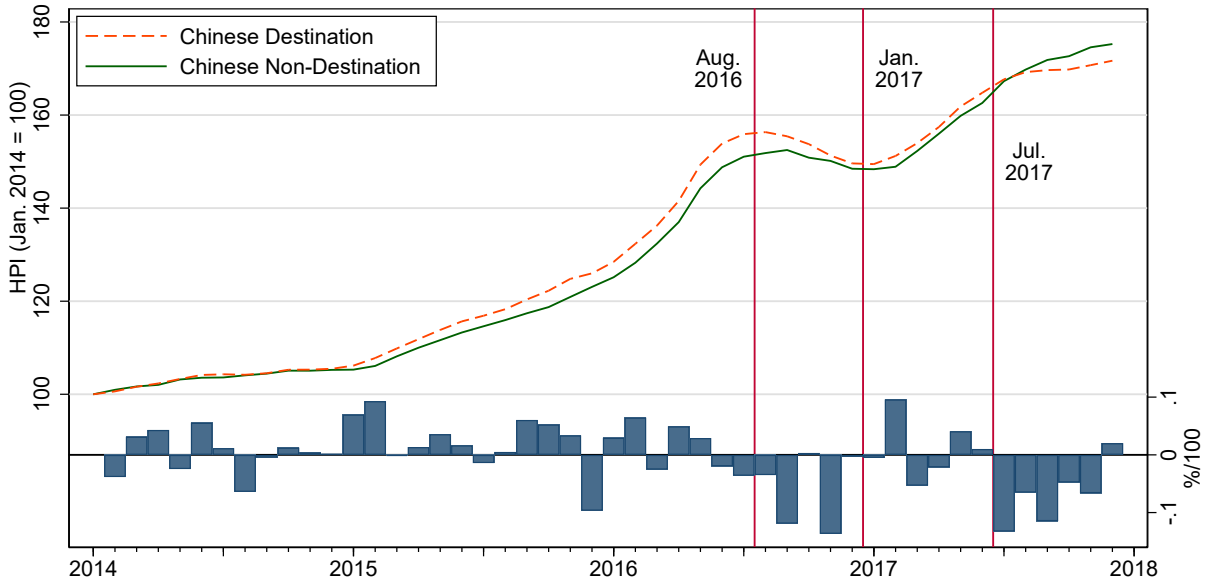
In sum, our primary analysis suggests that shifts in foreign demand had major price effects in Vancouver's home purchase market. While declining foreign buyer demand due to the FBT was concentrated in the most expensive category of detached housing, changing activity surrounding the capital controls largely affected apartments.

5.2 Parallel Trends and Cumulative Impact

The ability to draw causal inferences from a difference-in-difference analysis requires the assumption of parallel trends to be upheld; i.e., that the treatment and control groups would have followed the same trend in the absence of any treatment. The counterfactual is of course unobservable, but the parallel trends assumption also implies the absence of different pre-trends, which is testable. Since the dependent variable in our main analysis is house price growth, in this section we test whether destination and non-destination growth rates were parallel preceding passage of the FBT. Importantly, we do not expect growth rates to be the same. The home-bias abroad theory predicts that house price growth should be *higher*

in Chinese destination subdivisions pre-FBT. The parallel trends assumption is that this difference is relatively constant.

Figure 5: HPI Levels and Difference in Growth Rates, Destination versus Non-Destination Subdivisions of Vancouver, 2014-17



Notes: This graph shows the average composite HPI, separately for Chinese destination and non-destination subdivisions of Vancouver (lines); and the average difference in growth rates between destination and non-destination subdivisions (bars). The HPIs are indexed to a base time period of January 2014 = 100.

The simplest test of parallel tends is visual (Angrist and Krueger 1999). In Figure 5 we plot the average level of the composite HPI in Chinese destination vs. non-destination subdivisions between 2014 and 2017 (lines) and the difference in average growth rates (bars). Consistent with the home-bias abroad theory and the estimates in Table 3, annual house price growth averaged 1.3 log p.p. higher in Chinese destination subdivisions during the two and a half years prior to the FBT. This translates into an effective difference of 4.8 p.p. of additional house price growth between January 2014 and July 2016.[19] However, the bar graph

[19]The average HPI in July 2016 for destination subdivisions is 155.9, versus 151.1 for non-destination subdivisions, from a base of 100 in January 2014.

at the bottom of the figure shows that this difference in growth rates is relatively constant and has no systematic trend in the 30-month pre-period. I.e., although the average growth rate is higher in destination subdivisions, the growth rates are parallel.

We test for the presence of different pre-trends more formally in two ways. First, we estimate six different panel regressions of log HPI or the change in log HPI on linear, quadratic, or cubic time trend polynomials and their interactions with $chinDest_i$ prior to the FBT, between January 2014 and July 2016. Table 5 reports F-tests of the null hypothesis that the interaction terms in each regression are all zero, i.e., that the pre-trends are the same. Consistent with the visual evidence, house prices exhibit small but significantly different pre-trends, at a less than 1% level, whereas house price growth rates do not. In all specifications, we estimate precise differences of zero in growth rate trends (column 2). This strongly supports the parallel growth rates assumption.

Table 5: F-Tests for Pre-trends

Dependent variable is:	(1) *log(HPI)*	(2) *HP Growth*
H_0: Common linear trend	6.11**	1.94×10^{-5}
	[0.014]	[0.996]
H_0: Common quadratic trend	11.73***	0.385
	$[1.05\times10^{-5}]$	[0.681]
H_0: Common cubic trend	11.56***	0.265
	$[2.45\times10^{-7}]$	[0.851]

F statistics [p-values in brackets]
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents results from testing the null hypothesis of common pre-trends in Chinese destination and non-destination subdivisions of Vancouver. Each cell reports the F statistic and associated p-value from a joint test that the coefficient(s) on $chinDest_i \times g(t)$ is 0, where $g(t)$ is a linear, quadratic, or cubic polynomial time trend. The coefficients are obtained from six different panel regressions of log(HPI) or change in log in HPI on $g(t)$, $chinDest_i \times g(t)$, and subdivision fixed effects, over January 2014 - July 2016.

Second, following the recommendation of Mora and Reggio (2012) and Mora and Reggio

(2019), we estimate a fully-flexible specification in which we replace the three post-event indicator interaction terms in eq. (3) with a full vector of time dummies interacted with $chinDest_i$:

$$Y_{it} = \alpha_i + \alpha_t + \sum_{s=-T_0}^{-1} \beta_s(chinDest_i \times I_s) + \sum_{s=1}^{T_1} \beta_s(chinDest_i \times I_s) + \varepsilon_{it}, \tag{4}$$

where we observe T_0 periods before the inital shock, T_1 periods after, and I_s is an indicator variable for time period s. We set the base category, time 0, to July 2016, the month before the FBT was enacted.[20] The full set of lead- and lag-times-treatment interactions are presented in Table 6, for a two-year estimation window of January 2016 - December 2017. As in our simple visual test, the dependent variable remains the price *level*—specifically, the natural log of the composite HPI for each subdivision.

[20] Other empirical papers adopting this strategy include Reber (2005) and Dessaint and Matray (2017).

Table 6: Dynamic Impact of Foreign Demand Shocks on Vancouver House Prices

Dependent variable is:	(1) log(Price Level)		(2) log(Price Level)	
Destination x postAug2016	-0.0158*	(0.008)		
Destination x postJan2017	-0.0053	(0.007)		
Destination x postJul2017	-0.0236***	(0.008)		
Destination x Jan2016			-0.0051	(0.022)
Destination x Feb2016			0.0003	(0.023)
Destination x Mar2016			-0.0019	(0.025)
Destination x Apr2016			0.0023	(0.026)
Destination x May2016			0.0047	(0.025)
Destination x Jun2016			0.0030	(0.024)
Destination x Jul2016			(Omitted)	
FBT Announced and Enacted				
Destination x Aug2016			-0.0029	(0.021)
Destination x Sep2016			-0.0129	(0.023)
Destination x Oct2016			-0.0126	(0.020)
Destination x Nov2016			-0.0240	(0.018)
Destination x Dec2016			-0.0243	(0.017)
CCC Announced				
Destination x Jan2017			-0.0247	(0.018)
Destination x Feb2017			-0.0167	(0.018)
Destination x Mar2017			-0.0212	(0.018)
Destination x Apr2017			-0.0230	(0.019)
Destination x May2017			-0.0196	(0.019)
Destination x Jun2017			-0.0187	(0.020)
CCC Implemented				
Destination x Jul2017			-0.0298	(0.021)
Destination x Aug2017			-0.0352	(0.024)
Destination x Sep2017			-0.0448*	(0.025)
Destination x Oct2017			-0.0488*	(0.025)
Destination x Nov2017			-0.0543**	(0.025)
Destination x Dec2017			-0.0526*	(0.028)
Subdivision and Time Fixed Effects	Yes		Yes	
Observations	408		408	
R^2	0.958		0.958	

Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents the impact of foreign demand shocks on Vancouver house prices over time. In both columns the dependent variable is the price *level* (log of the composite HPI), rather than the growth rate. Column 1 runs the baseline pooled DID model (3). In column 2, independent variables of the form $Destination_i \times MmmYYYY_t$ are interactions between the Chinese destination indicator and the corresponding year-month indicator. $chinDest_i \times Jul2016_t$ is the omitted category (one month prior to passage of the FBT). Both columns additionally control for the full vectors of subdivision and time fixed effects. The sample is 17 consistently-defined subdivisions of Vancouver, over Jan 2016 - Dec 2017.

The leading (pre-August 2016) interaction terms are all small, and none are significantly different from zero, either individually or jointly. However, when we extend the estimation sample back to January 2014, we can reject the null hypothesis of no difference between destination and non-destination prices (the joint test statistic of the pre-FBT interaction coefficients all equaling zero is $F_{(30,705)} = 1.56$, $p = 0.03$).[21] This is consistent with a small, constant difference in growth rates that is only detectable over long time horizons. The longer event window indicates that house prices in Chinese destination subdivisions were 3 percent higher in July 2016 than in January 2014, relative to non-destination subdivisions, consistent with higher foreign demand for houses in these neighborhoods. When we replicate these tests using growth rates as the dependent variable, we fail to reject the null of common pre-trends (in the 2016-17 window, $F_{(6,345)} = 0.37$ and $p = 0.90$; in the 2014-17 window, $F_{(29,690)} = 0.73$ and $p = 0.85$).

Inspection of the lagging interaction coefficients (post-August 2016) allows us to assess the cumulative, long-run effect impact of foreign demand shocks on Vancouver house prices. Immediately after passage of the FBT in August 2016, a gap opens up between prices in destination and non-destination subdivisions and widens through the end of the year. Although the monthly estimates in column (2) are not individually significant, when we pool August-December together, i.e., estimate eq. (3) with log prices as the dependent variable, the average post-FBT price difference is different from zero at a 10% level (column 1: $\hat{\beta} = -1.6$ percent, $p = 0.06$).[22]

[21] This longer specification is not shown due to space constraints. Most of the power comes from 2014: all of the interaction coefficients are negative, and nine of the twelve months are significant at a 10% level.

[22] Each lead or lag interaction term in column (2) is estimated off of only 17 data points, so the dynamic analysis stretches the statistical power of our tests. In an unreported robustness check, we re-estimated the DID model in column (1) with the restriction that the coefficient on $chinDest_i \times postJan2017_t = 0$. This maximizes our power to detect price differences due to the FBT. The estimated coefficient on $chinDest_i \times postAug2016_t$ increases in magnitude to -1.9% and is significant at a 5% level ($p = 0.0105$).

By December 2016, prices in Chinese destination subdivisions had differentially fallen by 2.4% from July, the month before the tax. This downward trend might have continued into 2017, but for the announcement of new capital controls by the PBOC on December 30. Over the ensuing six months, the price gap remained constant or closed slightly, as Chinese investors rushed to buy housing in Vancouver prior to the implementation of the new capital controls. Following the implementation of the capital controls in July 2017, this positive demand shock dissipated and the downward trend in prices resumed or even accelerated. By December 2017, prices in destination subdivisions were differentially 5% lower than in July 2016.

We draw two main conclusions from the dynamic analysis in Table 6. First, the results are consistent with the story in Table 3 of negative house price growth between August-December 2016, positive growth that mostly offsets the negative FBT shock (= net zero growth) between January-June 2017, and a resumption of negative growth in July 2017. Second, the dynamic analysis reaffirms our decision to use growth rates rather than levels in the main specification. The dynamic specification allows treatment to have different immediate versus cumulative effects on the log price level. We observe a price gap that continuously widens after the FBT and Chinese capital controls were enacted. This is strongly suggestive that the demand shocks had *growth*, rather than *level*, effects on Vancouver house prices.

5.3 Further Robustness Checks

In this section we run a number of additional tests of our identification strategy. First, we check whether our results are robust to different cutoffs for classifying destination subdivisions. Second, we validate the the home-bias abroad strategy by using a placebo classification scheme that should not be predictive of foreign investor capital flows. Third, we run a placebo test of

the FBT using a different city (Toronto) that experienced similar house price appreciation over this time period but did not enact an FBT. Finally, we re-estimate our difference-in-difference specification using the city of Toronto as an entirely new control group; i.e., relying on across-city rather than within-city variation.

5.3.1 Different Definitions of Destination Subdivisions

Following Pavlov and Somerville (2018), the first test we conduct to assess the robustness of results is to modify the median cutoff we initially employed for destination subdivisions. Based on the "home-bias abroad" theory, increasing the Chinese origin cutoff for how a destination subdivision is defined should not diminish the estimated results for the difference-in-difference coefficients. If anything, restricting destination subdivisions to be locations that contain a much higher density of foreign origin residents (beyond the baseline median level) should increase the magnitude of the results. However, we observe the opposite in our analysis.

Appendix Table B.3 reports the results of our baseline pooled-fixed effects model (3) from increasing the fraction Chinese origin residents cutoff used to define a destination subdivision from the median (top eight fraction Chinese origin) through the 88th percentile (top two fraction Chinese origin), reducing the number of destination subdivisions by two. We drop inframarginal subdivisions so as to keep the non-destination control group the same. As the cutoff increases, the magnitudes of the estimated difference-in-difference coefficients decline monotonically. Although the estimate on $Destination \times postJuly2017$ remains significant through the 76% cutoff (top four; further evidence supporting the significant impact of the capital controls going into effect), these estimates broadly suggests that our results are somewhat sensitive to how we have allocated treatment in the form of destination versus non-destination subdivisions. However, it is worth noting that predictive power diminishes as

the cutoff increases due to a reduction in sample size: standard errors also increase nearly monotonically as the destination cutoff increases and an increasing number of subdivisions drop out of the sample. As such, interpreting the results, especially of columns 3 and 4, needs to take this sampling size issue into consideration.

5.3.2 Placebo Tests

To check the validity of our identification strategy, we run two placebo tests. First we test the home-bias abroad strategy using a theoretically irrelevant distinction for treatment and control subdivisions, based on the density of a different ethnic group: South Asians.[23] South Asians are the second largest ethnic minority group in Vancouver, but non-citizen South Asian investors accounted for precisely 0% of home purchases in British Columbia in June 2016, the month before the FBT (B.C. Ministry of Finance 2016). This an ideal placebo test: since there is effectively no demand for Vancouver real estate by non-citizen South Asian purchasers, the FBT and Chinese capital controls cannot have affected the Vancouver housing market via capital flows from South Asian investors into South Asian destination neighborhood. I.e., this is a test of whether Chinese investors (who were affected by the demand shocks) have a particular affinity for Chinese destination neighborhoods, as claimed by the home-bias abroad strategy.

This test is only useful if people of South Asian origin are not concentrated in the same parts of Vancouver as people of Chinese descent, so we first check that the correlation between neighborhoods where these two ethnic groups live is low ($\rho = 0.14$, see Appendix Table B.1 and Figure A.3). We then classify subdivisions with an above- or below-median fraction of ethnically South Asian residents as "destination" or"non-destination." If the home-bias abroad

[23]Statistics Canada defines this group as "East Indian, Pakistani, Sri Lankan, etc."

theory is correct, we expect to find no differential effect of the FBT or Chinese capital controls across the placebo-treatment and -control subdivisions, since wealthy Chinese investors should not have greater immigration motives, superior soft infrastructure, or lower monitoring costs in high South-Asian origin neighborhoods, as discussed in Section 3. Column 1 of Table 7 reports the results of this placebo test. Not only are all of the estimated coefficients (other than the constant) statistically insignificant, they are also the wrong signs. This suggests that foreign buyers (i.e. Chinese investors) do not target areas with above median levels of South Asian origin residents, supporting our home-bias abroad strategy.

Our second placebo test attempts to rule out the possibility that there were general trends across Canada that are driving the main results: e.g., a decline in Chinese investor demand for Canadian real estate in general, that just happened to coincide with the passage of Vancouver's FBT in August 2016. If this were the case, we would expect to see a differential decline in house prices in Chinese destination neighborhoods of other major Canadian cities. Toronto is the most comparable Canadian city to Vancouver, for our purposes: it experienced the second largest rate of house price appreciation among major Canadian cities after Vancouver (see Figure 2). However, Toronto did not enact an FBT in 2016, so there should be no differential decrease in housing demand in Chinese destination subdivisions of Toronto post-August 2016. Unfortunately, Toronto eventually did enact its own FBT eight months later, on April 20, 2017. Because this occurred in-between the two different Chinese capital control events, we only run the Toronto placebo test in 2016, for Vancouver's FBT.

Column 2 of Table 7 presents results from estimating our baseline model using house price growth in Toronto instead of Vancouver. Following our original methodology, destination subdivisions are classified using the Toronto median ethnic-Chinese population share (3.4%) as the cutoff. As expected, the interaction coefficient of interest is not statistically different than

Table 7: Placebo Tests of Vancouver's Foreign Buyers Tax

City:	(1) Vancouver	(2) *Toronto*
"Destination" Subdivisions:	*South Asian Origin*	Chinese Origin
Destination x postAug2016	0.0427	-0.0257
	(0.041)	(0.038)
Destination x postJan2017	-0.0139	
	(0.038)	
Destination x postJul2017	0.0080	
	(0.027)	
Subdivision and Time Fixed Effects	Yes	Yes
Subdivisions (N)	17	25
Time periods (T)	24	12
Observations (NT)	408	300
R^2	0.734	0.311

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table runs two placebo tests. The first test uses South Asian origin instead of Chinese origin to identify destination subdivisions. Hence in column 1, *Destination* refers to subdivisions that contain above the median level (4.58%) of South Asian origin residents. The second test uses data from Toronto instead of Vancouver. Hence in column 2, *Destination* indicates a Chinese destination subdivision in Toronto, defined using the Toronto median fraction of 3.4% Chinese origin residents. The dependent variable in both columns is %Δ of the composite index. Both specifications include time and subdivision fixed effects. The time window is Jan. 2016 - Dec. 2017 in column 1, and Jan. - Dec. 2016 in column 2.

zero ($p = 0.50$). To address concerns that the overall fraction of Chinese residents is lower in Toronto than Vancouver, we also try adjusting the destination cutoff up to higher levels, closer to the Vancouver median; the null finding does not change (see Appendix Table B.4). These results indicate that the decline in Chinese investor demand was significantly greater in Vancouver destination subdivisions than in a comparable Canadian city, suggesting that a major fraction Vancouver's house price declines are attributable to the passage of the FBT.[24]

[24]In unreported results, we re-estimated the Toronto placebo test without time or subdivisions fixed effects, to

5.3.3 Using Toronto as a Control City

Our analysis thus far has focused on within-city differences, comparing neighborhoods in Vancouver that differ only by their exposure to foreign investor demand. This has the advantage of controlling for city-specific shocks: e.g., a decline in domestic resident demand that is homogenous across Vancouver subdivisions. However, a within-city strategy is vulnerable to source-country specific shocks that coincide with Vancouver's policy intervention. As an example, suppose the PBOC had enacted new capital controls in August 2016 rather than July 2017. A purely within-city analysis cannot disentangle whether foreign demand shocks (the PBOC's action) or the domestic policy intervention (Vancouver's FBT) is driving any observed slow-down in house price growth, since both policies are predicted to disproportionately impact high-Chinese origin subdivisions. To address these types of concerns, we would need to compare Vancouver to a similar city that was also exposed to the source-country demand shock, but unaffected by Vancouver's FBT. In this section we propose doing exactly that, running an across-city comparison using Toronto as a "control city."

Toronto is the most comparable Canadian city to Vancouver for this type of analysis, but there are differences that make the comparison problematic. In the ideal experiment Vancouver and Toronto would face equal exposure to foreign capital flows, but in practice Vancouver appears to be a much greater destination for foreign buyers. In addition to its greater geographic distance from mainland China, Toronto has significantly fewer Chinese-origin residents. The median share across Toronto's metro subdivisions is just 3.4%, versus 12.1% in Vancouver. Only four of the 25 Toronto subdivisions would exceed the Vancouver

check the single-difference coefficients. Interestingly the coefficient on $postAug2016_t$ is significant ($p = 0.012$) and negative in magnitude, -9.3%. This suggests that there *was* a slowdown in house price growth in Toronto around the same time as the enactment of the FBT in Vancouver. However, the decline in house price growth was not concentrated in Chinese destination areas – i.e., there was not an exogenous shift in Chinese investor demand in Toronto.

median cutoff to be designated as Chinese destination subdivisions. Although the Province of Ontario (which contains Toronto) has not publicly released enough foreign purchaser data to make a direct comparison, this is strongly suggestive that Toronto is structurally less exposed to foreign investor demand. What this means is that a comparison of Toronto to Vancouver is really a comparison of non-destination to destination locations.

In order to control for these underlying differences in foreign demand exposure, we restrict our attention to the high Chinese-origin subdivisions of both cities only. I.e., while Toronto overall may be less exposed to foreign investor demand, we posit that the high Chinese-origin subdivisions of Toronto face similar exposure as the high Chinese-origin subdivisions of Vancouver. We use a common cutoff of 7.6%, which classifies 12 out of 17 subdivisions in Vancouver (just over two-thirds) and 9 out of 25 subidivions in Toronto (just over one-third) as Chinese destination areas. We then run a standard difference-in-difference of house price growth post-August 2016 in Chinese destination subdivisions of Vancouver (treatment group), using Chinese destination subdivisions in Toronto as the control group.

Table 8 reports results akin to Table 3, except that we now use Toronto destination subdivisions as the control. The sample for this analysis is January 2016 through December 2016, in order to avoid confusion with the capital controls announcement. The estimated double-difference coefficient on $Vancouver_i \times postAug2016_t$ is negative and highly significant. It indicates that destination subdivisions in Vancouver experienced a differential price growth decline of 32 p.p. following the FBT relative to the destination subdivisions in Toronto, which did not face any tax. This suggests that lower foreign buyer demand had a huge adverse effect on house price growth following the Vancouver FBT.

The across-city estimate should be interpreted with caution for several reasons. First, the coefficient on $postAug2016_t$ indicates that destination subdivisions in Toronto also experienced

Table 8: Impact of Vancouver's FBT, Using Toronto as the Control Group

	(1) No Controls	(2) Time and Subdivision FE
Vancouver	0.0945***	
	(0.028)	
postAugust2016	-0.116***	
	(0.026)	
Vancouver × postAugust2016	-0.320***	-0.320***
	(0.038)	(0.032)
Observations	252	252
R^2	0.534	0.736

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents results from estimating the baseline difference-in-difference and fixed effects models, using Toronto as the control group. The dependent variable in both specifications is monthly log change in the composite HPI for all housing types, annualized. The estimation sample is the 21 Chinese-destination subdivisions in both cities (12 in Vancouver + 9 in Toronto), defined as ≥7.6% Chinese ethnic origin population share. $Vancouver_i$ is a dummy variable that equals 1 for Vancouver subdivisions and 0 for Toronto subdivisions. Non-Chinese destination subdivisions are excluded from the analysis. The time window is Jan - Dec 2016.

a decline in house price growth in the last five months of 2016, of almost 12 p.p. This may be indicative of shifts in foreign demand unrelated to Vancouver's FBT. To the extent that we have not constructed a perfect control group and the destination subdivisions of Vancouver are more exposed to foreign demand, the across-city estimate is likely to overstate the true impact of the FBT. Second, and relatedly, it is possible that foreign buyers substituted away from Vancouver and toward Toronto following imposition of Vancouver's FBT, so Toronto was also "treated." This would also lead the across-city comparison to overstate the true effect. However, were this the case, we would expect the coefficient on $postAug2016_t$ to be positive rather than negative. Third, unlike our previous within-city estimates, we are now attributing 100% of post-August 2016 differences between Vancouver and Toronto to the

FBT. This may overstate the true effect if there were other city-specific shocks during this time period. On the other hand, the within-city estimates are likely to understate the true effect size, since some of the decline in house price growth in below-median Chinese-origin subdivisions of Vancouver may also be due to the FBT. We conclude from this discussion that the true effect size is somewhere between the within-city estimate (-7.1 p.p.) and the across-city estimate (-32 p.p).

6 The Effect of Foreign Demand on the Rental and Construction Markets

Housing affordability encompasses multiple dimensions, and what is good for prospective owners is not necessarily good for renters (Quigley and Raphael 2004). In this section we evaluate the impact of our three foreign demand shocks on the home rental market and on new housing construction. To carry out these analyses, we obtain data on average rents, rental vacancy rates, and construction starts from the Canadian Mortgage and Housing Corporation (CMHC). The CMHC data are more granular but less frequent than the MLS HPI data: they are measured at the Census tract level (there are over 400 tracts in Metro Vancouver) but on an annual, rather than monthly, basis. See Appendix D.2 for a detailed description of this data source and its limitations,

The rental and and owner-occupied markets are linked by both the tenure choices of households and the construction decisions of firms.[25] As discussed in Section 3.3, given that

[25]Early studies of user cost and housing demand, inspired by the neoclassical investment theory of Jorgenson (1963), include Hendershott and Shilling (1982) and Rosen (1985). Poterba (1984) is one the first to explicitly invoke asset pricing to link house prices to future rents. On the tax arbitrage theory of tenure choice, see Swan (1984) and Narwold and Sonstelie (1994). On residential investment and the housing stock, see DiPasquale and Wheaton (1992).

houses purchased by out-of-town investors are often not rented out, foreign buying reduces the supply of housing available for occupancy, bidding up both prices and rents. It is therefore reasonable to expect that negative foreign demand shocks in the home purchase market, such as the FBT and China's new capital controls, will increase the short-run supply available for occupancy, so rents will fall (Hypothesis 4, the investment channel). But, if foreign buyers are buying with the intent to eventually migrate, then buying and renting are close substitutes, so the FBT and capital controls should cause rents to rise rather than fall (Hypothesis 5, the consumption channel). Given that rents in Vancouver may be constrained by binding price ceilings, rental vacancy rates and construction starts give important additional information about how the supply of rental housing and the overall house supply respond to foreign demand shocks.

6.1 The Rental Market

We begin our analysis by estimating eq. (3) with annual rent growth (the log change in each Census tract's average rent) as the dependent variable. This calculation includes both new and existing rental units, so reflects changes in landlords' asking prices and in housing quality. Since rents are measured only once a year, in October, we can include only two post-event indicator variables: $postFBT_t$ and $postCCC_t$, indicating observations after the FBT (October 2016 and October 2017) and after *both* capital control events (October 2017), respectively. As we discuss in Appendix D.2, our analysis is based on just under 30% of the entire sample of Vancouver Census tracts due to pervasive missing data in the public-use files.

Table 9, column 1, reports the effect of our two negative foreign demand shocks on the CMHC average rents data. The coefficient on $postFBT_t$ is significant and suggests that rent growth accelerated by around 2% over the time period. However, neither of the

Table 9: Impact of Foreign Demand Shocks on the Rental Market in Vancouver

	Rental Price Growth (%)	Vacancy Rate (%)			
	(1) All Types	(2) All Types	(3) Studio	(4) One BR	(5) Two BR
postFBT	2.042*	-0.257	0.0417	-0.137	-0.394*
	(1.079)	(0.156)	(0.262)	(0.170)	(0.218)
postCCC	0.554	0.388**	0.206	0.171	0.343
	(1.076)	(0.150)	(0.302)	(0.204)	(0.223)
Destination × postFBT	-0.290	0.167	-0.665	0.0959	0.329
	(1.496)	(0.235)	(0.483)	(0.267)	(0.309)
Destination × postCCC	-0.0197	-0.593**	-0.424	-0.488*	-0.303
	(1.569)	(0.241)	(0.454)	(0.269)	(0.317)
Tract Fixed Effects	Yes	Yes	Yes	Yes	Yes
N Tracts	133	142	72	126	129
Observations	372	371	174	325	316
R^2	0.209	0.538	0.673	0.539	0.534

Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table reports the effects of the FBT and Chinese capital control (CCC) shocks on average rent growth, defined as the change in log rents × 100% (column 1), and rental vacancy rates (columns 2-5). Regressions use CMHC data for all Vancouver Census tracts with available data in October 2015, October 2016, and October 2017. *postFBT* refers to observations in 2016 and 2017. *postCCC* indicates 2017 data only. Since data are annual, all specifications implicitly include year FE.

difference-in-difference coefficients are significant, suggesting that foreign buyers had no impact on rents in Vancouver. Rental market regulations likely explain this result: prior to Jan. 1, 2019, Vancouver landlords were prevented from increasing rents by greater than the rate of inflation plus two percentage points (*Residential Tenancy Regulation* 2018). The maximum allowable increase was 2.9% in 2016 and 3.7% in 2017 (Canada Mortgage and Housing Corporation various years). Moreover, landlords could only increase rents once per year and the landlord must allow 12 months between consecutive increases. They must also

provide tenants with three months' notice before raising rents. Since the post-event rent data are from just three months after the FBT and four months after the capital controls went into effect, these restrictions would make it very difficult for landlords to increase rents in full response to either shock. We are thus not surprised to observe no differential price effects.

Moving on from rental prices to the quantity of rental housing, columns 2-5 of Table 9 reports our estimates of the effect of foreign buying activity on rental vacancy rates.[26] The coefficient on the FBT interaction term is insignificant for every category of housing, which suggests that foreign buyers did not impact rental vacancies in the three months following enactment of the FBT. This is again a reasonable result given the short time window. However, the estimated coefficient on $Destination_i \times postCCC_t$ in column 2 is significant and large, -0.59, suggesting that rising foreign demand contributed more than half a p.p. decline to the overall rental vacancy rate. This is an economically important tightening in Vancouver's rental market: the mean vacancy rate in these three years was only 0.81%. The estimate is negative across all apartment sizes, and largest for one-bedrooms ($p = 0.07$).

The evidence in Table 9 is supportive of Hypothesis 5 rather than Hypothesis 4, i.e., the consumption channel dominates the investment channel. This fits with a narrative wherein Chinese buyers on the margin, no longer finding it feasible to purchase a property, instead chose to rent in the interim. Indeed, such behavior was documented in contemporaneous news accounts; see Nonko (2017).

6.2 The Construction Market

To disentangle the potential supply side response, we now analyze changes in construction starts over 2015-17. Each observation represents the cumulative flow of new construction

[26] We do not analyze the "three bedroom and up" category because the data are extremely sparse ($N = 28$, $NT = 73$).

starts in a Census tract over the entire calendar year. As such, year-2016 observations include construction projects that were begun both prior to and after the surprise enactment of the FBT in August. It is not obvious whether to categorize this year as pre- or post-treatment, so we exclude it from the analysis and compare construction activity in 2017 relative to 2015. Although the Chinese capital controls similarly did not go into effect until the middle of 2017, we are less worried about intra-year contamination because the controls were announced at the end of 2016. Developers are forward-looking and construction projects take many months to complete, so expectations of post-enactment sales prices likely affected new construction starts as soon as the controls were announced, i.e., beginning in January 2017.[27] In interpreting the results of our annual difference-in-difference regressions, the coefficient on $Destination \times post2016$ now captures the full effect $\beta_1 + \beta_2 + \beta_3$ in (3). Our predictions for its sign correspond to those of β_1 and β_3 in Section 3.3.

Table 10 reports results from estimating an annual version of eq. (3) with the log of residential construction starts as the dependent variable. The difference-in-difference coefficient is not significant for aggregate construction starts, in column 1. This suggests there was not an aggregate dynamic response to foreign buying activity. However, the individual building type categories suggests there were targeted responses by developers. The interaction coefficient is significantly less than zero for the detached housing category, in column 2 ($p < .001$). The estimate of -0.316 suggests that the combined decline in foreign demand caused a relative slowdown of construction starts for detached houses of 31.6% in destination neighborhoods in 2017 versus 2015. (The sum of the negative interaction

[27] Ideally we could also include 2018 data to obtain a cleaner estimate of the total impact of the Chinese capital controls, particularly if developers respond with a lag. However, in February 2018 Vancouver implemented a new "vacancy" tax, targeting buyers who do not pay local income taxes and who leave their homes vacant for a large portion of the year, and additionally raised the original FBT from 15% to 20%. So as not to conflate the effects of these additional policy shocks, we stop our analysis at year-end 2017.

Table 10: Residential Construction Starts in 2017 vs. 2015
(by Building Type)

	(1) All Types	(2) Detached	(3) Apartments	(4) Townhouse
post2016	0.205*	0.265***	0.148	0.209
	(0.119)	(0.065)	(0.161)	(0.429)
Destination × post2016	-0.0250	-0.316***	0.148	-0.335
	(0.158)	(0.087)	(0.219)	(0.475)
Tract fixed effects	Yes	Yes	Yes	Yes
N Tracts	422	387	379	118
Observations	764	697	652	158
R^2	0.775	0.897	0.786	0.840

Robust standard errors in parentheses
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table shows the combined effect of the FBT and CCC shocks on new housing supply in Vancouver, by building type. The regression model is an annual version of (3), with log(*Construction Starts*) in a calendar year the dependent variable. The sample is Metro Vancouver Census tracts in 2015 or 2017 with available data from CMHC (2016 is excluded).

coefficient with the positive level coefficient on *post*2016 indicates that new construction in destination neighborhoods was close to flat in absolute terms.) Detached houses tend to be more expensive on average and are particularly attractive targets for foreign buyers *cum* investors, so this result supports Hypothesis 3. Developers appear to have decreased building new detached homes in precisely the neighborhoods where foreign buyer demand was previously the highest. Looking at the apartment category in column 3, the estimated interaction coefficient is a large positive number, 0.148 ($p = 0.50$). We are cautious not to over-interpret a statistically insignificant estimate, but note that the sign of the estimate aligns with Hypothesis 5, whereby developers might substitute out of building detached homes and into apartments.

Table 11: Residential Construction Starts in 2017 vs. 2015
(by Intended Market)

	(1) All Markets	(2) Home Ownership	(3) Rental	(4) Condo
post2016	0.205*	0.201***	0.305**	-0.0586
	(0.119)	(0.070)	(0.118)	(0.375)
Destination × post2016	-0.0250	-0.354***	-0.204	0.307
	(0.158)	(0.093)	(0.147)	(0.632)
Tract fixed effects	Yes	Yes	Yes	Yes
N Tracts	422	390	356	189
Observations	764	709	618	254
R^2	0.775	0.864	0.832	0.818

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table shows the combined effect of the FBT and CCC shocks on new housing supply in Vancouver, by the intended market of the building under construction. The regression model is an annual version of (3), with log(*Construction Starts*) in a calendar year the dependent variable. The sample is Metro Vancouver Census tracts in 2015 or 2017 with available data from CMHC (2016 is excluded).

Table 11 reports similar results, but now analyzing construction starts by their intended market. The difference-in-difference estimate for the homeowner market segment is highly significant and negative (column 2). Our estimate suggests that the decrease in foreign buyer demand lead to a relative decline of over 35% in the construction of new buildings intended to be sold to homeowners in destination neighborhoods. Since foreign buyers are primarily interested in purchasing property, they would certainly count as prospective homeowners for developers. This result fits with Hypotheses 1 and 3: the foreign demand shocks combined to reduce overall housing demand in destination neighborhoods, and developers responded by decreasing the number of construction projects targeting homeowners.

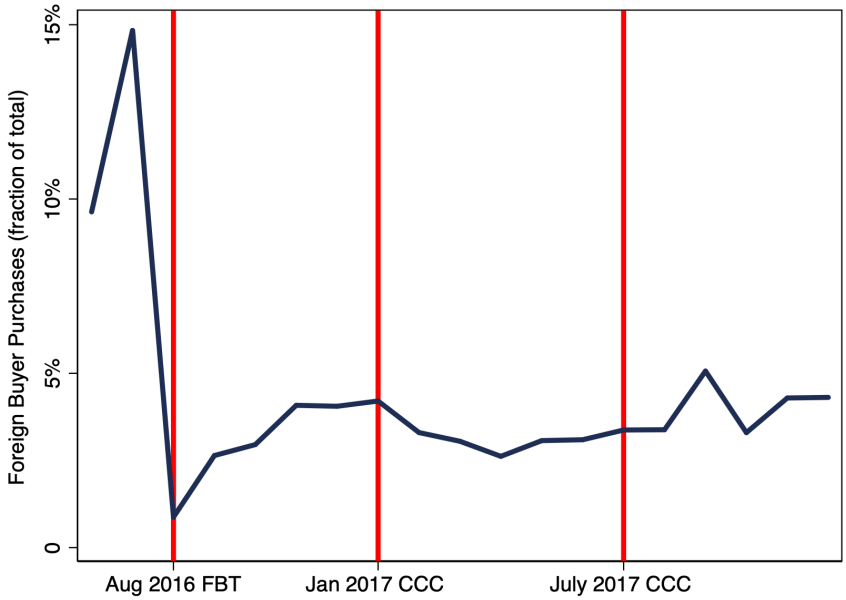
7 Policy Implications

Although the bulk of our analysis has used three exogenous demand shocks resulting from policy interventions to identify the impact of foreign buyers on real estate in destination neighborhoods, the difference-in-difference methodology offers a second interpretation. Namely, we can use destination versus non-destination neighborhoods to identify the effectiveness of the two policy actions. This interpretation has important implications, given that more and more global cities are considering adopting policies targeting foreign buyers (Favilukis and Van Nieuwerburgh 2018). The nascent empirical literature directly addressing policy interventions is mixed on whether these policies are effective at curbing house price growth (e.g., Suher 2016; Hilber and Schöni 2018; Somerville, Wang, and Yang 2018).

Returning to the visual evidence presented in Figure 1, the raw time-series data suggests that the FBT had a dramatic effect. Greater Vancouver house prices rose 34.5% at an annualized rate over the first seven months of 2016, but fell by 8% annualized between August and December (in log points). Taken at face value, this would suggest that the FBT lowered annual house price growth by 42.5%. On the other hand, a longer event window that compares house price growth in 2017 to 2016, ignoring the problem of intervening capital control shocks, might suggest that the FBT had no effect. After conducting a thorough empirical analysis using a credible identification strategy, we find that the FBT had a negative but moderate effect on house price growth. Our within-Vancouver estimate provides a lower bound on the effect size of -7.1% annualized, while our Vancouver versus Toronto comparison provides an upper bound on the effect size of -32%. Since Toronto is a less comparable control group, we favor estimates on the lower end of this range as the true effect size.[28]

[28] Both approaches rely on a destination vs. non-destination comparison, so provide estimates of the localized neighborhood impact. Whatever the true value, the aggregate city-wide impact is likely to be smaller, since the FBT presumably had a smaller impact on non-destination subdivisions of Vancouver.

Figure 6: Foreign Buying Activity in Vancouver



Notes: This figure illustrates trends in the volume of Vancouver foreign buying activity surrounding each of the three exogenous shocks examined by this paper. The graph runs from June 2016, two months prior to the FBT, to December 2017. The foreign buying variable measured by the vertical axis is defined as the percentage of total property purchases by volume that were made by foreign buyers in Metro Vancouver for a given month. Source: B.C. Ministry of Finance Property Tax Transfer data.

Another source of evidence is the data on foreign purchasing activity that the provincial government started collecting in June 2016, two months before the surprise enactment of the FBT. Figure 6 plots the monthly percent of total property purchases by foreign buyers from June 2016 through December 2017 by volume. Directly following the FBT's implementation in August 2016, the fraction plummeted from almost 15% to below 2%. Interestingly, there are no visible effects surrounding the announcement of the Capital Controls in January 2017 or their enactment in July later that year. These data would seem to suggest that the FBT was highly effective at reducing foreign demand, while the capital controls seem to have had almost no effect. However, our analysis suggests that the effects of the two policy

shocks were comparable, and if anything, the Chinese capital controls had a bigger impact on curbing overall house price growth (Table 3). On the other hand, the FBT was more narrowly targeted and may have a bigger impact on the most expensive category of detached housing (Table 4). The short time window between these events ultimately makes it hard to disentangle what the long-run effect of either policy would be individually, underscoring the need for further research into other cities' interventions.

Finally, our analysis suggests that Vancouver's FBT is a case study in the Law of Unintended Consequences. In a simulation calibrated to Vancouver, Favilukis and Van Nieuwerburgh (2018) find that the FBT should increase overall city welfare by increasing the supply of available housing and causing rents to fall. But as the authors fully acknowledge, this story relies on out-of-town buyers being modeled as investors who "use the home as a pied-à-terre rather than renting it out to locals, thereby removing housing from the market" (p. 1). We find strong evidence that the story is more complicated. Following passage of the FBT and enactment of the enhanced Chinese capital controls, foreign buyers appear to have switched from buying to renting, leading to a tighter rental market in which rents likely would have risen if not for rent controls. Moreover, we find that the two policies induced a significant decline in construction of owner-occupied housing in destination neighborhoods. This dynamic supply response raises questions about the long-run effect on house prices, and it has important consequences for future policy interventions that are enacted with the intent of improving housing affordability by slowing foreign buyer demand.

8 Conclusion

Accelerating house price growth in many global cities has been accompanied by a significant rise of foreign investment in residential real estate. This paper exploits three exogenous shocks to foreign buyer demand in Vancouver, in an attempt to investigate the direct impact of foreign buyers on housing market outcomes. The results suggest that slowing foreign buyer demand has a negative, but moderate effect on house price growth that is attenuated by a negative supply response in the construction market. Further, governmental regulations in the rental market prevent declining foreign buyer activity from impacting rental price growth within a two-year time window. However, evidence from rental vacancies suggests that foreign buyers substituted into the rental market following the imposition of a tax on foreign buying. Thus, even for wealthy foreign investors, renting and purchasing property are close substitutes.

The empirical analysis presented in this paper of both demand- and supply-side channels represents an important extension to the existing literature on foreign buying activity. Furthermore, this paper uniquely contributes to the growing literature that specifically investigates the impact of Chinese foreign investment on residential housing markets. In order to fully address the impact of foreign buyers on housing affordability, future researchers may want to examine outcomes in the labor market and changes to aggregate wealth. Additionally, future research should attempt to examine the above mentioned substitution dynamics in greater detail. A comprehensive analysis of investor substitution into other asset classes such as commercial real estate would provide important information about the full extent of foreign buying activity. Finally, future research should look into the effectiveness of more recent policy interventions that specifically target foreign speculation and properties that are left vacant.

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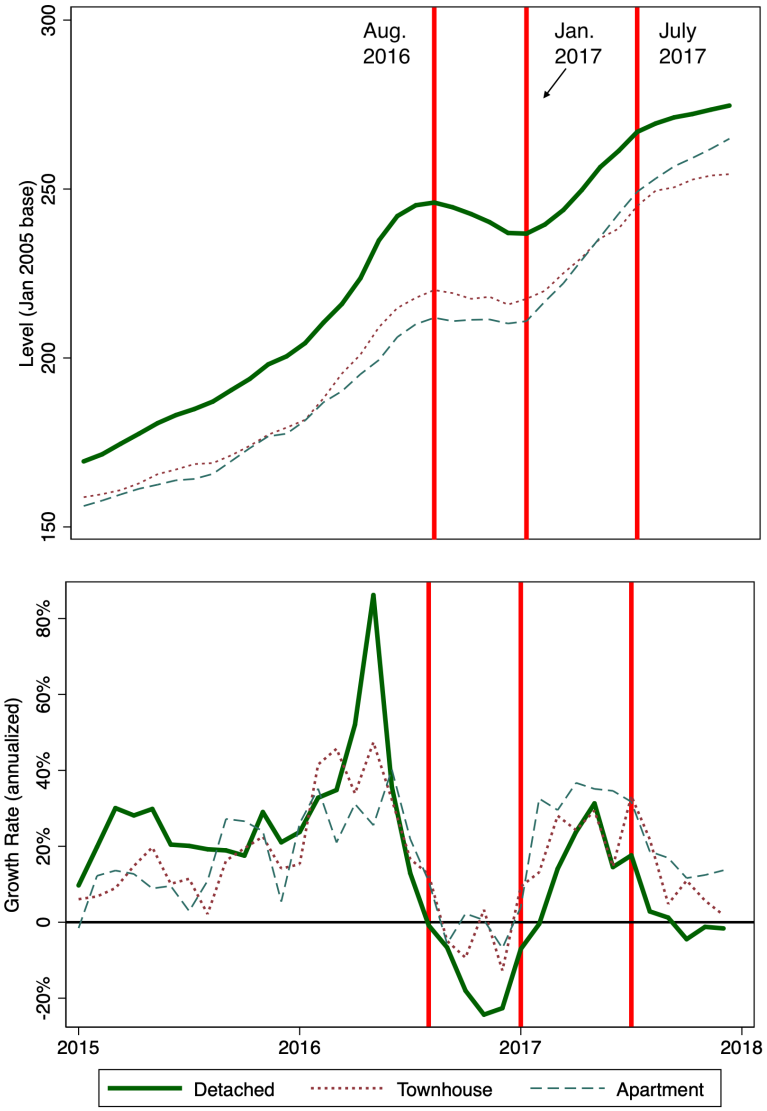
A Additional Figures

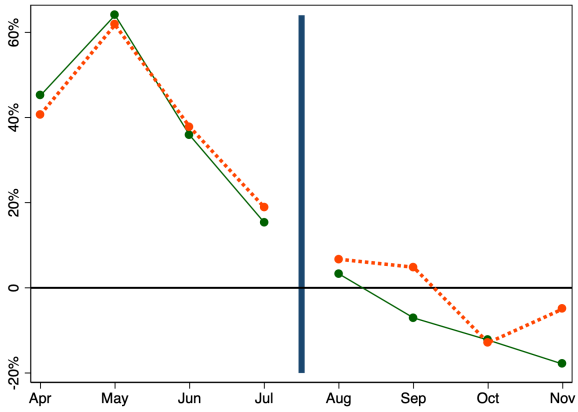
Figure A.1: Vancouver House Price Dynamics by Housing Type



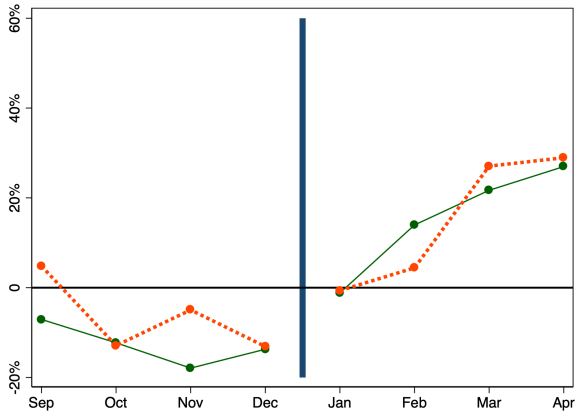
Notes: The top panel plots the same HPI measure as shown in Figure 1, but disaggregated into three separate housing categories. The bottom panel calculates the annualized percentage change growth rate for these three categories.

Figure A.2: HPI Growth Rates in Destination and Non-Destination Subdivisions

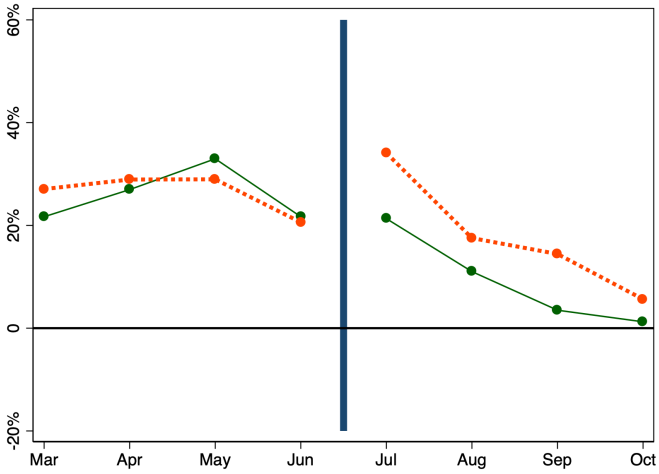
(a) Aug. 2016: FBT Implemented



(b) Jan. 2017: Capital Controls Announced



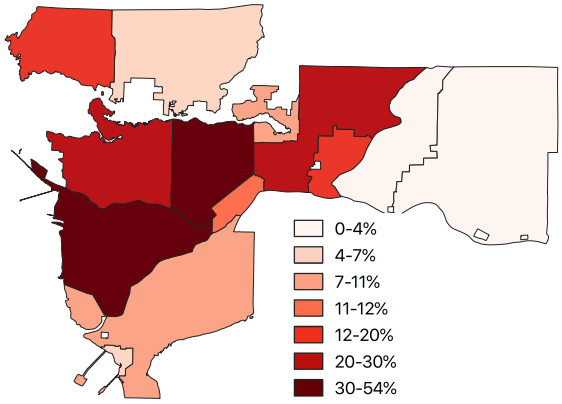
(c) July 2017: Capital Controls Go into Effect



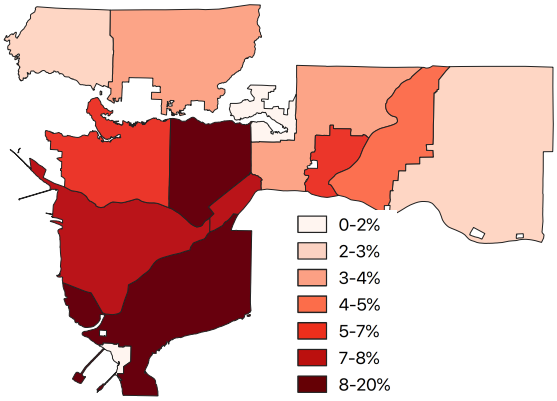
Notes: Each panel illustrates the movement of the annualized HPI growth rate variable (using the composite measure) for destination and non-destination subdivisions surrounding each event of interest. The vertical bar in each panel separates the pre and post periods. Because each data point represents a monthly measure, we have made the decision to place the bar after the final month in the pre-period.

Figure A.3: Geographic Density of Chinese and South Asian Origin Residents in Vancouver

(a) Fraction Chinese



(b) Fraction South Asian



Notes: Panel A illustrates the geographical variation of our baseline Chinese ethnicity variable that we use to designate destination/non-destination subdivisions measured as the percentage of population in each subdivision that is of Chinese ethnic origin. Panel B illustrates the same type of variable, but for South Asian ethnic origin instead.

B Additional Tables

Table B.1: Correlation Between Foreign Purchases and other Variables of Interest

Variable	Percent Foreign Buyer Purchases	Percent Chinese Ethnic Origin
Percent Chinese Ethnic Origin	0.95*	1
Percent South Asian Ethnic Origin	0.23	0.14
Total HPI Growth from 2014-2016		
All Types	0.06	0.08
Detached	0.49	0.49
Demographic Characteristics		
Population	0.48	0.52
Income	-0.54	-0.47
Percent with College Degree	0.54*	0.60*
Percent with Public Transit Access	0.30	0.35
Percent Condomoniums	0.60*	0.61*

Notes: This tables presents correlation estimates of Vancouver foreign buyer purchases and Chinese ethnic share with other variables of interest. The foreign buying variable is defined as the percentage of total property purchases that were made by foreign buyers in each Vancouver subdivision, using data aggregated from June 2016 through December 2017. This data was only made public by the Province of British Columbia following the August 2016 FBT.

* $p<0.05$

Table B.2: Foreign Demand Shocks and Vancouver House Price Growth: Specifications with Housing and Demographic Controls

	Controls				Fixed Effects	
	(1)	(2)	(3)	(4)	(5)	(6)
	None	Housing	Demographic	Both	Subdivision	Time and Subdivision
Destination	0.0108	0.0250	0.0310	0.127		
	(0.033)	(0.036)	(0.041)	(0.102)		
postAugust2016	-0.390***	-0.390***	-0.390***	-0.390***	-0.390***	
	(0.036)	(0.035)	(0.036)	(0.035)	(0.035)	
postJanuary2017	0.221***	0.221***	0.221***	0.221***	0.221***	
	(0.035)	(0.034)	(0.034)	(0.033)	(0.033)	
postJuly2017	-0.0333	-0.0333	-0.0333	-0.0333	-0.0333	
	(0.030)	(0.029)	(0.029)	(0.029)	(0.029)	
Destination × postAugust2016	-0.0673	-0.0673	-0.0673	-0.0673	-0.0673	-0.0673*
	(0.048)	(0.048)	(0.048)	(0.047)	(0.048)	(0.038)
Destination × postJanuary2017	0.0678	0.0678	0.0678	0.0678	0.0678	0.0678*
	(0.046)	(0.045)	(0.044)	(0.044)	(0.044)	(0.035)
Destination × postJuly2017	-0.0771**	-0.0771**	-0.0771**	-0.0771**	-0.0771**	-0.0771***
	(0.038)	(0.037)	(0.037)	(0.036)	(0.037)	(0.025)
Constant	0.352***	-14.88***	-0.240	8.253	0.357***	0.217***
	(0.024)	(4.768)	(1.063)	(22.752)	(0.017)	(0.024)
Observations	432	432	432	432	432	432
R^2	0.484	0.499	0.500	0.510	0.510	0.749

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents results from estimating the basic DD specification of Table 3 using different sets of control variables and fixed effects. The dependent variable in every specification is the monthly log change in the composite HPI for all housing types, annualized. The time window is Jan 2016 - Dec 2017.

Table B.3: Testing Different Destination Cutoffs

Destination subdivisions:	(1) *Top 8*	(2) *Top 6*	(3) *Top 4*	(4) *Top 2*
Destination × postAugust2016	-0.0712*	-0.0321	-0.0318	-0.0289
	(0.040)	(0.038)	(0.041)	(0.052)
Destination × postJanuary2017	0.0693*	0.0390	0.0255	0.0144
	(0.037)	(0.036)	(0.040)	(0.050)
Destination × postJuly2017	-0.0790***	-0.0721**	-0.0520*	-0.0404
	(0.026)	(0.028)	(0.030)	(0.038)
Subdivision and Time Fixed Effects	Yes	Yes	Yes	Yes
N subdivisions	17	15	13	11
Observations	408	360	312	264
R^2	0.740	0.736	0.727	0.714

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents results from estimating the baseline model using higher cutoffs to define a destination subdivision within Metro Vancouver. The definition of a non-destination subdivision remains the same, $fractChinese_i \leq$ the median, thus causing subdivisions to drop out as the destination cutoff increases. The dependent variable in every specification is the monthly log change in the composite HPI for all housing types, annualized. The time window is Jan 2016 - Dec 2017.

Table B.4: Testing Different Cutoffs of Toronto Placebo

	(1) 50th Percentile	(2) 60th Percentile	(3) 70th Percentile	(4) 80th Percentile
Destination × postAugust2016	-0.0257	-0.0238	-0.0190	-0.0124
	(0.038)	(0.039)	(0.042)	(0.046)
Subdivision and Time Fixed Effects	Yes	Yes	Yes	Yes
N subdivisions	25	23	20	18
Observations	300	276	240	216
R^2	0.311	0.292	0.263	0.251

Robust standard errors in parentheses

* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Notes: This table presents results from estimating the Toronto Placebo model using higher cutoffs to define a Toronto destination subdivision. In each column the definition of a non-destination subdivision remains the same, $fractChinese_i \leq$ the Toronto median of 3.4%, thus causing subdivisions to drop out as the destination cutoff increases. The dependent variable in every specification is the monthly log change in the composite HPI for all housing types, annualized. The time window of analysis is Jan 2016 - Dec 2016.

C Narrative Evidence That the 2016 Foreign Buyers Tax Was a Surprise Event

A thorough review of the Provincial Government's position and the public's awareness of that position shows that the FBT was an unexpected shock. From scouring the archives of *The Vancouver Sun*, a leading daily newspaper, we found no pre-emptive allusion to the specific legislation announced on July 25, 2016. Although there was extensive coverage of Vancouver's housing affordability crisis, the possible causal role of foreign buyers, and policy proposals such as a speculation tax, the Provincial Government strongly and publicly opposed taxing foreign buyers throughout 2015 and the first half of 2016. We document the history of this opposition below and show that the Provincial Government's introduction of the FBT in July 2016 was an unexpected reversal of course.

An event that took place one year before the FBT was implemented helps explain how we made this determination. In June of 2015 the leader of the B.C. Provincial Government, Premier Christy Clark, pointedly rejected an appeal by Vancouver Mayor Gregor Robertson to introduce legislation that might curb foreign speculation. Clark cited a finance ministry report asserting that "there is little evidence wealthy or foreign investors are driving housing unaffordability." The government worried that measures to reduce foreign investment "would have little impact on general housing prices," would cause the loss of real estate sales and construction jobs, and might cause rents to rise (Lee 2015). Premier Clark and her Liberal Party majority remained in office through July 2017.

In February 2016 the Provincial Government tabled a budget that reaffirmed its anti-interventionist position. While the minority New Democratic Party proposed a tax on foreign buyers, the Liberal government instead proposed tax incentives for new residential

construction and a small increase in the property transfer tax on luxury homes over $2 million. Finance Minister Mike de Jong reiterated his opposition to stronger measures: "If by cool you mean actually reduce the value of people's major asset, their home, clearly we were not interested in taking that step," (Shaw and Robinson 2016). He even emphasized the benefits of foreign investment and immigration to British Columbia: "Our government continues to welcome, indeed, encourages those who choose to come to our province to invest, create new jobs and hopefully make their lives here, contributing to the social and economic fabric of our communities" (Yaffe 2016). In one notable concession, the budget also authorized the collection of data on foreign buying activity starting in June. However, de Jong indicated in a May 2016 press conference that he would want at least "six months" of data before proceeding with any new proposals, and again cautioned against "singling out foreign investment for a separate or punitive tax" (Palmer 2016d).

The first hint that legislative changes might be in the work came on June 6. After Mayor Robertson renewed his call for a luxury or speculation tax in June 2016 (Hoekstra 2016), Premier Clark promised "more action 'in the coming weeks.'" However, a *Vancouver Sun* columnist noted that implementing a tax would require a special session of the legislature, which was not scheduled to meet again until 2017, and speculated that action on densification around public transit lines was more likely (Palmer 2016a). On June 14 Mayor Robertson proposed implementing a vacancy tax on homes that are left empty (Robinson 2016). The B.C. government responded favorably to this proposal, describing it a "thoughtful suggestion" to increase the supply of rental housing (Palmer 2016b), and announced two weeks later that the legislature would be called back into session on July 25 to amend Vancouver's city charter (Cassidy 2016). Reporting on this summer session again emphasized that the B.C. government's agenda focused on "measures to boost the housing supply" (Palmer 2016b).

On July 11 Finance Minister de Jong stated, "It is ultimately about supply" (Palmer 2016c). On July 21, days before the summer session convened, de Jong told reporters that "he does not believe government can use taxes to solve the problem" of housing affordability (Shaw 2016b).

On Tuesday July 26, the front-page headline of *The Vancouver Sun* read, "B.C. Adds Foreign Buyers Tax to Insulate Metro Real Estate." The opening paragraph described this as a "surprise move by the B.C. Liberal government." The article goes on to call this "an abrupt about-face" and "an end to a promise" to lower property transfer taxes rather than raise them (Shaw 2016a). An editorial on July 28 described the government as moving "quickly and decisively," stating that it was not clear when the government decided to act ("Impact of Property Tax Unclear" 2016). Moreover, the magnitude of the FBT (15%) also came as a surprise; a proposal by ten professors from the University of British Columbia and Simon Fraser University in January had called for only a 1.5 percent surcharge on foreign buyers (Lee 2016). Subsequent articles discuss "a mad rush on the last Friday before the tax took effect" (Duggan 2016) and "the collapse of deals struck but not closed before it went into effect" ("Tax Fallout Hits Locals" 2016).

The narrative record thus provides strong evidence that the Provincial Government's actions on July 25, 2016, came as a surprise. The Liberal majority clung to its public opposition to taxing foreign investors as late as July 21. One article described the political debate as follows: "The New Democrats emphasize the need to discourage foreign buyers, the Liberals push to increase the housing stock" (Palmer 2016d). Even when the summer legislative session was announced on July 11, observers thus expected the Liberal government to propose a vacancy tax and other measures to increase housing supply, not to tax foreign demand. Therefore, we can confidently assert that the 2016 FBT was a surprise shock to the

residents of Vancouver as well as to foreign buyers around the world.

D Data Sources

D.1 Vancouver House Price Data

The MLS HPI combines the repeat-sales method and the hedonic approach to create a robust measure of overall house prices. HPIs created using the repeat-sales method overcome the important problem of controlling for often hard to observe characteristics that may vary across homes because they literally measure the change in sales price of the same home sold more than once. These characteristics might range from the specific heating system to access to a certain regional amenity. Nevertheless, indices constructed using a pure repeat-sales approach assume that the attributes of a particular house do not change between when it was last sold. This might be an unrealistic assumption given the popularity of home renovations and upgrades. Furthermore, only using homes that have been sold multiple times necessarily restricts the sample size available to the researcher constructing the index, which could potentially lead to bias. Therefore, merging the benefits from the repeat sales method and the traditional hedonic approach produces an HPI statistic that can reliably measure changes in house price growth over a given period of time.

The different housing categories for the MLS HPI are defined as follows. Detached homes are defined as independent structures (typically one or two story single-family homes) built on land that exceeds the footprint of the structure on all sides. Apartment units are defined as being part of a multi-unit building where residents might not have access to the shared lot from their units. Townhouses occupy a middle ground between apartment units and detached buildings. They are differentiated from apartment buildings by the fact that owners share in

maintenance fees and have exclusive access to a portion of the lot. A composite HPI, the aggregate measure, is calculated by taking the weighted average of the above four categories based on their contribution to overall sales activity. We obtained the monthly MLS HPI data by manually scraping the REBGV website for years 2012 through 2018, although we will generally focus on years 2016-2017 for our analysis.

Constructing our panel data sets consisted of merging the census data with the HPI data at the relevant geographic level. This was complicated by the fact that certain REBGV geographic boundaries do not align exactly with the corresponding census subdivision boundaries. For example, REBGV splits the Burnaby subdivision into three separate regions, Burnaby West, East, and North. Instead of losing precious observations by aggregating these three boundaries to match the Burnaby census subdivision, we used QGIS software to combine the relevant Census tracts in order to create three custom regions with the census data. This required direct communication with an REBGV representative in order to obtain the exact boundaries that are behind their custom regions. Another modification we performed consisted of splitting the Census data for the downtown Vancouver subdivision into West Vancouver and East Vancouver in order to match the custom REBGV regions. Again, we did this from the ground level by aggregating the appropriate Census tract data within each East/West region, being careful to enact the correct averaging and summing depending on each specific variable. The final modification that was required was to aggregate the census subdivisions of North Vancouver and North Vancouver City to match the single REBGV region of North Vancouver. After all of this heavy lifting, we were left with 17 regions within Metro Vancouver for our analysis.

D.2 Vancouver Rental Market Data

The CMHC conducts a Rental Market Survey of major Candian urban areas every October. We take rental price data from the table titled "Urban Rental Market Survey Data: Average Rents in Urban Centres". This table includes average rents for four different types of units (studios and one/two/three bedroom rentals). Rental vacancy rates data comes from the table titled "Urban Rental Market Survey Data: Vacancy Rates". The construction market data are from the larger Starts and Completions Survey and is released in two different tables, titled "Housing Starts: By Dwelling Type" and "Housing Starts: By Intended Market". Dwelling Type simply refers to the type of structure that has begun construction and includes different categories for detached, semi-detached, townhouses, and apartments. Intended Market refers to the "tenure in which the unit is being marketed". The categories composing this measure are homeownership, condominium, and rental. Homeownership means both the unit and lot will be sold to a single buyer. Condominium is a form of ownership where the owners of individual units collectively own the building and/or lot. Rental refers to a dwelling that is being constructed for the purpose of renting out. The Starts and Completions Survey is carried out through on-site visits using construction permit information and supplemented with local sources and other searching procedures.

The CMHC rental and construction data contains two different kinds of limitations. The first relates to missing data. Starting with rents and vacancy rates, a significant number of observations are missing data. The composite rent measure has just over 70% of the 438 tracts missing with individual categories ranging from 72% to 95%. According to CMHC, the missing data are due to a combination of privacy concerns for tracts with a small number of housing units within a given category and statistical reliability concerns. From inspecting the patterns in the missing data there does not appear to be a distinct cutoff based on tract

population. If the majority of the population were located in non-missing tracts, the 70% number would be made less problematic. Unfortunately, since Census tracts are drawn to have similar population levels, this is not the case. A simple test illustrates that 68% of the population resides in the 70% of tracts for which there are no data. The vacancy rate data follows the same patterns and has 72% of its composite category missing. The construction market data are much better on this front and only contains 13% missing tracts for the composite measure (although the row and semi-detached categories have 85 and 83% missing respectively). In both cases, missingness can vary from year to year within a Census tract, so our available-cases dataset is an unbalanced panel.

The second limitation inherent in the CMHC data is the frequency of measurement. The rent and vacancy rate data are reported once a year for the month of October. The construction market data are also reported yearly and measures the aggregate activity for the entire year. Because of the nature of our event-based analysis, this annual frequency is limiting. For the construction data, we are unable to measure the individual effects for any of our three events. We are restricted to comparing aggregate construction activity in 2015, before any major shocks occurred, to the aggregate activity that took place in 2017, amidst the announcement and implementation of the capital controls. For the rental data, because it reports a snapshot for the single month of October, things are a little better. We are able to use three years of data: October 2015 (before any shocks), October 2016 (shortly after the FBT) and October 2017 (after both capital control events have taken place).