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The Housing Market Impacts of Constraining Second Home Investments*

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Abstract

We investigate how political backlash against wealthy second home investors in high-amenity places – tourist areas and superstar cities – affects local residents. We exploit a quasi-natural experiment: the 'Swiss Second Home Initiative' (SHI), which banned the construction of new second homes in desirable tourist locations. Consistent with our model, we find that the SHI lowered transaction prices of primary homes in affected areas by around 12% but did not adversely affect prices of second homes. Our findings suggest that the negative effect on local economies dominated positive amenity-preservation effects. Constraining second home investments may reinforce rather than reduce wealth inequality.

Key words: Second homes; wealth inequality; land use regulation; house prices; homeownership; real estate investments.

JEL classification: D63, G12, R11, R21, R31, R52.

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1 Introduction

In this paper we explore a recent global phenomenon; the surge of investment in 'second homes' – properties that are not used as primary residence – and the subsequent political backlash against wealthy investors in such properties. Our main focus is on the impact of constraining second home investments on local residents and the value of their primary residences. Exploiting a unique quasi-natural experiment in Switzerland – the 'Second Home Initiative' (SHI) that was narrowly approved by voters in March 2012 – we find that the effective ban on the construction of new second homes in touristic areas has substantially lowered the value of residents' primary homes in these areas. Our most conservative estimates suggest that constraining second home investments lowered prices of primary residences in affected municipalities by around 12%. We also explore the effects of the ban on the price of second homes. The estimated effect is positive, albeit statistically insignificant.

The number of second homes across the globe has surged dramatically over the last two decades, and particularly in recent years, fueled by rising earnings and wealth accumulation among a growing cohort of 'top earners'. The lack of alternative investment opportunities in recent years – a consequence of the low interest environment – may have additionally contributed to the surge.

In Switzerland alone there are currently around 600,000 second homes – almost one such home for every five households. Yet, the investment boom in second homes is neither just a Swiss phenomenon nor is it confined to touristic countries. It is a world-wide phenomenon. Countries such as the United States, the United Kingdom, France, China, or Singapore have seen a dramatic increase in wealthy individuals investing in second homes in recent years. Within these countries, major cities – such as New York, London or Paris – and popular tourist regions observed the most pronounced investment booms.

In the United States, the number of second homes increased by about 20% to 6.8 million between 1995 and 2005 alone (Belsky *et al.*, 2007). In the United Kingdom, according to the English Housing Survey, the number of second homes more than doubled between 1995 and 2013, to 671,000 units.[1] The rise of the market for second homes is perhaps most dramatic in China. In 2002, 6.6% of all urban households owned a second home. By 2007, this share surged to 15% (Huang and Yi, 2011). Finally, in France, according to the French National Institute of Statistics and Economic Studies, INSEE, by 2014, second homes represented 9.3% of the total housing stock.

The surge in second home investments has triggered a serious political backlash in many countries, reflecting a diverse array of concerns. Critically, wealthy second home investors – especially foreign ones – are being blamed for the dramatic house price increases in many desirable high-amenity locations – tourist places as well as superstar cities such as New York or London.[2] Antipathy to new second home investors may also reflect "an ugly dislike of outsiders" or in some cases even "NIMBYism of second home investors themselves, keen to

[1] This number is fairly low relative to the size of the country. This is because the UK has an extraordinarily restrictive planning system that focuses on urban containment, driving up house prices (Hilber and Vermeulen, 2016) and thereby encouraging British investors to buy in nearby countries such as France or Spain.

[2] A national poll conducted for the Observer and Guardian Cities in April 2016 suggested that survey respondents mainly blamed 'immigration' and 'foreign investors buying up property' for Britain's housing crisis. Fifty-one percent of survey respondents thought foreign investors had a "significant impact".

preserve the exclusiveness of their holiday patch" (The Economist, 2016). This antipathy may be further reinforced by a growing number of wealthy at the top end and rising wealth inequality (Rognlie, 2014) in conjunction with jealousy motives. The proposition that the political backlash is driven by jealousy motives of the less wealthy is consistent with a simple analysis of the SHI-voting outcome: The SHI found most support in municipalities with a high share of renters, low incomes and low second home rates.[3]

Other concerns relate more directly to the impact of owners of second homes in the affected localities: The uncontrolled construction of second homes may blight the beautiful landscape in touristic areas. Moreover, second homes typically stay empty for much of the year, creating a ghost town atmosphere outside tourist seasons, yet generating little or no local tax revenue.

One prime example of political backlash is the UK, where the then Chancellor George Osborne announced a 3% hike on the stamp duty of second homes, effective from April 2016.[4] Popular tourist destinations located on the South West coast of the country – such as Lynton and Lynmouth in Devon and, recently, St. Ives and Carbis Bay in Cornwall – went a step further and adopted complete bans on second homes to limit the investors' footprint (the ban in St. Ives and Carbis Bay was backed by 83% of the voters).

Another example is New York City. In 2012, the city abolished a 20% tax-abatement for owners of condos that were not primary residences. More recently, the Fiscal Policy Institute proposed a steep property tax surcharge on the city's expensive pied-à-terre residences.

Similar policies were enacted in Continental Europe. For example, in France, the national government approved a law in 2014, allowing municipalities with overheating housing markets to introduce a property tax on second homes of up to 20%. In Denmark, municipalities grant building permits for summer cottages only if projects meet stringent planning requirements – mainly intended to preserve the coastline. These restrictions were imposed mainly to prevent an inflow of (foreign) investors.

The political backlash against second home investors is not confined to Europe and the US. The Chinese government for example announced a whole series of measures to curb second home investment. These include drastic minimum requirements on down-payments in the entire country (although recently somewhat relaxed) and even more drastic measures in certain cities such as Beijing, where single-person households were banned from buying more than one residence and where a 20% capital gains tax on property was imposed. In a similar vein, Singapore's government introduced several measures between 2010 and 2015 including an additional stamp duty tax and increased compulsory down-payments to discourage second home investments. In Australia, a review board ensures that the purchase of existing properties by foreign investors benefits local communities. It precludes purchases by foreign buyers for investment motives (buy-to-let or expected capital gains) or for "weekender" recreational use. Finally, Israel introduced a property tax increase on second homes in 2015 with the intent to fight so called 'phantom apartments'.

[3] We discuss these results in more detail in Section 3. Regression results are reported in Appendix Table A1.
[4] We provide newspaper references to this and other second home policies proposed or implemented in various countries in Web-Appendix A.

To date we know little about the consequences of these policies and, in particular, we lack evidence on the impact of restrictions on the construction or ownership of second homes vis-à-vis instruments that tax non-primary residences.

In our empirical analysis we exploit a unique quasi-natural experiment – the SHI – to explore the impact of a constraint on the construction of new second homes in high-amenity places. The SHI stipulates that in municipalities with a share of second homes – determined prior to the initiative's approval – of over 20%, investors are not allowed to plan and build any new second homes going forward, though primary residences built prior to 2013 can still be converted into second homes. Fiscal authorities in Switzerland legally categorize all housing units as either 'primary' or 'second' homes depending on whether or not a household uses a housing unit as primary residence.[5] There is certainty about whether a unit is a primary residence because households only pay local income taxes in their primary place of residence (i.e., in the place where they live more than half of the year).[6]

In theory, both quantity restrictions and taxes could be efficient means to internalize alleged negative externalities caused by second home investors (Weitzman, 1974)[7]. In practice, however, market restrictions and regulations often have unintended consequences.[8] In this paper, we explore the potential intended *and* unintended consequences on the market for primary homes of constraining second home investments (as a potential alternative to disproportionally taxing them via a local property or land value tax).

When conducting our analysis, we faced four main challenges. The first challenge is of a theoretical nature: to understand the mechanisms through which a constraint on second homes may affect the price of primary and second homes. To this end, we develop a simple dynamic general equilibrium framework. We first consider a setting in which primary and second homes effectively trade in separate markets (i.e., are poor substitutes). Still the two housing markets are linked: a growing number of wealthy second home investors positively affects local economies (including local wages) but adversely affects the primary residents' valuation of local amenities. Our model yields two main propositions: The ban adversely affects the equilibrium price of primary homes (Proposition 1) but positively affects the equilibrium price of second homes (Proposition 2).

We also consider the converse setting in which primary and second homes are perfect substitutes and consequently trade in the same market. In this case, the price of existing primary and second homes must move in the same direction. Whether this direction is positive or negative is theoretically ambiguous.

[5] The second home status does not depend on the tenure (owner-occupied vs. renter-occupied) of the unit. Developers can still build rental properties—sometimes labelled 'investment properties'—post 2012 but, crucially, renter-occupiers must live in these new units permanently, not just during the tourist season.
[6] Cantonal inspectors can monitor an occupier's presence in a second home. They can also conduct surprise visits for control purposes if they suspect misconduct. In a similar vein, in Israel authorities check the water usage of properties to determine whether an occupier may falsely claim to use a property as second home.
[7] This theoretical argument only holds for technological externalities that are associated with market failure (e.g., negative vision externalities) but not for pecuniary externalities (e.g., primary house prices increase because of investor-driven demand in the local market).
[8] One such example is rent control that has been associated with significant welfare costs from misallocation across demographic subgroups (Glaeser and Luttmer, 2003).

Our empirical evidence, which reveals a strong negative effect of the ban on the price of primary homes but an insignificant positive effect on the price of second homes, seems largely consistent with the view that primary and second homes may be rather poor substitutes in the case of Swiss tourist areas. The fact that the number of transactions from primary residents to other primary residents did not decrease post-ban (i.e., few primary residents appear to have exercised their conversion option) provides further support for the notion that primary and second homes trade in separate markets.

The second challenge concerns the estimation of the treatment effect on the price of primary homes. Although the treatment assignment variable – which is a deterministic function of second home rates – is pre-determined, it may correlate with unobserved dynamic price fundamentals at the municipality level. For example, if the second home rate of a municipality positively correlates with its proximity to major amenities – such as attractive skiing areas – and demand for this proximity increases over time, then the treatment variable is not exogenous, and accounting for municipality fixed-effects does not solve the problem.[9]

To counter this potential endogeneity, we employ two different strategies. The first strategy allows for different time trends in our explanatory variables and – in particular – second home rates. The estimated effects remain stable when we allow for time trend differentials. Our second strategy is to restrict the sample to municipalities whose second home rates belong to a reasonably narrow interval containing the threshold value. We document results for the [0.1, 0.5] and [0.15, 0.3] intervals. This approach, which corresponds to a parametric regression discontinuity design, allows us to focus on "similar" municipalities by way of excluding most major urban areas and highly touristic municipalities. It thus addresses the concern that unobserved price dynamics might be correlated with the treatment itself. Reassuringly, our estimated effects of interest hardly change.

The third challenge is the possibility that the market for primary residences may experience policy-induced compositional changes in the characteristics of traded properties. One recurring feature of the literature on the estimation of treatment effects using hedonic models[10] is the implicit assumption that the treatment exclusively affects the dependent variable of interest leaving explanatory variables unaffected. The validity of this assumption depends on the nature of the experimental setting itself and, as pointed out by Angrist and Pischke (2009), on the timing of the measurement of explanatory variables with respect to the dependent one.

In the case of the SHI, the assumption is likely invalid when control variables are measured post policy implementation: the ban slows the economic development of touristic places, and, consequently, fewer new properties change hands. The proposition that the composition of the traded properties did not change post policy – in particular with respect to age-related characteristics – seems to be too far-fetched to ignore. To address this concern we conduct a mediation analysis as suggested by Imai *et al.* (2010) and Imai *et al*. (2011) and as recently employed by Heckman *et al.* (2013) and Heckman and Pinto (2015). Specifically, we include

[9] A similar problem may arise for fiscal trends because in Switzerland local taxes apply at the place of primary residence. Low fiscal burdens are capitalized into higher house prices (Basten *et al.*, 2014; Hilber, forthcoming).

[10] A vast and thriving literature considers the estimation of treatment effects using hedonic models – most prominent examples include, Chay and Greenstone (2005), Greenstone and Gallagher (2008), or Cellini *et al.* (2010). This literature has contributed greatly to our understanding of how environmental (dis)amenities and public policies capitalize into housing prices.

contemporaneous controls in our model and estimate the importance of the compositional change with respect to the treatment assignment.

We find that including contemporaneous controls and taking into account the mediation effect of age-related characteristics does not substantially alter the magnitude of the estimated total price drop, which is about 10 per cent after taking into account mediation effects. We do, however, find that the implementation of the policy significantly altered age-related characteristics of traded properties. This explains 23% of the total price decline.

A final challenge is the fact that our estimate of the impact of the SHI-imposed ban on the price of primary homes is a 'net effect'. As we point out in our model, constraints on second home investments have two opposing effects; a negative effect via adversely affecting the local economy and a positive effect via preserving the landscape. In an attempt to identify these two mechanisms, we estimate a heterogeneous treatment effect model. We proxy the adverse local economy effect with the share of votes against the SHI (a higher share of no votes implies a stronger adverse effect on the local economy) and the positive landscape effect with the share of unproductive land (such as lakes, glaciers, etc.) in the municipality. (More unproductive land implies a higher natural amenity value.) We interact these two proxy variables separately with the treatment variable and, all else equal, indeed find a negative effect of the SHI in places with a higher share of no votes and a positive effect in places with high natural amenity values. The implied net effect is again negative and of a similar magnitude as in our base specification.

The remainder of this article is structured as follows. In section 2 we discuss the related literature. Section 3 discusses the institutional setting and the specifics of the SHI. The next section presents a simple dynamic general equilibrium model with for the empirical analysis. Section 5 discusses the data and provides descriptive statistics. We outline our empirical setup in Section 6 and present main results and robustness checks in Section 7. The final section concludes.

2 Related Literature

Our paper relates to a relatively small but growing recent literature that focuses on the role played by residential real estate investors in housing markets. To begin with, Haughwout *et al.* (2014) investigate the role of investors in the recent U.S. housing crisis. Three main findings arise from their analysis. First, investors are overrepresented in states that display the strongest boom-bust cycles. Second, investors misreporting their occupancy status to obtain better credit conditions had the tendency to bid more aggressively during the boom than owner-occupiers and admitted investors. Third, investors defaulted at a higher rate during the bust phase than owner-occupiers.

Chinco and Mayer (2016) compare local second home buyers to out-of-town investors. They find that out-of-town buyers – unlike local second home buyers – behave as misinformed speculators, increasing future house prices and the implied-to-actual rent ratio. They develop an estimation strategy taking into account the possible reverse causality between housing prices and the out-of-town demand of investors. In a related paper, Bayer *et al.* (2015) classify investors into two categories according to their observed investment strategies: middlemen and speculators. The former group aims to make profit by buying from motivated sellers at prices below the market value and re-selling quickly, whereas the latter group times their investments to markets displaying strong price increases. By excluding the possibility that speculators possess superior information on housing price dynamics, they indirectly establish a causal link between speculative behavior and housing price bubbles.

Three recent papers focus on international second home investments in major world cities. Cvijanovic and Spaenjers (2015) explore the effect of international demand for luxury secondary residences in Paris. They point out how investors concentrate in specific areas, increasing local housing prices. In line with Chinco and Mayer (2016), they find that foreign investors realize lower capital gains compared to local ones. Badarinza and Ramadorai (2015) focus on London and document how foreign real estate investors possess a "home bias abroad". They invest in areas displaying high shares of residents of the same country thus affecting housing prices and transaction volumes. Finally, Suher (2016) explores the response of non-resident owners of second homes in New York City to targeted annual property taxes. Using the city's 2013 change in the property tax treatment of condominiums, he documents that non-resident buyers have a significant impact on house prices within a subset of highly desirable neighborhoods, but no impact outside of these areas.

Overall, the literature appears to support the widespread concern that non-resident investors into residential real estate increase local house prices and fuel market instability. This gives potential legitimacy to policies that aim to constrain non-resident real estate investments either by imposing higher local taxes on non-primary owners or by constraining the quantity of such investments. To date, we know little about the effects of such investment constraints on local housing market outcomes. This paper aims to fill this gap.

Our contribution to the literature is fourfold. First, we develop a simple dynamic general equilibrium model that describes the opposing forces affecting the price of primary and second homes. Second, we provide corresponding evidence that quantifies not only the net effect of a ban on new second homes on the price of primary homes but also the direction and economic significance of the opposing channels at work. Third, we propose an econometric approach to distinguish the direct effect of the policy on the price of primary homes from compositional changes of the traded housing characteristics. Fourth, our analysis also considers mid- and long-term investors and does not exclusively focus on short-term speculators. The latter do not fully capture the significance of the global second home investment phenomenon. The presence of short-term, often inexperienced, speculators may only be one of the ultimate symptoms associated with overheating local housing markets.

3 Institutional background and the Second Home Initiative (SHI)

Popular initiatives are an instrument of direct democracy that allows Swiss citizens to modify the country's constitution. Supporters of an initiative are required to collect 100'000 valid signatures in favor of the initiative within 18 months. In order to avoid undue influence of populous regions (in Switzerland called 'cantons' and 'half-cantons'), the initiative must be approved by the majority of voters *and* cantons. Popular initiatives have a low approval rate: up to April 2015 only 22 out of 198 initiatives obtained dual majority.[11] This is for two reasons. First, popular initiatives are often considered extreme and meant to send a signal to policy makers rather than being intended to actually modify the constitution. Second, authorities are

[11] See http://www.admin.ch/ch/d/pore/vi/vis_2_2_5_9.html for further details.

allowed to formulate a more moderate counter-proposal, often leading proponents to withdraw the initiative.

Supporters of the SHI collected enough validated signatures by January 2008. The Federal Council, the Parliament, most of the political parties and economic organizations recommended to vote against the initiative.[12] Thus it came as a surprise when in March 2012 Swiss voters approved the SHI with the narrowest of margins; 50.6% of the votes and 13.5 of the 26 cantons.[13] Although voting polls suggested a tight majority in favor of the initiative is feasible, its approval by the majority of cantons was a complete bolt from the blue.

On January 1st, 2013 the SHI ordinance came into force, banning construction of new second homes in municipalities where such homes represented 20% or more of the total housing stock. Two elements of the ordinance are particularly relevant for our analysis. First, second homes that had obtained a construction permit prior to the vote were still allowed to be built after the ordinance came into force. This prevented the number of newly built second homes above the threshold to fall to zero in the years just after the approval of the initiative. Second, primary homes built – or possessing a construction permit issued – before the ordinance came into force (i.e., before 2013) may still be converted into second homes, but those planned and built after the ordinance was enacted lost their conversion option.[14]

Both elements of the ordinance were defined after the approval of the initiative, thus they were unknown to the voters prior to August 2012. Although the wording of the initiative had to be introduced into the Swiss constitution, implementation-specifics (and conformity with existing laws) were open to debate. In fact, the final text of a popular initiative is usually an arm-wrestled compromise between politicians supporting the initiative and those representing lobbies' interests. Therefore, the uncertainty concerning the specific implementation of the SHI made anticipation strategies extremely unlikely even after the voting results were known.

Figure 1 illustrates a strong positive correlation between the SHI-share of no votes and the share of second homes in a municipality. This positive association survives when we conduct a simple analysis of voting results at municipality level and control for other confounding factors such as voter turnout, income, homeownership rate, distance to major urban centers, or distance to major ski resorts. Detailed findings are reported in Appendix Table A1.

Treated areas in our setting – mountainous and other areas near lakes with shares of second homes above 20% – typically possess local economies that are reliant on tourism. A majority of voters in these areas, on balance, benefit substantially from the investment home industry, directly or indirectly. It is therefore no surprise that the majority of local residents – especially in municipalities with very high shares of second homes and high homeownership rates – were strongly opposed to the SHI. The last column in Appendix Table A1 illustrates this persuasively:

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[12] See https://www.parlament.ch/de/services/volksabstimmungen/fruehere-volksabstimmungen/volksabstimmungen-2012/volksabstimmung-2012-03-11.

[13] Switzerland counts 6 half-cantons. The SHI was approved by 12 cantons and 3 half-cantons.

[14] Initially the 'conversion option' was confined to sales that did not trigger the construction of a new primary home in the treated or another nearby municipality. This measure intended to avoid speculative behavior of primary homeowners. However, the restriction was not included in the final law – implemented in January 2016 – because policy makers deemed it ineffective, likely for two reasons. First, mobile skilled individuals are likely to move over longer distances, so the restriction would not prevent them from moving away and pocketing the proceeds from the conversion option. Second, implementation (coordination across local jurisdictions) would have been very difficult and costly to monitor.

the higher the share of second homes, the higher the homeownership rate, the closer a municipality to a major ski resort, the higher the voter turnout, and the higher the number of tax payers and the average income, the more strongly permanent residents were opposed to the SHI. This is suggestive that – consistent with our main findings – permanent local residents in the affected areas weighed the adverse economic effects of the SHI much more strongly than the positive effects highlighted forcefully by the supporters of the initiative (preservation of beautiful landscape and views, prevention of a ghost-town atmosphere, and avoidance of negative fiscal externalities).

The voters in the affected areas, despite their strong opposition and turnout, did not manage to prevent the approval of the SHI. This is because voters in populous and non-touristic (control) areas also had a say. A simple voting analysis of these non-treated areas – reported in column 2 of Appendix Table A1 – indicates that the overall support may have been mainly driven by jealousy motives of voters with little wealth: the higher the share of renters and the lower the income in a non-treated municipality the stronger was support in favor of the SHI. Moreover, perhaps driven by an 'existence value' associated with preserved landscape, the further away voters lived from high amenity places (and therefore the higher the travel cost associated with a second home) the greater was their likelihood to support the SHI.

4 The Model

In this section, we present a simple dynamic general equilibrium model in the spirit of Rosen (1979) and Roback (1982). We build on recent work by Glaeser and Gottlieb (2009) who provide a general spatial equilibrium setting for the structural analysis of housing prices, wages, and population growth when agglomeration economies are present.[15]

We consider a system of local jurisdictions that differ in the quality of major natural amenities, such as mountains or lakes (but an amenity could also be interpreted e.g. as the touristic or consumer center of a superstar city). High quality amenities attract second home investors and increase the production efficiency of firms that exploit these amenities, leading local economies to exclusively specialize in the tourism sector. Mobile workers choose their primary residence by sorting across local jurisdictions according to wages, housing prices, natural amenities, and the negative externalities caused by second home investors. Investors generate such externalities via adversely affecting the landscape and creating ghost towns.

One key assumption in our model is that primary and second homes trade in two distinct markets within each local jurisdiction, that is, the two markets have separate demand and supply functions. This implies that primary and second homes are *poor substitutes*. In section 4.6 we discuss the contrasting case of *perfect substitutability* along with predictions.

The assumption of poor substitutability does not seem farfetched. It arises when second home investors and primary residents differ in their preferences for the micro-location within municipalities or for the layout of a property. For example, second home investors tend to have strong preferences for nice views onto mountaintops or lakes or for quick access to ski lifts. These micro-locations are typically scarce. Vice versa, primary residents tend to strongly value good access to employment opportunities, local schools or supermarkets. Moreover, the layout

[15] Our theoretical framework also relates to recent work by Desmet and Rossi-Hansberg (2013), Hsieh and Moretti (2015), and Gaubert (2015).

of permanent homes often differs starkly from that of second homes. Differences in preferences for micro-locations and layouts, within municipality heterogeneity in locational access to amenities and services, and differences in the layouts of properties may thus effectively create separate markets. Strong wealth differentials between well-off second home investors and less well-off primary residents may further reinforce this market separation.

4.1 Tourism industry

The local tourism industry produces non-tradable goods and services such as local ski lifts or restauration services that are sold to second home investors. We assume that residents in the municipality supply one unit of labor inelastically and we ignore cross-commuting, such that the number of local residents corresponds to local employment. Following Glaeser and Gottlieb (2009) and Hsieh and Moretti (2015), the output of firms is characterized by a Cobb-Douglas production function that displays decreasing returns to scale at the aggregate level:

$$Y_{it} = A_{it} N_{it}^{\beta} K_{it}^{\gamma} \bar{Z}_i^{1-\beta-\gamma}, \quad 0 < \beta, \gamma < 1, \; \beta + \gamma < 1 \tag{1}$$

where Y_{it}, N_{it}, and K_{it} represent local output, employment, and traded capital in municipality i at time t, respectively; A_{it} is the local total factor productivity; $\bar{Z}_i$ represents the municipality fixed stock of non-traded capital (e.g. land) that makes returns to scale decreasing at the municipality level but constant for individual firms. The industry is assumed to be perfectly competitive and firms choose the level of the factors of production to maximize their profits. Traded capital is supplied with infinite elasticity at an exogenous price set equal to 1. Labour and capital first order conditions lead to the labour demand equation:

$$N_{it} \propto A_{it}^{\frac{1}{1-\beta-\gamma}} p_{it}^{\frac{1}{1-\beta-\gamma}} W_{it}^{\frac{\gamma-1}{1-\beta-\gamma}}. \tag{2}$$

4.2 Local residents

Local residents are perfectly mobile and equalize their indirect Cobb-Douglas utility function

$$V_t = \theta_i N_{it}^{S^{\eta}} \frac{W_{it}}{r_{it}^{a}}, \quad 0 < a < 1, \; \theta_i > 0, \; \eta < 0 \tag{3}$$

across municipalities, where r_{it} represents the cost of local housing in the considered time period – i.e. the rental cost or the periodical cost of homeownership – and W_{it} denotes the wages paid by the local tourism industry. The term $\theta_i N_{it}^{S^{\eta}}$ denotes an endogenous amenity index that decreases as the number of second home investors N_{it}^{S} in the municipality increases. In our context, the factor θ_i reflects either the exogenously given value of natural amenities or the quality of the social-life in the municipality. The value primary residents attach to this index evolves dynamically according to the negative externalities imposed by second home investors. The parameter a is the constant expenditure share on housing.

4.3 Second home investors

Second home investors sort across municipalities to maximize their indirect Cobb-Douglas utility, which we assume depends on the optimal consumption of tourism services, housing, and natural amenities:

$$V_t^{S} = \theta_i^{S} N_{it}^{S^{\epsilon}} \frac{W_t^{S}}{p_{it}^{1-b} r_{it}^{S^{b}}}, \quad 0 < b < 1, \; \theta_i^{S} > 0, \; \epsilon < 0, \tag{4}$$

where r_{it}^{S} represents the local second home market housing cost, p_{it} is the price of tourism services, and W_t^S denotes the exogenous wages of second home investors that are determined outside our system of municipalities.[16] Similar to the case of primary residents, the amenity index $\theta_i^S N_{it}^{S^\epsilon}$ reflects the dislike of an investor for the presence of other investors. (The endogenous amenity index could also be interpreted as congestion costs associated with the consumption of tourism services such as the use of ski lifts.) The parameter b is the constant expenditure share on housing of second home investors.

4.4 Housing developers

We describe the problem of developers of primary residences following Glaeser (2008). (Developers of second homes solve a similar optimization problem. See Appendix B.) Let us assume that in every municipality at an arbitrary point in time $t_0 < t$ there is a fixed supply of housing units $H_i C_{it_0}^{\rho_i}$ – where $H_i, \rho_i > 0$ are parameters affecting the supply elasticity – that can be built at a unitary cost of C_{it_0} or less and sold at the market price P_{it_0}. Prices and heterogeneous construction costs are assumed to increase at steady state rates g_i and g_i^c, respectively, prior to the ban. Both rates are lower than the interest rate r. Profit maximizing developers choose the optimal period t in which to develop and sell a property. The profit at t_0 of developing a plot of land is given by the discounted value of the future property price $P_{it} = (1+g)^{t-t_0} P_{it_0}$ less the discounted value of its future unit cost $C_t = (1+g^c)^{t-t_0} C_{it_0}$:

$$\max_t \left((1+r)^{-(t-t_0)}\left((1+g_i)^{t-t_0} P_{it_0} - (1+\ g_i^c)^{t-t_0} C_{it_0}\right)\right),\ \ t \geq t_0. \quad (5)$$

Marginal development in period t occurs when either the optimal stopping rule obtained by time-deriving the continuous-time version of (5) is satisfied, or when the profit function decreases with time. In that case, waiting to develop harms housing developers.

As we assume that primary ($\mathcal{P}$) and secondary ($\mathcal{S}$) residences are produced by two distinct supply functions, the housing supply of each type of residence is then given by

$$H_i^j \left(\frac{r - g_i^j}{\left(1+ g_i^{j,c}\right)^{t-t_0} (r - g_i^{j,c})} P_{it}^j\right)^{\rho},\ \ j \in \{\mathcal{P}, \mathcal{S}\}. \quad (6)$$

For ease of exposition, in what follows we only report the $\mathcal{S}$ superscript to distinguish second homes from primary ones.

We model a ban on second homes as the limiting case of an increase in the cost of producing such houses. By exogenously increasing $g_i^{\mathcal{S},c}$ the second home supply becomes more inelastic. If the increase in costs is large enough, the supply will become perfectly inelastic, which corresponds to a ban on second homes. Comparative static results based on the growth of construction costs of second homes thus correspond to those of a ban of such homes.

[16] The wage W_t^S can be thought of as the share of wage investors spend where their second home is located. This is the case, for example, if second home investors – which consume composite goods and services c_{it} and housing H_{it} where their primary residence is located (location i) and touristic services c_{lt} and housing H_{lt} where they own a second home (location l) – have preferences according to a nested Cobb-Douglas function of the form $U^S(u_{it}, u_{lt}) = (u_{it})^{s_1}(u_{lt})^{1-s_1}$ with $u_{kt} = \theta_{kt}(c_{kt})^{1-s_k}(H_{kt})^{s_k}, k = i, l$. Then investors spend a constant share $(1-s_1)$ of their "total" wage W_t in location l, i.e. $W_t^S = (1-s_1)W_t$.

4.5 *Equilibrium prices*

Having stated the problem of firms in the tourism sector, primary residents, second home investors, and housing developers, we can solve for the equilibrium solution of the system. To link the endogenous stock price of primary and secondary residences to the value of their housing flows, we use the standard dynamic price equation:

$$P_{it}^{j} = \sum_{l=0}^{+\infty} \frac{r_{it+l}^{j}}{(1+r)^{l}} = \frac{1+r}{r-g_{i}^{j}} r_{it}^{j}, \; j \in \{\mathcal{P}, \mathcal{S}\}, \tag{7}$$

where we assume that rents grow at a steady state rate g_i^j. We can now define the concept of dynamic equilibrium:

DEFINITION 1. A dynamic equilibrium is a vector $\left(\frac{W_{it+1}}{W_{it}}, \frac{P_{it+1}}{P_{it}}, \frac{N_{it+1}}{N_{it}}, \frac{P_{it+1}^{S}}{P_{it}^{S}}, \frac{N_{it+1}^{S}}{N_{it}^{S}}, \frac{p_{it+1}}{p_{it}}\right)$ such that for every municipality i and every time period t:

i) Local labour markets clear according to equation (2).

ii) Primary residents and second home investors equalize their indirect utilities across municipalities according to equations (3) and (4), respectively.

iii) Housing markets of primary and secondary residences clear.

iv) The market of tourism services clears.

As the dynamic system of equations characterizing local economies can be linearized, we have

COROLLARY 1. There exists a unique dynamic equilibrium.

Proof. See Appendix B.

We can use the dynamic equilibrium to make comparative static predictions about the impact of constraining second home investments (i.e. increase their construction costs) on primary and second home prices. Let $P_{it+1}^{0,j}$ and $P_{it+1}^{1,j}$ denote the post-ban price of primary and second homes if the ban would not have been/is enacted, respectively. We can express the average treatment effect on the treated as

$$E\left(\ln\left(P_{it+1}^{1,j}\right) - \ln\left(P_{it+1}^{0,j}\right) | D = 1\right) = E\left(\ln\left(\frac{P_{it+1}^{1,j}}{P_{it}^{j}}\right) - \ln\left(\frac{P_{it+1}^{0,j}}{P_{it}^{j}}\right) | D = 1\right), \quad j \in \{\mathcal{P}, \mathcal{S}\} \tag{8}$$

where P_{it}^{j} denotes pre-ban prices and D is a dummy variable equal to 1 if the municipality is subject to the ban and 0 otherwise. We obtain the following propositions, which we test in the empirical part of the paper:

PROPOSITION 1. If primary and second homes are not substitutable, the average price effect on primary homes of constraining new second home investments in high-amenity municipalities is negative.

PROPOSITION 2. If primary and second homes are not substitutable, the average price effect on second homes of constraining new second home investments in high-amenity municipalities is positive.

Proof. See Appendix B, Table B1.

The intuition behind Proposition 2 is straightforward: A constraint (or outright ban) on new second homes makes supply more price inelastic, thus capitalizing future demand growth of second homes into comparatively higher equilibrium prices. More inelastic supply also implies fewer second home investors and this in turn reduces demand for tourism services, lowering prices for such services.

To understand the intuition behind Proposition 1 consider the effects of a constraint (or outright ban) on new second homes on the local landscape and the local economy: If local residents don't care much about the disamenity caused by the presence of investors ($\eta \approx 0$), the constraint (ban) hurts the local tourism industry without providing any benefit to primary residents, causing wages and the number of residents to be lower in the new equilibrium. This negatively impacts the aggregate housing demand for primary homes, leading to a negative equilibrium price effect. Now consider the other extreme where local residents care a lot about the negative externality imposed by investors ($\eta \ll 0$). In this case, a constraint (or ban) on second home construction attracts local residents into treated municipalities, relative to the counterfactual. However, the negative effect of the constraint on wages is now reinforced by this increase in the number of residents due to the decreasing returns to scale assumption. Despite a comparatively higher number of primary residents, the aggregate housing demand for primary residences is lower, explaining the negative price effect in this case.

In this latter case with $\eta \ll 0$ Proposition 1 hinges on the decreasing returns to scale assumption, which may be plausible for the local tourism industry. In Appendix B, we explore whether Proposition 1 still holds when we instead assume agglomeration economies in the local tourism industry. We demonstrate that if agglomeration forces become very strong and exceed a certain threshold, a constraint (ban) on new second homes may increase the price of primary homes. However simulations suggest that such a threshold is unrealistically high.[17]

Propositions 1 and 2 also allow us to identify the winners and losers in the treated areas. Proposition 1 implies a negative wealth effect for primary homeowners in treated areas driven by the fact that constraining second home investments impose a significant economic cost on local residents that is capitalized into lower primary house prices. Since prices are measured as the present value of imputed rents, constraining second home investments is also expected to lower future rent levels.[18] But this does not mean that renters are better-off. This is because the fall in rents is commensurate to a decrease local wages. In a spatial equilibrium setting without relocation costs, renters should be neither better nor worse off. Proposition 2 implies that existing second home investors in treated locations are, on average, better-off. These theoretical considerations are consistent with our simple SHI voting analysis. While existing second home investors could expect to benefit from the proposed ban, they did not vote in the affected municipality and local homeowners at least had a strong incentive to vote against the SHI. Indeed, municipalities with high homeownership rates and high second home shares were most strongly opposed.

[17] See Web-Appendix B for the simulations.

[18] We would not expect a negative effect of the ban on primary house prices in a setting with exogenously determined incomes. Consider a retirement community where retirees receive an exogenously determined pension income. Retirees will welcome the preservation effects of the ban on the local landscape, whereas local labor market considerations are, in the extreme, irrelevant. These considerations could explain the popularity of banning second homes in British sea resorts, which are popular with retirees.

4.6 Equilibrium prices when primary and second homes are perfect substitutes

We now consider the case where primary properties and second homes are *perfect substitutes*. In this setting, the price of existing primary and second homes must be the same and, by implication, the impact of the ban on the price of existing primary and second homes must go in the same direction as well. Although the ban prevents the construction of new second homes, it does not prevent second home investors from entering the location. This is because existing primary residents have the valuable option to sell their property to second home investors and either move away or build a new – cheaper – primary home *without conversion option* at the outskirts of the location.[19] Nevertheless, the expected growth rate of the number of second home investors should decrease post-ban. This is because eventually the municipality will run out of existing primary homes with a conversion option, at which point the ban puts an absolute upper limit on the number of second homes.

In our setting, if the expected growth rate of the number of new second home investors decreases, this has a negative feedback effect – via local wages – on local residents. Aggregate demand for housing in the local jurisdiction decreases, yet, at the same time, supply of second homes (or primary homes with a conversion option respectively) becomes perfectly inelastic. The net impact of these two opposing effects on the equilibrium price of houses with a conversion option is theoretically ambiguous.

In contrast to the separate market case, primary homeowners retain a 'conversion option' to sell their property to second home investors post-ban. How valuable this option for existing owners is depends on their moving costs. In the extreme (excessively high moving costs) the option to convert is worthless. However, in reality the option may at least partially hedge primary homeowners against the adverse effects on the local economy. Put differently, ignoring moving costs, primary residents may not be worse-off compared to existing second home investors.

Interestingly from a policy point of view, in a setting with perfect substitutability, banning second homes is likely to reinforce the very problems it is supposed to tackle: The ban reduces the willingness-to-pay for housing of local residents due to the adverse effect on local wages. The ban thus creates incentives for primary homeowners to sell their properties to second home investors, whose willingness-to-pay has not changed post-ban. Some primary residents may sell and move away, which would mean that the share of second home investors relative to the total local population rises and the 'ghost town' problem worsens. Some primary residents may sell and purchase newly constructed primary dwellings that do not have a conversion option at the outskirts of the location, in effect creating a new separate market of 'properties without a conversion option' for primary residents. To the extent that existing primary homes are clustered mainly in the center of municipalities and new primary homes have to be built at the outskirts, this could reduce social cohesion and may even increase sprawl – because a ban on second homes does not prevent construction of primary homes at the outskirts.

[19] In theory, lawmakers could retrospectively revoke the right of existing primary residents to sell their homes to second home investors. This severely infringes property rights and is thus unlikely. New primary homes built after the ban cannot include a conversion option as otherwise the ban would be inconsequential.

5 Data and descriptive statistics

We combine housing data from mortgage lenders provided by the Swiss Real Estate Datapool Association (SRED) with municipality-level data from the Swiss Federal Statistical Office (FSO), the Swiss Federal Office for Spatial Development (ARE), and the Swiss Federal Tax Administration (FTA). In this section we briefly describe the data and provide summary statistics. We provide more detail on the sources and data in the Web-Appendix C.

5.1 Data sources and variables

Housing transaction data — Data on individual transaction prices and corresponding housing characteristics for all of Switzerland and from 2000q1 to 2015q1 come from the SRED, which collects and pools transaction data from various mortgage lenders – both private and cantonal banks. For each housing unit, in addition to the transaction price, we know whether the buyer intends to use the unit as primary or secondary residence. Moreover, we obtained detailed information on the physical characteristics of the unit (number of rooms, number of bathrooms, number of parking places, micro-location quality, housing unit quality, housing condition, construction year, and an indicator for whether the unit is a single-family house or an apartment) and on the unit's location (municipal and cantonal identification codes and 'municipality type').

Second home rates — We obtained the municipality-level second home rate from ARE. Since no official statistics were available right after the approval of the SHI, ARE combined data from the Federal Population Census of 2000 – containing an inventory of Switzerland's buildings and dwellings – with data from the Federal Register of Buildings and Dwellings of 2011 to compute second home shares to determine whether municipalities were affected by the SHI. The number of second homes per municipality is calculated as the total housing stock less the number of primary homes. Second home rates are thus fixed over the period of our analysis, although some municipalities were allowed to revise their rates.

Municipality characteristics — We obtained municipality-level data on the share of SHI-no voters from the FSO. Land-use category data, sourced from the FSO and measured between 2004 and 2009, allow us to construct a measure for the share of undevelopable land – lakes, glaciers, and bedrock – capturing the value of natural amenities in a given municipality. We use these two variables – share of no votes and share undevelopable land – to estimate how the impact of a second home ban may vary according to the extent to which a municipality relies on tourism, and with respect to the value of its natural amenities.

Geographical Information System (GIS) data on the boundaries of administrative units at national, cantonal, and municipal level in 2013 is supplied by the Federal Office of Topography. GIS information allows us to compute the distance in km of each municipality from 15 major Swiss urban centers and 53 major ski resorts. These two measures capture how households value the proximity to major labor markets and natural amenities, respectively. Finally, we collected data from the FSO on the number of workers and firms active in the service sector as measured in 2011 and on the homeownership rate in 2000.

Fiscal data — Fiscal data at municipality level comes from the FTA. Annual data is currently available from 1995 to 2011. In our analysis, we use the number of taxpayers present in a given municipality, the municipality average net income after taxes, and the municipality's Gini index based on this average net income. Additionally, we consider the share of foreign residents in the municipality – only available from 2008 to 2014 – to take into account the share of the population represented by foreign individuals paying local taxes.

5.2 *Descriptive statistics*

We provide summary statistics of the data in Tables 1A (control group) and 1B (treatment group) for the pre (2010-2011) and post (2013-2014) SHI approval periods. For the purpose of our regression analysis we aggregate individual transaction data of primary and second homes at municipality level in each of the two periods.[20]

A comparison of the two samples reveals that the threshold imposed by the initiative essentially divides areas with major urban centers (control) from mountainous ones (treatment). Below the threshold, municipalities are nearer to major urban centers and more distant to major ski resorts, whereas the opposite is true for treated municipalities. Control municipalities thus – on average – have more taxpayers and higher salaries. Interestingly, the percentage of individuals and firms active in the service sector is similar for the two groups, suggesting that local economies in treated places mostly rely on tourism and that agriculture may only play a marginal role. Figure 2 illustrates the geographic distribution of treated municipalities: most of them are situated in or near the Alps, further supporting our claim that for these municipalities the tourist industry is the main pillar of their local economies, consistent with our model. Given this proximity to the Alps, treated municipalities have more natural amenities, as measured by the share of unproductive surface, compared to the control group.

Treated municipalities have lower average house prices, both before and after the approval of the initiative. However, whereas the control places have a positive price trend in the traded primary properties pre and post the SHI-approval, the price trend in the treated locations is reversed post implementation of the policy. House prices are lower in treated municipalities in part because they are further from major urban areas, but in part also because of lower housing quality. In treated places traded properties are older, although the difference is not statistically significant. Interestingly, we observe an increase in this age differential after the SHI-approval: The average age of transacted properties in the control group remained stable. In the treatment group however it increased by more than four years. Similarly, the aggregate housing stock quality of traded properties in treated municipalities appears to have been adversely affected by the ban.

Two remaining points are worth noting. First, as depicted in Figure 3, the SHI did not noticeably affect the pattern of primary housing transactions with respect to second home rates: primary homes are mainly transacted in and nearby major urban centers, which typically possess second home rates between 10% and 15%. Similarly, very little of the second home demand from the above-20%-municipalities appears to have shifted to control municipalities just below the 20% threshold. Consistent with this, Table 1A and 1B show that the average number of transacted primary homes has not been significantly affected by the policy in treated municipalities. Second, as Figure 4 illustrates, prior to the approval of the SHI, the linear time trends of (disaggregated) average annual log-prices of transacted primary homes are extremely similar below and above the initiative's threshold. The equality of the trend coefficients cannot be

[20] This corresponds to computing bi-annual averages of data for each municipality. Computing averages over two years allow us to include a greater number of Swiss municipalities in our sample and to increase the number of transactions observed in a given municipality. See the next section for further details.

rejected at the standard level, suggesting that the common trend hypothesis implicitly assumed in the two period Difference-in-Differences (DD) model may be appropriate. One possible explanation for the similarity of the pre-trends is the arbitrariness with which the threshold was chosen by the supporters of the SHI. Moreover, consistent with our Proposition 1, after the approval of the SHI, log-prices decline for the treated primary properties, while they continue to increase for the control units.

6 Empirical research design

We carry out a two period analysis by dividing the data into pre (2010-2011) and post (2013-2014) approval of the SHI. We consider an additional pre period (2008-2009) to include lagged independent variables. Individual transaction data is aggregated at the municipality level by computing bi-annual averages in these periods. Computing bi-annual averages allows us to retain a larger share – approximatively 35% – of all Swiss municipalities in our less restrictive specifications and perform robustness checks based on sample restrictions.

We dropped municipalities from our sample that requested a review and revision of their classification as having an alleged share of second homes above 20%. We do so because, during our sample period, these municipalities did not need to comply with the ban imposed by the initiative.[21] This explains the relative lack of observations for second home rates between 20 and 25%. Additionally, we dropped municipalities that had recently merged, as second home rates were not available for these places. This addresses the concern that some municipalities may have attempted to manipulate the treatment assignment by merging with municipalities that had a second home rate below the threshold. Although the initiative was approved in March 2012, there was great uncertainty concerning its practical application until August 2012. Individuals may or may not have anticipated its effects during this year despite the ordinance not being in force, making its evaluation difficult. We thus decided to drop 2012 observations from our sample.

We proceed as follows. In a first step, only predetermined controls – measured before the policy implementation – are included in the empirical models. In order to compare only primary homes that possess a conversion option before and after the SHI approval, we dropped from our sample primary residences built after 2012. We estimate the policy's net effect on primary house prices using a standard Difference-in-Differences (DD) model. We subsequently account for unobserved municipality fixed effects by restricting our sample to municipalities observed in both time periods and estimate a First Differences (FD) model. The FD model is then generalized to allow for differential time trends.[22]

In a second step, we re-include primary residences built after 2012 in our sample and also consider contemporaneous controls – i.e. local housing characteristics measured at the same point of time as local primary house prices. We then estimate a FD mediation model for age-related characteristics. We review the model's main identifying assumption as theorized by Imai *et al.* (2010) and Imai *et al.* (2011) and adopt their estimation strategy. Following Heckman *et*

[21] Virtually all municipalities that requested a revision of their rates were in the end found to be below the threshold set by the SHI, although exact rates were not published. As robustness check we included these municipalities back in the control group in the FD specification presented below (second home rates are not included as control). Results are unchanged (see Table W-D1 in Web-Appendix D).

[22] We do not explicitly present the regression discontinuity design approach in this section, as we simply restrict the sample to municipalities that have a second home rate near the threshold value set by the initiative.

al. (2013) and Heckman and Pinto (2015), we carry out the analysis using a single latent factor as mediator. This factor summarizes all the age-related characteristics into one single variable, therefore reducing the model's parameters and simplifying the interpretation of the findings.

6.1 Estimating the net impact of the policy with predetermined controls

Let P_{i10-11} and P_{i12-13} denote the log of the average price of primary homes transacted in municipality i in 2010-2011 (pre-period) and 2013-2014 (post-period), respectively. Our Difference-in-Differences (DD) specification can then be expressed as

$$P_{it} = \alpha + \gamma D_i + \tau d_t + \delta\, d_t \times D_i + \beta_1 Sr_i + \boldsymbol{\beta}_2 \boldsymbol{c}_i + \boldsymbol{\beta}_3 \boldsymbol{h}_{it-1} + \boldsymbol{\beta}_4 \boldsymbol{z}_{it-1} + \varepsilon_{it}. \quad (9)$$

The term Sr_i denotes the second home rate of municipality i, D_i represents the treatment dummy defined as $D_i = 1\{sr_i \geq 0.2\}$, and d_t is a time dummy equal to 1 for post-initiative observations and zero otherwise. The term $\boldsymbol{c}_i$ is a vector of time-invariant variables that captures various characteristics of the municipality. The vector includes canton fixed effects, municipality type, share of unproductive surface, distance from major urban centers, distance from major ski resorts, homeownership rates, and share of individuals and firms active in the service sector.[23] The vector $\boldsymbol{h}_{it-1}$ contains local lagged housing characteristics: number of rooms, number of bathrooms, number of parking places, housing quality, housing condition, micro-location of the property inside the municipality, age of the property at the time of the transaction, share of traded houses (vs. share of traded flats), and number of transacted primary properties in the municipality. Finally, the vector $\boldsymbol{z}_{it-1}$ contains lagged fiscal variables: the number of taxpayers present in the municipality, the share of foreign residents – i.e. foreign individuals paying local taxes in the municipality – the average income in the municipality, and the corresponding Gini index – measuring income inequalities inside the municipality. The variable ε_{it} is a stochastic error term.

We use our knowledge about the mechanism generating the treatment assignment (i.e., the fact that municipalities with a share of second homes equal to or above 20% are affected by the policy) to narrow down possible sources of endogeneity. In fact, controlling for Sr_i, the treatment variables D_i and D_{it} ($= d_t \times D_i$) can be considered to be exogenous. Unbiased estimation of the coefficient of interest δ is thus obtained if $E(\varepsilon_{it}|Sr_i) = 0$ (assuming that predetermined controls are exogenous too). In particular, this assumption is violated if the unobserved municipality heterogeneity a_i contained in the error term ε_{it} is correlated with the second home rate of the municipality. If we decompose the error term as $\varepsilon_{it} = a_i + u_{it}$ – where u_{it} is the time-varying part of ε_{it} – and restrict our sample to repeated observations, we can address the endogeneity issue due to time-invariant unobserved variables by estimating the following First Differences (FD) model:

$$\Delta P_{i13-14} = \tau + \delta D_i + \boldsymbol{\beta}_3 \Delta \boldsymbol{h}_{i10-11} + \boldsymbol{\beta}_4 \Delta \boldsymbol{z}_{i10-11} + \Delta u_{i13-14}, \quad (10)$$

Where $\Delta P_{i13-14} = P_{i13-14} - P_{i10-11}$, $\Delta \boldsymbol{h}_{i10-11} = \boldsymbol{h}_{i10-11} - \boldsymbol{h}_{i08-09}$, and $\Delta u_{i13-14} = u_{i13-14} - u_{i10-11}$. Note that $\Delta\, d_t \times D_i = D_i \Delta d_t = D_i$. The identifying assumption is now $E(\Delta u_{i13-14}|D_i) = 0$. Since D_i is a deterministic function of the second home rate, we thus

[23] See Web-Appendix C for further details. Data on the share of individuals and firms active in the service sector was available only for 2011 and thus included in the "fixed" effects category for ease of exposition.

must have $E(\Delta u_{i13-14}|Sr_i) = 0$, i.e. the (predetermined) second home rate of a municipality must be strictly exogenous with respect to the dynamic error terms.

This assumption is violated, for example, if investors over time increasingly value proximity to particular amenities – like prestigious ski resorts – and second home rates proxy for the distance to these amenities. Due to the increased labor supply associated with the inflow of second home investors, our theoretical model predicts a positive shock of the growth of second home investors on the local demand for primary residences in touristic (treated) municipalities. In order to address this problem, we allow different time trends for our explanatory variables and – in particular – for second home rates. We generalize model (9) by adding post-initiative interaction terms with predetermined controls as follows:

$$\begin{aligned} P_{it} = \alpha + \gamma D_i + \tau d_t + \delta D_{it} + \beta_1 Sr_i + \beta_1' d_t \times sr_i + \boldsymbol{\beta}_2 \boldsymbol{c}_i + \boldsymbol{\beta}_2' d_t \times \boldsymbol{c}_i \\ \boldsymbol{\beta}_3 \boldsymbol{h}_{it-1} + \boldsymbol{\beta}_3' d_t \times \boldsymbol{h}_{it-1} + \boldsymbol{\beta}_4 \boldsymbol{z}_{it-1} + \boldsymbol{\beta}_4' d_t \times \boldsymbol{z}_{it-1} + \varepsilon_{it}. \end{aligned} \quad (11)$$

Importantly, by interacting the fixed effects $\boldsymbol{c}_i$ with d_t, we allow for different time trends at the cantonal level, thus partialling out trend differentials of regional housing markets. The difference in time trends at the cantonal level may be particularly important in Switzerland, since cantons can display different trends in their fundamentals. This generalization leads to the following generalization of the FD model (10):

$$\begin{aligned} \Delta \mathrm{P}_{i13-14} = \tau + \delta D_i + \beta_1' Sr_i + \boldsymbol{\beta}_2' \boldsymbol{c}_i + \boldsymbol{\beta}_3 \Delta \boldsymbol{h}_{i10-11} + \boldsymbol{\beta}_3' \boldsymbol{h}_{i10-11} + \\ \boldsymbol{\beta}_4 \Delta \boldsymbol{z}_{i10-11} + \boldsymbol{\beta}_4' \boldsymbol{z}_{i10-11} + \Delta u_{i13-14}. \end{aligned} \quad (12)$$

Over the period of our analysis the second home rate Sr_i was measured using data collected before the ordinance came into force, hence, its values are fixed in the pre and post periods. It is thus extremely unlikely that Sr_i is correlated with the error term Δu_{i13-14} once trend differentials have been partialled out, thus making the treatment variable D_i exogenous.

6.2 A note on heterogeneous effects and sorting

In the previous section, we advocate the exogeneity of the treatment assignment D_i with respect to the dynamic shock Δu_{i13-14} from the aggregate perspective of municipalities. In fact, due to the hardly predictable approval of the SHI and the extremely slow dynamic of second home rates, it seems extremely unlikely that municipalities were able to manipulate the treatment assignment. From the aggregate perspective of municipalities as treated units, selection bias should thus not be a problem.

However, our theoretical framework predicts a heterogeneous treatment effect δ_i in the market of primary residences if the growth in the number of second home investors varies across municipalities. Workers might sort into or out of a treated municipality according to the expected gain/loss in order to maximize their utility (selection on gains). The main question is what the causal effect δ represents when heterogeneous effects are present. To answer this, we must assess whether sorting according to the treatment status is likely or not. Let us consider the random coefficient version of model (10):

$$\begin{aligned} \Delta P_{i13-14} = \tau + \delta_i D_i + \boldsymbol{\beta}_3 \Delta \boldsymbol{h}_{i10-11} + \boldsymbol{\beta}_4 \Delta \boldsymbol{z}_{i10-11} + \Delta u_{i13-14} = \\ \tau + \delta D_i + \boldsymbol{\beta}_3 \Delta \boldsymbol{h}_{i10-11} + \boldsymbol{\beta}_4 \Delta \boldsymbol{z}_{i10-11} + (\delta_i - \delta) D_i + \Delta u_{i13-14}, \end{aligned} \quad (13)$$

where δ_i represents the heterogeneous (random) effect of the SHI on municipality i. The treatment effect δ estimated by model (13) may be biased for two reasons. First, there might be a potential correlation between omitted variables contained in the error term Δu_{i13-14} and the treatment assignment D_i. Second, the heterogeneous effect δ_i may be correlated with the treatment assignment D_i, i.e. $E((\delta_i - \delta)D_i) \neq 0$. This corresponds to the sorting of households across municipalities with respect to potential gains.

If sorting is present, we should observe a shift in the distribution of primary home transactions with respect to the municipalities' second home rates. This, however, is not the case. The histogram of transactions presented in Figure 3 shows no evident change in the distribution of transacted primary homes, suggesting that sorting from control municipalities to treated ones – and vice versa – did not take place. Therefore, our estimates may still be interpreted as an average treatment effect, as in the case of homogenous treatment effects.

6.3 Contemporaneous controls and mediation effect

We now re-include primary residences built after 2012 in our sample and consider contemporaneous differences of housing characteristics as controls in model (10).[24] The model choice is dictated by its empirical tractability – reduced number of parameters and fewer multicollinearity problems – and the fact that the estimated net effects are similar to those estimated by its extended version (12). We thus have

$$\Delta P_{i13-14} = \tau + \delta D_i + \boldsymbol{\beta}_3 \Delta \boldsymbol{h}_{i13-14} + \boldsymbol{\beta}_4 \Delta \boldsymbol{z}_{i10-11} + \Delta u_{i13-14}. \quad (14)$$

As illustrated in the theoretical section, banning new second home investors also stops or at least reduces the net inflow of primary residents. As a consequence, treated municipalities should have a smaller number of transacted new primary homes, affecting age-related characteristics of primary residences. These characteristics are "bad" controls as suggested by Angrist and Pischke (2009). Estimates of the parameter of interest δ are biased.

We next assume that age related characteristics $j \in J$ – such as age itself, housing quality, housing condition, and micro-location[25] – of the contemporaneous housing differences Δh^j_{i13-14} have been affected by the second home ban:

$$\Delta h^j_{i13-14} = \alpha^j + \delta^j D_i + \boldsymbol{\beta}^j \Delta \boldsymbol{z}_{i10-11} + \Delta \mathrm{u}^j_{i13-14}, \quad j \in J. \quad (15)$$

Two problems arise in this setting. First, we must estimate the indirect effect of the ban – via the quality of traded primary residences – on prices and understand under which assumptions this estimate may be interpreted causally. Second, the higher the number of age-related characteristics, the higher is the complexity of the system of equations. This complexity is unwarranted in the present case, as we are not interested in assessing the impact of the ban on each individual age-related characteristic.

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[24] Except for the share of foreign residents, data on fiscal variables post approval of the initiative are not available. The term $\Delta \boldsymbol{z}_{i10-11}$ thus includes the fiscal variables for which post information is not available. To keep the notation as simple as possible, we included the dynamic share of foreign residents in the term $\Delta \boldsymbol{h}_{i13-14}$.

[25] These four variables are those that constitute the mediation effect. The choice of the age variable is obvious. Condition and quality are negatively correlated with age for straightforward reasons. The micro-location is related to the age of the housing stock because older houses tend to be situated in the municipality's center. These localities tend to have fewer light-hours and poorer landscape views, explaining their lower value.

To solve the second problem, we reduce the number of equations in (15) that have to be estimated using factor analysis. Following Heckman *et al.* (2013) and Heckman and Pinto (2015), we assume that contemporaneous controls affected by the policy are all different measures of a single latent factor ξ. This seems justified in our case since the affected variables can all be related to age. Appendix C contains details on the latent factor estimation.

We now turn to the problem of identifying the mediation effect. Having reduced the number of controls being affected by the policy to a single factor, we can rewrite equations (14) and (15) as

$$\Delta P_{m13-14} = \tau + \delta D_i + \gamma \Delta \xi_{i13-14} + \boldsymbol{\beta}_3 \Delta \boldsymbol{h}_{i13-14}^{(-J)} + \boldsymbol{\beta}_4 \Delta \boldsymbol{z}_{i10-11} + \Delta u_{i13-14}. \tag{14'}$$

$$\Delta \xi_{i13-14} = \tau^* + \delta^* D_i + \boldsymbol{\beta}_3^* \Delta \boldsymbol{h}_{i13-14}^{(-J)} + \boldsymbol{\beta}_4^* \Delta \boldsymbol{z}_{i10-11} + \Delta u_{i13-14}^*, \tag{15'}$$

where $\Delta \boldsymbol{h}_{i13-14}^{(-J)}$ denotes the contemporaneous covariates excluding those being affected by the policy. As usual, we capture the policy's direct effect by δ, whereas the housing covariates' mediation effect can be estimated as $\gamma \cdot \delta^*$. This product highlights the two main conditions under which a mediation effect is present. First, the policy must affect the latent factor summarizing age-related characteristics (i.e. $\delta^* \neq 0$). Second, the latent factor must have an impact on prices (i.e. $\gamma \neq 0$).

We now explore, using mediation analysis, under which assumptions the estimated effects can be interpreted causally. Estimation of mediation effects – as given by the product $\gamma \cdot \delta^*$ – dates back to Baron and Kenny (1986).[26] Only recently however Imai *et al.* (2010) and Imai *et al.* (2011) provided the identification assumptions necessary for a causal interpretation of the mediation effect.[27] This assumption is known under the name of Sequential Ignorability and includes two conditions. First, the classic conditional independence assumption must hold for both the dependent variable of interest (ΔP) and the mediator ($\Delta\xi$). Second, conditional on predetermined controls *and* on the treatment, the mediator is ignorable. The validity of the Sequential Ignorability assumption cannot be directly tested using the data. To try to overcome this problem, Imai *et al.* (2010) suggest a procedure to assess the sensitivity of the mediation estimates to the existence of (unobserved) predetermined confounders, which we carry out in the next section.

7 Results

We first report our main results. Next, we subject these to two robustness checks. We verify that municipalities that belong to the control group have not been affected by the policy and that the estimated treatment effect was not present before the SHI implementation.

[26] Mostly unknown in economics -- and policy evaluation in particular – statistical mediation analysis is has been widely used for decades in psychology and other social sciences, whereas mediators are typically represented by personality traits affected by some program.

[27] Since both our dependent and mediator variables are continuous – they are averages computed at municipality level – the estimation and inference procedures we employ based on Imai *et al.* (2010) are equivalent to those originally suggested by Baron and Kenny (1986).

7.1 *Main Estimates*

Tables 2 and 3 document pooled cross-sectional DD and panel FD estimates describing the impact of the SHI on the average price of transacted primary homes at municipality level, as estimated by equations (9) and (10), respectively.[28] Both estimation approaches suggest a strong negative impact on the price of primary homes: on average, the policy decreased the value of primary homes by about 12% to 14%.[29] The estimated average treatment effect is highly significant independent of the set of controls and extremely stable across DD and FD specifications, suggesting an exogeneity of second home rates with respect to municipalities' unobserved fixed effects and – as a consequence – of the treatment assignment.

Table 4 illustrates the estimated average treatment effects obtained when estimating equation (12). Allowing for differences in the trends of the predetermined variables does not significantly affect the magnitude of the estimated impact of the policy – the estimated effects are very similar to those in Tables 2 and 3 – although larger standard errors due to multicollinearity reduce statistical significance. Consistent with this observation, the second home rate interacted with a time dummy is statistically insignificant in all specifications, suggesting that its valuation into the price of primary homes does not possess a time-trend. Overall, these findings strongly suggest that trend differentials are not likely to cause endogeneity issues of the treatment variable. Further support for the exogeneity of the treatment variable is provided in Table 5, where the sample of municipalities is restricted to those that have a second home rate in the [0.1, 0.5] (Panel A) and [0.15, 0.3] (Panel B) intervals, respectively, thus excluding most major urban areas and highly touristic municipalities.[30] Again, results are in line with those shown in Tables 2 and 3, thus providing further evidence that our estimates are likely not plagued by potential endogeneity arising from the dynamic component of the stochastic error term.

Finally, Table 6 presents FD estimates when contemporaneous differences of housing characteristics and the share of foreign residents are included in the model. We divide contemporaneous controls in two groups depending on their likelihood to be affected by the policy: age related and none-age related characteristics. The number of rooms, number of bathrooms, number of parking places, share of traded single-family houses, number of transacted primary properties[31], and share of foreign residents are unlikely to be affected by the SHI, whereas age-related characteristics such as age itself, housing quality, housing condition, and micro-location are. In fact, we observe a reduction in the magnitude of the estimated effect when this latter group of variables is included in the model. A similar effect is obtained when the single latent factor summarizing these variables is included, suggesting that the factor replicates the behavior of age-related characteristics. This variation in the estimated effects may suggest that including age related contemporaneous controls may bias our estimates.

[28] We report robust standard errors. Clustering standard errors by period and canton cells in specification (9) – cantons are the "most aggregate" institutional entities in Switzerland – does not alter the statistical significance of our results, although standard errors are smaller when clustered. Clustering standard errors in specification (10) provides virtually the same statistical significance, even though these errors may not be reliable due to the small number of clusters. In what follows, we report the most conservative standard errors.

[29] The obtained FD estimates are stable when observations at the municipality level are weighted according to the number of transactions observed in 2008/2009. See the Web-Appendix D, Table W-D2.

[30] As apparent from Figure 3, the Panel B-interval corresponds to one of the smallest intervals allowing us to provide stable FD estimates (about 50 municipalities belong to the treated group).

[31] Empirically we do not observe a significant drop in the number of transacted primary residences at the municipality level.

Table 7 illustrates the estimated direct effect of the policy on the price of primary homes – i.e. the effect not due to compositional changes in the housing characteristics – and the indirect – mediated – effect of age related characteristics as summarized by the latent factor. The direct effect on primary home prices is about -7.7% and statistically significant. The indirect effect on prices amounts to -2.4% and is significant at the 5% level. It is comforting to find that the total effect – which amounts to -10% – is not statistically different from the one estimated using predetermined characteristics. The compositional changes due to age-related characteristics thus account for nearly a quarter of the total effect. Regarding the validity of the Sequential Ignorability assumption, unless a fairly strong positive correlation (greater than 0.5) between the error terms of equations (14') and (15') is present, the average causal mediation effect remains negative and significant.

Another pertinent question is whether the initiative affected the price of second homes. Only a small percentage of second homes are traded below the threshold set by the initiative and these are traded only in a small number of control-municipalities. This lack of data makes estimating the treatment effect on second homes extremely challenging. DD estimates following specification (9) are reported in Table 8.[32] Once the characteristics of municipalities are included in the model, the sign of the treatment effect – although statistically insignificant – suggests a positive effect of the policy on the price of second homes.

This finding is consistent with our theoretical base model that assumes poor substitutability between primary and second homes. This should not be too surprising in the case of Switzerland's touristic areas. Second homes are usually located where access to a ski resort is easiest, are built using specific materials –wood-built chalets – and usually lack some of the comforts of primary residences, such as access to broadband connection and covered parking garages. Additionally, it may be that primary houses that were good substitutes for second homes were already converted into second homes during the last couple of decades, leaving only properties without conversion potential in the stock of primary residences.

Another possible explanation is that post SHI-implementation, primary residences that retained a conversion option systematically dropped out from our sample – as they were sold as second homes – thus causing a selection bias. This seems unlikely for two reasons. First, primary residences built before 2012 do retain a conversion option. If they are systematically sold as second homes, it means that potential primary residents prefer to buy properties not having the conversion option. As the price of second homes did not significantly increase, this could only be explained by a change in the preferences of primary home buyers post policy, an unlikely case. Second, if primary residences that have a conversion option are systematically converted post policy, we should observe a significant drop in the number of transacted primary residences in treated municipalities, and this is not the case.[33]

[32] FD estimates are not reported because less than 7 municipalities were present in the control group of the less restrictive FD specification, making estimates erratic when including predetermined controls. DD specifications shown in Table 8 contain 86, 83, 13, and 13 control municipalities, respectively.

[33] In the implementation of the SHI ordinance, municipalities had to ascertain that the conversion of primary residences into secondary ones was not driven by pure speculative reasons. For example, primary homeowners were not allowed to convert a primary residence and directly build/buy a new one in the same (or nearby) municipality.

7.2 *Heterogeneous effects of ban on second homes*

Our model implies heterogeneous treatment effects depending on the disamenity value caused by the investors' presence (positive landscape preservation effect) and the local labor output elasticity in the tourism sector (negative local economy effect). We empirically investigate this heterogeneity by interacting the treatment dummy with two predetermined controls. The first control aims to capture the positive landscape preservation effect induced by the second home ban. We capture this effect by the share of unproductive surface area (lakes, mountains etc.) present in the municipality. The second control represents the economic cost of keeping investors away. We proxy for this effect by using the share of no votes against the SHI observed in a given municipality. The results are reported in Table 9. The first column of the table shows the effect when time trends are not included in the regression model, whereas the last two columns do include time differentials together with the opposing effects. The last column also adds fiscal variables as controls. Adding time trend differentials substantially increases the regression fit, allowing us to identify the individual effects more precisely. The validity of the chosen proxies is supported by several facts. First, each individual effect has the expected sign. Second, the estimated average net effect is smaller but in line with previous estimates. Using the average values reported in Table 1B for the share of no votes and the share of unproductive land, we obtain a net effect of $0.259 - 0.802 \cdot 0.61 + 0.665 \cdot 0.23 \cong -0.073$ (treatment effects are taken from the last column of Table 9), implying a policy-induced reduction in the price of primary homes of 7.3%.

7.3 *Robustness checks*

If second home investors shift their demand to the nearest control municipalities (i.e., the closest available substitutes) we may overestimate the average treatment effect. This is because a spatial shift of the second home demand might cause primary house prices to increase in the control municipalities, thus biasing the absolute magnitude of our estimates upwards. To investigate this concern, Tables A2 and A3 in Appendix A document the estimated average treatment effects when we use as control group municipalities situated more than 5 kilometers away from the nearest treated ones. Reassuringly, the estimated impacts are virtually identical to our baseline estimates reported in Tables 2 and 3.

The choice of a 5km distance band is arbitrary. In a next step we thus vary this distance band continuously to document that the estimated effects of our FD specifications – including all predetermined controls – are robust to the precise choice of the distance band. The results are illustrated in Figure 5. The estimates are extremely stable over a wide range of distance bands used to exclude the nearest-to-treated control municipalities, suggesting that the potential spatial sorting of individuals across municipalities is not relevant in our setup. These results can be explained as follows. First, the entire second home demand in municipalities that did not exceed the threshold represents is very small (<0.5% of the total transactions of primary residences), thus hardly affecting local primary house prices in non-treated areas. Second, investors may value the proximity to amenities – such as ski resorts – and would rather invest in another country than losing the benefit of this proximity (i.e., even nearby municipalities may not be sufficiently close substitutes).

Finally, we conduct a placebo test to verify that no treatment effect was present before the policy implementation. Specifically we use the years 2006-2007 and 2008-2009 as pre-policy periods, and 2010-2011 as post-policy period.[34] Tables A4 and A5 in Appendix A report the estimation results for regression models (9) and (10), respectively. The treatment effect is statistically insignificant in all specifications, suggesting that no price differential between treated and control municipalities was present before the approval of the SHI. Table A6 illustrates placebo results when differential time trends are included. Again, the treatment effect is insignificant in all specifications. Finally, in Table A7 we report a placebo test on the heterogeneous treatment effects. As soon as trend differentials are included in the model, each one of the opposing effects is statistically insignificant.[35]

8 Conclusion

Rising inequality has led to a global political backlash against wealthy elites. One increasingly popular policy is to constrain or impose an outright ban on new second home investments in high-amenity places (highly touristic places or superstar cities). We propose a dynamic general equilibrium model that describes the mechanisms through which this policy affects primary residents and existing second home investors.

Local residents face a basic trade-off. Constraints on second home investments hurt the local economy but provide benefits in the form of landscape preservation effects. Theory suggests that the predicted impact on the price of primary homes depends on a number of factors, importantly, whether or not primary and second homes are close substitutes, whether or not local residents attach a strong disamenity value to the presence of second home investors, and the local labor output elasticity in the tourism sector.

Exploiting the unique empirical setting provided by the unexpected approval of the Swiss Second Home Initiative (SHI), we find that the ban induced by the SHI reduced the value of primary homes in the affected areas by around 12 percentage points. The estimated effect of the ban on the price of second homes is positive, albeit not statistically significant.

Our findings are consistent with the view that primary homes in Swiss tourist areas are poor substitutes for second homes. In a setting with poor substitutability, in the extreme, the option to convert a primary residence into a second home is worthless and it does not provide a hedge against the negative impact of banning investors.

When exploring heterogeneous treatment effects, we find that, *all else equal*, the ban had a stronger negative impact on primary house prices in places with strong opposition against the SHI (negative local economy effect) and a smaller negative impact in places with more valuable natural amenities (positive landscape preservation effect), providing support for our proposition that the negative net effect of the SHI-ban is driven by two opposing mechanisms, with the adverse local economy effect on average dominating the positive landscape preservation effect.

Constraining new second home investments hurts local homeowners via lower wages and lower primary house prices. Renters benefit from lower rents but overall they are not better off. This is because the fall in rents is commensurate to a decrease local wages. In a spatial equilibrium setting without relocation costs, renters should be neither better nor worse off. Our empirical findings are inconclusive as to whether existing second home investors were beneficiaries in

[34] Since no data on the share of foreign residents was available before 2008, we excluded this variable from our model.

[35] Additional robustness checks are presented in Web-Appendix D.

the treated areas: The estimated effect of the SHI-induced ban on the price of second homes is consistently positive, albeit statistically insignificant, possibly due to small sample size issues.

In light of our findings, it is hardly surprising that local residents in touristic Swiss municipalities – particularly homeowners in the most touristic places – were firmly opposed to the ban. Interestingly, this is in contrast to the second home-ban in the popular British sea resort St. Ives, which was overwhelmingly supported by local residents. We speculate that local demographics matter.[36] Moreover, existing homeowners may support a ban as long as existing primary homes are good substitutes for second homes and homeowners are able to retain a conversion option, as was the case in St. Ives. In this case, they may even have a property price induced incentive to vote in favor of a ban.

Our findings hold important lessons for other countries, tourist areas, and superstar cities in which inequality has led to a political backlash against the wealthy and, in particular, against (foreign) second home investors. Overall, our findings are indicative that constraining second home investments may reinforce rather than reduce wealth inequality. While bans do nothing to improve local economies, local taxes on the value of land or (investment) property could potentially help local economies whilst at the same time preserve the landscape.

[36] Retirees in high-amenity places may care little about local economic growth prospects but a lot about preservation of the landscape. While retirees may be drawn to the mild climate of St. Yves, Swiss ski-resorts are more likely to attract a younger crowd. Moreover, the elderly living in the Swiss Alps belong to families that live there for generations, so they are likely to have intergenerational motives to oppose a ban and protect the livelihood of tourist places. We leave a rigorous analysis of voting behavior for future research.

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TABLES

TABLE 1A

Summary Statistics of Primary Residences – transactions below the 0.2 threshold (control group)

	2010-2011 (*N*=1’464)				2013-2014 (*N*=1’430)			
VARIABLES (municipality level averages)	Min	Max	Mean	Sd	Min	Max	Mean	Sd
Price (1'000 CHF)	120.00	3’040	753.14	331.55	120.00	2’880	813.88	332.73
Housing characteristics								
Number of rooms	2	9	4.86	0.79	2	11	4.75	0.85
Number of bathrooms	1	4	2.05	0.41	1	4	2.04	0.43
Number of parking places	1	4	2.81	0.49	1	4	2.75	0.49
Micro-location (1 to 4, bad to excellent)	1	4	2.91	0.39	1	4	2.76	0.39
Quality (standard of finishing) (1 to 4, bad to excellent)	1	4	2.97	0.52	1	4	2.85	0.54
Condition (1 to 4, bad to excellent)	1	4	2.92	0.57	1	4	2.83	0.61
Age of building at time of transaction†	-1	161	27.82	24.70	-1	164	28.60	24.94
Single-family house (yes/no)	0	1	0.61	0.32	0	1	0.58	0.33
Number of transactions	1	798	15.32	34.37	1	855	13.54	32.72
Municipality characteristics								
Second home rate (%)	1.60	19.90	10.55	3.56				
Share of no votes (%)	0.29	0.82	0.50	0.07				
Unproductive surface (%)	0.00	0.87	0.03	0.06				
Distance to major city (Km)	0	75.70	10.51	10.61				
Distance to major ski resort (Km)	0	78.90	34.85	19.34				
Homeowners (%)	0.04	0.83	0.52	0.15				
Pct. of workers in the 3rd sector (%)	0.05	0.99	0.58	0.18				
Pct. of firms in the 3rd sector (%)	0.15	0.94	0.65	0.14				
Fiscal variables								
Number of taxpayers (1'000)	0.07	247.49	2.73	8.95				
Foreign residents (%)	0.01	0.51	0.16	0.09	0	0.53	0.18	0.10
Mean net income (1'000 CHF)	41.61	328.73	69.01	22.95				
Net income Gini index	0.31	0.81	0.44	0.06				

Note† The age of the building at the time of transaction is defined as the year in which the transaction takes place minus the construction year. Since some dwellings are sold before being constructed, the age variable can take negative values. *N* = Number of municipalities with transactions.

TABLE 1B

Summary Statistics of Primary Residences – transactions above the 0.2 threshold (treatment group)

	2010-2011 (*N*=276)				2013-2014 (*N*=255)			
VARIABLES (municipality level averages)	Min	Max	Mean	Sd	Min	Max	Mean	Sd
Price (1'000 CHF)	100	3'366	608.77	366.37	100	2'396	592.07	312.74
Housing characteristics								
Number of rooms	2	10	4.25	1.19	1	9	4.09	1.18
Number of bathrooms	1	4	1.85	0.47	1	4	1.79	0.52
Number of parking places	1.50	4	2.57	0.49	1.67	4	2.56	0.50
Micro-location (1 to 4, bad to excellent)	1	4	3.09	0.48	1	4	2.89	0.52
Quality (1 to 4, bad to excellent)	1	4	2.73	0.67	1	4	2.52	0.64
Condition (1 to 4, bad to excellent)	1	4	2.68	0.71	1	4	2.50	0.75
Age of building at time of transaction†	-0.83	161	32.57	28.64	0	164	36.91	29.65
Single-family house (yes/no)	0	1	0.49	0.40	0	1	0.50	0.41
Number of transactions	1	121	7.12	12.85	1	148	6.25	12.46
Municipality characteristics								
Second home rate (%)	20.30	86.10	47.88	17.21				
Share of no votes (%)	0.26	0.89	0.61	0.12				
Unproductive surface (%)	0.00	0.95	0.23	0.22				
Distance to major city (Km)	0	102.50	36.77	24.85				
Distance to major ski resort (Km)	0	81	15.29	22.11				
Homeowners (%)	0.21	0.95	0.60	0.14				
Pct. of workers in the 3rd sector (%)	0	0.95	0.62	0.18				
Pct. of firms in the 3rd sector (%)	0	0.94	0.63	0.15				
Fiscal variables								
Number of taxpayers (1'000)	0.02	15.18	1.30	1.72				
Foreign residents (%)	0	0.61	0.16	0.10	0.02	0.61	0.17	0.10
Mean net income (1'000 CHF)	26.61	98.89	50.76	11.31				
Net income Gini index	0.38	0.71	0.49	0.07				

Note: † The age of the building at the time of transaction is defined as the year in which the transaction takes place minus the construction year. Since some dwellings are sold before being constructed, the age variable can take negative values. *N* = Number of municipalities with transactions.

TABLE 2

DD Estimates

Log primary home prices	(1)	(2)	(3)	(4)
Treatment x Post	-0.121**	-0.117**	-0.125**	-0.123***
	(0.0562)	(0.0502)	(0.0490)	(0.0451)
Treatment (main effect)	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Second home rate	Yes	Yes	Yes	Yes
Cantonal FE	No	Yes	Yes	Yes
Municipality characteristics	No	Yes	Yes	Yes
Lagged housing characteristics	No	No	Yes	Yes
Lagged fiscal variables	No	No	No	Yes
Observations	2,898	2,898	2,898	2,898
R-squared	0.055	0.456	0.497	0.564

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 3

FD Estimates

Δ Log primary home prices	(1)	(2)	(3)
Treatment	-0.145***	-0.140***	-0.141***
	(0.0379)	(0.0367)	(0.0369)
Lagged difference of housing characteristics	No	Yes	Yes
Lagged difference of fiscal variables	No	No	Yes
Observations	1,354	1,354	1,354
R-squared	0.023	0.124	0.125

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 4

FD Estimates with Difference in Trends

Δ Log primary home prices	(1)	(2)	(3)
Treatment	-0.124*	-0.134**	-0.118*
	(0.0719)	(0.0648)	(0.0681)
Second home rate	Yes	Yes	Yes
Cantonal FE	Yes	Yes	Yes
Municipality characteristics	Yes	Yes	Yes
Lagged housing characteristics	No	Yes	Yes
Lagged difference of housing characteristics	No	Yes	Yes
Lagged fiscal variables	No	No	Yes
Lagged difference of fiscal variables	No	No	Yes
Observations	1,330	1,330	1,330
R-squared	0.078	0.267	0.274

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 5

FD estimates – Restricting interval of second home rates

	Panel A: [0.1, 0.5]			Panel B: [0.15, 0.3]		
Δ Log primary home prices	(1)	(2)	(3)	(1)	(2)	(3)
Treatment	-0.134***	-0.123***	-0.123***	-0.177**	-0.175**	-0.164**
	(0.0471)	(0.0465)	(0.0468)	(0.0752)	(0.0695)	(0.0714)
Lagged diff. of housing ch.	No	Yes	Yes	No	Yes	Yes
Lagged diff. of fiscal var.	No	No	Yes	No	No	Yes
Observations	647	647	647	183	183	183
R-squared	0.020	0.129	0.130	0.036	0.112	0.135

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 6

FD Estimates – Contemporaneous housing differences

Δ Log primary home prices	(1)	(2)	(3)	(4)
Treatment	-0.118***	-0.100***	-0.0648***	-0.0767***
	(0.0371)	(0.0279)	(0.0232)	(0.0239)
Lagged difference of fiscal variables	Yes	Yes	Yes	Yes
Contemporaneous differences: not age-related	No	Yes	Yes	Yes
Contemporaneous differences: age-related	No	No	Yes	No
Contemporaneous differences: single factor	No	No	No	Yes
Observations	1,388	1,388	1,388	1,388
R-squared	0.018	0.381	0.587	0.537

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 7

FD Estimates – Contemporaneous housing differences: mediation effect on Δ Log primary home prices

Effect	Mean	95% Confidence Interval
Mediation Effect	-0.024	[-.048, -.002]
Direct Effect	-0.077	[-.122, -.031]
Total Effect	-0.100	[-.149, -.049]
Pct. of Total Effect mediated	0.237	[.16 ,.482]

TABLE 8

DD Estimates – Effect on price of second homes

Log second home prices	(1)	(2)	(3)	(4)
Treatment x Post	-0.111	0.0796	0.179	0.154
	(0.157)	(0.157)	(0.317)	(0.285)
Treatment (main effect)	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Second home rate	Yes	Yes	Yes	Yes
Cantonal FE	No	Yes	Yes	Yes
Municipality characteristics	No	Yes	Yes	Yes
Lagged housing characteristics	No	No	Yes	Yes
Lagged fiscal variables	No	No	No	Yes
Observations	473	418	273	273
R-squared	0.007	0.316	0.479	0.630

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE 9

FD Estimates – Heterogeneous effects

Δ Log primary home prices	(1)	(2)	(3)
Treatment	0.162	0.289	0.259
	(0.203)	(0.191)	(0.194)
Treatment x Share no votes	-0.563	-0.886**	-0.802**
	(0.371)	(0.352)	(0.363)
Treatment x Share unproductive land	0.431	0.701***	0.665**
	(0.265)	(0.265)	(0.268)
Second home rate	No	Yes	Yes
Lagged difference of housing characteristics	Yes	Yes	Yes
Lagged difference of fiscal variables	Yes	Yes	Yes
Cantonal FE	No	Yes	Yes
Municipality characteristics	No	Yes	Yes
Lagged housing characteristics	No	Yes	Yes
Lagged fiscal variables	No	No	Yes
Observations	1,330	1,330	1,330
R-squared	0.126	0.278	0.282

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

FIGURES

FIGURE 1
Voting Results at the Municipality Level with Respect to Second Home Percentage

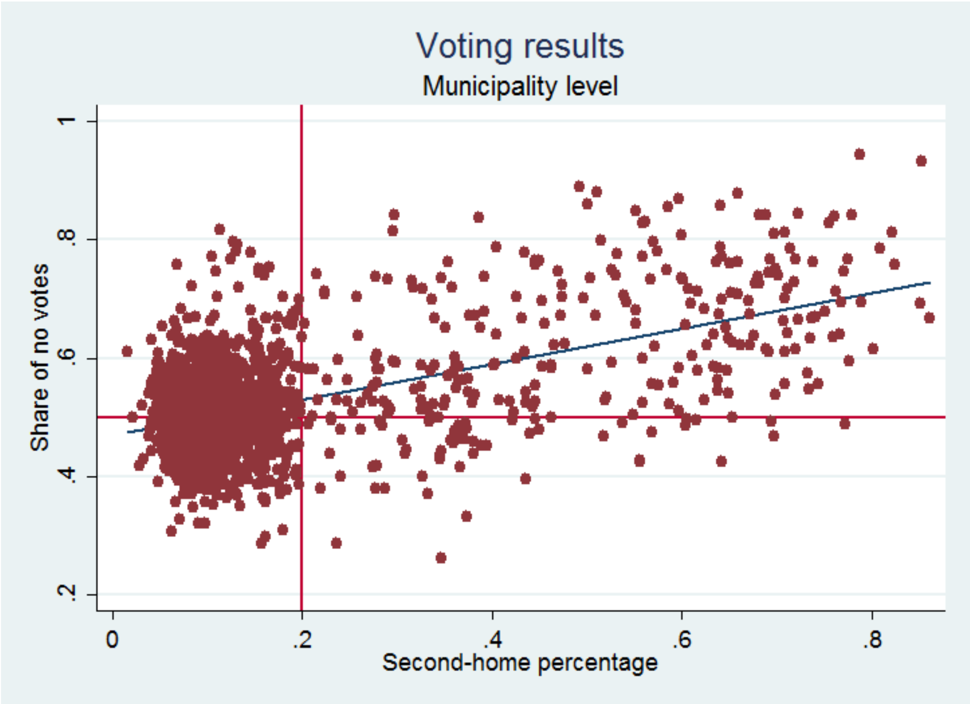


FIGURE 2
Treatment and Control Groups

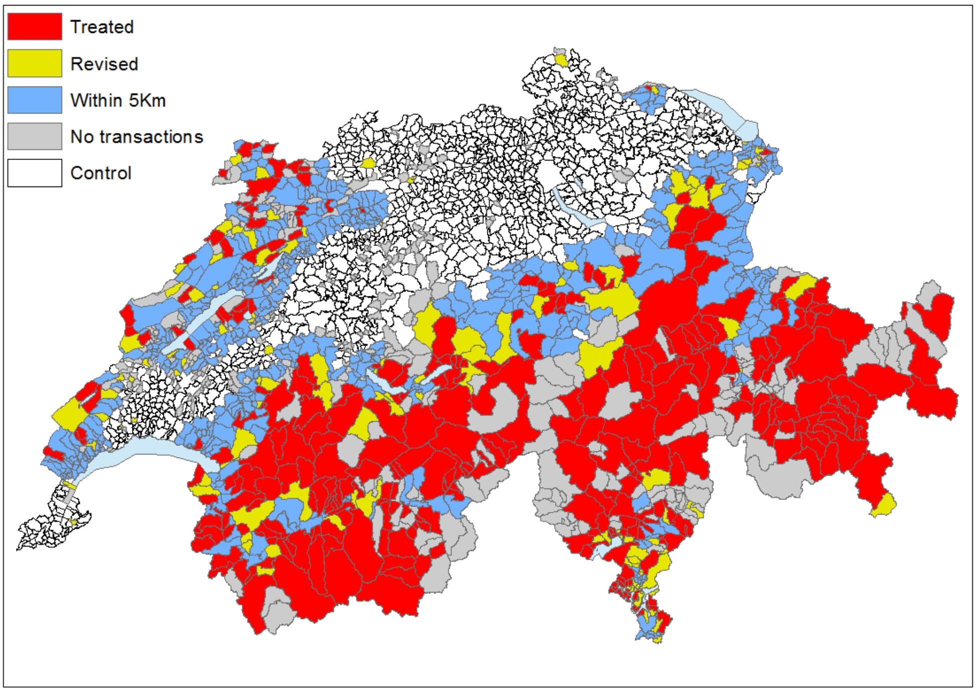


FIGURE 3

Histogram of Transacted Primary and Second Homes According to Second Home Percentage

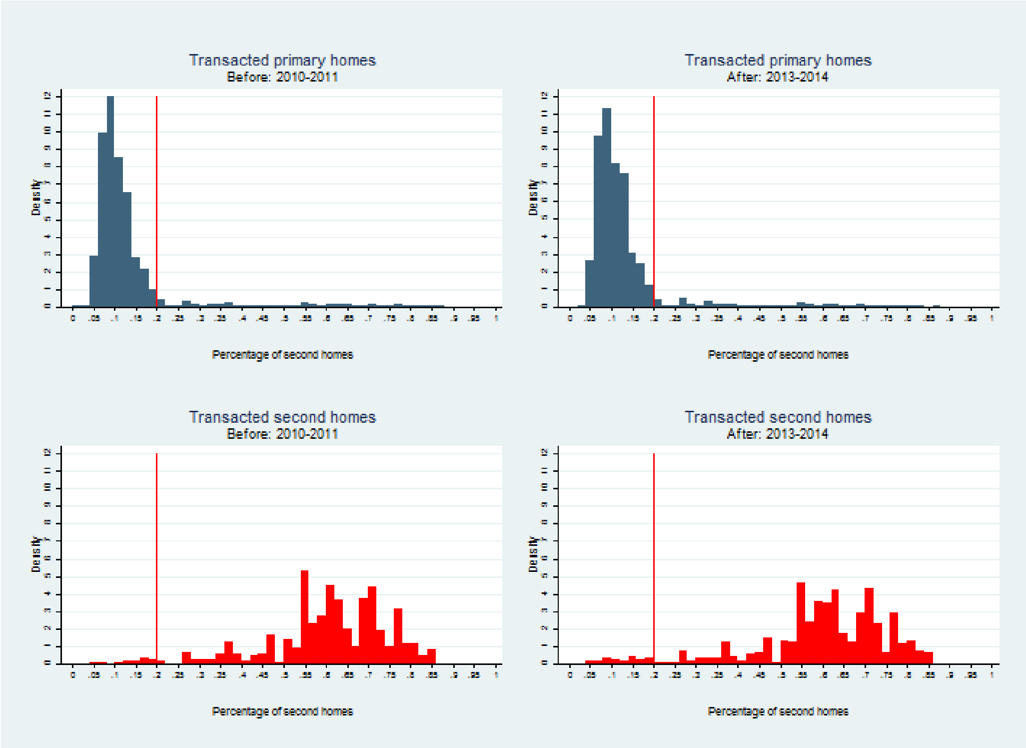


FIGURE 4

Log of Annual Average Transaction Prices

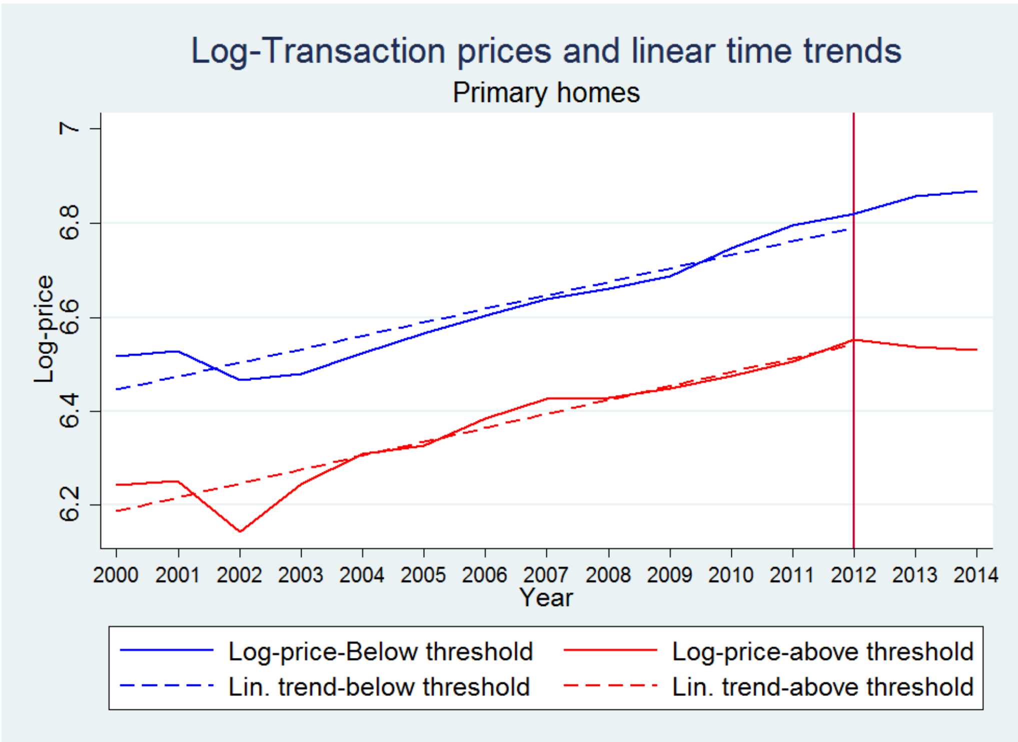
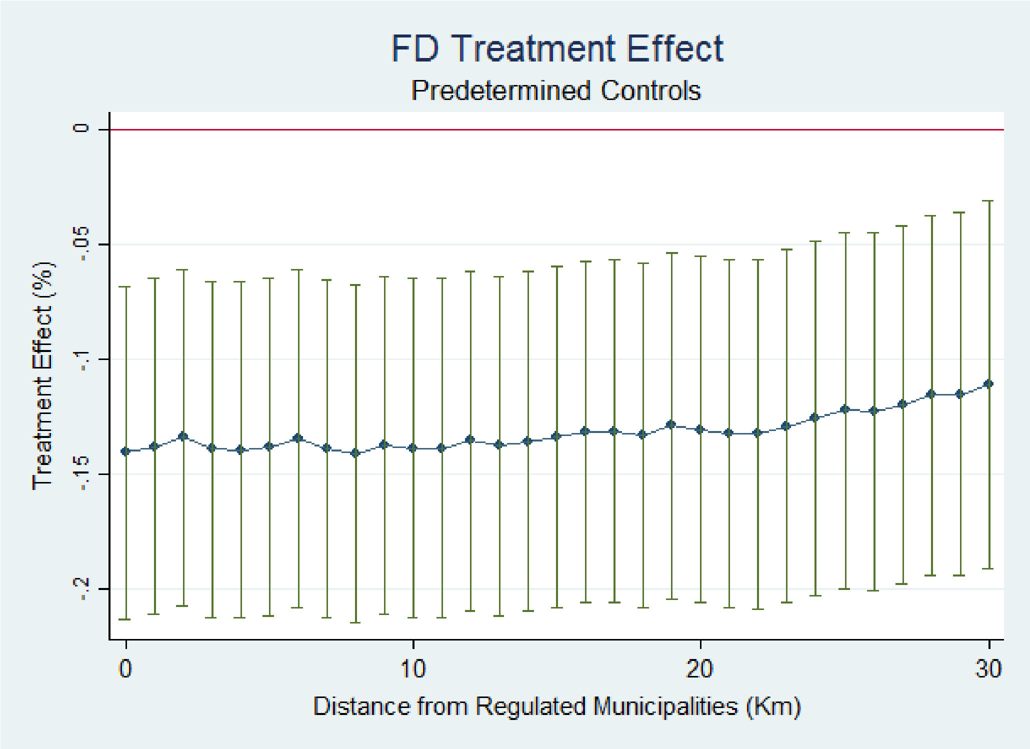


FIGURE 5

Excluding control municipalities within given distance from treated



APPENDICES

Appendix A: Voting Results and Robustness Checks

TABLE A1:

Determinants of share of no votes in municipalities with housing transactions in 2010-2011

Share of no votes	All	Only control	Only treated
Second home rate	0.1324***	-0.0176	0.2024***
	(0.0264)	(0.0454)	(0.0595)
Voting turnout	0.0841**	0.0239	0.2334***
	(0.0326)	(0.0297)	(0.0592)
Average net income	0.0010***	0.0008***	0.0013*
	(0.0002)	(0.0002)	(0.0007)
Gini coefficient for net income	-0.0953	0.0708	-0.2264*
	(0.0635)	(0.0559)	(0.1311)
Number of taxpayers	-0.0004***	-0.0006**	0.0087**
	(0.0001)	(0.0002)	(0.0037)
Share of foreign residents	0.0202	0.0308	-0.0645
	(0.0288)	(0.0247)	(0.0735)
Unproductive surface	0.0314	0.0443	-0.0031
	(0.0266)	(0.0281)	(0.0309)
Share of residents in the service sector	-0.0059	0.0002	-0.0059
	(0.0118)	(0.0112)	(0.0451)
Share of firms in the service sector	-0.0714***	-0.0783***	-0.0986
	(0.0207)	(0.0193)	(0.0834)
Homeownership rate	0.0809***	0.0587***	0.3167***
	(0.0169)	(0.0151)	(0.0675)
Distance from major CBD	-0.0002	0.0000	-0.0012***
	(0.0002)	(0.0002)	(0.0004)
Distance from major ski resort	-0.0010***	-0.0004***	-0.0031***
	(0.0002)	(0.0001)	(0.0005)
Cantonal FE	Yes	Yes	Yes
Observations	1,688	1,422	266
R-squared	0.6453	0.5981	0.6635

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A2

DD Estimates - Control Group more than 5km away

Log primary home prices	(1)	(2)	(3)	(4)
Treatment x Post	-0.118**	-0.114**	-0.128***	-0.129***
	(0.0570)	(0.0504)	(0.0493)	(0.0452)
Treatment (main effect)	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Second home rate	Yes	Yes	Yes	Yes
Cantonal FE	No	Yes	Yes	Yes
Municipality characteristics	No	Yes	Yes	Yes
Lagged housing characteristics	No	No	Yes	Yes
Lagged fiscal variables	No	No	No	Yes
Observations	2,178	2,178	2,178	2,178
R-squared	0.085	0.464	0.509	0.582

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A3

FD Estimates - Control Group more than 5km away

Δ Log primary home prices	(1)	(2)	(3)
Treatment	-0.144***	-0.137***	-0.138***
	(0.0381)	(0.0368)	(0.0373)
Lagged housing characteristics	No	Yes	Yes
Lagged fiscal variables	No	No	Yes
Observations	1,021	1,021	1,021
R-squared	0.029	0.125	0.128

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A4

DD Estimates - Placebo Test

Log primary home prices	(1)	(2)	(3)	(4)
Treatment × Post	0.00550	0.00810	0.00639	0.00982
	(0.0533)	(0.0496)	(0.0480)	(0.0446)
Treatment (main effect)	Yes	Yes	Yes	Yes
Time FE	Yes	Yes	Yes	Yes
Second home rate	Yes	Yes	Yes	Yes
Cantonal FE	No	Yes	Yes	Yes
Municipality characteristics	No	Yes	Yes	Yes
Lagged housing characteristics	No	No	Yes	Yes
Lagged fiscal variables	No	No	No	Yes
Observations	2,947	2,947	2,947	2,947
R-squared	0.047	0.439	0.474	0.541

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A5

FD Estimates - Placebo Test

Δ Log primary home prices	(1)	(2)	(3)
Treatment	0.0203	0.0214	0.0171
	(0.0310)	(0.0287)	(0.0287)
Lagged difference of housing characteristics	No	Yes	Yes
Lagged difference of fiscal variables	No	No	Yes
Observations	1,403	1,403	1,403
R-squared	0.001	0.157	0.161

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A6

FD Estimates with Difference in Trends – Placebo Test

Log primary home prices	(1)	(2)	(3)
Treatment	0.0585	0.0542	0.0734
	(0.0702)	(0.0617)	(0.0632)
Second home rate	Yes	Yes	Yes
Cantonal FE	Yes	Yes	Yes
Municipality characteristics	Yes	Yes	Yes
Lagged housing characteristics	No	Yes	Yes
Lagged difference of housing characteristics	No	Yes	Yes
Lagged fiscal variables	No	No	Yes
Lagged difference of fiscal variables	No	No	Yes
Observations	1,383	1,383	1,383
R-squared	0.036	0.282	0.292

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE A7

FD Estimates - Placebo Test of Heterogeneous Effects

Δ Log primary home prices	(1)	(2)	(3)
Treatment	0.359**	0.235	0.179
	(0.159)	(0.165)	(0.170)
Treatment x Share no votes	-0.581**	-0.332	-0.184
	(0.282)	(0.313)	(0.328)
Treatment x Share unproductive land	-0.283	-0.159	-0.222
	(0.184)	(0.196)	(0.193)
Second home rate	No	Yes	Yes
Lagged difference of housing characteristics	Yes	Yes	Yes
Lagged difference of fiscal variables	Yes	Yes	Yes
Cantonal FE	No	Yes	Yes
Municipality characteristics	No	Yes	Yes
Lagged housing characteristics	No	Yes	Yes
Lagged fiscal variables	No	No	Yes
Observations	1,383	1,383	1,383
R-squared	0.170	0.287	0.295

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Appendix B: Theoretical results and model extensions

Symbolic computations presented in this section have been made using Mathematica.

Proof of Corollary 1

We prove the existence and uniqueness of the dynamic equilibrium. We start by explicitly stating the equations defining the equilibrium according to Definition 1.

Labor market clearing: $N_{it} = \beta^{\frac{\gamma-1}{1-\beta-\gamma}}\gamma^{\frac{\gamma}{1-\beta-\gamma}}\bar{Z}p_{it}^{\frac{1}{1-\beta-\gamma}}A_{it}^{\frac{1}{1-\beta-\gamma}}W_{it}^{\frac{\gamma-1}{1-\beta-\gamma}}$ (B1)

Primary residents spatial equilibrium: $V_t = \theta_i N_{it}^{\mathcal{S}\,\eta}\frac{W_{it}}{r_{it}^{a}}$ (B2)

Investors spatial equilibrium: $V_t^{\mathcal{S}} = \theta_i^{\mathcal{S}} N_{it}^{\mathcal{S}\,\epsilon}\frac{W_t^{\mathcal{S}}}{p_{it}^{1-b}r_{it}^{s,b}}$ (B3)

Primary residences housing market clearing: $\frac{aN_{it}W_{it}}{r_{it}} = H\left(\frac{(r-g_i)P_{it}}{(r-g_i^c)(1+g_i^c)^t}\right)^{\rho_i}$ (B4)

Secondary residences housing market clearing: $\frac{bN_{it}^{\mathcal{S}}W_t^{\mathcal{S}}}{r_{it}^{\mathcal{S}}} = H^{\mathcal{S}}\left(\frac{(r-g_i^{\mathcal{S}})P_{it}^{\mathcal{S}}}{\left(r-g_i^{\mathcal{S},c}\right)\left(1+g_i^{\mathcal{S},c}\right)^t}\right)^{\rho_i}$ (B5)

Tourism services clearing: $\beta^{\frac{\beta}{1-\beta-\gamma}}\gamma^{\frac{\gamma}{1-\beta-\gamma}}p_{it}^{\frac{\beta+\gamma}{1-\beta-\gamma}}A_{it}^{\frac{1}{1-\beta-\gamma}}W_{it}^{\frac{-\beta}{1-\beta-\gamma}} = N_{it}^{\mathcal{S}}(1-b)\frac{W_t^{\mathcal{S}}}{p_{it}}$ (B6)

Using the dynamic price equation $r_{it}^j = (r-g_i^j)P_{it}^j/(1+r)$, $j \in \{\mathcal{P},\mathcal{S}\}$, expressing the system of equations in changes, and applying a log-transformation we obtain

$$\ln\left(\frac{N_{it+1}}{N_{it}}\right) = \frac{1}{1-\beta-\gamma}\ln\left(\frac{p_{it+1}}{p_{it}}\right) + \frac{1}{1-\beta-\gamma}\ln\left(1+g_{A_i}\right) + \frac{\gamma-1}{1-\beta-\gamma}\ln\left(\frac{W_{it+1}}{W_{it}}\right) \quad \text{(B1')}$$

$$\ln(1+g_V) + a\ln\left(\frac{P_{it+1}}{P_{it}}\right) = \eta\ln\left(\frac{N_{it+1}^{\mathcal{S}}}{N_{it}^{\mathcal{S}}}\right) + \ln\left(\frac{W_{it+1}}{W_{it}}\right) \quad \text{(B2')}$$

$$\ln(1+g_{V^{\mathcal{S}}}) + b\ln\left(\frac{P_{it+1}^{\mathcal{S}}}{P_{it}^{\mathcal{S}}}\right) + (1-b)\ln\left(\frac{p_{it+1}}{p_{it}}\right) = \epsilon\ln\left(\frac{N_{it+1}^{\mathcal{S}}}{N_{it}^{\mathcal{S}}}\right) + \ln(1+g_{W^{\mathcal{S}}}) \quad \text{(B3')}$$

$$\ln\left(\frac{N_{it+1}}{N_{it}}\right) + \ln\left(\frac{W_{it+1}}{W_{it}}\right) = (\rho+1)\ln\left(\frac{P_{it+1}}{P_{it}}\right) - \rho\ln(1+g_c) \quad \text{(B4')}$$

$$\ln\left(\frac{N_{it+1}^{\mathcal{S}}}{N_{it}^{\mathcal{S}}}\right) + \ln(1+g_{W^{\mathcal{S}}}) = (\rho+1)\ln\left(\frac{P_{it+1}^{\mathcal{S}}}{P_{it}^{\mathcal{S}}}\right) - \rho\ln(1+g_c^{\mathcal{S}}) \quad \text{(B5')}$$

$$\frac{1}{1-\beta-\gamma}\ln\left(\frac{p_{it+1}}{p_{it}}\right) + \frac{1}{1-\beta-\gamma}\ln\left(1+g_{A_i}\right) - \frac{\beta}{1-\beta-\gamma}\ln\left(\frac{W_{it+1}}{W_{it}}\right) = \ln\left(\frac{N_{it+1}^{\mathcal{S}}}{N_{it}^{\mathcal{S}}}\right) + \ln(1+g_{W^{\mathcal{S}}}), \quad \text{(B6')}$$

where we have used the notation $\frac{V_{t+1}}{V_t} = (1+g_V)$, $\frac{V_{t+1}^{\mathcal{S}}}{V_t^{\mathcal{S}}} = (1+g_{V^{\mathcal{S}}})$, $\frac{A_{it+1}}{A_{it}} = (1+g_{A_i})$, $\frac{W_{t+1}^{\mathcal{S}}}{W_t^{\mathcal{S}}} = \left(1+g_{W^{\mathcal{S}}}\right)$ for the exogenous parameters' growth.

As the system is linear in the endogenous quantities $\ln\left(\frac{W_{it+1}}{W_{it}}\right), \ln\left(\frac{P_{it+1}}{P_{it}}\right), \ln\left(\frac{N_{it+1}}{N_{it}}\right)$, $\ln\left(\frac{P_{it+1}^{\mathcal{S}}}{P_{it}^{\mathcal{S}}}\right), \ln\left(\frac{N_{it+1}^{\mathcal{S}}}{N_{it}^{\mathcal{S}}}\right), \ln\left(\frac{p_{it+1}}{p_{it}}\right)$ we can solve it with respect to the exogenous parameters $\ln(1+g_V), \ln\left(1+g_{V^{\mathcal{S}}}\right), \ln(1+g_{W^{\mathcal{S}}})$, $\ln\left(1+g_{A_i}\right)$, $\ln(1+g_i^c)$, $\ln\left(1+g_i^{\mathcal{S},c}\right)$, $a, b, , \eta, \epsilon, \rho, \beta, \gamma$. Assuming parameters do not take degenerate values, the existence and uniqueness of the solution follows from standard linear algebra.

Proof of Propositions 1 and 2

In the previous section we have shown the existence and uniqueness of the equilibrium describing local economies. We make comparative static predictions about the effect of banning second homes (i.e. making their housing supply more/perfectly inelastic) by computing the derivative of the equilibrium solution with respect to $g_i^{S,c}$. In fact, the post-ban costs of providing new second homes increased due to the imposed constraints. Table B1 summarizes the impact of the ban on the endogenous variables of the system, with $c := -1 + \epsilon + (-1 + b + \epsilon)\rho - (-1 + b)\gamma(1 + \rho) + (-1 + b)\beta(a - (1 + \eta)(1 + \rho))$.

TABLE B1

Treatment effects – No agglomeration economies

Variable	Comparative static treatment effect	Sign
Wages	$-\frac{b\rho(-a + \eta + \eta\rho)}{(1 + \rho)c(a, b, \epsilon, \eta, \rho, \beta, \gamma)(1 + g_{s,c})}$	< 0
Primary home prices	$\frac{b\rho}{(1 + \rho)c(a, b, \epsilon, \eta, \rho, \beta, \gamma)(1 + g_{s,c})}$	< 0
Number of primary residents	$\frac{b\rho(1 - a + \eta + \rho + \eta\rho)}{(1 + \rho)c(a, b, \epsilon, \eta, \rho, \beta, \gamma)(1 + g_{s,c})}$	$\lesseqgtr 0$
Second home prices	$-\frac{\rho(-b - c(a, b, \epsilon, \eta, \rho, \beta, \gamma))}{(1 + \rho)c(a, b, \epsilon, \eta, \rho, \beta, \gamma)(1 + g_{s,c})}$	> 0
Number of investors	$\frac{b\rho}{c(a, b, \epsilon, \eta, \rho, \beta, \gamma)(1 + g_{s,c})}$	< 0
Price of tourism services	$-\frac{b\rho((-1 + \gamma)(1 + \rho) + \beta(1 - a + \eta + \rho + \eta\rho))}{(1 + \rho)c(a, b, \epsilon, \eta, \rho, \beta, \gamma)(1 + g_{s,c})}$	< 0

The last column of Table B1 shows the sign of the impact of a constraint on new second homes. As stated in Proposition 1, the price of primary homes subject to the ban is lower than its counterfactual. The opposite is true for the price of second homes (Proposition 2). We now prove the signs of these effects. The assumptions on our model's parameters are $\beta, \gamma, \rho > 0$ (output elasticities of input factors and housing supply are positive), $0 < a, b < 1$ (housing consumption of primary residents and investors is positive but housing does not consume their entire budget), $\eta, \epsilon < 0$ (primary residents and investors are subject to a disamenity effect caused by the presence of these latter), and $\beta + \gamma < 1$ (decreasing returns to scale).

We now turn to the effect of the constraint on the remaining endogenous variables. Let us start with the price of second homes. We have that $\rho\big(-b - c(a, b, \epsilon, \eta, \rho, \beta, \gamma)\big) = \rho(1 - b)(1 - \beta - \gamma - \beta\eta)(1 + \rho) - \epsilon\rho(1 + \rho) + \rho(1 - b)\beta a > 0$, as each term of the sum is positive by assumption. The overall price effect is thus positive, which proves Proposition 2.

The effect of the ban on the number of primary residents is uncertain, as it depends on the magnitude of the parameter η describing the dislike of primary residents for investors. If primary residents strongly dislike investors, the ban may succeed in attracting more new primary residents than in the counterfactual case due to the comparative increase in the endogenous amenity value of the municipality. On the other hand it's easy to show that if we let $\eta \to 0$ the ban effect on the number primary residents is unambiguously negative with respect to its counterfactual: while hurting the local economy, the ban provides no incentive for them to move into the municipality. The sign of the other endogenous variables is the same.

Finally, let us consider prices of tourism services. We have that $-b\rho\big((-1+\gamma)(1+\rho)-\beta(1-a+\eta+\rho+\eta\rho)\big)=-b\rho(-1+\beta+\gamma)(1+\rho)-b\rho\beta(-a+\eta+\eta\rho)>0$ as each term of the sum is positive. The overall price effect on tourism services is thus negative.

Agglomeration economies and reverse effects

In the previous sections we have assumed that no agglomeration economies were present and, in particular, that returns to scale at the aggregate level were decreasing. We now consider the case in which agglomeration economies are present, possibly leading to increasing returns to scale in the tourism sector. In particular, we investigate how agglomeration forces may reverse Propositions 1 and 2. Following Glaser and Gottlieb (2009), the most straightforward way to introduce agglomeration economies in the model is to modify the aggregate production function as follows

$$Y_{it}=A_{it}\widetilde{N}_{it}^{\alpha}N_{it}^{\beta}K_{it}^{\gamma}\bar{Z}_i^{1-\beta-\gamma},\quad 0<\alpha,\beta,\gamma<1,\qquad \beta+\gamma<1,$$

where $\widetilde{N}_{it}^{\alpha}$ denotes an agglomeration term depending on the total number of primary residents (workers) in the municipality which increases total factor productivity. Importantly, this factor is treated as parametrically given to individual firms. We maintain the hypothesis of decreasing returns to scale in absence of agglomeration economies.

Deriving comparative static results when agglomeration economies are present is easy in our context. As the term N_{it}^{β} is replaced by $N_{it}^{\alpha+\beta}$ in the industry first order conditions and noting that non-traded capital $\bar{Z}$ (the only other term involving the output elasticity β) drops out from the system of equations in changes, we can simply substitute β with $\alpha+\beta$ in equations B1' and B6'. The new dynamic equilibrium is thus equal to the one in the absence of agglomeration economies with β replaced with $\alpha+\beta$. The resulting comparative static results are shown in Table B2.

We now investigate whether the sign of the impact of the ban on primary homes may be reversed and what are the implications for second home prices. The starting point is to investigate when the sign of the constant c is reversed by α, i.e. when $c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)>0$. One can show that

$$c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)>0 \iff (-1+b)\alpha\big(a-(1+\eta)(1+\rho)\big)>-c(a,b,\epsilon,\eta,\rho,\beta,\gamma).$$

Let $\bar{\alpha}:=\frac{-c(a,b,\epsilon,\eta,\rho,\beta,\gamma)}{(-1+b)\big(a-(1+\eta)(1+\rho)\big)}$ denote a threshold value of agglomeration economies. This leads to the conditions

$$\alpha>\bar{\alpha}\ \text{ if }\ a-(1+\eta)(1+\rho)<0 \qquad \text{(Case 1)}$$

$$\alpha<\bar{\alpha}\ \text{ if }\ a-(1+\eta)(1+\rho)>0. \qquad \text{(Case 2)}$$

Case 2 can easily be dismissed, as it implies negative values of α. In fact, from the previous section we know that $c(a,b,\epsilon,\eta,\rho,\beta,\gamma)<0$. If $a-(1+\eta)(1+\rho)>0$ this would imply a negative threshold $\bar{\alpha}$. As the agglomeration parameter α is assumed to be positive, we discard Case 2. This implies that the ban effect on primary home prices (and on wages, and the number of second home investors) is reversed only if the agglomeration economies are strong enough.

Interestingly, the threshold $\bar{\alpha}$ decreases with η: the more primary residents (comparatively) benefit from the ban, the weaker the agglomeration forces must be to create a positive effect of the ban on primary home prices.

TABLE B2
Treatment effects with agglomeration economies

Variable	Comparative static treatment effect
Wages	$-\frac{b\rho(-a+\eta+\eta\rho)}{(1+\rho)c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)(1+g_{s,c})}$
Primary home prices	$\frac{b\rho}{(1+\rho)c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)(1+g_{s,c})}$
Number of primary residents	$\frac{b\rho(1-a+\eta+\rho+\eta\rho)}{(1+\rho)c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)(1+g_{s,c})}$
Second home prices	$-\frac{\rho(-b-c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma))}{(1+\rho)c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)(1+g_{s,c})}$
Number of investors	$\frac{b\rho}{c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)(1+g_{s,c})}$
Price of tourism services	$-\frac{b\rho((-1+\gamma)(1+\rho)+(\alpha+\beta)(1-a+\eta+\rho+\eta\rho))}{(1+\rho)c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)(1+g_{s,c})}$

Let us now consider the effect of the ban on the price of second homes when the effect on the price of primary homes is reversed, i.e. when $\alpha > \bar{\alpha}$. The sign of the effect is reversed if $-\rho\big(-b-c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)\big) < 0$. One can show that

$$-\rho\big(-b-c(a,b,\epsilon,\eta,\rho,\alpha+\beta,\gamma)\big) < 0 \iff \alpha < -\frac{b+c(a,b,\epsilon,\eta,\rho,\beta,\gamma)}{(-1+b)\big(a-(1+\eta)(1+\rho)\big)} =: \bar{\alpha}'.$$

However, as $\bar{\alpha}' = \bar{\alpha} - \frac{b}{(-1+b)\big(a-(1+\eta)(1+\rho)\big)}$, we have that $\bar{\alpha}' < \bar{\alpha}$. Therefore, it is not possible to reverse the price effect on second homes if it is already reversed for primary ones. In other words, in the presence of strong agglomeration economies causing the ban to comparatively increase the price of primary homes, the price of second homes must also be comparatively higher.

Appendix C: Factor analysis

Let h_{it}^{j} denote the j-th age-related housing characteristic in municipality i at time t. The latent factor model is given by

$$h_{it}^{j} = \mu^{j} + l^{j}\xi_{it} + v_{it}^{j},\ j \in J,$$

where μ^{j} is an intercept term, l^{j} is the measure-specific loading, and v^{j} is a measurement error assumed to be independent across the h_{it}^{j} and exogenous with respect to the factor ξ. We further assume that $E(\mu^{j}) = E(v^{j}) = 0$ and that v^{j} is independent of Δu_{i13-14}. We estimate ξ by accounting for the covariance between the observed controls $h_{it}^{j},\ j \in J$ in a given time period.

Importantly, in the present context we assume that the intercept term μ^{j}, the loadings l^{j}, and the covariates' covariance structure – which is a function of $\Phi = \text{Var}(\xi_{it})$ and $\Theta = \text{Var}(\nu_{it})$ – are time invariant in the periods considered in our analysis, such that the structure of the measurements is invariant over time. We estimate these parameters using the covariates h_{it}^{j} measured in 2008-2009 and subsequently estimate the latent factor for the 2010-2011 and 2013-2014 periods. We are then able to compute the factor's first difference $\Delta\xi_{it}$ pre and post the approval of the SHI. We test the robustness of our results with respect to this assumption and no significant changes were observed when either a different time period was used to estimate the parameters, or factor scoring was performed independently in each time period.

WEB-APPENDICES

Web-Appendix A: References to Second homes' policies

In this section we provide a small selection of non-academic references on second homes policies described in the introduction. The list is by no means exhaustive. Rather, the cited references provide a brief description of the implemented policies and how they were welcomed by the press.

TABLE W-A1

Second homes policies around the world

Country	Reference
UK	HM Treasury and The Rt Hon George Osborne MP (2015). Spending Review and Autumn Statement 2015, Cm 9162. Morris, S. (2014). St. Ives council toys with banning outsiders buying holiday homes. *Guardian*, November 17. Swerling, G. (2014). St. Ives aims to turn tide on city dwellers with second home ban. *The Times*, November 7. The Economist (2016). To the lighthouse. April 2016. The Economist (2016). Stay away. May 2016. The Guardian (2016). St. Ives backs residents-only home ownership plan in referendum. May 2016.
New York	Barbanel, J. (2014). New Yourk City Mayor De Blasio Weighs Pied-à-Terre Tax. *Wall Street Journal*, September 23. Higgins, M. (2013). Tax-Abatement Changes Affect Many Unit Owners. *The New York Times*, March 26.
Israel	Gross, Judah Ari. (2015). Bid to make housing affordable sends buyers scrambling, but will it work? *The Times of Israel*. June 21.
Singapore	Harper, J. (2013). Singapore gets tough on foreign property buyers, *The Telegraph*, Jan 16. Shamim, A. (2011). Singapore Extends Housing Measures; Developers Drop. *BloombergBusiness*, January 14.
France	Le Parisien (2014). Résidences secondaires: l'Assemblé a voté la hausse de la taxe d'habitation. December 3. Samuel, H. (2014). Britons face tax hike on coveted French second homes. *Telegraph*, November 4.
China	Bloomberg. (2013). Beijing Curbs Second Home Buying as China Cools Property Market. *Bloomberg News*, 30 March 2013. Fung, E. (2015). China Lowers Down Payments for Buyers of Second Homes. *Wall Street Journal*, 30 March.

Web-Appendix B: Simulations

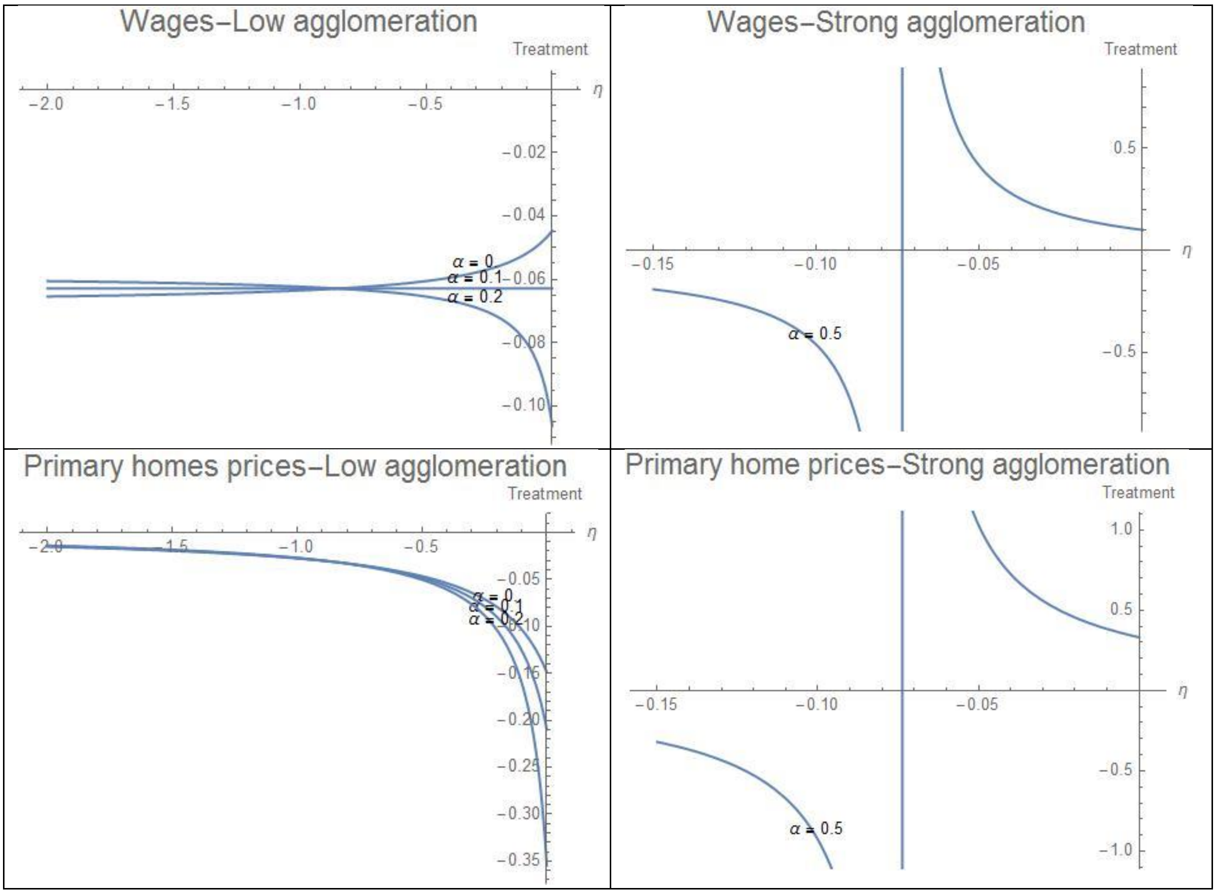
Figure W-B1 provides simulation graphs on the comparative static predictions with and without agglomeration economies. Different treatment effects corresponding to several agglomeration parameters are represented as a function of the disamenity parameter η of primary residents. In particular, we show that for α above a given value, the effect of the ban is reversed. To this end, we calibrate our model as follows:

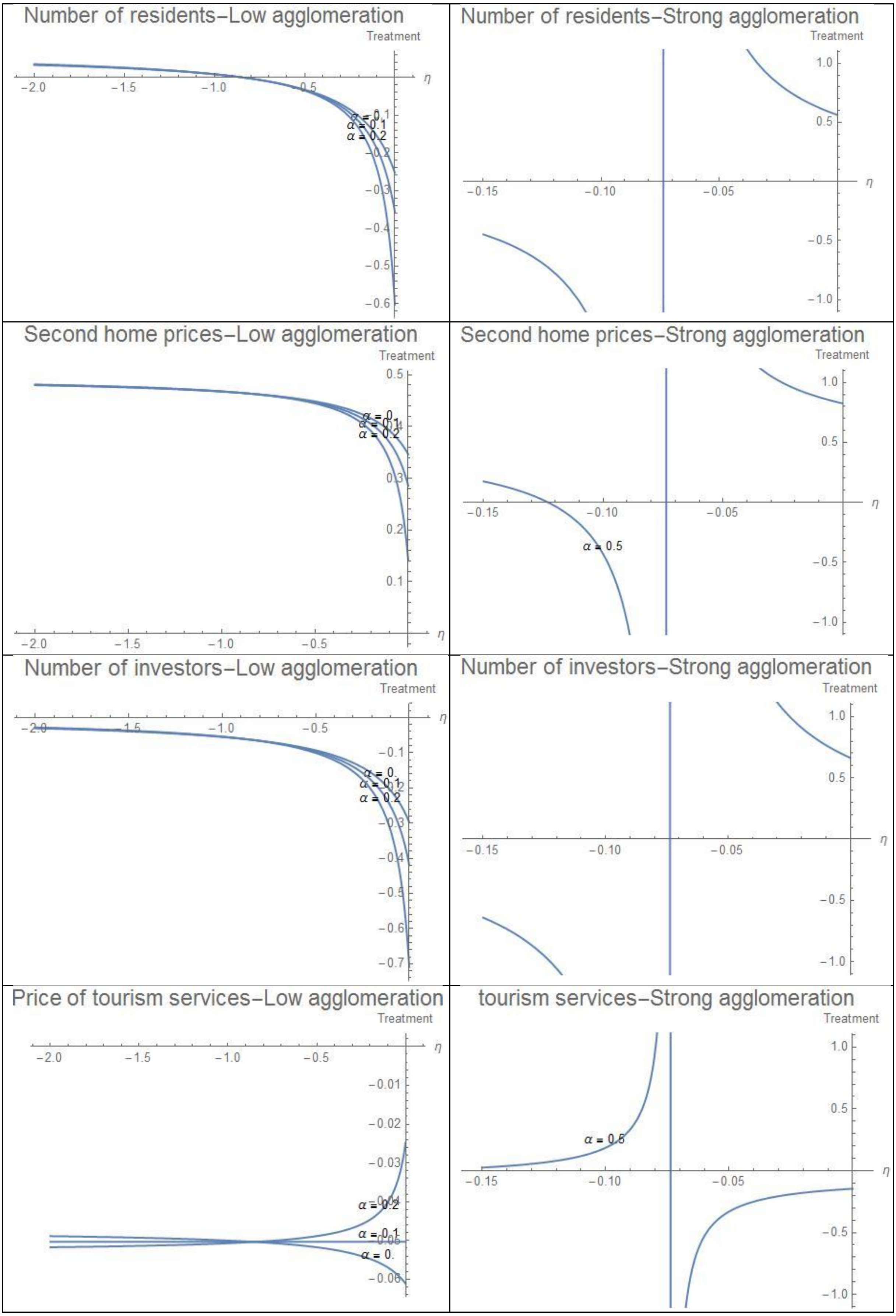
$a = 0.3,\ b = 0.15,\ \rho = 1,\ \beta = 0.7,\ \gamma = 0.2,\ g_c^S = 0.01.$

The share of housing consumption for primary residents corresponds to rough rule of thumb used by mortgage lenders to finance house purchases. We assume second home investors spend half of that share for their secondary residences. To simplify we assume a linear housing supply function. The assumed output elasticities' values are standard in the literature. Growth of construction costs of second homes are arbitrarily assumed to increase 1% from one period to another. Finally, we assume that investors are less negatively affected by their own presence and set $\epsilon = 0.5\eta$. The considered values of the agglomeration parameter α are 0 (decreasing returns to scale), 0.1 (constant returns to scale), 0.2 (increasing returns to scale but below the reverse threshold), 0.5 (increasing returns to scale and above the reverse threshold).

FIGURE W-B1

Simulation results – Agglomeration economies and reversed effects





The above graphs show how investors' dislike and returns to scale affect the impact of the ban on the endogenous variables of the system. It can be seen that for the considered calibration the ban effects are reversed when the agglomeration parameter α is above a given threshold (right hand side graphs). This threshold is apparently extremely high for the considered calibration – for $\alpha = 0.2$ the ban effects remain stable – and it seems plausible to assume that in the real world agglomeration forces are not that strong. We thus discuss only left hand side graphs in detail.

In line with Proposition 1, the policy effect is unambiguously negative (resp. positive) for primary (resp. secondary) residences. Interestingly, we can see how returns to scale of local tourism industries magnify or decrease the effect of the ban on local economies depending on its effect on the number of residents. For example, if primary residents don't dislike investors much – and their number is comparatively lower post ban – the wage effect of the regulation will be more negative in the case of increasing returns to scale ($\alpha = 0.2$) than for constant or decreasing ones ($\alpha = 0, 0.1$). The opposite is true for prices of tourism services. On the other hand, if primary residents strongly dislike investors – and their number is comparatively higher after the ban – the negative wage (tourism prices) effect for decreasing returns to scale will be stronger (weaker) than in the case of increasing return to scale.

Web-Appendix C: Detailed Description of Data and Sources

The present appendix contains detailed information on the sources and definitions of the data used in the paper. Web links to data sources are provided at the end of the section.

Housing transaction data

Individual transaction data has been provided by the Swiss Real Estate Datapool Association (SRED). The proprietary data can be obtained against payment from the association, see reference [1] below. Table W-C1 reports the definition of the variables used in the empirical part before being aggregated at the municipality level over given time periods or used to subset the data.

TABLE W-C1

Description of housing characteristics and data sources

Variable name	**Description**	**Values**
Number of rooms	Self-explanatory. To aggregate.	1, 2, 3…
Number of bathrooms	Self-explanatory. To aggregate.	1, 2, 3…
Number of parking places	Self-explanatory. To aggregate.	1, 2, 3…
Quality	The property standard: bad, average, good, very good. To aggregate.	1, 2, 3, 4
Condition	The property condition: bad, average, good, very good. It implicitly describes whether the property needs major renovations. To aggregate.	1, 2, 3, 4
Micro-location	The micro-location of the property inside the municipality: bad, average, good, very good. It depends, for example, whether the property has an open view, is situated in a spot with a lot of sun hours, etc. To aggregate.	1, 2, 3, 4
Age	Age of the property at the moment of the transaction. Has been computed by subtracting from the transaction year the year in which the property has been built. To aggregate. Negative values represent properties having been sold before being constructed.	…,-2, -1, 0, 1, 2, 3…
House type	House versus flat indicator. To aggregate.	0,1
Primary	Primary versus secondary residence indicator. Used to subset the data.	0,1
Municipality	FSO identifier for municipalities. More detailed information is available at [2]. Used to compute geographic distances (see below).	1, 2, 3…
Municipality type	FSO identifier for the municipality type (level 1). Classifies municipalities with respect to their local economy, population, richness, labour market, etc. More detailed information is available at [3] and [4]. Used as categorical variable.	1, 2, 3,…,9
Canton	FSO identifier for cantons. More detailed information is available at [5]. Used as categorical variable.	1, 2, 3…,26

Second home rates

The text of the SHI ordinance, as well as the methodology used to measure municipalities' second home rates are provided by the Federal Office for Spatial Development (ARE), see [6]. Data on second home rates are freely available on their website.

According to ARE the approach used to compute second home rates – total housing stock less primary residences – may overestimate the second home number in some municipalities, since not all housing units that are not primary homes are necessarily second homes. They point out that a comparison of the Federal Population Census of 2000 and the Federal Register of Buildings and Dwellings reveals only minor differences between the two data sets, and the classification of municipalities into below and above 20% second homes does not vary across the two data sets. In general, the ordinance was applied according to this approximated measure, independently of a municipality's "true" second home rate.

However, when the draft of the ordinance – that listed all affected (treated) municipalities – was made public in August 2012 – municipalities were allowed to request a revision of their second home rate if they could document that the one published by the ARE was incorrect. Municipalities that opted to propose a revision of their second home rate did not have to comply with the restriction imposed by the initiative. About 6% of Swiss municipalities requested a revision of their second home rate and virtually all of them were able to provide proof that their second home rate was indeed below 20%. The ARE continues to systematically verify and update the second home rate of all municipalities. Only very few municipalities that were initially assumed to be below the threshold, have subsequently been added to the list of treated municipalities. In our analysis we drop all municipalities that were either subject to a revision or were subsequently reclassified.

Municipalities' characteristics

Data on municipalities' characteristics are freely provided by the Federal Statistical Office (FSO). The indicators used in the present paper can be directly downloaded using the interactive statistical atlas of Switzerland – available only in French and German – see [7]. Table W-C2 describes the considered variables and the corresponding data sources. When necessary, we provide additional information on how data were computed.

TABLE W-C2

Description of municipalities' characteristics and data sources

Variable name	Description	Values
Vote No	Share of voters having rejected the SHI on the 11 March 2012. Provided by the FSO, see [8].	[0,1]
Unproductive surface	Surface of lakes, mountains, glaciers, etc. present in a municipality. Provided by the FSO, see [7]. See below for further details.	[0,1]
Distance to major city	Distance to one of the 15 major urban centers of Switzerland. See below for further details.	Km
Distance to major ski resort	Distance to one of the 53 major ski resorts of Switzerland. See below for further details.	Km
Homeowners	Share of homeowners in the municipality as measured in 2000. Provided by the FSO, see [7]	[0,1]
Percentage of firms/ individuals in the 3rd sector	Share of firms and individuals working in the third sector. Provided by the FSO, see [7]	[0,1]

The share of undeveloped developable land has been computed using land-use data measured from 2004 to 2009. This time interval corresponds to the time necessary to take areal pictures by overflying the whole country's territory. More up-to-date measurements are presently underway and will be available in 2018. The FSO classifies municipalities' surface into four main categories: urban, wood, agriculture, and unproductive surfaces. This latter category mainly corresponds to lakes, rivers, glaciers, and bedrock surfaces. Additional information on the methodology used to measure and classify land surfaces is available at [9].

Distances to major city centers and ski resorts have been computed using GIS data provided by the Federal Office of Topography, see [10]. Geographic boundaries updated to 2014 were used. In particular, distances were computed as the minimal planar distance between the two closest points of the considered municipalities' boundaries. For example, if a municipality is adjacent to a major urban center/ski resort, the corresponding distance is equal to zero. The 15 major urban centers were identified using FSO information on major agglomerations, see [11]. Table W-C3 contains the selected municipalities and their respective population as measured in 2014.

The 52 major ski resorts were identified using Google results obtained by searching 'Switzerland + ski resorts', to which we added the municipalities of Ste Croix, St Cergue, and Le Lieu to represent ski resorts belonging to the district of Jura-Nord Vaudois. Table W-C4 contains the list of the considered ski resorts. Some of the considered ski resorts belong to the same municipality and thus have the same FSO identification number.

TABLE W-B3

Major urban centers (individual municipalities)

FSO number	City Name	FSO number	City Name
261	Zürich	230	Winterthur
6621	Genf	1711	Zug
2701	Basel	4021	Baden
351	Bern	371	Biel
5586	Lausanne	2196	Fribourg
1061	Luzern	2581	Olten
3203	St. Gallen	6458	Neuchatel
5192	Lugano		

TABLE W-B4

Major ski resorts (individual municipalities)

FSO number	City Name	FSO number	City Name
1202	Andermatt	3612	Obersaxen
6031	Verbier	6139	La Tzoumaz
3851	Davos	3539	Savognin
5409	Villars-sur-Ollon	6252	Zinal
584	Mürren	6252	Grimentz
6300	Zermatt	3982	Disentis
584	Wengen	1631	Elm
3575	Laax	1004	Flühli
6243	Crans-Montana	5411	Les Diablerets
6290	Saas-Fee	6151	Champéry
1402	Engelberg	6285	Grächen
3787	St. Moritz	5061	Airolo
3871	Kloster-Serneus	6252	Saint-Luc
3921	Arosa	6252	Chandolin
6024	Nendaz	6193	Bürchen
561	Adelboden	3981	Brigels
3506	Lenzerheide	6135	Ovronnaz
576	Grindelwald	1501	Beckenried
3752	Samnau	794	Zweisimmen
5407	Leysin	6111	Leukerbad
3732	Flims	6156	Morgins
783	Hasliberg	584	Mürren
3357	Wildhaus	3311	Amden
3986	Tujetsch	5568	Ste Croix
792	Lenk im Simmental	5727	St. Cergue
3762	Scuol	5873	Le Lieu
6082	Anzère		

Fiscal data

Data on municipalities' fiscal data are freely available on the website of the Swiss Federal Tax Administration (FTA), see [12]. Based on individuals liable to pay the Federal Tax, we used the average net income and the corresponding Gini index at the municipality level computed including both married and not married individuals. We supplemented this data by adding the share of foreign residents available at [7].

Web references

Reference	Link
[1]	http://www.sred.ch/
[2]	http://www.bfs.admin.ch/bfs/portal/de/index/infothek/nomenklaturen/blank/blank/gem_liste/03.html
[3]	http://www.bfs.admin.ch/bfs/portal/de/index/infothek/nomenklaturen/blank/blank/gemtyp/01.html
[4]	http://www.bfs.admin.ch/bfs/portal/de/index/regionen/11/geo/raeumliche_typologien/01.html
[5]	http://www.bfs.admin.ch/bfs/portal/en/index/regionen/thematische_karten/maps/raumgliederung/institutionelle_gliederungen.parsys.0002.PhotogalleryDownloadFile2.tmp/k00.22s.pdf
[6]	http://www.are.admin.ch/themen/raumplanung/00236/04094/index.html?lang=fr
[7]	http://www.bfs.admin.ch/bfs/portal/en/index/regionen/thematische_karten/02.html
[8]	http://www.bfs.admin.ch/bfs/portal/de/index/themen/17/03/blank/key/2012/011.html
[9]	http://www.bfs.admin.ch/bfs/portal/fr/index/themen/02/03.html
[10]	https://shop.swisstopo.admin.ch/fr/products/landscape/boundaries3D
[11]	http://www.bfs.admin.ch/bfs/portal/fr/index/themen/01/02/blank/key/raeumliche_verteilung/agglomerationen.html
[12]	https://www.estv.admin.ch/estv/de/home/allgemein/dokumentation/zahlen-und-fakten/steuerstatistiken/direkte-bundessteuer.html

Web-Appendix D: Additional Robustness Checks

TABLE W-D1

FD Estimates-Including municipalities with revised second home rates in the control group

Δ Log primary home prices	(1)	(2)	(3)
Treatment	-0.147***	-0.142***	-0.143***
	(0.0379)	(0.0368)	(0.0369)
Lagged difference of housing characteristics	No	Yes	Yes
Lagged difference of fiscal variables	No	No	Yes
Observations	1,419	1,419	1,419
R-squared	0.021	0.128	0.129

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

TABLE W-D2

FD Estimates – 2008/2009 Weights

Δ Log primary home prices	(1)	(2)	(3)
Treatment	-0.110***	-0.113***	-0.111***
	(0.0306)	(0.0298)	(0.0298)
Lagged difference of housing characteristics	No	Yes	Yes
Lagged difference of fiscal variables	No	No	Yes
Observations	1,354	1,354	1,354
R-squared	0.021	0.115	0.119

Notes: Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

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