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By
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Effects of Airbnb in the Icelandic housing market

Lúðvík Elíasson and Önundur Páll Ragnarsson[1]

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Abstract

This paper looks at the effects of recent growth in private renting to tourists on the net supply of housing and house prices in Iceland. The growth in private renting to tourists is documented and used to adjust estimates of housing supply. Data on actual bookings of apartments in the capital region of Iceland on Airbnb is used as an indicator for supply of housing to short term tourism rentals. This information is used to estimate the effects of short-term lodging on real house prices in Iceland as well as for making a suggestion for the measure of the residential housing stock. The contribution of the growth in the Airbnb market on real house prices is estimated at 2% per year over the last three years, or about 15% of the total increase in real house prices during that period.

Introduction

Prices of residential houses in Iceland have risen sharply in recent years, particularly in the capital region. Prices in the central region of the capital have clearly led the rise in prices this time which is rather unusual in this particular market (Central Bank of Iceland 2015). Real prices have in most areas topped previous extremes attained prior to the global financial crisis of 2008 (Central Bank of Iceland 2018). During the period from 2004 to 2008 household debt increased significantly and in tandem with rising house prices (Elíasson and Skúlason 2016). This time, however, there are no signs of increased household debt being a driver of the current price boom. This time house prices have deviated less than in previous upswings from development of disposable income (Central Bank of Iceland 2017).

Rapidly rising house prices have been observed in other countries around the world in recent years and this has, at least in some cases, been linked to an explosion in private renting to tourists, particularly through websites such as Airbnb (Airbnb and the Berlin housing market, Airbnb's impact on the Canadian housing market, Barron *et al.* 2017, Dayne 2016, Merante *et al.* 2016, Sheppard and Udell 2016, Wachsmuth *et al.* 2017). We test this in the case of Reykjavík, Iceland, by using information on bookings through Airbnb and estimate their effects

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on residential house prices and on the stock of residential housing. There is an apparent negative supply effect of Airbnb listings in the housing market as apartments are moved from being owner occupied or long term rental apartments to the short term rental market catering to the needs of the tourism sector. Estimation shows significant positive effects of Airbnb bookings on house prices.

A short overview of the development of tourism in Iceland and different types of lodging is given in the next section. Following that is a description of the data and methodology used for measuring the Airbnb effects in the housing market in Iceland. Next is an introduction of the real price equation and the estimation results, making use of information on Airbnb bookings. The final section contains conclusions and discussion.

Tourism and the housing market

Tourism has been a growing source of export revenues in Iceland for decades and has been highly seasonal, with the bulk of visits happening in the third quarter. The growth seemed to level off following the global financial crisis of 2007 and 2008. Since 2010 the number of foreign nationals travelling through the main airport has grown faster than before. By 2015 tourism had become Iceland's largest export sector (exceeding exports from industrial production including aluminium production and all other industrial products). Along with the increased growth since 2010 the seasonality has diminished as tourism is increasingly becoming a year-round source of export revenues (fig. 1).

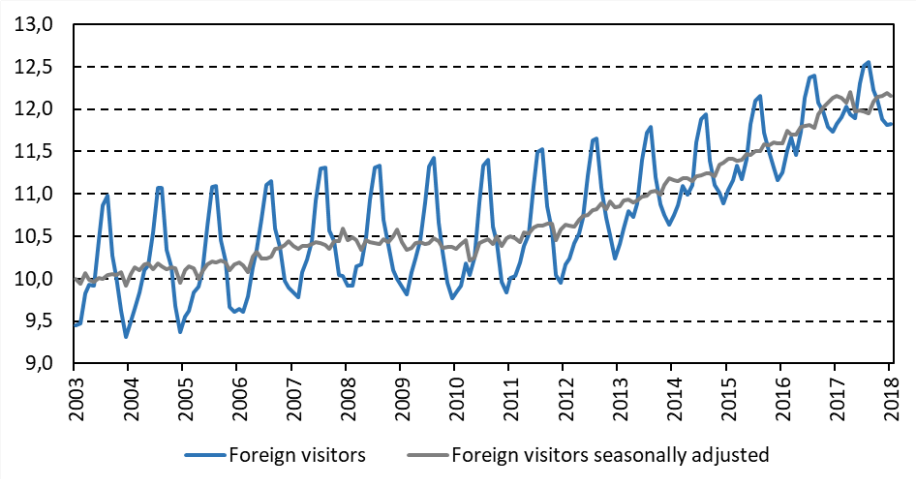

Figure 1. Natural logarithm of the number of foreign nationals who go through customs at the international airport in Keflavík each month. Seasonal adjustment is done by the X-11 procedure in Eviews. *Sources*: Statistics Iceland and authors' calculations.

Demand for short term rental housing has increased in line with rapidly growing tourism. This has been partly met by investment in hotels and partly by adapting some of the current stock of housing for short term rentals to tourists. The profitability from short term apartment rentals has also led to rising prices of, and increased investment in, centrally located apartments.

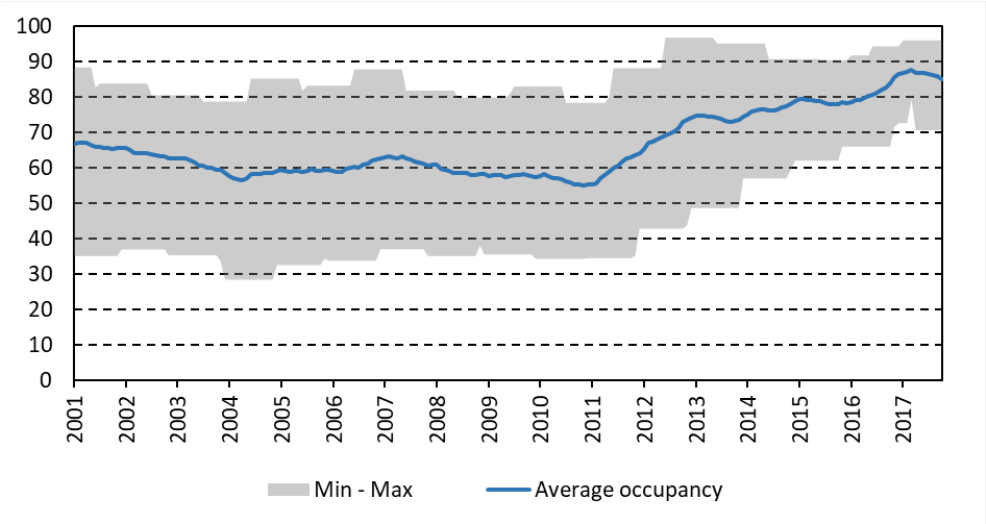

Figure 2. Average occupancy rate for rooms in hotels and guesthouses in the capital region. The blue line shows average percentage and the shaded area shows the maximum and minimum for the past twelve months. *Sources*: Statistics Iceland and authors' calculations.

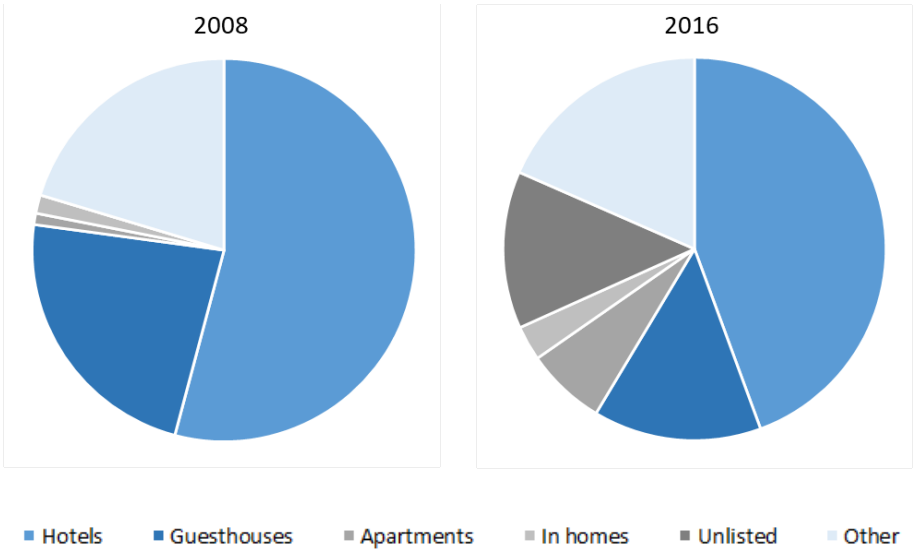

Figure 3. Overnight stays of foreign visitors in Iceland by type of lodging. Included for 2016 is an estimate of total unlisted stays. Total number of nights was 1.9 million in 2008 and 7.8 million in 2016. *Source:* Statistics Iceland.

Increased demand for lodging by foreign visitors has led to rising occupancy rates in Icelandic hotels, particularly in the capital area (fig. 2). Growing number of visitors and hence of overnight stays, in all types of lodging goes hand in hand with rising investment in the hotel and restaurant sector which has risen to an all-time high (fig. 4). The share of unconventional

types of lodging is, however, increasing at the cost of the more traditional stays in hotels and guesthouses (fig. 3).

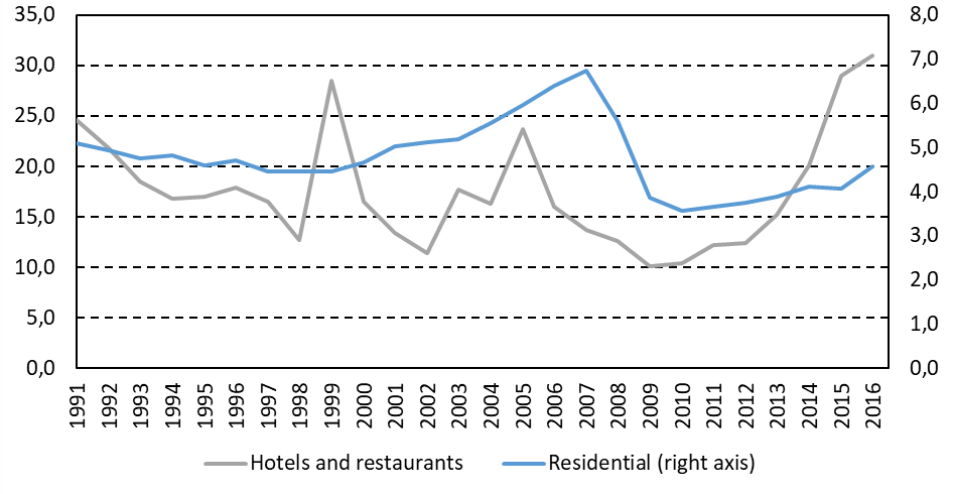

Figure 4. Investment in residential housing and in hotels and restaurants as a percentage of the previous year's stock. *Sources*: Statistics Iceland and authors' calculations.

It appears that the expansion of tourism has led to a rise in demand for short term lodging which has not only led to increased investment in hotels and guesthouses but also to supply of apartments which previously were solely used as housing by residents. This has helped in meeting the increased demand for short term lodging but at the same time it has withdrawn supply from the housing market, causing residential house prices to rise, particularly in the central capital region.

Data on the supply and demand for Airbnb lodging

Although Airbnb is not the only website for listing of short term rental apartments it maintains its position as a leader in the market. AirDNA offers an extensive dataset on Airbnb activity, and with that the opportunity to estimate its effect on the residential housing market. The opportunity for added income through Airbnb's platform has been seized by Icelandic homeowners and landlords alike. From Airbnb's appearance up to year-end 2017, a total of 8,162 hosts made 14,088 listings on the website. As of 2017, Iceland had around 134,000 residential properties in total. Accounting for the possibility of multiple listings per property, the proportion of residential housing in Iceland listed on Airbnb at one time or another may be as high as 10%. Up until December 2017 the total revenues from Airbnb activity had amounted to roughly 32 billion Icelandic krónur (ISK), at December 2017 prices, around 1.3% of Iceland's 2017 GDP.

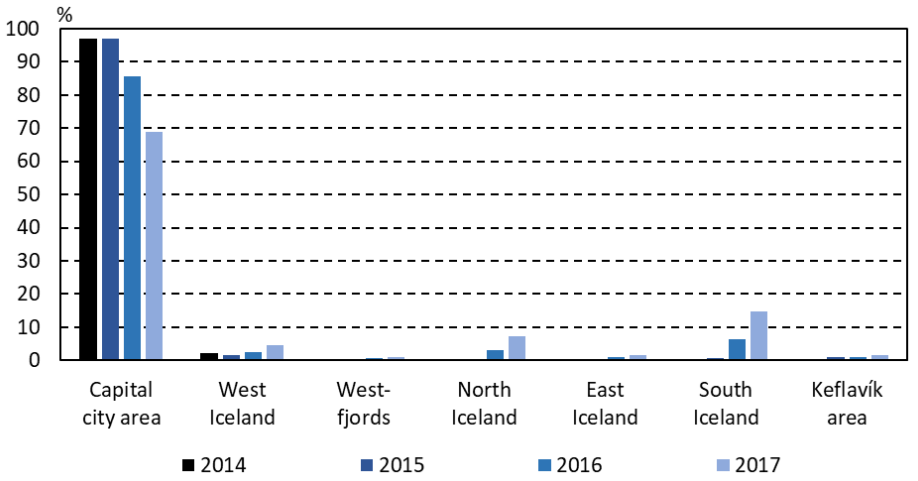

Figure 5. Region's share in Airbnb revenues 2014-2017. *Sources*: AirDNA, authors' calculations.

The lion's share of this market is in the greater capital city area and, in particular, central Reykjavík. The precise registration of location via a Google Maps application, by hosts themselves, allows a categorisation based on geographical areas, using GPS-coordinates. As of 2017, around 80% of accumulated listings in Iceland were in the greater capital area. Close to 48% thereof were in central Reykjavík. In terms of revenue the distribution is equally heterogeneous. At 2017 prices the total revenues earned in the capital area since 2014 were roughly 25 billion ISK and amounted to 77% of the country total. A distant second is the vast southern region, with 11% of the revenue. Table 1 shows the number of listed whole dwellings and revenues in the period from September 2014 to December 2017, for each area and four rural towns.

The capital region includes Reykjavík and the surrounding municipalities which together form a continuous urban area, also referred to as the greater Reykjavík area. Greater Reykjavík is the only area in Iceland with a smoothly functioning real estate market while also serving as a single labour market and tourist destination. This means that long-term inhabitants whose dwellings are shifted to short-term renting will generally search for new housing within the same area, and a shock to tourism will hit the area in a relatively uniform manner. Greater Reykjavík contains more than 60% of all residential housing in Iceland. Furthermore, 53% of all hotel rooms in the country are in the greater Reykjavík area, as of November 2017. Close to 30% of the three systemically important banks' exposure at default (EAD) are accounted for by mortgage lending. Although under 10% of the three largest banks' loans to customers are loans to the tourism sector, that ratio may rise in the coming years, if the sector sustains its rapid growth for some time still. This provides an incentive to study the link between tourism and the housing sector in the greater Reykjavík area.

Table 1. Geographic distribution of Airbnb activity throughout the country, in the years 2014-2017. *Sources*: AirDNA, authors' calculations.

	Whole dwellings listed	Share in total (%)	Whole dwellings revenue, bn.ISK, 2017 prices	Share in total (%)
Central Reykjavík	4057	47,6	14,19	44,2
Capital area (incl. central Rvk.)	6780	79,6	18,15	56,6
West Iceland (incl. Akranes)	266	3,1	0,86	2,7
Akranes	34	0,4	0,04	0,1
Westfjords	94	1,1	0,20	0,6
North Iceland (incl. Akureyri)	506	6,0	1,24	3,9
Akureyri	266	3,1	0,62	1,9
East Iceland	113	1,3	0,29	0,9
South Iceland (incl. Ölfus/Árborg)	696	8,2	2,52	7,9
Ölfus/Árborg	162	1,9	0,39	1,2
Keflavík area (Suðurnes)	153	1,8	0,31	1,0
Total	**8519**		**32,10**	

Measuring Airbnb's effect on residential housing supply using the AirDNA dataset demands some assumptions on what constitutes an apartment, and when that apartment is part of the vacation rental market, and not the residential housing market. In other words, in this context, what is a dwelling and what is not? When is said unit's Airbnb activity so extensive that other residency is not possible in it simultaneously?

Listings on the website entail properties being offered either in part or whole. One room in a house being rented out doesn't mean that the house cannot be inhabited by its owners at the same time. In addition, many of the spaces listed aren't complete dwellings. So far, they comprise 32 categories, many of which clearly aren't houses or apartments. Therefore, their utilisation as vacation rental spaces does not entail a dwelling being extracted from the residential housing supply, negatively affecting supply. Or turning it the other way around, it does not entail inhabitants of a dwelling going out on the market to secure other housing, positively affecting demand. Examples of categories listed are: boat, hut, yurt, camper/RV, treehouse and igloo. Also, an overlap with the hotel sector is apparent in categories such as guesthouse, bed & breakfast and boutique hotel. To minimize possible distortions of our measurement, we only include listings specified as 'entire home/apartment' and the following property categories: apartment, house, loft, townhouse, villa, condominium, castle, bungalow, serviced apartment and floor.

To decide for each listing which satisfies the aforementioned conditions, whether it is Airbnb-active enough to be considered solely a part of the market for short term renting, and not the residential housing market, we take two different approaches where one is booking-based and the other revenue-based. For the purposes of obtaining smooth, non-seasonal series we use a 12 month period and the resulting measures are presented in figures 6 through 8. Graphs showing the same measurements using a six-month period, a three month-period and a one month-period are presented in appendices 1 and 2.

The first approach takes the stance that a dwelling cannot be lived in by owners or long-term tenants if it is booked through Airbnb for a certain number of days in a year. In any given month we take stock of the days booked through Airbnb in that month, the preceding three months, six months and twelve months. We then apply differing definitions, with 30 day intervals, to obtain a spectrum of measurements of the number of dwellings taken over by Airbnb activity. The least stringent criterion states that a dwelling must have been booked for at least 30 days in the last 12 months to be counted out of the residential housing market. The second least stringent criterion has a threshold of 60 days, and so on to the tightest threshold of 360 booked days. This yields a spectrum of estimates anywhere between 3 and 3,087 dwellings in the greater Reykjavík area in December 2017, presented in figure 6. A corresponding spectrum for regional Iceland (i.e. the rest of the country) is between 1 and 1,585 dwellings in the same month.

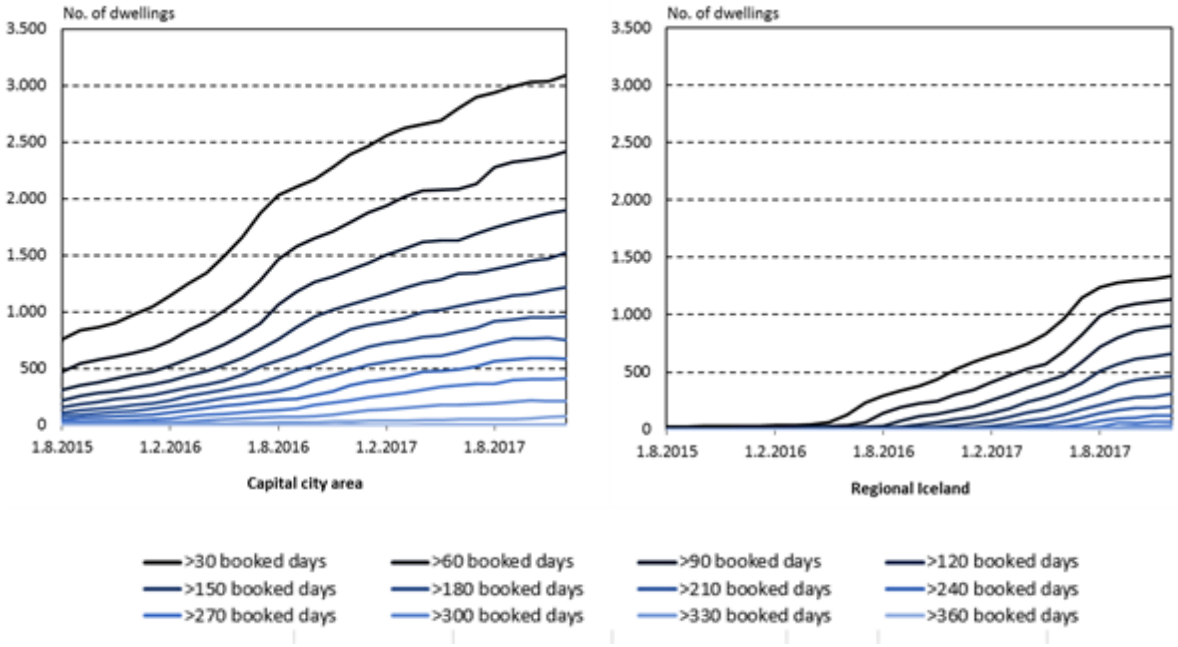

Figure 6. Airbnb's effect on the capital city area's residential housing stock. Results from booking-based criteria. The period of reference is the preceding 12 months. *Sources*: AirDNA, authors' calculations.

The following observation allows a significant narrowing of this spectrum. In reality, it is possible for many to live elsewhere on weekends, while renting their own dwelling out. The lower bound should therefore be at least somewhere close to 90 days. In addition, many people rent out their dwellings while on vacation themselves. The most common duration of a summer vacation is one month, so another plausible limit is 120 booked days. Yet another possible criteria is that the dwelling is booked at least half of the time, i.e. 180 days. However, the average booking is around 4 days. Since it is difficult to make each booking meet on ends with the previous one, 150 booked days might in reality also represent close to 50% utilisation of a dwelling on Airbnb. Lastly, when booked days account for well over half the year, it seems

unlikely that the dwelling is anyone's primary home simultaneously. A criterion of 210 booked days in 12 months should therefore suffice as an upper bound.

Using only these criteria we obtain a more fine-tuned interval of estimates, shown in fig. 7. These estimates range from 752 to 1,898 dwellings for greater Reykjavík in December 2017, and from 204 to 902 for regional Iceland. We take 150 booked days to represent the most plausible criteria. That yields a measurement of roughly 1,200 dwellings for greater Reykjavík, and 460 for regional Iceland. However, the reader is free to make his own choice. One notable attribute of the outcome is that regional Iceland doesn't seem to have had any year-round Airbnb activity at all until 2016, lagging approximately 12-18 months behind the Reykjavík area in the great inflow of overnighting tourists.

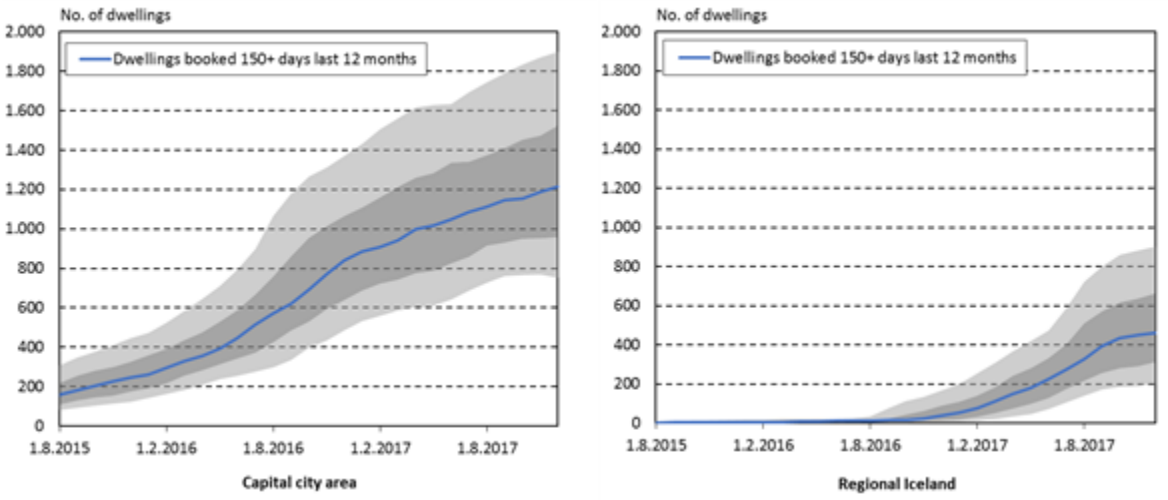

Figure 7. Most plausible range of estimates, from booking-based criteria. The inner bounds represent the number of dwellings booked for at least 120 to 180 days, and the outer bounds at least 90-210 days. *Sources*: AirDNA, authors' calculations.

With the revenue-based approach we apply two criteria. The looser one demands that the revenue of an Airbnb listing in the preceding 12 months exceed the payment burden on a representative dwelling. Here, the rationalisation is that a proprietor will exit a market where he doesn't turn a profit. Although simply affording payments is not seen as making an economic profit, due to opportunity costs, it can be taken as sufficient by some owners, e.g. for lack of willingness to enter a long-term contract. The representative dwelling for greater Reykjavík is taken to fetch 40 million ISK, financed with an 80% mortgage loan with a 35 year maturity. The interest rate is given as the rate on a given class of Housing Financing Fund bond (HFF44), with an added premium equal to the one taken by one of the largest pension funds on mortgage loans to its members.

The tighter criterion demands that the proprietor make an economic profit, so that revenue exceeds the opportunity cost of renting out on Airbnb, i.e. the average long-term rent price for the capital city area in the corresponding 12 month period. However, the variable cost

associated to Airbnb hosting is higher than when renting out long-term. This entails frequent cleaning, reception of visitors and the apartment being fully furnished. To gauge for this difference we discount each property's revenue stream by 25%, a common fee charged for the complete service of Airbnb flats. The series for the average rent price is obtained from the Registers Iceland database. Each listing's monthly income is registered in USD in the dataset. For comparison, each listing's income is converted to ISK using the corresponding month's average ISK/USD exchange rate.

Here it's worth noting the possibility of multiple listings for the same property. The same property may have a double listing, one as a whole dwelling and one as a private or shared room. Thus any whole dwelling listed might in actuality have a higher revenue stream than indicated by only including whole dwelling listings. This supports the view that revenue-based estimates should be regarded as cautious.

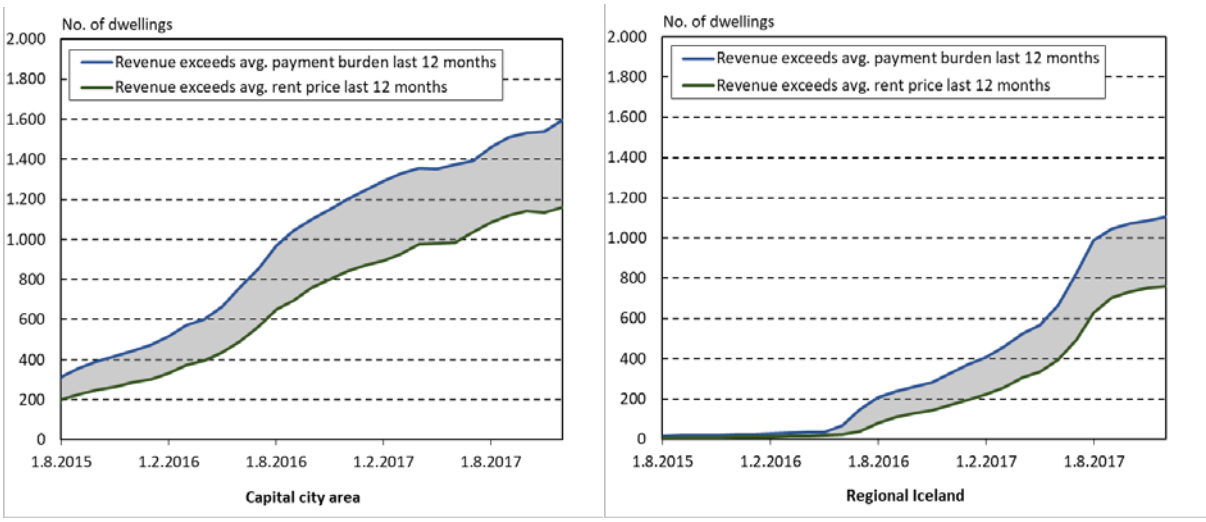

Figure 8. Estimates from revenue based-criteria. *Sources*: AirDNA, Registers Iceland, authors' calculations.

The results are displayed in figure 8. They indicate that in December 2017 1,159-1,595 residential dwellings in the capital region were actually used for short term lodging by tourists. For regional Iceland the range indicated is 759-1,107 dwellings, which supersedes the range indicated by the booking-based criteria. This may be somewhat affected by our use of average rent prices and payment burdens for the whole of regional Iceland, as those prices vary across regions. The average rent price for regional Iceland was obtained from Registers Iceland, while the payment burden series was identical to the one used for greater Reykjavík, except for being scaled down to par with the average price difference of dwellings between greater Reykjavík and regional Iceland.

The range indicated by the revenue-based approach lies in the upper half of the most plausible range indicated by the booking-based approach. When using a short reference period of 1-3 months, it's upper bound lies right at the upper outer bounds given by criteria of at least 9 and 23 booked days respectively. This might be evidence that the upper outer bound is the best

estimate. Then again, it might simply reflect the great demand for vacation rental space in recent years, during the great growth spurt of the tourism services sector. It has been attractive to many apartment owners to extend their income by renting out now and then, meanwhile living with relatives or friends. When using a longer reference period of 6 to 12 months the revenue-based range lies closer to the centre of the booking-based one (although still in the upper half) in the capital city area, but still follows the outer upper bound in regional Iceland. This may be caused by inaccuracies for regional Iceland, as we use the same revenue benchmark for the whole of regional Iceland. Rent prices and real estate prices (used to create the representative dwelling for the payment burden criteria) may however vary across different regions.

Model and estimation

Shocks to equilibrium in the housing market can be studied with the help of a simple model showing demand for, and supply of, housing in a graph with housing price on the vertical axis and the amount of housing on the horizontal axis. The demand schedule is a downward sloping line while supply is represented by two abstract lines representing the extremes. The short run supply indicates the amount of housing available instantly (with $\Delta t = 0$) and is therefore drawn as a vertical line, while the long run supply (with $\Delta t = \infty$) is horizontal, since given enough time supply will be perfectly elastic as long as price exceeds the building cost (Elíasson and Pétursson 2009, Elíasson 2018). Note that these extremes are shown in order to ease the representation of responses to shocks where the immediate response is a jump in the price while the long run response comes through adjustment in supply. Hence, for all intermediate time intervals (between 0 and ∞) a corresponding supply schedule would be upward sloping.

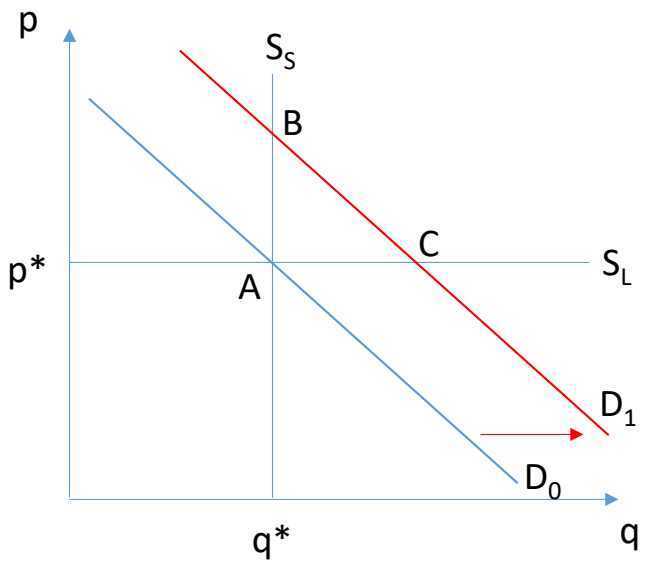

Figure 9. Shift in the demand D (from D_0 to D_1) for residential apartments due to increased demand from tourists. This is a representation of the Airbnb effect as increased demand for residential housing.

The way in which increased tourism puts pressure on the residential housing market can be expressed in two ways in this model, either as increased demand for housing or as a contraction of housing supply. Demand for short term lodging exceeds the availability of rooms in hotels and guesthouses and therefore starts competing with the demand for residential housing. This can be interpreted as a shift in the demand for residential housing since it implies additional demand for the same living spaces but for a different use. This shift in demand is depicted in fig. 9.

As the demand for housing increases, due to new use as short term rentals for tourists, the price of housing goes up. This is shown as a shift of the demand schedule from D_0 to D_1 in fig. 9, and the movement of the short-term housing market equilibrium (the intersection of the demand curve and the short term supply curve S_S) from point A to point B. If this shift in demand is permanent then the increased price of housing will boost the profitability from supplying more housing. As a result the short run supply curve would start to move to the right until it reaches the intersection of the new demand schedule and the long run supply curve (at point C in fig. 5) where the price of housing is once again at the equilibrium level equal to the building cost.

Effects of increased short-term rentals on the housing market can also be studied in the same model by looking at their effects on the supply of housing. Increased profitability from short-term renting to tourists causes the owners of some apartments to move them from the market for housing and supply them instead as alternatives to hotels or guesthouses. This effectively shifts the short term supply in the housing market to the left (fig. 10).

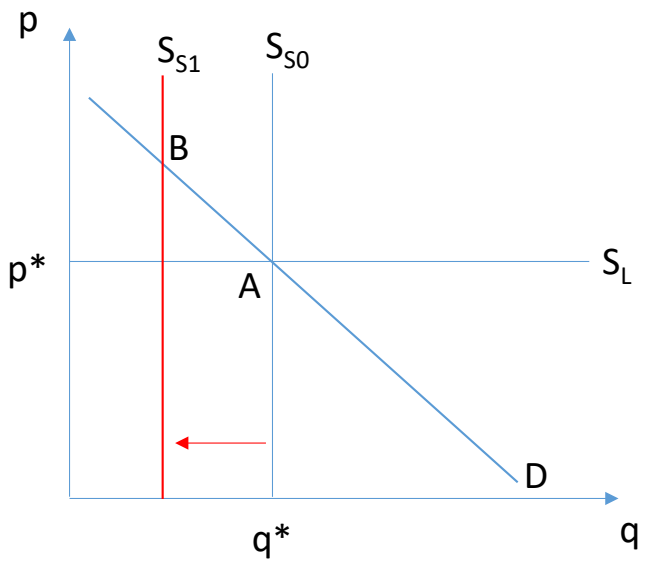

Figure 10. A part of the housing stock moves from being supplied in the market for housing to the market for short term renting to tourists. This causes the short term supply curve S_S in the housing market to shift to the left (from S_{S0} to S_{S1}).

After the initial shift in the short term supply a new short-run equilibrium appears (at point B in fig. 10) with higher housing prices than before. The resulting dynamic responses are the same as in the case where an outward shift in demand occurred. Profitability of supplying new housing has increased and the short run supply curve (which here is the supply to the housing market net of what has shifted to short-term rentals to tourists) will move to the right over time until it intersects the demand curve at the long-run equilibrium where the price of housing equals the building cost once again.

Elíasson and Pétursson (2009) estimated equations for house prices and housing investment derived from housing demand and housing supply relationships along similar lines as done by e.g. Poterba (1984). A function for real house prices is derived as an inverse demand function for housing. Housing demand is assumed to be proportional to income and a function of the real house price, the real interest rate and debt relative to income (as a proxy for access to credit). Their model uses annual data from 1962 to 2003 and was later extended through 2014, allowing for the effects of net immigration (Elíasson 2017). Data on the use of residential apartments for short term lodging for the tourist sector is very recent, with the AirDNA data series starting in 2014. In order to capture some of the potential short term dynamic effects of this phenomenon it is preferred to use a quarterly rather than an annual model when estimating effects on house prices and housing investment. Due to data availability a slightly modified version of the corresponding house-price equation and housing-investment equation for the Central Bank of Iceland's quarterly macroeconomic model QMM (Daníelsson *et al.* 2015) were used in the estimation of the effects of Airbnb rentals on the capital region's housing market.

All data other than on the use of residential apartments for short-term lodging, are from the Central Bank of Iceland's database for the QMM. The data series chosen to reflect the extent of Airbnb shows the quarterly average of the number of Apartments (in thousands) which are rented for 15 days or more through Airbnb. This series is added as an explanatory variable to both the house price equation and the housing investment equation. Estimation uses quarterly data from 1990 through 2017.

House prices

Building on the corresponding equation from the Central Bank of Iceland's quarterly macroeconomic model the change in real house prices was estimated as

$$\begin{aligned}\Delta(p_H - p) = {} & 0.165 + 0.062D_{051} - 0.073D_{082} - 0.058D_{084} + 0.365\Delta(p_H - p)_{-1} \\ & - 0.057[(p_H - p) + 1.316(k_H - y) + 0.615R]_{-1} - 0.889\Delta R + 0.027I \\ & + 0.016\Delta A_{-2}\end{aligned} \tag{1}$$

where lower case letters are the natural logarithms of the corresponding upper case variable,

P_H is the house price index
P is the consumer price index
R is the long-term real interest rate

I is net immigration in the quarter as a percentage of population
A is the quarterly average of the number of apartments per thousand inhabitants rented on Airbnb for 60 or more nights during the past six months
K_H is the real stock of housing
Y is the disposable income
D's are dummies identified by the last two digits of the year and the number of the quarter in which they take the value 1.

Standard errors of the estimates and p-values for diagnostic equation tests are given in table 2. The equation (1) differs from the real house price equation in the Central Bank of Iceland's QMM model in that it omits the quarterly dummy variables, which were found to be insignificant. Two additional dummy variables are added. A new dummy is introduced for the second quarter in 2008, when the foreign exchange market in ISK froze over, hindering short term financing of the banking sector in foreign currency while the debt burden in foreign currency mortgages, which then had recently become popular, rose sharply due to depreciation of the domestic currency. A second dummy variable catches the effects of the financial crisis in the fourth quarter of 2008 when the three large Icelandic banks were unable to honour their payments and were thus taken over by the financial supervisory authority. The Icelandic króna started on a downward spiral which was halted by the introduction of capital controls in November 2008. This caused the purchasing power of domestic revenues to fall because prices of imported goods moved up in tandem with the depreciating currency. It also affected domestic demand because many households had borrowed in foreign currencies against collateral in their homes. This foreign currency borrowing by households accelerated in 2006, 2007 and the first quarter of 2008. About 4.5% of household debt to the banking sector was in foreign currencies at the end of 2004, 8.4% in 2006, 13% at the end of 2007 and 23% three months later (Central Bank of Iceland 2008).

Only the estimated coefficient on the real long-term interest rate in the long-run relationship is significantly different from its estimated value for the pre-crisis period used in QMM (Daníelsson *et al.* 2015, p. 84). The Central Bank's model uses the coefficient 1.763 compared to 0.615 in the current version (eq. 1). This means that now the long-term effects of the real interest rate on real house prices are found to be smaller than when focusing solely on the pre-crisis period. The rest of the estimated coefficients are well within one standard error of the estimates produced by Daníelsson *et al.* (2015).

In addition to the dummy variables mentioned above, two explanatory variables are included which are not in the QMM model. Elíasson (2017) found net immigration to Iceland to be a significant explanatory variable in a similar model of the Icelandic housing market, using annual data, explaining to some extent the rapid rise in house prices between 2004 and 2007, as well as the following price drop. Justification of adding net immigration as an explanatory variable was given by arguing that it might pick up stronger housing demand effects than expected by solely looking at the income statistics. Immigration during 2004 to 2008 was found to be concentrated in low-income jobs in construction and in addition it may not be fully reported. The effects of immigration on house prices have been studied in several other countries (see the survey by Barbu *et al.* 2017). For example Frostad (2014) found that

immigration of 1% of the population led to a 2.9% rise in house prices in Norway and Gonzales and Ortega (2009) showed that immigration amounting to 17% of working age population led to a 52% rise in prices (equivalent to 1% immigration relative to working age population leading to 3.1% rise in prices). In all these countries a significant part of the immigration was of workers in the construction sector which therefore was also related to the supply of new housing.

Table 2. Estimation results for the real house price equation (1). QMM is based on the equation from the Central Bank of Iceland's quarterly macroeconomic model (leaving out the quarterly dummies which were found insignificant. PH(A) adds a measure of Airbnb (number of apartments rented on Airbnb per 1000 inhabitants). PH(I) adds immigration in the quarter as a percentage of the population and PH(AI) adds both variables (eq. 1 above).

	QMM		PH(A)		PH(I)		PH(AI)	
		StDev		*StDev*		*StDev*		*StDev*
Constant	0.154	0.06	0.150	0.06	0.171	0.05	0.165	0.05
Change in lagged real house price	0.501	0.07	0.477	0.07	0.369	0.08	0.365	0.08
Change in real interest rate	-0.758	0.39	-0.748	0.38	-0.914	0.38	-0.889	0.37
Error correction term	-0.053	0.02	-0.052	0.02	-0.059	0.02	-0.057	0.02
Dummy 05Q1	0.064	0.02	0.065	0.02	0.060	0.02	0.062	0.02
Dummy 08Q2	-0.070	0.02	-0.070	0.02	-0.073	0.02	-0.073	0.02
Dummy 08Q4	-0.054	0.02	-0.054	0.02	-0.059	0.02	-0.058	0.02
Change in Airbnb apartments (lagged 2 quarters)			0.021	0.01			0.016	0.01
Net immigration					0.031	0.01	0.027	0.01
Diagnostic tests								
Adjusted R^2	0.513		0.533		0.554		0.563	
StDev of equation	0.018		0.018		0.018		0.017	
JB (p-value)	0.860		0.930		0.920		0.980	
BG (p-value)	0.06		0.03		0.22		0.16	
W (p-value)	0.65		0.80		0.77		0.91	
Log likelihood	287.6		287.3		293.0		291.5	

Estimates of change in Airbnb in all versions, change in real rate of interest in QMM and PH(A), are significant at the 10% level. All other parameter estiamtes are significant at the 5% level. JB is the $\chi^2(2)$ Jarque-Bera test for residual normality , BG is the Breusch-Godfrey LM test for first-order residual autocorrelation distributet as F(1,102) in QMM, F(1,100) in PH(A), F(1,101) in PH(I) and F(1,99) in PH(AI). W is the White LM test for residual heteroskedasticity distributed as F(12,97) in QMM, F(19,91) in PH(A), F(17,92) in PH(I) and F(23,85) in PH(AI).

Since quarterly data on net immigration and population before 2010 were unavailable they were constructed from the annual data. No evidence of seasonality was detected in the quarterly series for the more recent years. Annual values for net immigration prior to 2010 were therefore divided evenly between the quarters. Available data on the population on 1 January were available for all the years as well as estimates for 1 July population, and for 1 December for most years. These were bridged linearly to construct end of quarter population. The quarterly percentage change in the population due to net immigration was constructed from these series and included in the equation for real house prices (eq. 1). It was found to be statistically significant at the 1% level (see the PH(AI) column in Table 2) with 1% increase in the population due to net immigration leading to a 2.7% rise in real house prices. Immigration as a percentage of the population is clearly related to changes in the population. The change in the logarithm of population was also tested as an explanatory variable and it appeared to have significant effects at the 10% level. However, it did not measure significant once immigration was added.

The other new explanatory variable is a measure of the short-term lodging business. Several series were constructed above from the data on Airbnb bookings in Iceland. The series used in the estimation is the number of apartments in the capital region booked for more than 60 days during the past six months (second column of table I.3 in Appendix I and also shown in the bottom left panel of Figure I.1.). The argument was made above, when trying to determine when the primary use of an apartment had moved from serving as a place of residence for an owner or a long-term renter to serving as a place of short-term lodging for tourists, that a long-term view should be taken. Therefore the emphasis was on a significant number of nights booked through Airbnb during the past twelve months, although shorter time periods were also studied (see the appendices). When carrying out the regressions two more quarters were gained by limiting the definition of apartments primarily in short-term lodging to those rented for at least 60 nights during the past six months. The shorter series, defined as a number of booked nights during the past 12 months, did not produce significant parameter estimates. Using looser definition, i.e. booked for at least 45 nights during the past six months, resulted in a correspondingly lower parameter estimate, translating to similar effects on house prices, while the 60 day definition produced slightly better fit. Other parameter estimates were only marginally affected.

Although the data on bookings on Airbnb are monthly the rest of the series used in the estimation are quarterly. A quarterly series for bookings was constructed by taking the average of the series over the months during each quarter. The series thus records a number of apartments and it was scaled per thousand inhabitants. The change between quarters, lagged two periods, was included as a right hand side variable in the regression and captures direct effects of the growth in the short-term lodging market on residential house prices.

Given the estimate presented in eq. (1) the effects of Airbnb rentals on the real price of housing in Reykjavík are about 2% per year during 2014 to 2017 while the average annual increase in the real price during that period is 11.8%. This means that roughly 15% of the rise in real prices from 2014 to 2017 can be attributed directly to pressure on the housing market from short-term rentals to tourists, given the estimates presented in equation 1, which also implies that 85% of the rise in prices can be attributed to other things. For example, net immigration to the country during these three years appears to have double the effect of Airbnb, accounting for 30% of the rise in real house prices since 2014.

The effects of increased short term rentals to tourists on house prices may also be indirect. The large net immigration to the country during the past few years is undoubtedly related to the rapid growth in the tourism sector as well as in construction. It is mostly due to immigration of foreigners working in tourism related jobs in the service sector and in construction, including the building of hotels, guesthouses and apartments. Indirect effects of the tourism sector on the residential housing market could also be transmitted through the effect on available housing, where some apartments are shifted from both owner occupied and long-run rents to short-term lodging. If this is then swiftly offset, by a corresponding growth in housing investment, then the effects on prices are transient at best and may even evade detection.

Airbnb effects on the housing stock

The house price equation, as derived for the QMM, stems from the inverted demand for housing consumption. This may not have changed at all despite increased demand for residential homes when the change in demand is for a different use. This is in fact consistent with a part of the stock of housing being transferred to a different market, thus effectively shifting the supply and not the demand for housing. Modelling of the growth in the Airbnb lodging sector as a drain on the stock of housing would enable a direct estimation of this effect.

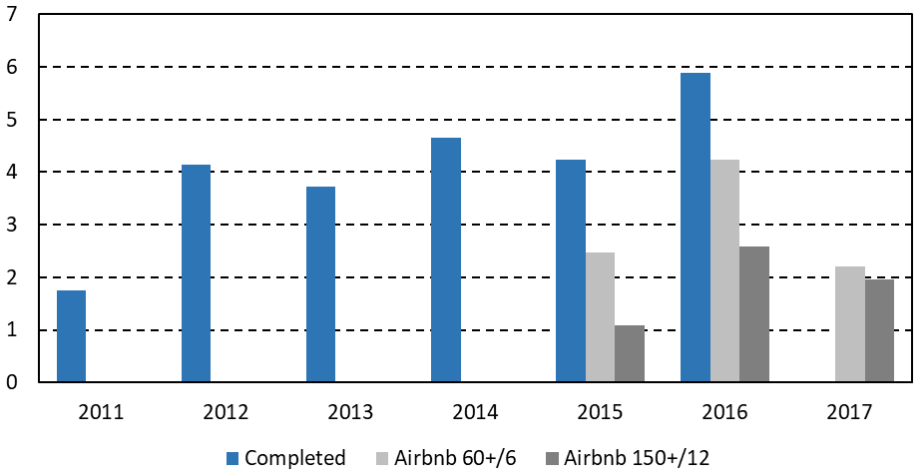

Figure 11. Completed apartments in the capital region per 1000 inhabitants and apartments per 1000 inhabitants added to the stock of Airbnb apartments during the year counting apartments rented for at least 60 nights during the past 6 months or 150 nights during the year. *Sources*: Statistics Iceland, AirDNA, authors' calculations.

Investment in housing fell to an all-time low following the financial crisis in 2008. By 2012 a recovery was underway in the construction sector. In 2012 roughly 4 new apartments were completed per thousand inhabitants in the capital region and 4.2 on average per year from 2012 to 2015. In 2016 housing investment grew by 40% on this measure and almost 5.9 new apartments were completed per thousand inhabitants in the capital region. However, a significant amount of apartments were transferred from the residential market to the market for short-term lodging. About 4.2 additional apartments per thousand inhabitants were transferred out of residential use into the market for Airbnb rentals in 2016 measured as apartments rented for more than 60 days in the past six months. Based on the number of apartments rented on Airbnb for at least 150 days during the past year about 2.6 apartments per one thousand inhabitants were transferred from residential housing to short-term lodging in 2016 (figure 11). This means that by the more conservative measure almost half of new apartments completed in 2016 substituted for apartments which were moved to renting to tourists. Looking at the less restrictive of the two measures shown in figure 11 over 70% of new apartments in the capital region in 2016 were merely replacing apartments that were added to stock of Airbnb rentals during the year.

The effective stock of housing can be estimated by assuming that the housing stock is homogenous such that the number of apartments in a sample represents a portion of the housing stock in proportion to its share in the total number of apartments in that stock. In addition, since the series for the total number of apartments is only known annually it is assumed to evolve over the year in accordance with the changes in the real value of the housing stock. Introducing the drain on the stock of housing capital due to short term lodging by tourists in this manner is equivalent to adding a new depreciation measure, or subtracting the cumulative effect at each instant from the stock of housing. This produces a measure of an effective housing stock for the housing market. In 2017 it was about 1.6% lower than the unadjusted number for the housing stock. Adjusting the hosing stock in this manner may prove to be useful for forecast scenarios, for example for the Central Bank of Iceland's annual stress tests of the banking sector (Kaloinen *et al.* 2017). Due to its rising status as the country's main export sector, tourism has been a regular source of shocks in these stress tests. Accounting for the effects of tourism on the housing sector can assist in estimating the effects of a shock to tourism on the housing sector and the wider economy.

Conclusions

Working with the AirDNA data on Airbnb rentals in Iceland shows that the effects of short-term lodging on the residential housing market are significant. It is estimated that 1676 apartments from the residential housing stock had been taken over by Airbnb activity by the end of 2017, 1214 thereof in the capital region, if measured as apartments rented for more than 150 nights during a twelve month period. This is considerable compared to an estimate of between 5,600 and 12,200 units in New York (Wachsmuth *et al.* 2017).

The growth in Airbnb puts pressure on the local housing market. Given the estimates above the number of apartments which are primarily serving short-term lodging through Airbnb was equivalent to about half to more than two thirds of new apartments in 2016.

Considerable effects on house prices are identified. Direct effects of the growth in Airbnb apartments on the real price of housing are estimated at about 2% per year from the fourth quarter of 2014 through 2017, or 6% accumulated. This is 15% of the total rise in real house prices in that period. This is significantly more than found e.g. by Barron *et al.* (2017) for the United States were Airbnb was found to explain 0.5% annual growth in house prices.

The house price equation from the Central Bank of Iceland's quarterly macroeconomic model was re-estimated, allowing for the effects of Airbnb as well as effects of net immigration which was found to have about double the effects of Airbnb on real house prices. In addition a separate measure of the real housing stock, adjusting for Airbnb apartments, was suggested. This could help in forecasting scenarios for banking sector stress tests using the quarterly macroeconomic model. The tourism sector in Iceland has in few years grown to surpass all other sectors as the largest generator of export revenues for the Icelandic economy and shocks to tourism have figured prominently in recent stress tests for the banking sector. It is clear that the macroeconomic effects of such shocks could be significant and spread for example trough the effects on the housing sector.

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Appendix I. Booking-based measurements

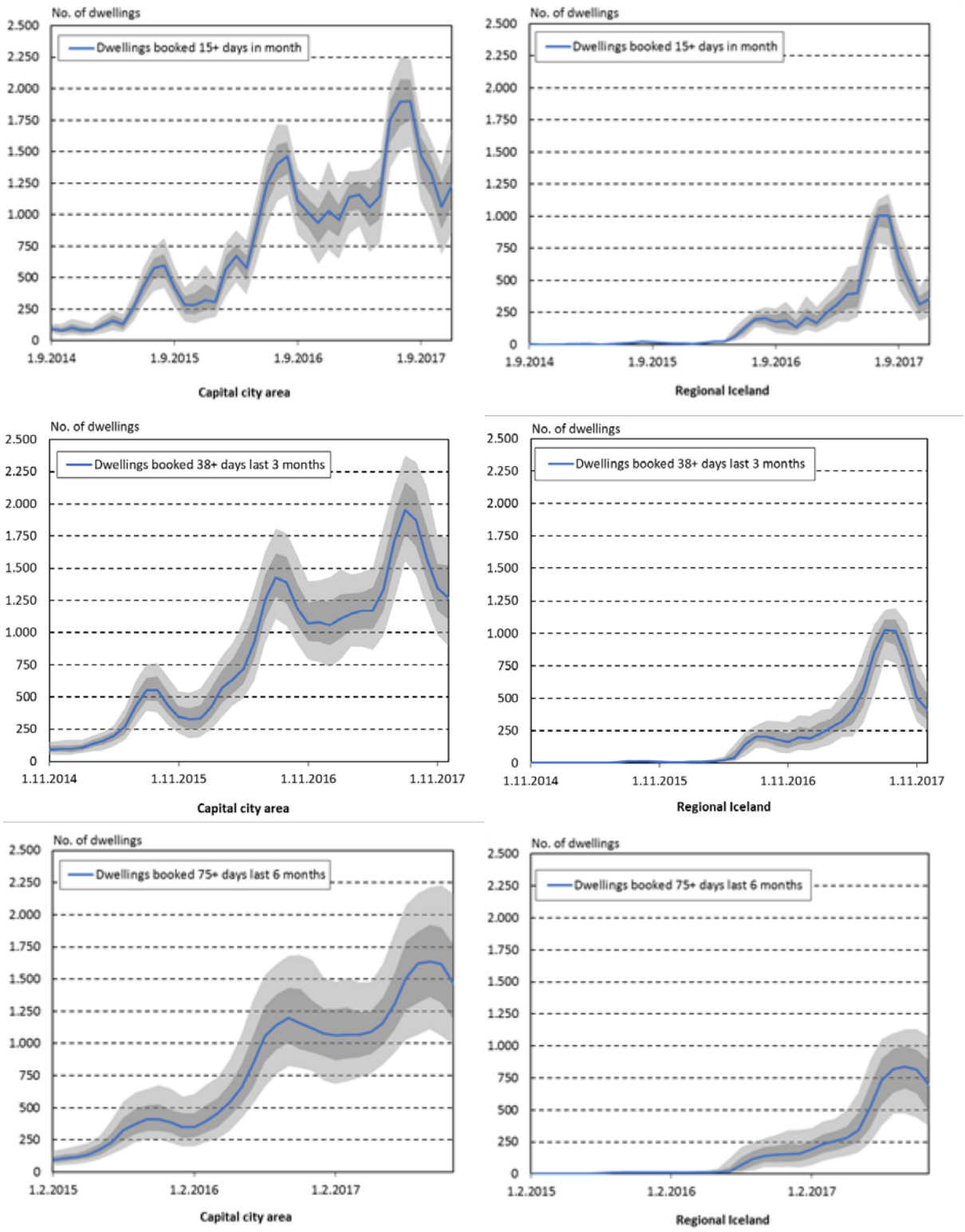

Figure I.1. Most plausible range of booking-based estimates. The stricter the criteria, the lower the estimate of the Airbnb effect. For a month-long reference period, the criteria included are at least 9, 12, 15, 18 and 21 booked days. For three months, the criteria are at least 23, 30, 38, 45 and 53 booked days. For six months, the criteria are at least 45, 60, 75, 90 and 105 booked days. *Sources*: AirDNA, authors' calculations.

Table I.1. Series for estimates using booking-based criteria, presented in panels 1,1 and 1,2 of Figure I.1. *Sources*: AirDNA, authors' calculations.

	Capital city area					Regional Iceland				
	9+ booked days in month	12+ booked days in month	15+ booked days in month	18+ booked days in month	21+ booked days in month	9+ booked days in month	12+ booked days in month	15+ booked days in month	18+ booked days in month	21+ booked days in month
1.9.2014	136	119	94	77	61	3	2	2	0	0
1.10.2014	133	104	79	66	39	4	2	1	1	1
1.11.2014	174	135	100	70	51	6	6	1	1	0
1.12.2014	156	112	84	59	40	2	2	0	0	0
1.1.2015	134	104	83	65	46	5	4	3	0	0
1.2.2015	196	157	122	94	58	5	4	2	1	0
1.3.2015	240	204	161	125	82	6	4	3	2	1
1.4.2015	212	172	129	90	67	4	1	0	0	0
1.5.2015	373	314	261	206	153	11	5	3	2	0
1.6.2015	588	506	429	357	297	15	11	10	5	3
1.7.2015	741	657	577	489	394	22	17	13	10	6
1.8.2015	814	688	597	510	419	26	20	20	16	12
1.9.2015	589	497	423	360	268	20	17	16	9	5
1.10.2015	424	356	283	212	154	15	12	11	3	1
1.11.2015	495	381	285	209	138	14	9	6	4	2
1.12.2015	603	451	322	243	172	15	12	8	5	3
1.1.2016	500	398	309	245	188	16	10	5	3	2
1.2.2016	775	679	563	467	353	22	18	11	7	7
1.3.2016	876	763	673	595	466	29	22	21	14	11
1.4.2016	796	678	576	478	367	37	26	20	18	12
1.5.2016	1150	1028	900	771	622	134	88	58	42	25
1.6.2016	1522	1386	1243	1086	910	206	161	128	89	57
1.7.2016	1718	1557	1402	1273	1108	264	228	193	167	132
1.8.2016	1712	1578	1461	1324	1159	292	241	206	159	132
1.9.2016	1360	1218	1111	983	843	279	233	178	127	90
1.10.2016	1254	1126	1019	896	762	334	262	187	116	80
1.11.2016	1193	1049	934	769	609	251	188	135	106	73
1.12.2016	1427	1203	1031	884	724	378	283	208	154	114
1.1.2017	1215	1082	961	823	649	293	230	169	133	95
1.2.2017	1343	1237	1139	1027	848	379	319	249	189	129
1.3.2017	1348	1267	1157	1038	910	460	380	312	235	179
1.4.2017	1365	1210	1057	903	704	604	492	392	278	178
1.5.2017	1454	1298	1144	963	777	620	509	399	287	215
1.6.2017	2036	1902	1753	1572	1370	963	873	755	618	486
1.7.2017	2251	2077	1896	1707	1512	1130	1077	1005	916	793
1.8.2017	2232	2074	1903	1747	1541	1174	1101	1004	904	765
1.9.2017	1764	1619	1470	1279	1105	906	800	670	541	428
1.10.2017	1587	1471	1324	1139	949	708	594	492	390	309
1.11.2017	1391	1257	1065	884	683	446	378	312	243	183
1.12.2017	1680	1438	1230	1061	856	560	430	353	277	215

Table I.2. Series for estimates using booking-based criteria, presented in panels 2,1 and 2,2 of Figure I.1. *Sources*: AirDNA, authors' calculations.

	Capital city area					Regional Iceland				
	23+ booked days in last 3 months	30+ booked days in last 3 months	38+ booked days in last 3 months	45+ booked days in last 3 months	53+ booked days in last 3 months	23+ booked days in last 3 months	30+ booked days in last 3 months	38+ booked days in last 3 months	45+ booked days in last 3 months	53+ booked days in last 3 months
1.11.2014	154	122	91	72	55	5	3	2	1	0
1.12.2014	160	125	98	77	52	5	5	1	1	0
1.1.2015	168	126	96	70	53	6	2	2	0	0
1.2.2015	167	133	107	84	63	6	3	3	0	0
1.3.2015	200	167	135	111	80	6	6	3	2	0
1.4.2015	229	196	158	130	88	5	5	2	1	0
1.5.2015	283	233	200	161	120	7	3	2	0	0
1.6.2015	416	346	269	212	168	12	6	4	0	0
1.7.2015	627	526	429	358	281	18	12	8	5	2
1.8.2015	756	651	552	474	395	27	21	16	9	8
1.9.2015	764	661	550	469	380	25	21	17	12	9
1.10.2015	654	541	432	366	281	24	19	15	12	8
1.11.2015	542	426	346	281	217	19	14	11	8	3
1.12.2015	533	416	328	246	180	18	15	8	4	1
1.1.2016	566	436	332	260	192	17	16	6	2	2
1.2.2016	688	574	421	337	249	19	17	10	7	2
1.3.2016	818	707	571	454	346	23	19	9	8	5
1.4.2016	921	798	635	528	436	34	25	15	11	8
1.5.2016	1097	954	721	604	491	53	40	23	15	11
1.6.2016	1343	1148	930	795	627	146	98	43	25	15
1.7.2016	1627	1451	1261	1102	922	243	202	143	97	57
1.8.2016	1809	1614	1428	1279	1109	292	244	203	167	118
1.9.2016	1772	1590	1390	1223	1052	329	260	203	162	118
1.10.2016	1599	1378	1188	1061	912	326	253	182	131	85
1.11.2016	1398	1232	1070	935	792	316	233	163	115	76
1.12.2016	1407	1251	1082	930	772	370	280	199	143	102
1.1.2017	1429	1243	1058	902	734	363	271	190	155	98
1.2.2017	1492	1299	1109	955	792	409	317	227	178	121
1.3.2017	1451	1306	1145	1023	894	422	344	276	225	146
1.4.2017	1470	1314	1169	1027	892	535	424	321	262	201
1.5.2017	1505	1353	1170	1027	865	632	529	403	298	206
1.6.2017	1831	1561	1336	1172	979	856	693	561	435	311
1.7.2017	2137	1933	1716	1511	1256	1067	960	850	706	533
1.8.2017	2376	2169	1951	1763	1557	1179	1107	1025	939	800
1.9.2017	2326	2097	1873	1669	1446	1194	1108	1016	909	771
1.10.2017	2135	1824	1573	1403	1199	1091	960	809	677	533
1.11.2017	1750	1534	1344	1169	982	792	657	506	405	318
1.12.2017	1740	1521	1271	1103	899	624	531	411	332	250

Table I.3. Series for estimates using booking-based criteria, presented in panels 3,1 and 3,2 of Figure I.1. *Sources*: AirDNA, authors' calculations.

	Capital city area					Regional Iceland				
	45+ booked days in last 6 months	60+ booked days in last 6 months	75+ booked days in last 6 months	90+ booked days in last 6 months	105+ booked days in last 6 months	45+ booked days in last 6 months	60+ booked days in last 6 months	75+ booked days in last 6 months	90+ booked days in last 6 months	105+ booked days in last 6 months
1.2.2015	167	122	95	72	50	4	2	1	1	0
1.3.2015	182	140	108	81	57	7	3	2	1	0
1.4.2015	203	147	115	94	63	6	3	2	0	0
1.5.2015	227	180	137	106	77	7	5	0	0	0
1.6.2015	284	221	176	133	101	7	4	1	0	0
1.7.2015	406	307	234	187	140	10	7	2	0	0
1.8.2015	551	427	325	246	182	17	10	7	4	0
1.9.2015	617	492	375	295	233	18	12	10	5	2
1.10.2015	647	520	411	320	251	23	13	11	7	2
1.11.2015	675	529	410	319	258	23	16	11	7	3
1.12.2015	651	486	386	306	228	22	20	13	6	2
1.1.2016	588	460	348	264	199	22	19	13	6	0
1.2.2016	606	459	352	271	199	21	18	12	1	1
1.3.2016	677	522	395	307	234	20	16	12	4	1
1.4.2016	739	577	458	349	260	23	18	11	5	2
1.5.2016	869	682	539	433	320	28	19	12	5	3
1.6.2016	1067	835	658	525	415	43	24	14	8	5
1.7.2016	1338	1062	840	656	531	122	54	22	13	7
1.8.2016	1532	1291	1058	857	664	210	133	70	25	11
1.9.2016	1618	1384	1141	952	763	248	180	116	62	27
1.10.2016	1681	1433	1199	1003	825	280	212	142	93	55
1.11.2016	1688	1425	1156	953	810	306	221	148	92	54
1.12.2016	1650	1336	1120	931	789	341	242	153	94	56
1.1.2017	1511	1271	1076	902	712	345	229	161	100	50
1.2.2017	1480	1269	1064	868	687	358	262	193	126	69
1.3.2017	1509	1283	1067	882	706	411	311	234	164	103
1.4.2017	1476	1244	1068	892	733	431	334	257	183	126
1.5.2017	1478	1253	1091	917	767	501	371	282	212	140
1.6.2017	1614	1356	1158	986	835	636	481	341	247	169
1.7.2017	1858	1544	1304	1104	927	887	700	522	356	243
1.8.2017	2078	1797	1505	1263	1031	1054	903	729	541	378
1.9.2017	2167	1869	1624	1314	1067	1100	980	819	635	471
1.10.2017	2214	1923	1635	1361	1111	1130	999	839	668	472
1.11.2017	2229	1904	1616	1314	1059	1132	971	813	628	439
1.12.2017	2165	1772	1470	1190	987	1074	890	697	488	376

Table I.4. Series for estimates using booking-based criteria, presented in Figure 7. *Sources*: AirDNA, authors' calculations.

	Capital city area					Regional Iceland				
	90+ booked days last 12 months	120+ booked days last 12 months	150+ booked days last 12 months	180+ booked days last 12 months	210+ booked days last 12 months	90+ booked days last 12 months	120+ booked days last 12 months	150+ booked days last 12 months	180+ booked days last 12 months	210+ booked days last 12 months
1.8.2015	308	219	159	109	82	10	5	1	0	0
1.9.2015	348	256	182	130	93	12	6	3	0	0
1.10.2015	377	282	203	145	104	13	7	4	0	0
1.11.2015	410	300	229	154	114	14	7	3	0	0
1.12.2015	446	327	246	175	123	16	8	6	0	0
1.1.2016	473	360	262	192	143	18	8	5	0	0
1.2.2016	524	392	295	216	163	18	12	4	0	0
1.3.2016	583	436	331	255	183	22	15	5	1	0
1.4.2016	644	475	356	282	209	22	17	8	2	1
1.5.2016	710	530	392	313	238	22	18	10	4	1
1.6.2016	794	589	445	343	255	21	18	12	4	2
1.7.2016	898	668	514	372	276	24	17	13	7	3
1.8.2016	1065	759	571	424	298	34	17	13	12	4
1.9.2016	1178	861	622	484	335	75	23	14	10	4
1.10.2016	1265	955	694	529	397	113	44	15	10	4
1.11.2016	1311	1014	772	592	434	134	63	23	10	7
1.12.2016	1370	1066	841	639	486	167	90	38	13	7
1.1.2017	1431	1109	886	687	533	199	110	55	18	7
1.2.2017	1505	1160	907	722	559	254	141	77	32	11
1.3.2017	1560	1213	941	742	586	308	184	110	51	21
1.4.2017	1615	1260	997	775	604	367	243	149	74	34
1.5.2017	1628	1283	1018	787	611	419	281	178	98	46
1.6.2017	1633	1336	1049	825	642	473	333	224	128	72
1.7.2017	1693	1341	1085	858	687	587	404	274	174	106
1.8.2017	1743	1374	1112	915	727	722	511	328	216	140
1.9.2017	1789	1410	1145	930	761	800	572	393	256	172
1.10.2017	1833	1453	1155	950	766	860	617	434	280	186
1.11.2017	1869	1473	1189	952	769	882	637	452	290	190
1.12.2017	1898	1525	1214	958	752	902	664	462	312	204

Appendix II. Revenue-based estimates

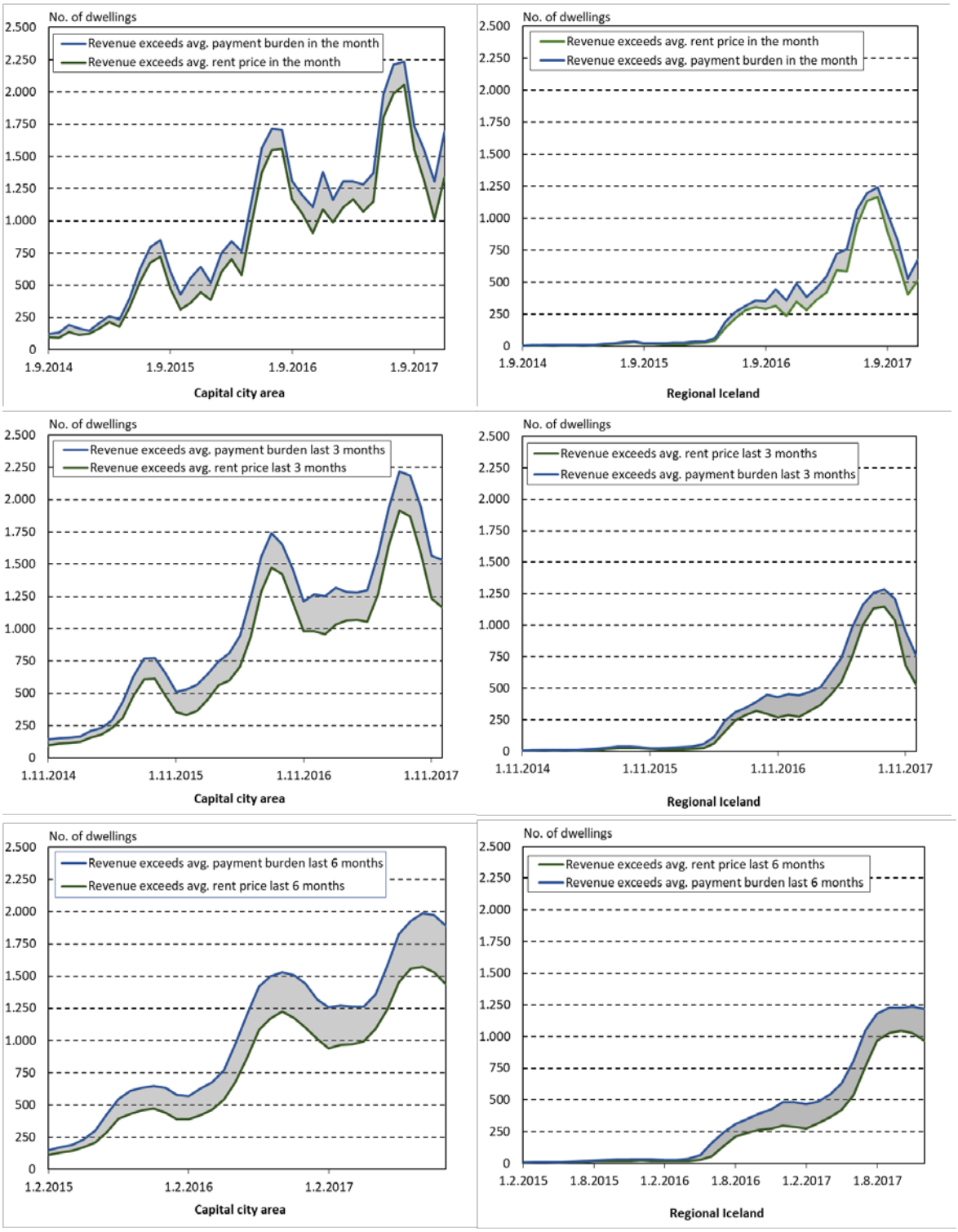

Figure II.1. Revenue based-criteria for regional Iceland may be inaccurate due to the use of single averages for all the regions combined, whereas average prices may differ between regions. Average payment burden is based on a representative dwelling, which may cause greater inaccuracies for regional Iceland than for greater Reykjavík. *Sources*: AirDNA, authors' calculations.

Table II.1. Series for estimates using revenue-based criteria, presented in Figure 8 and Figure II.1, capital city area. *Sources*: AirDNA, authors' calculations.

	Capital city area							
	Revenue > avg. rent price in month	Revenue > avg. rent price last 3 months	Revenue > avg. rent price last 6 months	Revenue > avg. rent price last 12 months	Revenue > avg. pmt. burden in month	Revenue > avg. pmt. burden last 3 months	Revenue > avg. pmt. burden last 6 months	Revenue > avg. pmt. burden last 12 months
1.9.2014	96				122			
1.10.2014	92				132			
1.11.2014	140	100			191	145		
1.12.2014	116	110			166	153		
1.1.2015	123	117			147	158		
1.2.2015	166	128	111		208	168	150	
1.3.2015	214	160	130		261	207	174	
1.4.2015	178	182	143		233	233	192	
1.5.2015	328	230	174		396	293	231	
1.6.2015	527	310	208		630	433	300	314
1.7.2015	675	481	288		795	632	426	359
1.8.2015	721	609	394	199	851	770	546	393
1.9.2015	474	613	433	225	607	774	610	418
1.10.2015	311	481	459	250	428	655	636	445
1.11.2015	363	354	473	264	556	513	650	475
1.12.2015	448	334	441	285	644	532	635	516
1.1.2016	386	367	390	303	518	567	579	572
1.2.2016	602	450	387	333	752	648	571	603
1.3.2016	706	563	422	373	844	747	631	665
1.4.2016	581	599	465	395	762	812	675	764
1.5.2016	984	703	542	438	1158	944	768	853
1.6.2016	1376	935	676	492	1562	1241	971	970
1.7.2016	1549	1290	863	564	1717	1563	1203	1043
1.8.2016	1560	1472	1084	649	1708	1740	1419	1099
1.9.2016	1167	1421	1171	697	1312	1653	1498	1149
1.10.2016	1058	1204	1226	759	1201	1461	1530	1203
1.11.2016	905	982	1175	799	1107	1211	1508	1248
1.12.2016	1092	979	1100	843	1378	1266	1443	1291
1.1.2017	990	957	1013	873	1163	1251	1320	1328
1.2.2017	1103	1033	941	893	1308	1315	1260	1356
1.3.2017	1167	1063	968	930	1305	1284	1274	1351
1.4.2017	1074	1070	973	978	1284	1282	1261	1373
1.5.2017	1152	1057	996	979	1370	1299	1264	1394
1.6.2017	1801	1268	1091	985	1982	1573	1358	1462
1.7.2017	1986	1643	1245	1036	2214	1935	1588	1509
1.8.2017	2057	1917	1454	1084	2234	2218	1824	1531
1.9.2017	1556	1867	1556	1120	1734	2187	1927	1541
1.10.2017	1306	1586	1572	1141	1544	1941	1988	1595
1.11.2017	1012	1232	1529	1135	1307	1567	1975	1541
1.12.2017	1340	1164	1439	1159	1694	1533	1893	1595

Table II.2. Series for estimates using revenue-based criteria, presented in Figure 8 and Figure II.1, regional Iceland. *Sources*: AirDNA, authors' calculations.

	Regional Iceland							
	Revenue > avg. rent price in month	Revenue > avg. rent price last 3 months	Revenue > avg. rent price last 6 months	Revenue > avg. rent price last 12 months	Revenue > avg. pmt. burden in month	Revenue > avg. pmt. burden last 3 months	Revenue > avg. pmt. burden last 6 months	Revenue > avg. pmt. burden last 12 months
1.9.2014	2				3			
1.10.2014	4				7			
1.11.2014	5	4			6	6		
1.12.2014	6	4			8	8		
1.1.2015	5	7			7	9		
1.2.2015	5	6	5		7	7	9	
1.3.2015	6	7	7		8	7	8	
1.4.2015	5	6	8		9	9	8	
1.5.2015	12	8	6		17	12	10	
1.6.2015	18	9	7		22	20	13	
1.7.2015	22	17	9		33	29	19	
1.8.2015	30	24	16	7	38	36	25	18
1.9.2015	19	25	19	8	24	35	26	20
1.10.2015	18	22	18	10	23	32	31	21
1.11.2015	11	16	19	10	23	24	32	20
1.12.2015	13	14	21	11	27	25	33	23
1.1.2016	15	12	18	13	27	29	31	25
1.2.2016	22	15	18	13	34	34	27	29
1.3.2016	29	18	18	16	38	37	29	31
1.4.2016	43	24	20	15	63	54	35	35
1.5.2016	144	60	26	19	191	115	67	36
1.6.2016	215	153	58	23	268	240	161	70
1.7.2016	281	244	137	40	314	312	247	146
1.8.2016	304	287	211	79	355	346	310	206
1.9.2016	291	319	243	110	352	393	352	236
1.10.2016	316	298	267	130	444	447	395	262
1.11.2016	235	269	274	143	354	431	425	281
1.12.2016	348	289	300	172	491	453	484	329
1.1.2017	282	274	289	197	383	443	482	374
1.2.2017	360	321	276	221	459	472	469	406
1.3.2017	420	367	317	256	547	511	488	460
1.4.2017	592	453	365	304	721	627	544	524
1.5.2017	582	552	420	337	761	739	628	570
1.6.2017	940	753	541	394	1064	982	809	667
1.7.2017	1132	1002	767	495	1195	1161	1053	824
1.8.2017	1168	1134	965	629	1241	1255	1178	988
1.9.2017	888	1148	1027	704	1032	1284	1227	1045
1.10.2017	663	1041	1047	735	822	1207	1229	1073
1.11.2017	403	682	1029	751	526	948	1235	1087
1.12.2017	514	522	965	759	677	755	1218	1107