

Cleanliness is Next to Income:
The Impact of COVID-19 on Short-Term Rentals

Lily Shen, Clemson University
Sean Wilkoff, University of Nevada, Reno

AREUEA 2022

January 7, 2022

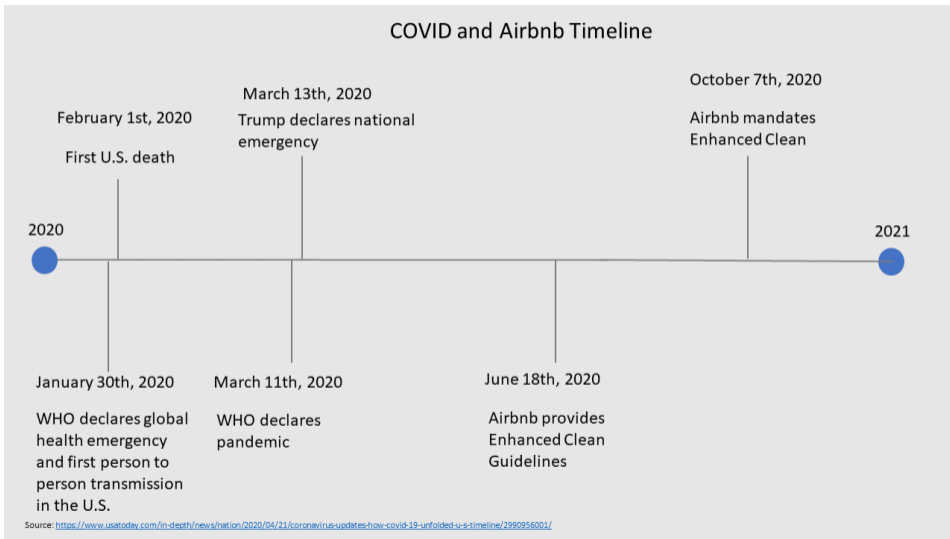
If you haven't got your health, you haven't got anything - Count Rugen

Research Question

- Did Covid-19 initially impact the short-term rental market?
- If so, what was the impact of Covid-19?
- Is cleanliness priced or valued during a pandemic?

Results Preview

- Available listings declined by 25%.
⇒ The remaining properties lost 22% of their income and had occupancy decrease by 20%.
- Properties perceived as clean increased their income by 17.5% and their occupancy by 16.5% relative to properties not perceived as clean.
⇒ During a pandemic guests value cleanliness.
- Rental prices for properties perceived as clean did not increase.
⇒ It suggests that properties perceived as clean are able to attract more guests than properties not perceived as clean.



How Airbnb Works

- Two parties: Guest and Host - Airbnb acts as the intermediary
- Host decides the price and availability of their property. Sometimes the guests that can stay as well.
- Guest can request the property and dates they want from a list of properties. They can also see past reviews by prior guests.
- Guests leave reviews of their experience and get reviewed. Reviews are left prior to seeing the review of themselves.

Creating a Cleanliness Indicator

- One of our contributions is to create a cleanliness indicator that we use to classify a property as *Clean*.
- We use a machine learning algorithm and Natural Language Processing (NLP) to read all the comments left by guests.
- We create two dictionaries: one of *Clean* words (e.g. clean and spotless) and one of *Dirty* words (e.g. dirt and dust).
- We then create a score for each review which is calculated as the sum of clean words minus the number of dirty words.
- For each property we sum up the score of all their reviews for a given month. If the total is positive than the property is considered to be perceived as *Clean*. If the score is zero or negative the property is not *Clean*.

Sample of Reviews with Cleanliness scores

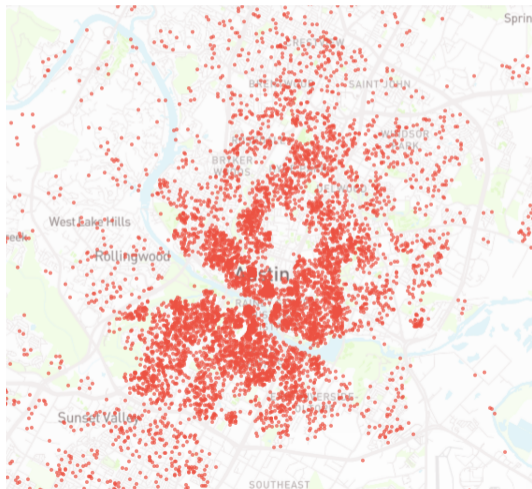
Reviews	Score
Clean Reviews	
Sylvia was an incredible host. Her space was very clean and tidy . Looked exactly like the photos. Location was fantastic and central to all the things we wanted to experience including Rainey street, South Congress and downtown. Thank you for a great stay. I would highly recommend!	2
Susan and Anthony are truly superhosts. The place was super clean and efficient, with a spacious bathroom. Best value in Austin that we have found, and we stay in Austin frequently.	1
Dirty Reviews	
I'm afraid this was a very negative experience. Among other things, the bed was dirty , and the bathroom smelled strongly of mold/mildew . We left early due to health concerns.	-2
The location is unbeatable and the apartment building is wonderful. However, the apartment was not clean when I arrived and I would be hesitant to book with Lux Haus again.	-1
No Dictionary Words Reviews	
Great spot in a very convenient location!	0

Notes: This table displays several examples of reviews with cleanliness scores. Total Reviews with Clean Words: 44,509; Total Reviews with Dirty Words: 2,462; Total Reviews with Negated Clean Words: 437; Total Reviews with no Clean or Dirty Words: 98,991; Total Reviews left by Occupants: 140,601. The reviews are presented as written on Airbnb; we did not correct the typos.

Data

- InsideAirbnb
- Information on listings and reviews including: property and host characteristics
- Location:
 - Austin, Texas specifically Travis County
 - No mandatory travel restrictions
 - Biggest Airbnb market in Texas
 - Popular travel destination
- Period: July 1, 2018 - July 31, 2020
- Airbnb properties: houses and apartments
- Active listings
 - Property listing exists in the data
 - A review of the property must exist during the sample period

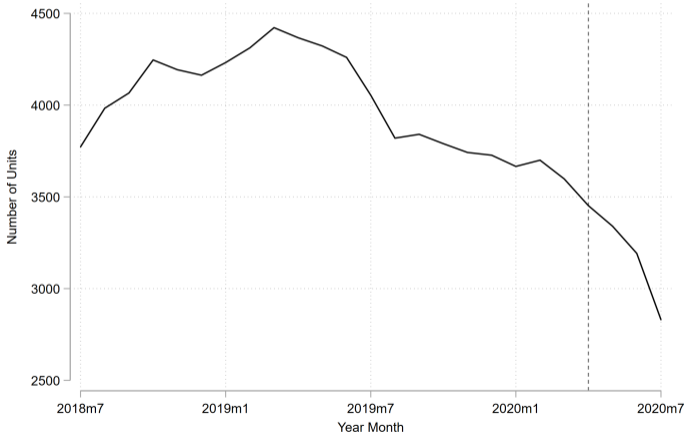
Geographical Distribution of the Airbnb Sample



Summary Statistics By Group

	Before COVID				During COVID			
	No Clean		Clean		No Clean		Clean	
	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.	Mean	Std. Dev.
Number of Bedrooms (Bedroom)	1.87	1.18	1.64	1.08	1.87	1.16	1.80	1.16
Number of Bathrooms (Bathroom)	1.56	0.79	1.39	0.63	1.55	0.77	1.47	0.70
Unit Capacity (Accommodation)	4.79	2.99	4.60	2.89	4.79	3.04	5.15	3.38
Indicator if Entire Space (Space)	0.77	0.42	0.81	0.39	0.79	0.40	0.89	0.31
Indicator if House (House)	0.64	0.48	0.58	0.49	0.64	0.48	0.59	0.49
Price Per Night (Price)	236	297	166	195	225	276	181.97	206
Income Per Month (Income)	540	926	1,382	1,835	371	769	1,341	1,644
Nights Booked per Month(Nights)	2.54	2.72	9.04	5.20	1.66	1.80	7.90	5.15
Comments Per Month (Comment)	0.77	1.36	4.02	2.60	0.33	0.90	3.45	2.58
Indicator if Instant Booking (Instant)	0.46	0.50	0.56	0.50	0.46	0.50	0.58	0.49
Indicator if Superhost (Superhost)	0.42	0.49	0.66	0.47	0.52	0.50	0.70	0.46
Indicator if Verified Host (Verified Host)	0.58	0.49	0.57	0.49	0.56	0.50	0.51	0.50
Indicator if Strict Cancel (Strict)	0.49	0.50	0.44	0.50	0.49	0.50	0.49	0.50
Indicator if Moderate Cancel (Moderate)	0.31	0.46	0.39	0.49	0.32	0.47	0.36	0.48
# Observations	55,405		25,274		14,136		2,277	
# Total Observations	97,092							
# Total Airbnb Property	6,460							

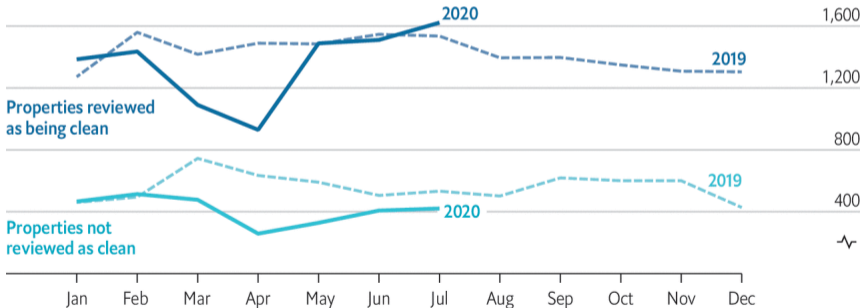
Units of Airbnb Available



Compare Monthly Income

Cleaning up

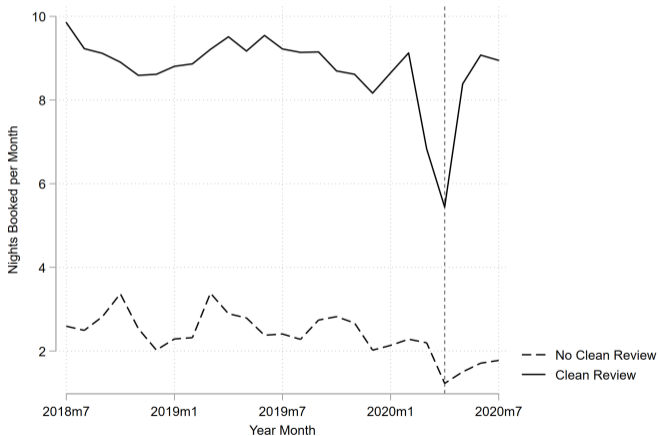
Average monthly Airbnb income, \$
Sample of 6,460 properties in Austin, Texas



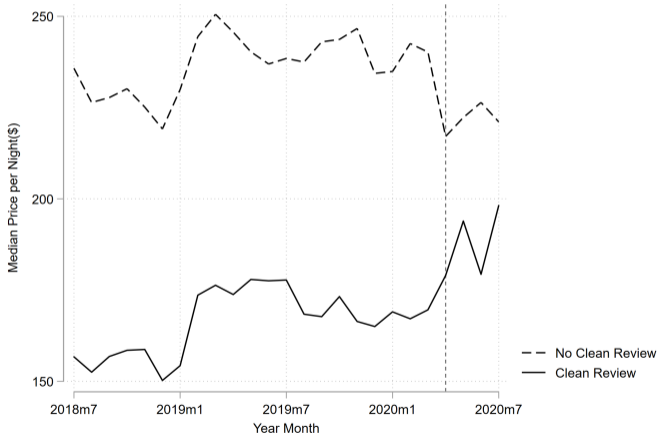
Source: "Cleanliness is Next to Income: The Impact of COVID-19 on Short-Term Rentals", by Lily Shen and Sean Wilkoff

The Economist

Compare Nights of Booking



Compare Price



Strategy: Difference-in-Differences

$$\ln(\text{Outcome}_{it}) = \alpha + \gamma_1 \text{Clean}_i + \delta \text{COVID}_t + \beta_{it}(\text{COVID}_t \times \text{Clean}_{i,t}) + X'_{it}\theta + \epsilon_{it}$$

$$\text{Outcome Variables} = \left\{ \begin{array}{l} \text{Income,} \\ \text{Occupancy,} \\ \text{Price,} \end{array} \right\}$$

$$\text{Controls} = \left\{ \begin{array}{l} \text{Physical Characteristics,} \\ \text{Booking Characteristics,} \\ \text{Year and Zipcode Fixed Effects,} \end{array} \right\}$$

DID Estimates for Income and Occupancy

	Host Monthly Income			Monthly Occupancy		
	Ln(Income)	Ln(Income)	Ln(Income)	Ln(Nights)	Ln(Nights)	Ln(Nights)
	(1)	(2)	(3)	(4)	(5)	(6)
Indicator if COVID-19 Period (COVID)	-0.239*** (0.029)	-0.244*** (0.029)	-0.251*** (0.028)	-0.209*** (0.024)	-0.219*** (0.025)	-0.227*** (0.026)
Indicator if Clean Review (Clean)	1.286*** (0.019)	1.227*** (0.019)	1.223*** (0.019)	1.441*** (0.010)	1.361*** (0.010)	1.352*** (0.011)
Interaction term (COVID×Clean)	0.150*** (0.025)	0.157*** (0.026)	0.162*** (0.025)	0.135*** (0.021)	0.147*** (0.020)	0.153*** (0.020)
Number of Bedrooms (Bedroom)	0.075*** (0.020)	0.085*** (0.019)	0.082*** (0.019)	-0.088*** (0.017)	-0.074*** (0.015)	-0.080*** (0.014)
Number of Bathrooms (Bathroom)	0.125*** (0.028)	0.143*** (0.029)	0.150*** (0.028)	-0.118*** (0.014)	-0.095*** (0.011)	-0.092*** (0.011)
Indicator if House (House)	0.061** (0.029)	0.046 (0.030)	0.044 (0.029)	0.013 (0.025)	-0.007 (0.021)	-0.016 (0.021)
Unit Capacity (Accommodation)	0.104*** (0.010)	0.094*** (0.010)	0.097*** (0.010)	0.054*** (0.003)	0.045*** (0.004)	0.048*** (0.004)
Indicator if Entire Space (Space)	0.613*** (0.038)	0.594*** (0.038)	0.594*** (0.037)	0.094*** (0.027)	0.079*** (0.025)	0.084*** (0.024)
Indicator if Superhost (Superhost)		0.195*** (0.013)	0.188*** (0.015)		0.277*** (0.019)	0.262*** (0.018)
Observations	97,092	97,092	93,173	97,092	97,092	93,173
R-squared	0.578	0.589	0.596	0.515	0.540	0.543
Physical Char	Yes	Yes	Yes	Yes	Yes	Yes
Booking Char	No	Yes	Yes	No	Yes	Yes
Airbnb Score	No	No	Yes	No	No	Yes
Location-Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Cluster SE	Zipcode	Zipcode	Zipcode	Zipcode	Zipcode	Zipcode

Note: The outcome variable of income is transformed by natural log. In order to interpret the coefficient we need to transform them back. The key coefficients for income and nights (occupancy) are equivalent to 17.5% and 16.5% respectively.

DID Estimates for Price

Dependent Variables:	Ln(Price) (1)	Ln(Price) (2)	Ln(Price) (3)
Indicator if COVID-19 Period (COVID)	-0.030** (0.013)	-0.025** (0.011)	-0.024** (0.010)
Indicator if Clean Review (Clean)	-0.155*** (0.020)	-0.134*** (0.017)	-0.129*** (0.014)
Interaction term (COVID×Clean)	0.015 (0.011)	0.010 (0.011)	0.009 (0.012)
Number of Bedrooms (Bedroom)	0.163*** (0.024)	0.159*** (0.023)	0.162*** (0.023)
Number of Bathrooms (Bathroom)	0.243*** (0.025)	0.239*** (0.026)	0.241*** (0.026)
Indicator if House (House)	0.048 (0.044)	0.053 (0.041)	0.060 (0.038)
Unit Capacity (Accommodation)	0.050*** (0.010)	0.049*** (0.010)	0.049*** (0.010)
Indicator if Entire Space (Space)	0.518*** (0.024)	0.515*** (0.025)	0.510*** (0.026)
Indicator if Superhost (Superhost)		-0.082*** (0.019)	-0.073*** (0.017)
Observations	97,092	97,092	93,173
R-squared	0.643	0.648	0.656
Physical Char	Yes	Yes	Yes
Booking Char	No	Yes	Yes
Airbnb Score	No	No	Yes
Location-Year FE	Yes	Yes	Yes
Cluster SE	Zipcode	Zipcode	Zipcode

Placebo Tests

Dependent Variables:	Ln(Income) (1)	Ln(Nights) (2)	Ln(Price) (3)
March to July (Placebo COVID)	0.069*** (0.024)	0.037*** (0.013)	0.032* (0.016)
Indicator if Clean Review (Clean)	1.179*** (0.020)	1.315*** (0.015)	-0.136*** (0.011)
Placebo COVID × Clean	0.023 (0.021)	0.004 (0.016)	0.019 (0.012)
Observations	51,475	51,475	51,475
R-squared	0.587	0.520	0.673
Physical Char	Yes	Yes	Yes
Booking Char	Yes	Yes	Yes
Airbnb Score	Yes	Yes	Yes
Location FE	Yes	Yes	Yes
Cluster SE	Zipcode	Zipcode	Zipcode

Takeaways

- COVID negatively impacted the short term rental market.
- Natural language processing allows us to create a measure of cleanliness for properties based on reviews.
- Being perceived as *Clean* during a pandemic has value.

Summary Statistics: Full Sample

	Mean	Std. Dev.
Number of Bedrooms (Bedroom)	1.811	1.158
Number of Bathrooms (Bathroom)	1.513	0.752
Unit Capacity (Accommodation)	4.748	2.980
Indicator if Entire Space (Space)	0.784	0.411
Indicator if House (House)	0.624	0.484
Price Per Night (Price)	215.3	271.1
Income Per Month (Income)	754.1	1,294
Nights Booked per Month(Nights)	4.232	4.614
Ln(Price)	4.966	0.838
Ln(Income)	5.900	1.218
Ln(Nights)	0.934	0.992
Comments Per Month (Comment)	1.616	2.307
Indicator if COVID-19 Period (COVID)	0.169	0.375
Indicator if Clean Review (Clean)	0.284	0.451
Interaction term (COVID×Clean)	0.0235	0.151
Indicator if Instant Booking (Instant)	0.490	0.500
Indicator if Superhost (Superhost)	0.504	0.500
Indicator if Verified Host (Verified Host)	0.575	0.494
Indicator if Strict Cancel (Strict)	0.479	0.500
Indicator if Moderate Cancel (Moderate)	0.333	0.471
Airbnb Score(Rate Accuracy)	9.850	0.488
Airbnb Score (Rate Check-in)	9.913	0.431
Airbnb Score (Rate Communication)	9.910	0.416
Airbnb Score (Rate Location)	9.813	0.495
Airbnb Score (Rate Value)	9.685	0.616
# Observations	97,092	
# Airbnb Property	6,460	