The Last Mile Matters: Impact of Dockless Bike Sharing on Subway Housing Price Premium: Online Appendix

Online Appendix A. Calculation of Distance to the Nearest Subway Station

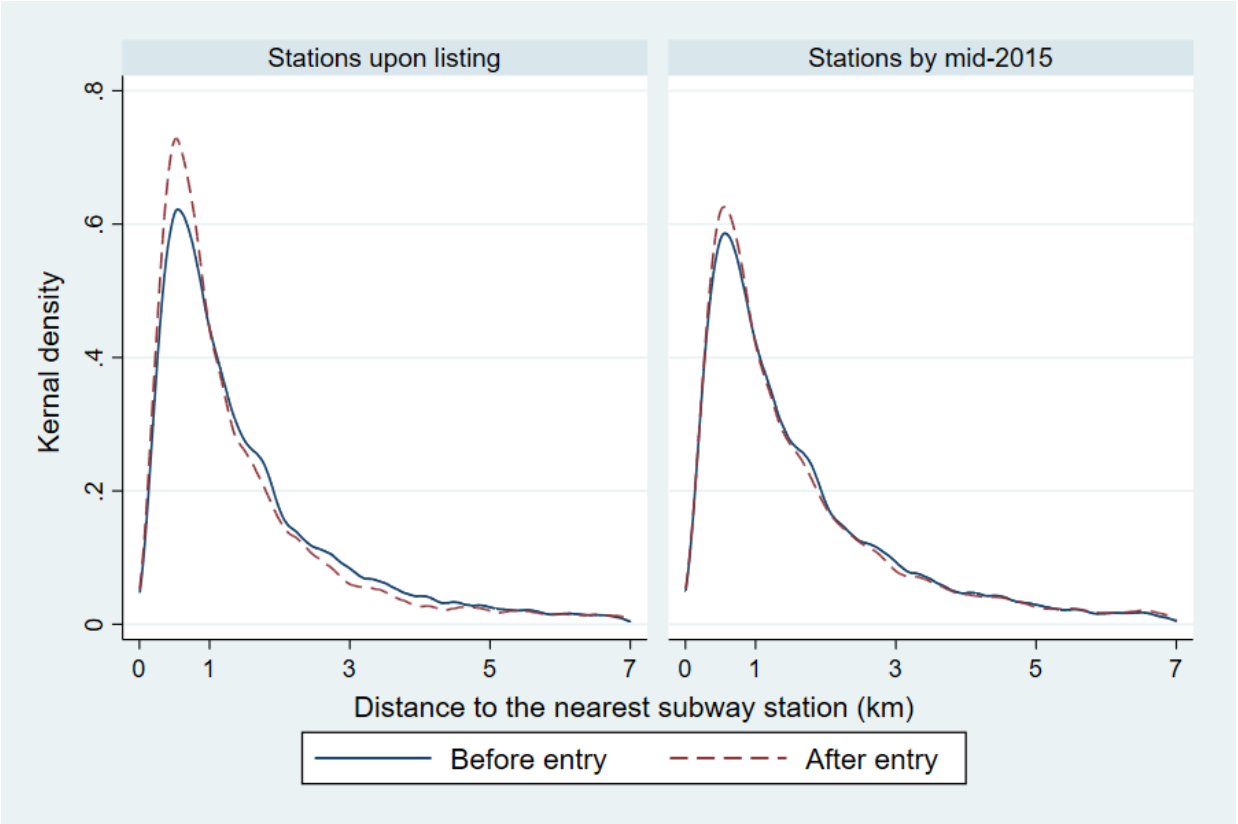
An apartment can have more than one record due to upward or downward price adjustments or change in sales status with a time stamp for the change. For each record, we define distance as that between the apartment and the nearest subway station which is open when the price record is created. Seventy percent of the apartments only have one price record. Their distances to subway stations are calculated only once and do not vary with time. But for apartments with multiple records, it is possible their distances to subway will vary with time: The distances typically decrease when a new and closer subway station is built. However, the distances do not change if the new station is further away from the apartment or its opening falls outside the listing period of the apartment. In the follows paragraph we give several examples to illustrate this idea.

As shown in Table A1, suppose Apartment *A* has three price records [1]-[3], created on May 15, June 15 and July 15, 2017, respectively. Before May 31, 2017, the nearest subway station (S0) to this apartment was 2.5 km away. On June 1, 2017, a new subway line was built, and a new station (S1) 1.5 km away from the apartment came into use. Opening at the same time was another new station (S2) 3.5 km away. Then on September 1, 2017, a third new station (S3) 1 km away came into use. In this case, Apartment *A*'s three observations [1]-[3] will have different distances to subway: Observation [1]'s distance to subway is 2.5 km. Observation [2]'s distance to subway is 1.5 km (the opening of S2 did not play a role because it was further from A than S0). Finally, Observation [3]'s distance to subway remains 1.5 km, because the nearest station by July 15 was still S1, and the opening of S3 has no effect because it opened after price record [3] was created.

Table A1. Illustration of how distance is measured

	Open date and distance from Apartment A			
Price record date	S0 (opened before May 15, 2017; 2.5 km away)	S1 (opened on June 1, 2017; 1.5 km away)	S2 (opened on June 1, 2017; 3.5 km away)	S3 (opened on Sep 1, 2017; 1 km away)
May 15, 2017	2.5 km			
June 15, 2017		1.5 km		
July 15, 2017				1.5 km

Figure A1. Distribution of Apartments by Distance to Nearest Subway Station



Note: Samples comprise apartments initially listed during mid-2015 to 2017, within 7 km to subway. Each apartment is matched to the nearest subway station at the time of listing (the left panel), or at July 1, 2015 (the right panel). The blue solid line and the red dashed line depict the kernel density distribution of apartments before and after the entry of bike sharing against distance to subway, respectively.

Online Appendix B. Additional Tables and Figures

Table B1. City Characteristics

City	(a) Bike sharing entry date			(b) # Subway stations		(c) # Apartments	(d) Average price	(e) Average size	(f) Income per
	Ofo campus	Ofo	Mobike	Jul 2015	Dec 2017		(CNY/m^2)	(m^2)	capita (CNY)
Beijing	6 Jun 2015	10 Oct 2016	1 Sep 2016	265	288	62,689	58,668	91.81	52,350
Chengdu	22 Aug 2016	16 Dec 2016	16 Nov 2016	48	100	53,294	12,233	95.35	35,902
Chongqing	10 Jan 2017	10 Jan 2017	1 May 2017	108	119	35,650	9,242	97.30	29,610
Dalian	26 Jun 2017	26 Jun 2017	16 Apr 2017	41	65	32,457	11,054	82.41	38,050
Hangzhou	12 Sep 2016	20 Feb 2017	16 Apr 2017	44	56	19,562	27,251	93.02	52,185
Nanjing	22 Aug 2016	8 Jan 2017	12 Jan 2017	113	128	34,073	26,247	89.02	49,997
Shanghai	9 May 2016	10 Oct 2016	22 Apr 2016	279	294	59,031	50,880	87.17	55,358
Shenzhen	11 Sep 2016	9 Dec 2016	16 Oct 2016	118	167	37,816	54,255	86.81	48,695
Tianjin	27 Aug 2016	13 Jan 2017	12 Feb 2017	84	105	29,969	26,833	77.28	34,074
Wuhan	18 Apr 2016	6 Jan 2017	29 Dec 2016	75	123	35,299	15,716	102.2	39,737

Notes: Column (a): Entry date of Ofo (campus only), Ofo (citywide) and Mobike (citywide); The first and third columns are from Cao, Jin and Zhou (2018) and the second column is collected from the Internet by authors; In subsequent tables, the entry of bike sharing is defined as the earlier citywide entry of Ofo or Mobike (as underlined). Column (b): Number of subway stations by mid-2015 and the end of 2017, calculated by authors; Columns (c)-(e): Number of apartments, average price per m^2 and average apartment size, calculated from the sample; Column (f): Income per capita in 2016, collected from *China City Statistical Yearbook 2017*, Beijing: China Statistics Press, 2018.

Table B2. City-specific Coefficient Estimates

Variables	(a) Beijing	(b) Chengdu	(c) Chongqing	(d) Dalian	(e) Hangzhou
Distance to subway	-0.055	-0.039	-0.008	-0.057	-0.037
	(0.007)	(0.008)	(0.007)	(0.011)	(0.020)
Distance x bike sharing	0.029	0.003	0.015	0.008	0.010
	(0.005)	(0.012)	(0.006)	(0.006)	(0.015)
Variables	(f) Nanjing	(g) Shanghai	(h) Shenzhen	(i) Tianjin	(j) Wuhan
Distance to subway	-0.025	-0.065	-0.023	-0.069	-0.047
	(0.014)	(0.007)	(0.009)	(0.009)	(0.008)
Distance x bike sharing	-0.007	0.037	0.021	-0.002	0.020
	(0.011)	(0.005)	(0.005)	(0.005)	(0.006)
Observations	617,271				
Apartments	339,840				
Subway stations	1,422				
R^2	0.91				

Notes: Estimated by OLS with subway-station fixed effects and year-month fixed effects. Samples comprise apartments initially listed from mid-2015 to 2017, within 3 km of the nearest subway station. The dependent variable is the logarithm of price per m^2. All estimates control for apartment characteristics, apartment density, and indicators for initial/last price. Robust standard errors clustered by subway station in parentheses.

Table B3. City-level Estimates

Variables	(a) Beijing	(b) Chengdu	(c) Chongqing	(d) Dalian	(e) Hangzhou
Distance to subway	-0.053	-0.041	-0.009	-0.054	-0.039
	(0.007)	(0.008)	(0.006)	(0.010)	(0.020)
Distance x bike sharing	0.030	0.002	0.015	0.004	0.012
	(0.005)	(0.011)	(0.006)	(0.006)	(0.015)
Observations	105,543	84,579	53,224	55,790	33,313
Apartments	62,689	53,294	35,650	32,457	19,562
Subway stations	285	100	117	62	56
R^2	0.75	0.54	0.51	0.57	0.64
Variables	(f) Nanjing	(g) Shanghai	(h) Shenzhen	(i) Tianjin	(j) Wuhan
Distance to subway	-0.024	-0.065	-0.028	-0.068	-0.046
	(0.014)	(0.006)	(0.008)	(0.009)	(0.008)
Distance x bike sharing	-0.009	0.036	0.021	0.001	0.017
	(0.011)	(0.005)	(0.005)	(0.005)	(0.006)
Observations	56,564	60,681	62,419	55,045	50,113
Apartments	34,073	59,031	37,816	29,969	35,299
Subway stations	121	294	163	102	122
R^2	0.60	0.65	0.60	0.67	0.60

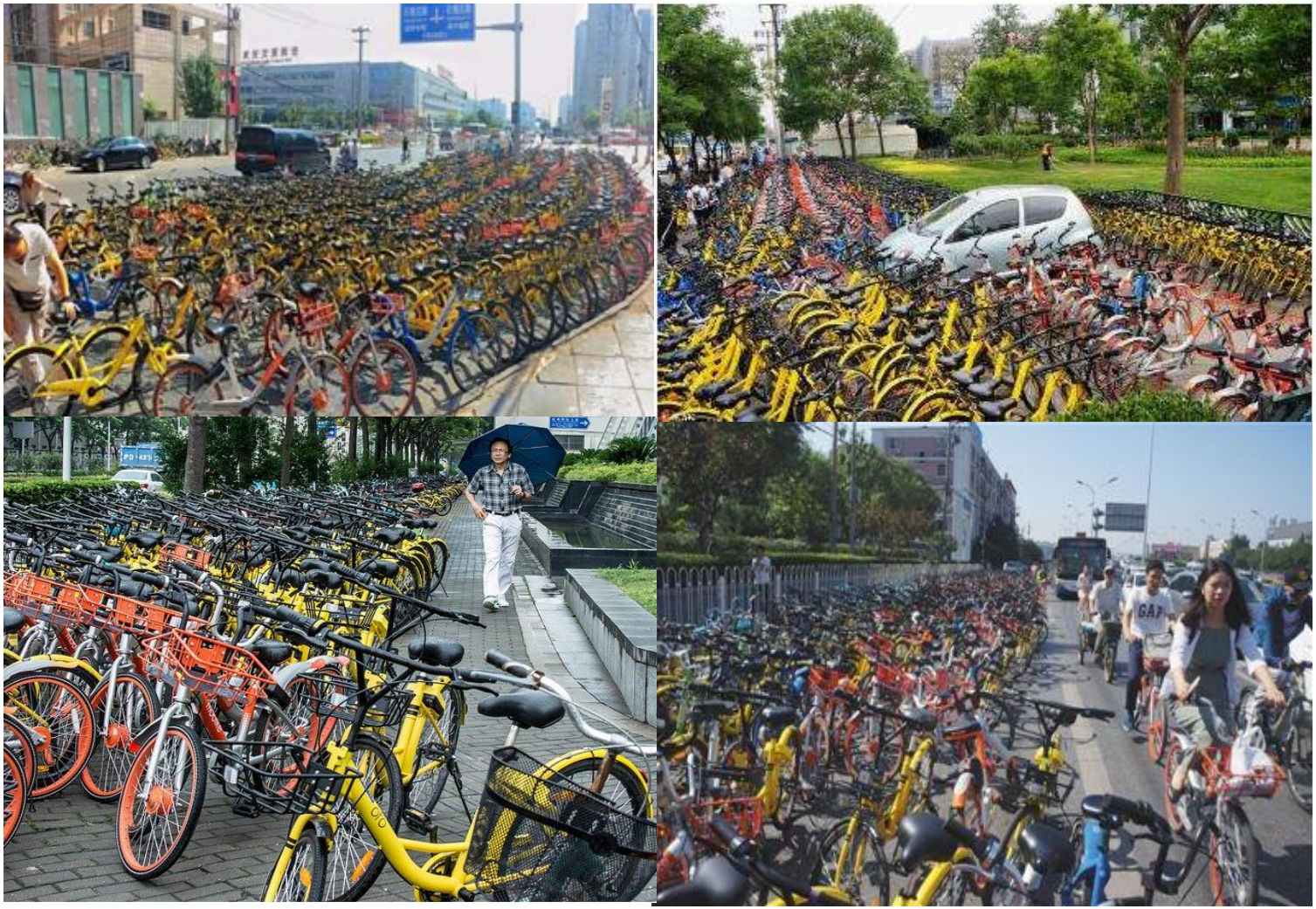
Notes: Estimated by OLS with subway-station fixed effects and year-month fixed effects. Samples comprise apartments initially listed from mid-2015 to 2017, within 3 km of the nearest subway station. The dependent variable is the logarithm of price per m^2. All estimates control for apartment characteristics, apartment density, and indicators for initial/last price. Robust standard errors clustered by subway station in parentheses.

Table B4. Exogenous Entry of Bike Sharing: The Hazard Rate Test

Variables	(a) Coefficients	(b) Hazard ratios
End-of-year population	-0.380	0.684
	(1.247)	(0.853)
Annual GDP	1.741	5.701
	(1.779)	(10.14)
Annual subway ridership	4.045	57.12
	(2.416)	(138.0)
Annual average housing price	0.613	1.846
	(0.712)	(1.314)
Observations	125	
Cities	10	
Log pseudolikelihood	-13.30	

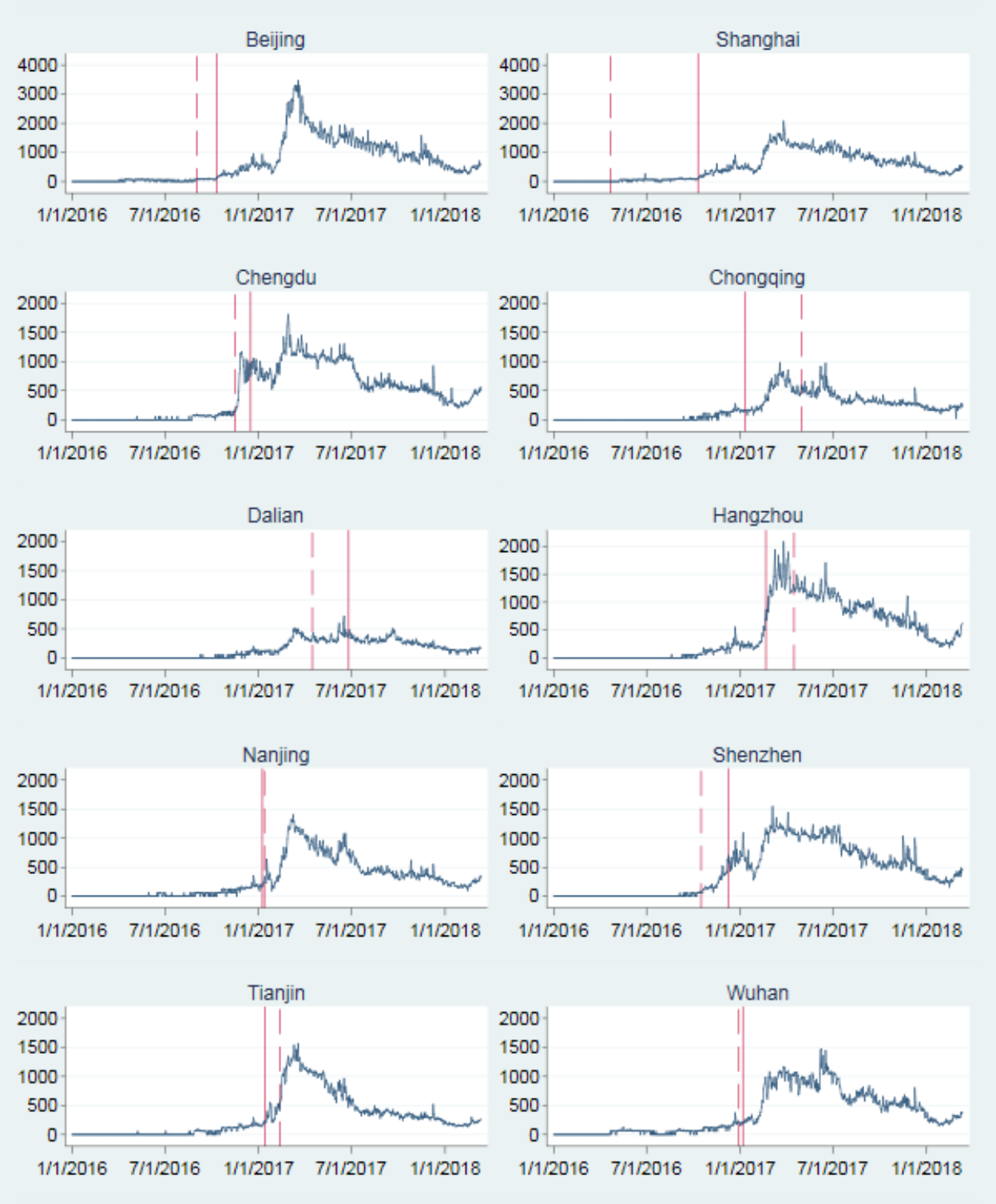
Notes: Estimated by a hazard rate model using Stata routine, stcox. Sample comprises city-year-months from January 2016 to the month of entry of bike sharing. Explanatory variables are standardized to zero mean and unit standard deviation. Column (a) reports the coefficients and column (b) reports the respective hazard ratios. Robust standard errors clustered by city in parentheses.

Figure B1. Photos of Dockless Shared Bikes in Chinese Cities



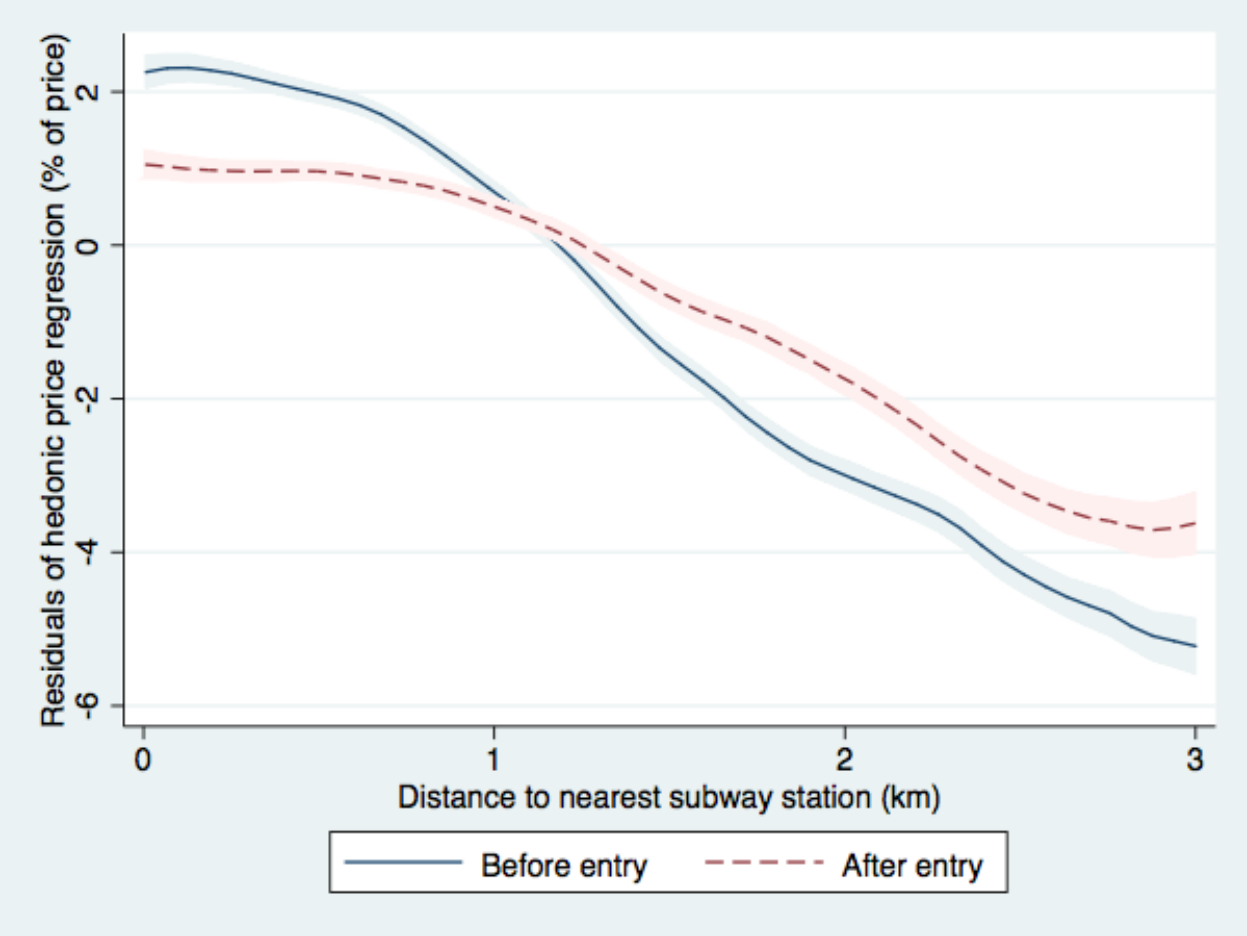
Source: Upper-left: http://www.010lf.com/news/2017/09/11/193632.html; upper-right: http://www.jlonline.com/ news/2017-0509/357030.shtml; bottom-left: https://www.planetizen.com/news/2018/03/97982-friday-eye-candy-dockless-bikes-far-eye-can-see; bottom-right: http://www.rmzxb.com.cn/c/2017-08-04/1698939_2.shtml; retrieved May 12, 2018.

Figure B2. Baidu Index for "Bike Sharing"



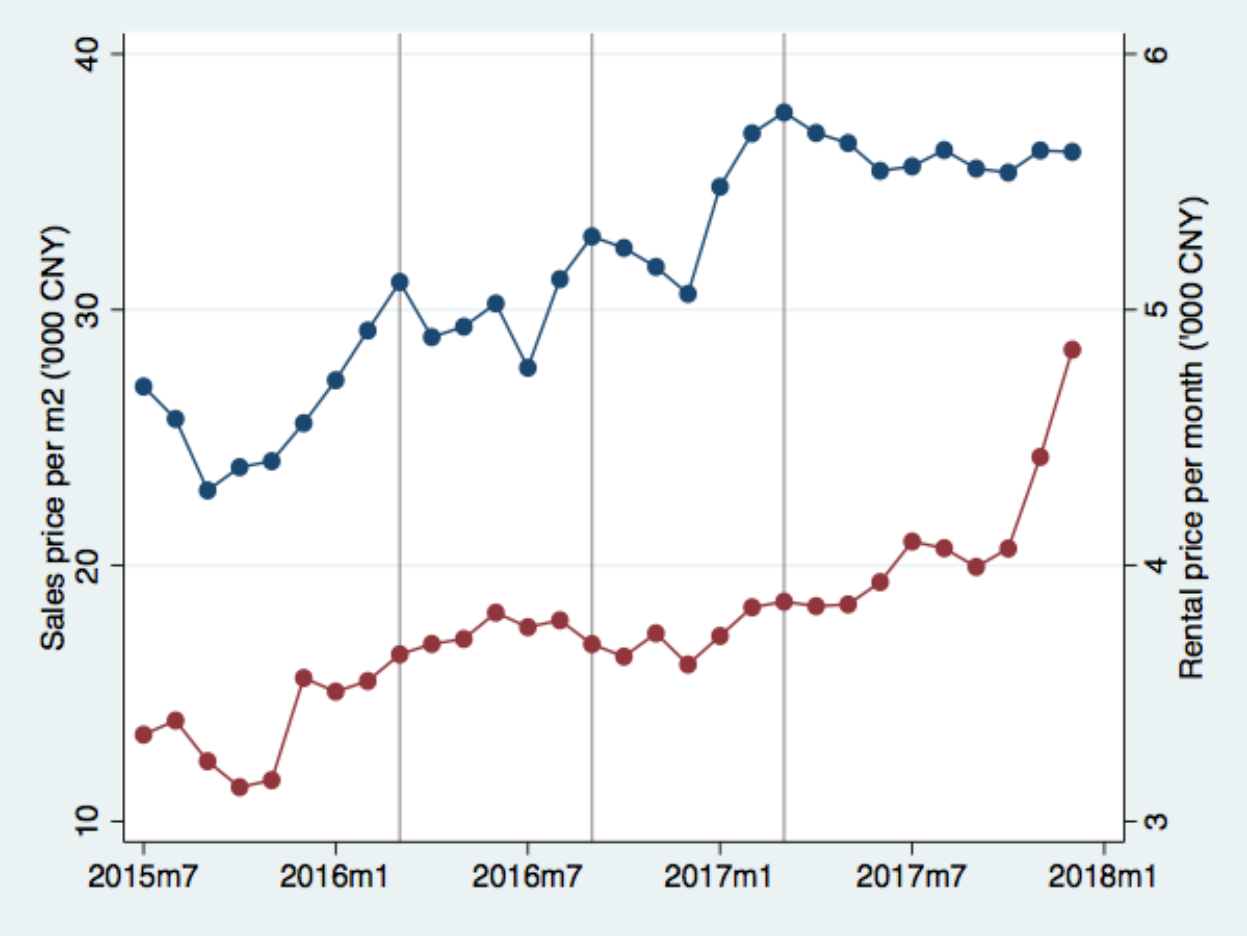
Notes: Blue curves depict daily Baidu search index for "bike sharing" from January 1, 2016 to March 12, 2018 by city (indices prior to 2016 all equal zero). Red solid lines represent entry time of Ofo and red dashed lines represent entry time of Mobike.

Figure B3. Housing Price Gradient: Non-parametric Estimates



Notes: The plot depicts hedonic price residuals from estimating model (1) against distance to the nearest subway station, before and after the entry of bike sharing. We estimate model (1) on logarithm of housing price per m^2 against subway-station fixed effects, city-year-month fixed effects, and apartment characteristics (apartment floor number, size, building age, number of bedrooms, apartment density, whether in a school district, decoration status, window directions, and indicators for initial/last price), using apartments initially listed from mid-2015 to 2017, within 3 km of the nearest subway station. Blue solid line and red dashed line represent non-parametric estimates of the hedonic price residuals as a smooth function of distance, for apartments listed before and after the entry of bike sharing, respectively. The shadows represent the 95% confidence intervals.

Figure B4. Monthly Average Prices of Resale and Rental Apartments in Beijing



Note: Samples comprise rental and resale apartments initially listed from mid-2015 to 2017, within 3 km of the nearest subway station. The blue dots depict the average price per m^2 of resale apartments in each month; the red dots depict the average rents per month of rental apartments. The grey vertical lines represent the housing market regulations on March 25, 2016, September 30, 2016, and March 20, 2017, respectively.

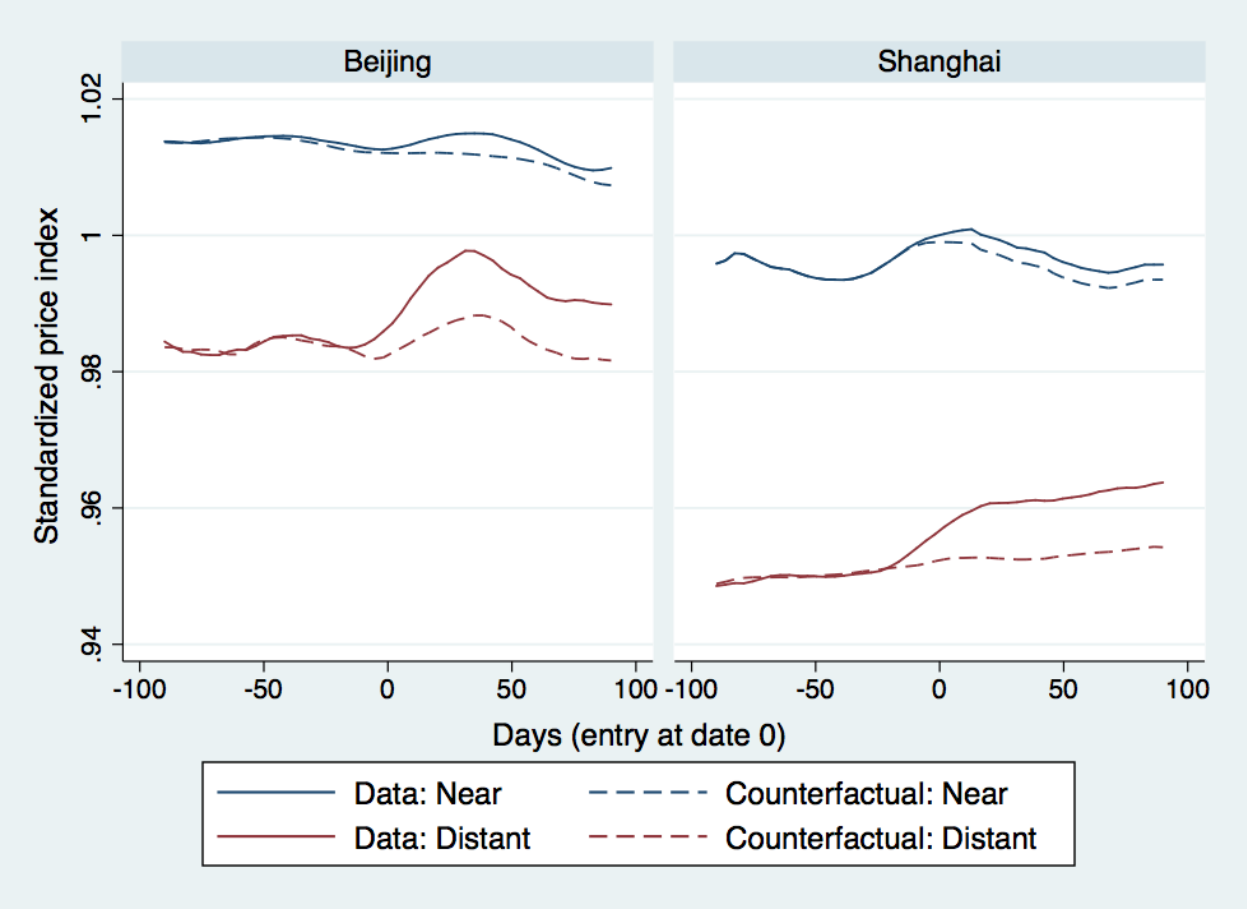
Online Appendix C. Back-of-the-envelope Calculation of Commuting Cost Reduction

The calculation method is as follows: (1) for each apartment listed after the entry, we use the estimates in Table 2, Column (a) to obtain the predicted total price (predicted price per m^2 *x* apartment size) and the counterfactual total price assuming no entry of bike sharing; and (2) we treat the difference between the predicted and counterfactual total prices as the total reduction in commuting costs, and amortize it into 30, 40, 50, 60 and 70 years of annual values. Columns (a) and (b) use the compound interest rate for 5-year fixed deposits (2.86% per annum) and 5-year treasury bills (3.86% per annum) as discounter factors, respectively. Exchange rate between CNY and USD is 6.7:1.

Table C1. Reduction in Commuting Costs per Annum

Discount duration	(a) 2.86% per annum	(b) 3.86% per annum
30 years	1,893 CNY, or 282 USD	2127 CNY, or 317 USD
40 years	1,597 CNY, or 238 USD	1,851 CNY, or 276 USD
50 years	1,429 CNY, or 213 USD	1,700 CNY, or 254 USD
60 years	1,324 CNY, or 198 USD	1,610 CNY, or 240 USD
70 years	1,255 CNY, or 187 USD	1,554 CNY, or 232 USD

Figure C1. Counterfactual Prices without Bike Sharing



Note: Samples comprise apartments in Beijing and Shanghai, listed 90 days before and after the entry of bike sharing. The figure plots housing price residuals from Equation (1), smoothed by local polynomial regressions and absent from subway-station fixed effects and city-year-month fixed effects.