The Value of Platform Endorsement

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Online Appendix

A Propensity Score

Table A1 shows the balance checks for users exposed to endorsement-eligible items during the pre-treatment period. We find that treatment group users have a significantly higher number of impressions (p-value=0.02) and clicks (p-value=0.05) than control group users in the pre-treatment period. However, the two groups do not differ significantly on other dimensions like number of orders, purchase price, rating of purchased services, total lifetime orders, and the proportion of business users. Our interpretation of the data is that the inherent randomness in search patterns leads to the imbalances we observe. To correct for these imbalances, we use IPW.

Table A1: Covariate balance before re-weighting observations

	N	Control	Treatment	p-value
# Impressions	392,613	132.77	140.27	0.02
# Clicks	392,613	3.08	3.16	0.05
# Orders	392,613	0.11	0.11	0.16
Purchase price	22,414	36.24	35.86	0.60
Rating of purchased service (If rated)	20,588	4.92	4.92	0.14
# Ratings of purchased service	22,414	491.34	515.44	0.34
# Lifetime Orders	392,613	15.70	15.81	0.75
% Business users	117,413	0.34	0.34	0.20

Table A2 shows the result of the propensity score estimation. We include pre-treatment browsing and purchase behavior of users in estimation of the propensity score because we believe these could be correlated with the probability that a user encounters an endorsement badge. For instance, users who are inherently more likely to browse and purchase might be more likely to come across an eligible service.

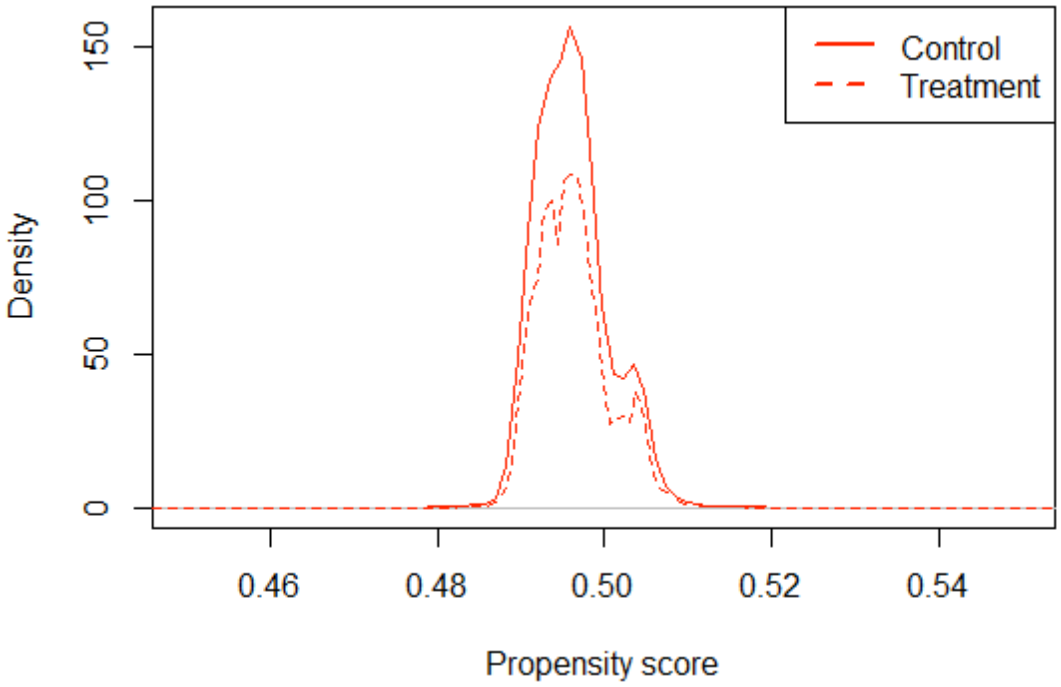
Table A2: Propensity score estimation

	Dependent variable:
	Treatment
	Logistic regression
If browse	0.010
	(0.009)
#Impressions	0.00000
	(0.00000)
#Clicks	0.0004
	(0.0003)
#Orders	-0.013^{**}
	(0.005)
If registered	-0.011
	(0.009)
Total lifetime orders	0.00001
	(0.00003)
Age on platform	0.00000
	(0.00001)
Days to first visit	-6.552
	(16.181)
If category#1	0.028^{**}
	(0.012)
If category#2	-0.016
	(0.010)
If category#3	-0.005
	(0.012)
If category#4	0.026
	(0.031)
If category#5	0.009
	(0.015)
If category#6	0.002
	(0.012)
If category#7	0.010
	(0.019)
If category#8	-0.023
	(0.016)
Constant	-0.008
	(0.011)
Observations	392,613
Log Likelihood	$-272{,}109.400$

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure A1 shows the distribution of estimated propensity scores in the control and treatment groups. There are two key takeaways. First, the distributions of propensity scores are similar in the control and treatment groups. Second, a large proportion of observations have a propensity score close to 0.5. Both patterns make sense because our data come from a randomized experiment.

Figure A1: Distribution of propensity scores



B ATT Using Instrumental Variable Estimation

To estimate ATT in a randomized experiment with an intent-to-treat design, researchers often use an instrumental variable (IV) approach where randomization is used as an instrumental variable. In settings where researchers lack information about the users in the control group who would have received the treatment had they been in the treatment group, this approach is useful since it helps identify users in the control group who would have been exposed to the treatment had they been in the treatment group.

In contrast, in our setting we have full information on users in the control group who would have been exposed to the endorsement badge had they been in the treatment group. This is because regardless of being in the control or treatment group, a user might still be exposed to an eligible service. The only difference is that for users in the treatment group, an endorsement badge is displayed on an eligible service, while for control group users, the endorsement badge is not displayed on an eligible service. Thus, using this information we can estimate the ATT directly rather than estimating the ATT indirectly using the IV approach. Compared to an IV approach, estimating the ATT directly by removing those users who would never have been exposed to the endorsement badge from the analysis reduces noise in the estimator (Johnson et al., 2017). Consequently, in our analysis we focus on users who were exposed to an endorsement-eligible service at least once during the experiment.

To demonstrate the robustness of our results, we report the ATT using an instrumental variable regression. We use the random assignment as the intrumental variable. Table B1 shows the results from the first stage of the two stage least square estimation. We conduct this analysis at a user level and control for users' pre-treatment browsing and purchase behavior and user characteristics. We find that the randomiz assignment explains users' exposure to the platform endorsement badge.

Table B2 summarizes the IV results for impressions, clicks, and orders from the second stage using a linear regression. The results for impressions and clicks mirror the findings from our estimation approach except for clicks for unendorsed services which is no longer significant ($p = 0.108$). For orders, the estimates obtained from the IV approach directionally mirror those of our specification. However, the effect on total orders becomes insignificant when using IV. This outcome is not surprising since, as previously explained, the IV estimators are less efficient and more noisy than the direct estimation of the ATT.

Table B1: First stage of IV regression

	(1) First Stage
Treatment	0.745***
	(0.000581)
Total lifetime orders	0.0000176***
	(0.00000225)
If browsed (pre-experiment)	0.0247***
	(0.000781)
# Impressions (pre-experiment)	0.00000411***
	(0.000000303)
# Clicks (pre-treatment)	0.000494***
	(0.0000269)
# Orders (pre-treatment)	0.00138***
	(0.000365)
If registered	-0.00306***
	(0.000813)
Age on platform	-0.00000622***
	(0.000000469)
First arrival day	-0.00173***
	(0.000150)
Constant	0.0492***
	(0.00133)
Category controls	Yes
First visit week	Yes
Observations	1,114,995
R sq.	0.597

Standard errors in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table B2: Effect of platform endorsement on impressions, clicks, and orders: IV

	(1) Linear
Impressions	5.263***
	(1.877)
Endorsed impressions	0.0247
	(0.0469)
Unendorsed impressions	5.238***
	(1.855)
Clicks	0.0582**
	(0.0279)
Endorsed clicks	0.0268***
	(0.00206)
Unendorsed clicks	0.0590
	(0.0367)
Orders	0.00254
	(0.00158)
Endorsed orders	0.00140***
	(0.000170)
Unendorsed orders	0.00114
	(0.00156)
Category controls	Yes
Past purchase controls	Yes
First visit week	Yes
Controls used in the first stage	Yes
Observations	1,114,995

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

C Estimation Equations for Section 3.5

We estimate how the effect of platform endorsement varies with the spatial distance of a service to the endorsed service for results shown in Columns (1)-(2) of Table 8 using the following specification:

$$\begin{aligned} ln(\lambda_{i,c,s}) = \beta_0 + \beta_1 Treatment_i + \beta_2 \text{I(services located nearby)}_{i,c,s} + \\ \beta_3 \times Treatment_i \times \text{I(services located nearby)}_{i,c,s} + \beta_4 X_{i,c,s}, \end{aligned} \tag{1}$$

where we assume that the dependent variable of interest for user i browsing in category c in session s, $Y_{i,c,s}$, is drawn from a Poisson distribution with parameter $\lambda_{i,c,s}$. All other variables are as defined in detail in Section 3.2 in the paper.

Similarly, to estimate how the effect of platform endorsement varies across services that are priced similarly to the endorsed service for results shown in Columns (3)-(4) of Table 8, we use the following specification:

$$\begin{aligned} ln(\lambda_{i,c,s}) = \beta_0 + \beta_1 Treatment_i + \beta_2 \text{I(similarly priced)}_{i,c,s} + \\ \beta_3 \times Treatment_i \times \text{I(similarly priced)}_{i,c,s} + \beta_4 X_{i,c,s}, \end{aligned} \tag{2}$$

where we assume that the dependent variable of interest for user i browsing in category c in session s, $Y_{i,c,s}$, is drawn from a Poisson distribution with parameter $\lambda_{i,c,s}$. All other variables are as defined in detail in Section 3.2 in the paper.

D Linear Regression Results

Table D1 shows the results using a linear regression for impressions, clicks, and orders. The majority of results are directionally consistent and have the same significance levels (an exception is the effect for unendorsed orders in the linear specification that now has a p-value = 0.101).

Table D1: Effect of platform endorsement on impressions, clicks, and orders

	(1)
	Linear
Impressions	6.037***
	(2.215)
Endorsed impressions	0.0465
	(0.0496)
Unendorsed impressions	5.990***
	(2.189)
Clicks	0.0812***
	(0.0295)
Endorsed clicks	0.0281***
	(0.00206)
Unendorsed clicks	0.0816**
	(0.0391)
Orders	0.00387***
	(0.00150)
Endorsed orders	0.00145***
	(0.000170)
Unendorsed orders	0.00242
	(0.00148)
Category controls	Yes
Past purchase controls	Yes
First visit week	Yes
Observations	834,853

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Tables D2-D6 demonstrate robustness when using a linear specification for the robustness tests and mechanism checks. In the heterogeneity analysis regarding business versus personal users, the results are consistent in both direction and significance level (Columns(1)-(3) of Table D7) except for results for endorsed orders. In the analysis regarding orders in the past two weeks, the effect of endorsement on total orders and on unendorsed orders while directionally consistent is no longer significant (Columns(4)-(6) of Table D7). This is not surprising given that the linear estimator is less efficient for count data.

Table D2: Effect on unendorsed non-qualifying services

	(1)	(2)	(3)
	Unendorsed not qualifying impressions	Unendorsed not qualifying clicks	Unendorsed not qualifying orders
Treatment	5.627***	0.0777**	0.00245*
	(2.152)	(0.0388)	(0.00147)
Category controls	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes
First visit week	Yes	Yes	Yes
Observations	834853	834853	834853
R sq.	0.00845	0.0125	0.0201

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D3: Effect on search based on spatial proximity and price similarity

	Unendorsed clicks	Unendorsed orders	Unendorsed clicks	Unendorsed orders
	(1)	(2)	(3)	(4)
Treatment	0.0341*	0.00191**	0.0242	0.00126*
	(0.0188)	(0.000785)	(0.0149)	(0.000647)
Services located nearby	-1.667***	-0.0350***		
	(0.0115)	(0.000531)		
Treatment × Services located nearby	-0.0437**	-0.00258***		
	(0.0172)	(0.000783)		
Similarly priced			-1.236***	-0.0226***
			(0.00952)	(0.000468)
Treatment × Similar priced			-0.0225	-0.00179**
			(0.0141)	(0.000695)
Category controls	Yes	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes	Yes
First visit week	Yes	Yes	Yes	Yes
Observations	1553692	1553692	1553692	1553692
R sq.	0.0575	0.0128	0.0397	0.00929

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D4: Browsing and clicks in categories without exposure to platform endorsement

	Impressions	Clicks	Orders
	(1)	(2)	(3)
Treatment	3.906***	0.0561*	0.00474**
	(1.327)	(0.0308)	(0.00240)
Category controls	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes
First visit week	Yes	Yes	Yes
Observations	110640	110640	110640
R sq.	0.00580	0.00745	0.00906

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Sample restricted to browsing behavior of users after the first exposure to platform endorsement-eligible service in categories where they were not exposed to platform endorsement-eligible service during the period of the experiment.

Table D5: Number of orders conditional on clicks

	Orders	Endorsed orders	Unendorsed orders
	(1)	(2)	(3)
Treatment	0.00289**	0.00126***	0.00176
	(0.00145)	(0.000192)	(0.00144)
# Clicks	0.0121***		
	(0.00111)		
# Endorsed clicks		0.00666*	
		(0.00366)	
# Unendorsed clicks			0.00807***
			(0.00137)
Category controls	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes
Week of first arrival controls	Yes	Yes	Yes
Observations	834853	834853	834853
R sq.	0.0718	0.00820	0.0597

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D6: Effect over time: Impressions, Clicks

	Impressions	Endorsed impressions	Unendorsed impressions	Clicks	Endorsed clicks	Unendorsed clicks
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	0.694	-0.0114	0.705	-0.00131	0.0184***	-0.0197
	(1.204)	(0.0183)	(1.196)	(0.0273)	(0.00144)	(0.0269)
Second exposure	150.6***	1.783***	148.8***	2.324***	0.0641***	2.260***
	(3.857)	(0.0523)	(3.821)	(0.0471)	(0.00207)	(0.0461)
Treatment × Second exposure	8.380	0.150	8.229	0.142**	0.0247***	0.118*
	(5.776)	(0.114)	(5.709)	(0.0726)	(0.00388)	(0.0712)
Category controls	Yes	Yes	Yes	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes	Yes	Yes	Yes
First visit week	Yes	Yes	Yes	Yes	Yes	Yes
Observations	477981	477981	477981	477981	477981	477981
R sq.	0.0120	0.00516	0.0120	0.0175	0.0102	0.0170

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table D7: Effect on orders by business vs. personal users and past orders

	Orders	Endorsed orders	Unendorsed orders	Orders	Endorsed orders	Unendorsed orders
	(1)	(2)	(3)	(4)	(5)	(6)
Treatment	-0.00148	0.000546*	-0.00203	-0.000421	0.00129***	-0.00171
	(0.00264)	(0.000281)	(0.00259)	(0.00303)	(0.000173)	(0.00300)
Business user	0.137***	0.00378***	0.133***			
	(0.00492)	(0.000456)	(0.00484)			
Treatment × Business user	0.0160**	0.00261***	0.0133*			
	(0.00705)	(0.000706)	(0.00696)			
Orders in past 2 weeks				0.0461***	0.000512***	0.0456***
				(0.00575)	(0.000156)	(0.00566)
Treatment × Orders in past 2 weeks				0.0135	0.000493**	0.0130
				(0.00968)	(0.000226)	(0.00960)
Category controls	Yes	Yes	Yes	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes	Yes	Yes	Yes
First visit week	Yes	Yes	Yes	Yes	Yes	Yes
Observations	267689	267689	267689	834853	834853	834853
R sq.	0.0319	0.00316	0.0309	0.0371	0.00215	0.0365

Clustered standard errors in parentheses, * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

E Robustness

We conduct a battery of robustness checks to ensure that the results are not driven by the specific functional form of the Poisson regression. These checks include model-free t-tests, Poisson regression using propensity score as a control rather than inverse probability weighting, and a negative binomial regression.

First, Table E1 presents results from t-tests and shows that the results on impressions, clicks, and orders, including endorsed and unendorsed services, are consistent with the results reported in Poisson specification.

Table E1: User level impressions, clicks, and orders after re-weighting

	Control	Treatment	p-value
# Impressions	317.60	332.96	0.00
# Endorsed impressions	4.65	4.78	0.21
# Unendorsed impressions	312.95	328.18	0.00
# Clicks	8.14	8.36	0.00
# Endorsed clicks	0.24	0.30	0.00
# Unendorsed clicks	8.72	8.95	0.00
# Orders	0.301	0.311	0.00
# Endorsed orders	0.008	0.011	0.00
# Unendorsed orders	0.293	0.300	0.04

The data covers 392,613 users during the period of the experiment.

Second, Column (1) of Table E2 shows the coefficient estimates for the number of impressions, clicks, and orders using a Poisson regression with propensity scores as a control. Again, the results are robust. Note that controlling for the propensity score makes the assumption that the treatment effect is homogeneous across units with different propensity scores (Wooldridge, 2010), which may not hold in our setting, as shown in Section 5.

Third, Column (2) of Table E2 shows the coefficient estimates for the number of impressions, clicks, and orders using an IPW estimation as in the paper but with a negative binomial model specification. Again, the results are robust except for the the effect on orders of unendorsed services. While directionally consistent, we lose significance (p-value = 0.116).

Together, this set of results suggest that our findings are not driven by functional form assumptions.

Table E2: Estimates of the effect of platform endorsement on impressions, clicks, and orders

	(1) Poisson regression Control for propensity score	(2) NBD regression
Dependent Variables		
Total Impressions	0.0414**	0.0246**
	(0.0172)	(0.0108)
Endorsed impressions	0.0257	0.0026
	(0.0232)	(0.0140)
Unendorsed impressions	0.0416**	0.0251**
	(0.0173)	(0.0109)
Total Clicks	0.0233***	0.0191***
	(0.00748)	(0.00683)
Endorsed clicks	0.226***	0.221***
	(0.0152)	(0.01455)
Unendorsed clicks	0.0224**	0.0173**
	(0.00925)	(0.00809)
Total Orders	0.0311***	0.0259**
	(0.0106)	(0.0102)
Endorsed orders	0.341***	0.348***
	(0.0400)	(0.0402)
Unendorsed orders	0.0216**	0.0163
	(0.0108)	(0.0104)
Category controls	Yes	Yes
Past purchase controls	Yes	Yes
First visit week	Yes	Yes
Propensity score controls	Yes	No
Observations	834,853	834,853

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

F Pre-Treatment Covariate Balances for Sub-Samples

To check whether the sub-sample of users used in the analysis for Table 9 (which examines whether platform endorsement improves users' perception of quality of services available on the platform) are balanced, we test the pre-treatment covariate balance between the control group and treatment group users for this analysis. Results are shown in Table F1 and indicate that the two groups are balanced, with none of the p-value below 0.10.

Table F1: Covariate balance for mechanism analysis

	N	Control	Treatment	p-value
# Impressions	76,557	310.14	304.27	0.63
# Clicks	76,557	7.26	7.42	0.33
# Orders	76,557	0.24	0.24	0.94
Purchase price	8,832	35.52	34.86	0.63
Rating of purchased service (If rated)	8,159	4.92	4.92	0.31
# Ratings of purchased service	8,832	461.96	476.44	0.75
# Lifetime Orders	76,557	40.63	38.34	0.20
% Business users	28,213	0.40	0.41	0.57

For the analysis of the novelty mechanism in Table 11 that uses a sub-sample of users, we check the pre-treatment covariate balance between the control group and treatment group observations. The results in Table F2 below show that the two groups are balanced, with none of the p-values below 0.10.

Table F2: Covariate balance for novelty analysis

	N	Control	Treatment	p-value
# Impressions	115,755	357.06	343.37	0.22
# Clicks	115,755	6.84	6.77	0.59
# Orders	115,755	0.21	0.21	0.92
Purchase price	11,361	34.68	35.75	0.35
Rating of purchased service (if rated)	10,555	4.92	4.92	0.19
# Ratings of purchased service	11,361	486.35	526.86	0.32
# Lifetime orders	115,755	32.86	32.17	0.55
% Business users	43,007	0.35	0.36	0.20

G Additional Analyses Regarding the Mechanism

We also compare the increase in search and purchase for categories in which users were exposed to an endorsement-eligible service relative to categories where they were not exposed to an endorsement-eligible service, conditional on being previously exposed to an endorsement-eligible service in another category. Table G1 shows that the increases in impressions, clicks, and orders in categories where users were not exposed to an endorsement-eligible service do not differ significantly from the increases in impressions, clicks, and orders in categories where users were exposed to an endorsement-eligible service. This result is in line with the proposed mechanism that platform endorsement improves users' beliefs in the overall quality of services across the platform, resulting in more search and purchase of both endorsed services and unendorsed services.

Table G1: Mechanism: Change in perceived quality in categories with exposure and categories without exposure

	#Impressions	#Clicks	#Orders
	(1)	(2)	(3)
Treatment	0.0643***	0.0247*	0.0576**
	(0.0233)	(0.0145)	(0.0282)
In exposed category	1.609***	1.059***	0.758***
	(0.0223)	(0.0136)	(0.0239)
Treatment × In exposed category	-0.00474	0.00413	-0.0134
	(0.0324)	(0.0197)	(0.0324)
Category controls	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes
First visit week	Yes	Yes	Yes
Observations	331,579	331,579	331,579
Log likelihood	-246,228,564.8	-4,320,605.5	-328,468.8

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table G2 shows a further check for the novelty mechanism. We identify among treatment group users those who were exposed to a platform endorsement badge on six separate calendar days.[1] We follow a similar logic for control group users. We combine the browsing behavior of users starting from the first exposure to the endorsement badge through the third exposure and consider it as one period. We combine the browsing behavior of users starting from the fourth exposure to the endorsement badge through the sixth exposure occasion into a second period. We then compare the change in impressions and clicks from the first period to the second period between the treatment and control groups. The interaction term

[1]We limit the sample to users with exposure to endorsement on exactly six separate days to ensure a large enough sample size while also allowing enough opportunity for the novelty effect to wear-off. The result from this analysis is robust to a change in the number of exposures. The results are similar if we limit the sample to users who are exposed on exactly two, three, four, and five different calendar days.

between the treatment and the next three visits captures the effect of platform endorsement on search over subsequent exposure. The statistically insignificant estimate suggests that the effect of platform endorsement on search does not attenuate over subsequent exposure. The results are consistent with the main analysis and we find no evidence that the effect of platform endorsement wears off over time.

We thus conclude that the novel feature of an endorsement badge alone is unlikely to explain the increase in browsing and clicks for unendorsed services.

Table G2: Novelty mechanism: Users with exposure to eligible services on six unique days

	(1) #Impressions	(2) #Endorsed impressions	(3) #Unendorsed impressions	(4) #Clicks	(5) #Endorsed clicks	(6) #Unendorsed clicks
Treatment	-0.0702	-0.00379	-0.0710	-0.0346	0.133**	-0.0396
	(0.0540)	(0.0299)	(0.0544)	(0.0422)	(0.0556)	(0.0430)
Next three visits	-0.0817	-0.0384	-0.0822	-0.118***	-0.104*	-0.119***
	(0.0368)	(0.0229)	(0.0371)	(0.0327)	(0.0547)	(0.0332)
Treatment × Next three visits	0.0456	-0.0239	0.0464	0.0449	-0.00132	0.0463
	(0.0491)	(0.0329)	(0.0495)	(0.0444)	(0.0742)	(0.0451)
Category controls	Yes	Yes	Yes	Yes	Yes	Yes
Past purchase controls	Yes	Yes	Yes	Yes	Yes	Yes
Week of first arrival controls	Yes	Yes	Yes	Yes	Yes	Yes
Observations	20,703	20,703	20,703	20,703	20,703	20,703
Log likelihood	-9,647,495.0	-114,744.1	-9,628,550.6	-286,148.5	-20,538.3	-282,887.4

Clustered standard errors in parentheses.* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

H Purchase Propensity for Control Group Users

We examine whether users who have purchased more in the two-week pre-treatment period have a higher propensity to purchase. We focus on control group users only and examine the number of orders placed by users during the period of the experiment as a function of the number of orders they placed in the pre-treatemnt period. Column (1) of Table H1 shows that users with more purchases in the pre-treatment period place a higher number of orders during the experiment.

Next, we examine whether business users have a higher propensity to purchase than personal users. We focus on control group users only and examine the number of orders placed by users during the period of experiment as a function of whether they are business users. Column (2) of Table H1 shows that business users place a higher number of orders during the experiment compared to personal users.

Table H1: Purchase propensity for control group users

	(1)	(2)
	#Orders	#Orders
Orders in past 2 weeks	0.0272***	
	(0.00412)	
Business user		0.972***
		(0.0283)
Category controls	Yes	Yes
Past purchase controls	Yes	Yes
First visit week	Yes	Yes
Observations	418,874	134,120
Log likelihood	-187,699.7	-59,598.3

Clustered standard errors in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Data sample includes control group users exposed to an endorsement-eligible service.

References

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