

Web Appendix: Online Reputation Mechanisms and the Decreasing Value of Chain Affiliation

November 28, 2017

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This appendix accompanies “Online Reputation Mechanisms and the Decreasing Value of Chain Affiliation.” It presents further evidence for the main effects, namely the differential effect on independent and chain firm revenues of added information via online reviews. This includes use of instrumental variables constructed from two exogenous changes in TripAdvisor.com’s review policies as well as instruments constructed from lagged number of reviews and other robustness checks. I also perform a number of tests to rule out reverse causality in the results in Section 4.

1 Robustness checks for Section 3

This section presents robustness checks on the results in section 3. The object of interest in this section is the effect on revenue of the interaction between the amount of information in online reputation mechanisms and whether the firm is chain or independent. The argument that this interaction is measured correctly is based on a broad set of controls for potential endogeneity.

To measure the association between online information and revenue for different firm types, I construct four related measures of quantity of information available: total number of reviews posted, total number of characters in the stock of reviews, total number of unique words in the stock of reviews, and a dummy for whether or not a review has been posted in the most recent month. In each case the variable of interest is lagged one month to avoid simultaneity and the focus is on the interaction with firm type. For each of the four tests I estimate:

$$\text{Log}(\text{RevPar}_{imt}) = x_{imt}\beta_1 + \beta_2c_{it} + \beta_3\#reviews_{i,t-1} + \beta_4c_{it} \cdot \#reviews_{i,t-1} + time_t + owner_j + hotel_i + \epsilon_{imt}, \quad (1)$$

1.1 Instrumental Variable Analysis

A potential bias in the parameters estimated using equation 1 comes from unobserved time-varying hotel service quality, which could create correlation between amount of reviews posted and revenue. If the controls used to measure time-varying hotel quality are incomplete or imperfect therefore, these estimates could be biased upwards. To rule out endogeneity bias, I perform tests using as instrumental variables two exogenous changes in TripAdvisor.com’s review posting policies. For the first years of the website, there was no restriction on how long reviews could be. In June 2009, they implemented a 100 character minimum length for reviews. Then, in August 2012, they increased the minimum length to 200 characters. See Figure 1 for a visual representation of the effects of the policy change, which shows a sharp break in the number of characters in reviews posted.¹ The purpose of these policy changes was to increase the informativeness of each review by eliminating very short reviews which typically had little information content.

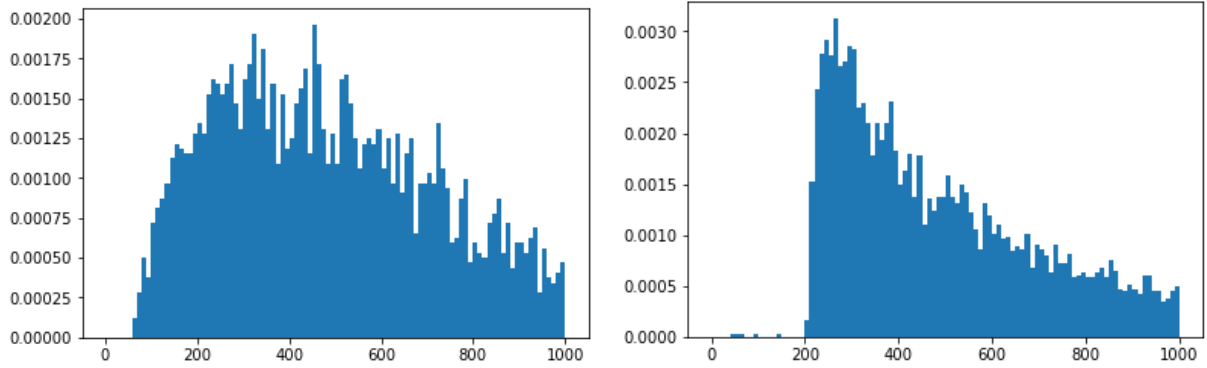
Eliminating these short and low-information reviews provides an exogenous shift with respect to the object of interest and notably this policy change had no impact on the average rating left by reviewers as shown in figure 2. These policy changes are unrelated to demand for hotel stays, but generate useful variation in both average number of reviews posted (by increasing the costs of posting a review) and number of characters posted per review.

Columns 2 and 3 show results from using the TripAdvisor review length policy change for number of reviews and number of characters, respectively. For both the first stage F-stat is above 10. The results are similar to the baseline results shown in column 1 but with a slightly higher magnitude, both for the number of reviews and the number of characters, which are the variables we would most expect to be affected by the policy changes. The higher magnitude might reflect that the policy effected not only number of reviews and characters, but also average informativeness. This is a useful robustness check but not a full substitute for the results in the paper which contain much more variation and can be used to measure effects across the quality spectrum as well as different market types.

As a secondary test to rule out bias from serial correlation in demand or in time-varying unobserved quality, I use as instruments additional lags of number of reviews. This is suggested by Wooldridge (2002) as a way of taking advantage of the sequential nature of the key variable. The number of reviews this month is the sum of the number last month plus the number posted in the interim. If the key variable is one month lagged number of reviews, prior lags of number of reviews is highly (positively) correlated with this and much less correlated with current revenue. The further back in time we lag, the more true this becomes. In theory, this could apply to very old lags who would have no direct effect on revenue but would still be correlated with the current number of reviews. In practice, we must temper our interpretation of the coefficients in acknowledgement that there is still possibly a direct effect in cases where hotel stays are booked well in advance. In other words, for a 9-month lagged number of reviews, we would expect a small but

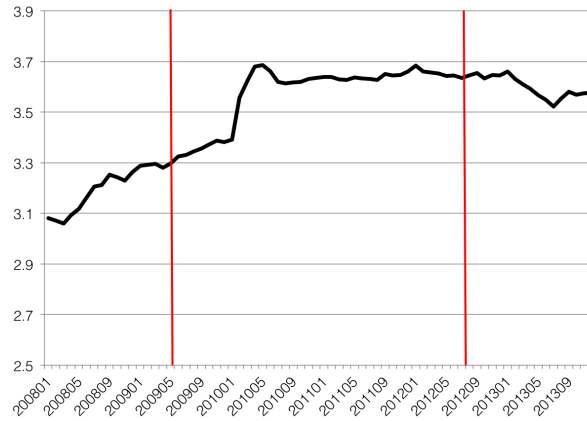
¹Because the characters in the review title count towards the limit, some reviews have fewer than 200 characters in the body of the text.

Figure 1: Histogram of TripAdvisor Review Lengths: July and August 2012



Note: These figures are histograms showing the distributions of TripAdvisor review lengths before and after the minimum length was changed to 200 characters in August 2012. The left figure is July 2012 and the right figure is August.

Figure 2: Average Monthly TripAdvisor Rating Over Time



Note: This chart shows the average TripAdvisor rating in each month from 2008-2013. The two lines represent the dates in which minimum review length policies were implemented.

theoretically positive effect on revenue if some consumers view reviews and book 9 months in advance. We would expect a clear and direct positive relationship the 9 month lag and current value of number of reviews, since this variable is cumulative by definition. Since property fixed effects account for time-invariant hotel characteristics the direct effect of the lagged variable on revenue is the main concern with these instruments.

I estimate three examples of this type of IV separately using GMM, and results are shown in Table 3. Column 1 shows the baseline result used in the paper, column 2 uses the 6 month lag as an IV, column 3 uses the 9 month lag, and column 4 uses the 12 month lag.²

While this deals effectively with serial correlation in demand, a second issue with this approach is that the lagged variable might still be correlated with time-varying omitted quality. To the extent that this is true, these lagged variables function as “imperfect instrumental variables” (IIV) as discussed by Nevo and Rosen (2012), Conley et al. (2012), Kolesar et al. (2015), and others, meaning that the IV’s are not completely uncorrelated with the unobserved term but may still be of some use. In particular, the instruments still allow partial identification of the parameter of interest. As described in Nevo and Rosen (2012), this type of IV can still be useful when “the correlation between the instrumental variable and the error term has the same sign as the correlation between the endogenous regressor and the error term and that the instrumental variable is less correlated with the error term than is the endogenous regressor”.

If the key variable is one month lagged number of reviews, prior lags of number of reviews is highly (positively) correlated with this and much less correlated with the current omitted variable. I implement the approach described in section 3c of Nevo and Rosen (2012) and construct bounds using the results from 4 instruments: the 6 month lag of number of reviews, the 9 month lag, and the 12 month lag, and the difference between the 6 and 12 month lags. This last IV is equivalent to the number of reviews posted between 6 and 12 months in the past and provides a plausible lower bound for the effect of interest. The results from this IV are shown in column 5. The bounds around the interaction effect of interest are $[-.0007, .0026]$. Again this is consistent with the result using no instruments.

1.2 Robustness Checks

Ultimately, there are six potential sources of bias in equation 1. (1) Property-level factors that impact revenue may be correlated with number of reviews. (2) Market level factors may correlate with both revenues and number of reviews. (3) Firms may change ownership or management, leading to changes in both revenues and reviews. (4) Unobserved quality factors may change over time, impacting both revenue and number of reviews. (5) Chain-wide marketing actions that vary over time may impact both revenue and the number of reviews posted and may persist over many periods and (6) online WOM may be correlated with offline WOM.

I eliminate concerns 1, 2, and 3 by including property and owner fixed effects to eliminate time-invariant

²The choice of 6, 9, and 12 months as the lags is admittedly arbitrary but testing other lags did not show any different results.

quality and service features, market level month and year dummies to account for time trends and seasonality. For concern 4, I include a set of eight variables that measure time-varying quality using information from online quality ratings.

Concern 5 is that advertising campaigns might increase both revenue and number of reviews over a medium-term period. I test for this using average chain partner RevPar. Because marketing activities are coordinated at the chain level and because activities like advertising have spillovers across chain partners, controlling for average chain partner performance should capture any medium-term demand driven by marketing. Results from including this can be seen in column 6 of Table 1. Including this measure does not change the main results. In addition, effects of advertising campaigns should be captured by the lagged dependent variable.

Concern 6 is that offline word of mouth is correlated with online word of mouth and is likely to affect revenues. In addition to including time dummies to capture any trends, I also test for this concern by including the number of reviews of chain partners from outside the focal hotel's market. The result of this test can be seen in column 5 of Table 1. The coefficient on number of reviews of chain partners is very close to zero and not significant. Including this measure also seems to strengthen the main empirical result, as it causes the coefficient on the number of reviews for independent hotels to increase.

After including these controls, there still exists potential simultaneity in short term demand shocks that could generate upward bias in the coefficient on number of reviews. While this would not necessarily bias the interaction term that is the object of interest, it is still worth testing to rule out bias of this sort. The concern is that after controlling for all the factors described above there is serial correlation in the remaining idiosyncratic component of revenue. This type of serial correlation can be tested for. The test follows Wooldridge (2002) and accounts for fixed effects such as the property fixed effects I include throughout. The results from these tests are shown in Table 2. The error term after accounting only for property fixed effects and basic characteristics such as age and capacity shows strong serial correlation. Including month dummies to account for seasonality reduces serial correlation but it is still significant. Adding mean competitor RevPar as a measure of market level shocks significantly reduces serial correlation to the extent that it is not significant and adding further controls for seasonality, short term quality changes, and the lagged dependent variable go even further to rule out a significant serial correlation in the remaining idiosyncratic term.

Table 1: Robustness Tests

| | (1) | (2) | (3) | (4) | (5) | (6) |
|--|---------------------------|--------------------------|--------------------------|---------------------------|----------------------------|---------------------------|
| Lagged # Reviews X Chain (Total) | 0.000727*** (0.000136) | | | 0.000713*** (0.000136) | 0.000621*** (0.000141) | 0.000734*** (0.000136) |
| Lagged # Reviews X Independent (Total) | 0.00166*** (0.000243) | | | 0.00165*** (0.000243) | 0.00274*** (0.000267) | 0.00153*** (0.000243) |
| Lagged # Reviews X Chain (Priceline) | | 0.0000695 (0.000308) | | | | |
| Lagged # Reviews X Independent (Priceline) | | 0.000160 (0.000923) | | | | |
| Lagged # Reviews X Chain (TripAdvisor) | | | 0.00102*** (0.000169) | | | |
| Lagged # Reviews X Independent (TripAdvisor) | | | 0.00213*** (0.000275) | | | |
| Lagged Market # Reviews | | | | -0.000218* (0.000102) | | |
| Lagged Chain partner # Reviews | | | | | 0.00000466 (0.00000441) | |
| Mean Chain Partner RevPar | | | | | | .00445*** (.00013) |
| Chain | 0.0660 (0.0563) | 0.0669 (0.0563) | 0.0661 (0.0563) | 0.0658 (0.0562) | 0.0702 (0.0563) | -0.122* (0.0564) |
| Independent Competitors | 0.000862 (0.000441) | 0.000897* (0.000441) | 0.000861 (0.000441) | 0.000904* (0.000440) | 0.000828 (0.000440) | 0.000690 (0.000441) |
| Chain Competitors | -0.000561 (0.000335) | -0.000592 (0.000336) | -0.000565 (0.000335) | -0.000625 (0.000337) | -0.000517 (0.000335) | -0.000744* (0.000333) |
| Age | -0.00715* (0.00289) | -0.00805*** (0.00235) | -0.00782*** (0.00237) | -0.00716* (0.00288) | -0.00586 (0.00369) | -0.00324 (0.00880) |
| Log(Capacity) | -1.078*** (0.0692) | -1.079*** (0.0693) | -1.078*** (0.0692) | -1.078*** (0.0692) | -1.072*** (0.0674) | -1.076*** (0.0691) |
| Mean Competitor RevPAR | 0.00695*** (0.000298) | 0.00695*** (0.000298) | 0.00695*** (0.000298) | 0.00695*** (0.000298) | 0.00690*** (0.000296) | 0.00685*** (0.000294) |
| Lagged Log(Revpar) | -0.0859*** (0.00184) | -0.0851*** (0.00182) | -0.0860*** (0.00184) | -0.0859*** (0.00184) | -0.0994*** (0.00211) | -0.0843*** (0.00184) |
| 1 AAA Star | -0.00560 (0.00331) | -0.00597 (0.00331) | -0.00569 (0.00331) | -0.00558 (0.00331) | -0.0131*** (0.00341) | -0.00494 (0.00331) |
| 2 AAA Star | 0.0207*** (0.00166) | 0.0213*** (0.00166) | 0.0207*** (0.00166) | 0.0207*** (0.00166) | 0.0194*** (0.00175) | 0.0204*** (0.00165) |
| 3 AAA Star | 0.0605*** (0.00190) | 0.0612*** (0.00190) | 0.0605*** (0.00190) | 0.0605*** (0.00190) | 0.0409*** (0.00192) | 0.0613*** (0.00189) |
| 4 AAA Star | 0.103*** (0.00380) | 0.109*** (0.00377) | 0.102*** (0.00379) | 0.103*** (0.00380) | 0.0913*** (0.00419) | 0.106*** (0.00376) |
| 5 AAA Star | 0.157*** (0.00988) | 0.162*** (0.00980) | 0.156*** (0.00993) | 0.158*** (0.00989) | 0.154*** (0.0138) | 0.157*** (0.00989) |
| TripAdvisor Rating | 0.0150*** (0.00245) | 0.0151*** (0.00245) | 0.0150*** (0.00245) | 0.0150*** (0.00245) | 0.0147*** (0.00244) | 0.0147*** (0.00245) |
| Priceline Rating | 0.00635*** (0.00165) | 0.00621*** (0.00165) | 0.00627*** (0.00165) | 0.00634*** (0.00165) | 0.00618*** (0.00164) | 0.00635*** (0.00165) |
| Mean of Last 5 on TA | -0.00720*** (0.00188) | -0.00729*** (0.00188) | -0.00717*** (0.00188) | -0.00717*** (0.00188) | -0.00722*** (0.00188) | -0.00694*** (0.00188) |
| Mean of Last 5 on PL | -0.00483** (0.00147) | -0.00471** (0.00147) | -0.00479** (0.00147) | -0.00482** (0.00147) | -0.00480** (0.00147) | -0.00479** (0.00147) |
| TripAdvisor Std Dev. | 0.00136 (0.00422) | 0.00105 (0.00422) | 0.00145 (0.00422) | 0.00137 (0.00422) | 0.00176 (0.00420) | 0.000998 (0.00419) |
| Priceline Std Dev. | 0.00695** (0.00227) | 0.00689** (0.00227) | 0.00690** (0.00227) | 0.00693** (0.00227) | 0.00667** (0.00226) | 0.00675** (0.00226) |
| Mean of Previous Month Ratings | -0.00188** (0.000723) | -0.00188** (0.000723) | -0.00188** (0.000723) | -0.00189** (0.000723) | -0.00193** (0.000721) | -0.00181* (0.000719) |
| Month FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Property FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Franchisee FE | Yes | Yes | Yes | Yes | Yes | Yes |
| Month X Market Type | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 241418 | 241418 | 241418 | 241418 | 241418 | 241418 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents a set of robustness tests for the main parameter of interest, the marginal effect of lagged # of reviews on independent versus chain hotels. In every case the dependent variable is Log(RevPar). Column (1) contains the primary specification as a benchmark. Column (2) uses only the number of Priceline reviews. Column (3) uses only the number of TripAdvisor reviews. Column (4) includes the total number of reviews of competing hotels in the same market where market is defined as city. Column (5) includes the total number of reviews of hotels in the same chain or chain as the hotel of interest. Column (6) includes as a control mean RevPar of hotels in the same chain or chain as the hotel of interest.

Table 2: Serial Correlation Tests

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|--------------------------------------|------|------|------|------|------|------|------|
| Chain | x | x | x | x | x | x | x |
| # Competitors | x | x | x | x | x | x | x |
| Age | x | x | x | x | x | x | x |
| Log(Capacity) | x | x | x | x | x | x | x |
| Mean Competitor RevPAR | | | x | x | x | x | x |
| Month Dummies | | x | | x | x | x | x |
| Month Dummies X Market Type | | | | x | x | x | x |
| TripAdvisor/Priceline Average Rating | | | | | x | x | x |
| Short Term Ratings | | | | | | x | x |
| Mean Chain Partner RevPar | | | | | | x | x |
| Lagged Log(RevPar) | | | | | | | x |
| F-Stat | 5.69 | 3.90 | 2.32 | 2.17 | 1.94 | 1.76 | 1.76 |
| p-value | .017 | .048 | .127 | .140 | .163 | .185 | .185 |

Note: This table presents the results of the test for serial correlation from Wooldridge (2002). The p-value shown corresponds to the probability of falsely rejecting the null hypothesis of no serial correlation.

Table 3: Instrumental Variables Tests

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|--------------------------------------|------------------------|-----------------------|------------------------|------------------------|------------------------|------------------------|------------------------|
| Lagged # Reviews | -0.000080 (0.0001) | | | -0.00072* (0.0003) | 0.000091 (0.0003) | 0.0012*** (0.0002) | -0.0015** (0.0005) |
| Lagged # Reviews X Independent | 0.0012*** (0.0003) | | | 0.0033*** (0.0008) | 0.0029*** (0.0004) | 0.0026*** (0.0003) | 0.00067 (0.0013) |
| Lagged TA # Reviews | | 0.00030 (0.0012) | | | | | |
| Lagged TA # Reviews X Independent | | 0.022* (0.0110) | | | | | |
| Lagged TA # Characters | | | -0.0000098 (0.0000) | | | | |
| Lagged TA # Characters X Independent | | | 0.00011* (0.0000) | | | | |
| Chain Affiliated | 0.069 (0.0564) | 0.31* (0.1329) | 0.79* (0.3666) | 0.032 (0.0303) | 0.036 (0.0313) | 0.036 (0.0313) | 0.037 (0.0313) |
| Independent Competitors | 0.0010* (0.0004) | 0.0020* (0.0008) | 0.0067* (0.0027) | 0.0016*** (0.0003) | 0.0015*** (0.0003) | 0.0014*** (0.0003) | 0.0015*** (0.0003) |
| Chain Competitors | -0.00059 (0.0003) | 0.0011*** (0.0003) | 0.0010 (0.0006) | -0.00036 (0.0002) | -0.00040 (0.0002) | -0.00033 (0.0002) | -0.00045 (0.0002) |
| Age | -0.0065 (0.0035) | -0.044*** (0.0027) | -0.050*** (0.0070) | -0.0041 (0.0057) | -0.0020 (0.0058) | -0.0019 (0.0058) | -0.0038 (0.0055) |
| log(Capacity) | -1.07*** (0.0675) | -0.37*** (0.0518) | -0.53*** (0.1453) | -1.05*** (0.0403) | -1.03*** (0.0403) | -1.03*** (0.0404) | -1.03*** (0.0403) |
| Mean of Competitor RevPar | 0.0069*** (0.0003) | 0.0062*** (0.0001) | 0.0075*** (0.0003) | 0.0066*** (0.0002) | 0.0066*** (0.0002) | 0.0066*** (0.0002) | 0.0066*** (0.0002) |
| 1 AAA Star | -0.0074* (0.0033) | 0.73*** (0.1171) | 0.29 (0.3388) | -0.0016 (0.0017) | -0.0021 (0.0017) | -0.0016 (0.0017) | -0.0020 (0.0017) |
| 2 AAA Star | 0.018*** (0.0017) | 0.71*** (0.0806) | 0.48* (0.2233) | 0.024*** (0.0012) | 0.023*** (0.0012) | 0.024*** (0.0012) | 0.024*** (0.0012) |
| 3 AAA Star | 0.049*** (0.0019) | 0.64*** (0.0806) | 0.39 (0.2267) | 0.048*** (0.0013) | 0.047*** (0.0014) | 0.047*** (0.0014) | 0.047*** (0.0014) |
| 4 AAA Star | 0.085*** (0.0038) | 0.51 (0.3296) | 0.21 (0.8912) | 0.078*** (0.0033) | 0.072*** (0.0033) | 0.071*** (0.0033) | 0.081*** (0.0038) |
| 5 AAA Star | 0.13*** (0.0099) | 0 (.) | 0 (.) | 0.13*** (0.0089) | 0.12*** (0.0091) | 0.12*** (0.0092) | 0.13*** (0.0092) |
| TripAdvisor Rating | 0.013*** (0.0024) | -0.0034 (0.0058) | 0.0057 (0.0156) | 0.010*** (0.0024) | 0.011*** (0.0025) | 0.011*** (0.0025) | 0.011*** (0.0025) |
| Priceline Rating | 0.0063*** (0.0014) | 0.0090 (0.0053) | 0.036* (0.0163) | 0.0061*** (0.0013) | 0.0059*** (0.0013) | 0.0061*** (0.0013) | 0.0058*** (0.0013) |
| Mean of Last 5 on TA | -0.0069*** (0.0019) | 0.012*** (0.0025) | 0.015* (0.0064) | -0.0074*** (0.0019) | -0.0075*** (0.0019) | -0.0077*** (0.0019) | -0.0077*** (0.0019) |
| Mean of Last 5 on PL | -0.0048*** (0.0012) | -0.0042 (0.0032) | -0.020* (0.0099) | -0.0045*** (0.0012) | -0.0045*** (0.0012) | -0.0046*** (0.0012) | -0.0044*** (0.0012) |
| TripAdvisor Std Dev. | 0.0036 (0.0042) | 0.033*** (0.0053) | 0.041** (0.0142) | 0.0018 (0.0043) | 0.0013 (0.0044) | 0.0026 (0.0044) | 0.000016 (0.0044) |
| Priceline Std Dev. | 0.0036** (0.0014) | 0.0093*** (0.0013) | 0.0038 (0.0041) | 0.0038** (0.0013) | 0.0037** (0.0013) | 0.0032* (0.0013) | 0.0037** (0.0013) |
| Mean of Previous Month Ratings | -0.0017* (0.0007) | -0.0011 (0.0011) | -0.0022 (0.0029) | -0.0015* (0.0007) | -0.0015* (0.0007) | -0.0015* (0.0007) | -0.0015* (0.0007) |
| Lagged Log(RevPar) | -0.095*** (0.0020) | 0.51*** (0.0038) | 0.50*** (0.0087) | -0.080*** (0.0012) | -0.080*** (0.0012) | -0.080*** (0.0012) | -0.079*** (0.0012) |
| Topic 1 Proportion (Room) | 0.33*** (0.0645) | -0.074 (0.0505) | -0.32* (0.1581) | 0.030*** (0.0037) | 0.031*** (0.0037) | 0.031*** (0.0038) | 0.030*** (0.0038) |
| Topic 2 Proportion (Service) | 0.27*** (0.0645) | -0.029 (0.0161) | -0.078 (0.0451) | -0.0099*** (0.0027) | -0.010*** (0.0028) | -0.0095*** (0.0028) | -0.0098*** (0.0028) |
| Topic 3 Proportion (General) | 0.32*** (0.0653) | 0.070* (0.0297) | 0.16 (0.0854) | 0.020*** (0.0031) | 0.020*** (0.0031) | 0.021*** (0.0031) | 0.019*** (0.0031) |
| Topic 4 Proportion (Location) | 0.34*** (0.0647) | -0.20** (0.0788) | -0.55* (0.2314) | 0.049*** (0.0088) | 0.051*** (0.0089) | 0.049*** (0.0090) | 0.054*** (0.0090) |
| Topic 5 Proportion (Brand) | 0.37*** (0.0646) | -0.47** (0.1560) | -1.35** (0.5225) | 0.072*** (0.0092) | 0.072*** (0.0092) | 0.069*** (0.0093) | 0.081*** (0.0095) |
| Topic 6 Proportion (Spanish) | 0.35*** (0.0654) | -0.014 (0.0902) | -0.44 (0.2742) | 0.063*** (0.0096) | 0.064*** (0.0096) | 0.064*** (0.0096) | 0.063*** (0.0096) |
| Topic 1 High Rating Share (Room) | 0.015*** (0.0018) | 0.024*** (0.0070) | 0.047* (0.0197) | 0.013*** (0.0018) | 0.013*** (0.0018) | 0.013*** (0.0018) | 0.013*** (0.0018) |
| Topic 2 High Rating Share (Service) | 0.0043 (0.0022) | 0.036* (0.0177) | 0.12* (0.0561) | 0.0054* (0.0022) | 0.0050* (0.0023) | 0.0050* (0.0023) | 0.0050* (0.0023) |

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Table 3 – continued from previous page

| | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|--------------------------------------|----------------------|----------------------|---------------------|----------------------|----------------------|----------------------|----------------------|
| Topic 3 High Rating Share (General) | 0.0067** (0.0024) | 0.0089 (0.0114) | -0.039 (0.0359) | 0.0043 (0.0024) | 0.0041 (0.0024) | 0.0032 (0.0024) | 0.0058* (0.0025) |
| Topic 4 High Rating Share (Location) | 0.019*** (0.0030) | 0.062* (0.0262) | 0.19* (0.0831) | 0.013*** (0.0030) | 0.011*** (0.0030) | 0.0072* (0.0030) | 0.017*** (0.0033) |
| Topic 5 High Rating Share (Brand) | 0.020*** (0.0031) | 0.049 (0.0289) | 0.19* (0.0900) | 0.016*** (0.0032) | 0.014*** (0.0032) | 0.011*** (0.0032) | 0.020*** (0.0035) |
| Topic 6 High Rating Share (Spanish) | 0.015*** (0.0029) | 0.030* (0.0137) | 0.10* (0.0460) | 0.011*** (0.0029) | 0.0096** (0.0030) | 0.0070* (0.0030) | 0.014*** (0.0031) |
| Under Renovation | -0.0016 (0.0101) | -0.12*** (0.0327) | -0.27** (0.1003) | -0.0075 (0.0100) | -0.013 (0.0101) | -0.021* (0.0103) | 0.0013 (0.0106) |
| Recently Renovated | -0.0010 (0.0049) | -0.064** (0.0227) | -0.17* (0.0670) | -0.00089 (0.0050) | -0.0029 (0.0051) | -0.0060 (0.0052) | 0.0022 (0.0052) |
| Property FE | Y | Y | Y | Y | Y | Y | Y |
| Owner FE | Y | Y | Y | Y | Y | Y | Y |
| Year FE | Y | Y | Y | Y | Y | Y | Y |
| Month FE | Y | Y | Y | Y | Y | Y | Y |
| Observations | 241418 | 137722 | 137722 | 241418 | 241418 | 241418 | 241418 |
| R^2 | 0.268 | 0.807 | 0.807 | 0.268 | 0.268 | 0.268 | 0.268 |
| First stage F-Stat | | 12.54 | 11.71 | 177.02 | 165.43 | 166.47 | 116.92 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents a set of robustness tests for the main parameter of interest, the marginal effect of lagged # of reviews on independent versus branded hotels. In every case the dependent variable is $\text{Log}(\text{RevPar})$. Column (1) contains the primary specification as a benchmark. Columns (2-3) use minimum review length policy changes for both number of reviews and number of characters. This column excludes observations before 2008 and after 2013. Column (4-6) uses the 6, 9, and 12 month lagged number of reviews as instruments. Column (7) uses the number of reviews posted between 6 and 12 months earlier.

2 Robustness checks for Section 4

This section presents robustness checks for the results in section 4. This section measures the aggregate effect on the value of branding over the years 2000-2015 and how this varies over firm and market type.

To test this, I calculate the aggregate revenue premium earned by chain firms compared to equivalent independent firms and track its value over time. Specifically, the model for RevPar that I consider is:

$$\text{Log}(\text{RevPar}_{imt}) = x_{imt}\beta_1 + c_{it}\delta^c + \text{market}_m + \text{time}_t + \text{owner}_j + \text{hotel}_i + \epsilon_{imt}, \quad (2)$$

where x_{imt} denotes firm characteristics and includes the number and type of competitors in each market, age, capacity, average star rating on TripAdvisor and Priceline, standard deviation of each set of ratings, and the average RevPAR of the firms in the same market as a control for market level demand, c_{it} indicates whether a firm is a member of a chain in period t , and market , time , owner_j , and hotel_i are fixed effects. The ultimate object of interest is δ^c , which is the remaining effect on revenue of chain affiliation after controlling for firm and market characteristics.

Equation 2 measures the aggregate revenue premium earned by chain firms, and relies on hotels that add or drop affiliation with national chains during the sample period. One concern is that observing revenues before and after a hotel joins or leaves a chain may not be valid because hotels that leave chains may be underperforming in terms of revenue and that those that join chains may be overperforming (in the opposite case, that chain leavers are overperformers, the arguments presented here are equally valid.)

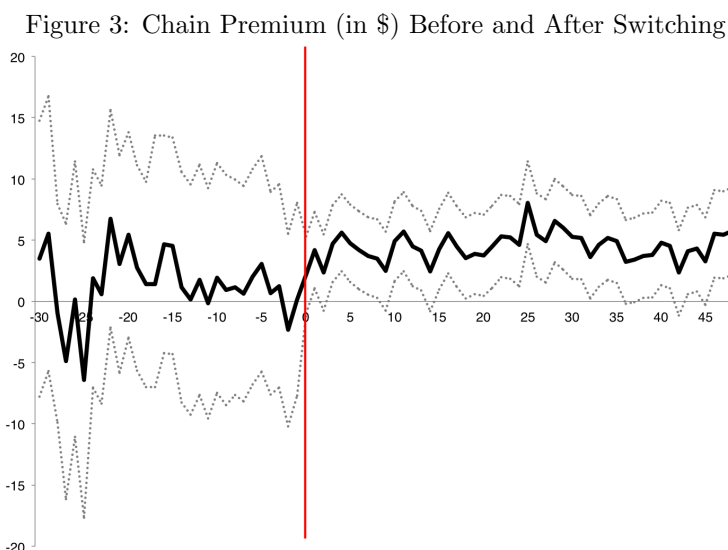
First, the nature of these switches is that they take place within already well-defined quality categories. In no cases does a firm that adds or drops chain affiliation see their AAA star rating change subsequently. These ratings correspond to basic physical amenities and offerings, such as breakfast being offered, presence of a pool, fitness center or conference facilities, as well as room layout and quality of construction. These elements are difficult and time-consuming to change and are not changing at the time of these switches, as evidenced by the lack of AAA rating changes in the data.

Second, more modest changes in quality that may precede or follow the addition or subtraction of chain affiliation are already controlled for using the TripAdvisor ratings, Priceline ratings, and the short term measures of each (the average of the 5 most recent ratings from both sites as well as the average of all ratings in the previous month.) If there are short term changes in things like service quality, on average these should capture that.

Third, while the estimates of the chain premium use the full data, measuring the full effect of the switch over many years while including property fixed effects, a more extreme version of the fixed effects argument can be used to insure this is not about reverse causality. In Table 4 below, I test for changes in revenue looking only at the quarter before and quarter after each switch occurred. This should, as much as possible, isolate the effects of the chain switch and remove longer term effects of changes in managerial quality or other factors. Column 2 compares the chain premium estimated using this very short time window to the

estimates from the paper that use the full dataset and the results are not significantly different. While the data is too sparse to use this short-term window approach to measure the changes over time in the chain premium for different chain qualities, it is a useful robustness check to the methodology.

Fourth, an additional robustness check for concerns about reverse causation is to include leads or lags of the switch. If it is the case that national chains are dropping the underperforming hotels, and that the chain premium merely reflects this, than a one year lead of the switch should capture the difference in revenue and the variable measuring the actual switch should not be significant. Column 3 shows the results of this test. The one year lead is positive and significant, but the estimated chain premium falls only from 24.8% to 21.5%. A more comprehensive version of this exercise includes the full set of leads and lags and plots them. See Figure 3 below for the results of this test, which shows that the chain premium appears essentially immediately and in full at the time of the switch. If reverse causality in revenue drove the switch the effect would disappear under this specification or appear as a trend.



Note: This figure shows detailed revenue estimates for firms that switch chain affiliation during the sample period. Dummies for the number of months before and after the switch occurred are included in revenue regressions and the coefficients on those are plotted. Month 0 corresponds to the first full month after adding affiliation. Dashed lines represent a 95% confidence interval.

Fifth, I find that 4.8% of hotels have a change in the number of rooms available or the owner/manager within one year of the switch taking place. These might pose the concern that major renovations are taking place roughly concurrent with the switch. In columns 5 and 7 of Table 4, I include only at the subsamples with and without these changes taking place. The results are very similar to the sample of switching hotels that maintain their current owner/manager and number of rooms.

Altogether, these tests strongly suggest reverse causality is not driving the results on the chain premium, and that the chain premium measured in the revenue data and the steep fall over time in this premium for certain chain types are well measured.

Table 4: Chain Premium Robustness Tests

| | (1) Full Sample | (2) 1 Qtr Window | (3) With Lead | (4) No Room Change | (5) Room Change | (6) Franchisee Change | (7) Same Franchisee |
|--------------------------|---------------------------|------------------------|----------------------------|----------------------------|---------------------------|---------------------------|----------------------------|
| Chain Affiliated | 0.243*** (0.0311) | 0.173*** (0.0465) | 0.215*** (0.0302) | 0.247*** (0.0303) | 0.256*** (0.0447) | 0.227*** (0.0324) | 0.251*** (0.0325) |
| 1 Year Lead Chain Switch | | | 0.0732*** (0.0222) | | | | |
| Independent Competitors | 0.000249 (0.000513) | 0.00143 (0.00635) | -0.000971*** (0.000225) | -0.000671 (0.000604) | 0.00165* (0.000651) | 0.00161** (0.000598) | -0.000569 (0.000590) |
| Chain Competitors | -0.00118*** (0.000291) | -0.365 (0.266) | -0.275*** (0.0555) | -0.00110*** (0.000283) | -0.00278*** (0.000672) | -0.00238*** (0.000573) | -0.00105*** (0.000278) |
| Age | 0.0452 (0.0361) | 0.0365 (0.0371) | 0.0613 (0.0569) | 0.0237 (0.0167) | 0.00686 (0.00692) | 0.00860 (0.00630) | 0.0234 (0.0180) |
| Log(Capacity) | -0.793*** (0.0593) | -0.698** (0.241) | -0.820*** (0.0581) | -0.853*** (0.0588) | -0.759*** (0.0713) | -0.757*** (0.0659) | -0.857*** (0.0588) |
| Mean Competitor RevPAR | 0.0109*** (0.000898) | 0.0157*** (0.00280) | 0.0114*** (0.00114) | 0.0108*** (0.000958) | 0.00922*** (0.00101) | 0.00999*** (0.000810) | 0.0108*** (0.000986) |
| TripAdvisor Rating | 0.0133** (0.00500) | 0.0314 (0.124) | 0.0236*** (0.00560) | 0.00373 (0.00475) | 0.00143 (0.0156) | 0.00125 (0.0141) | 0.00413 (0.00469) |
| Priceline Rating | -0.00103 (0.00357) | 0.0941 (0.126) | -0.000397 (0.00495) | -0.00174 (0.00326) | -0.0110 (0.0115) | -0.00978 (0.0109) | -0.00221 (0.00321) |
| Mean - Last 5 on TA | 0.00521 (0.00408) | 0.0911 (0.117) | -0.00572 (0.00484) | 0.00626 (0.00378) | 0.00229 (0.0165) | 0.0363* (0.0146) | 0.00412 (0.00372) |
| Mean - Last 5 on PL | 0.00532 (0.00328) | -0.103 (0.120) | 0.00311 (0.00471) | 0.00253 (0.00297) | 0.0167 (0.0112) | 0.0175 (0.0106) | 0.00296 (0.00291) |
| Previous Month Rating | -0.00162 (0.00175) | -0.0494 (0.0342) | -0.00340 (0.00178) | -0.000492 (0.00163) | -0.00592 (0.00846) | -0.00522 (0.00653) | -0.000163 (0.00161) |
| Lagged # Reviews | | 0.00120 (0.00163) | | 0.000192*** (0.0000316) | 0.0000821 (0.0000472) | 0.0000812 (0.0000438) | 0.000193*** (0.0000316) |
| Month FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Year FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Property FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Franchisee FE | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Month X Market Type | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 723,805 | 1,319 | 598,473 | 596,579 | 61,348 | 94,562 | 563,365 |

Standard errors in parentheses

* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Note: This table presents a set of robustness tests on the measurement of the chain premium. In each case the dependent variable is Log(RevPar). Column (1) shows results from the full sample. Column (2) excludes all data not from firms that add/drop chain affiliation as well as all time periods outside the quarter before and quarter after the switch occurs. It also excludes the quarter during which the switch occurs. Column (3) includes a variable that is a one year lead of chain affiliation status. Column (4) excludes firms that have a change in number of rooms available within one year of adding/dropping chain affiliation. Column (5) only includes firms that change room number within one year of adding/dropping chain affiliation. Column (6) excludes firms that have a change in franchisee (as noted by their tax ID) within one year of adding/dropping chain affiliation. Column (7) only includes firms that have a change in franchisee (as noted by their tax ID) within one year of adding/dropping chain affiliation. AAA ratings are generally excluded because no AAA ratings change within one year before or after the year a switch occurs.

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