

Relationships Among Minimum Requirements, Facebook Likes, and Groupon Deal Outcomes

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Daily deal coupons have gained a prominent foothold on the web. The earliest and largest player is Groupon. Originally, Groupon deals were a mix of deals with a minimum requirement (*MR*) of coupon sales before a deal became effective and of deals without a minimum requirement (*NMR*). Eventually, Groupon stopped using *MR* deals. For Groupon and its retailer customers, might this decision have actually resulted in negative impacts for both parties (fewer coupons sold and lower revenue)? The structure of Groupon deals (including a “Facebook like” option) together with electronic access to the necessary data offered the opportunity to empirically investigate these questions. We analyzed relationships among *MR*, Facebook likes (*FL*), quantity of coupons sold, and total revenue, performing the analysis across the four largest retail categories. Using timestamped empirical data, we completed a propensity score analysis of causal effects. We find that the presence of *MR* increases Facebook likes, quantity of coupons sold, and total revenue at the time point when the *MR* is met and at subsequent 2-hour intervals over the horizon of deals. A key finding is that the initial differences observed when *MR* is met not only continue but also actually increase over the life of the deals.

CCS Concepts: • **Information systems** ~ **Social advertising** • *Information systems* ~ *Online shopping*

Additional Key Words and Phrases: Social media, propensity score analysis (*PSA*), e-WOM, daily deal sites, Groupon

ACM Reference Format:

Xue Bai, James R. Marsden, William T. Ross Jr., Gang Wang. 2015. Relationships among minimum requirements, Facebook likes, and Groupon deal outcomes. *ACM Trans. Manag. Inform. Syst.* 6, 3, Article 9 (September 2015), 28 pages.

DOI: <http://dx.doi.org/10.1145/2764919>.

1. INTRODUCTION

Given the interest in social media sites, it is not surprising that marketers have sought to develop and implement innovative strategies using such sites. Numerous retailers have launched promotions on their Facebook pages, promotions which are claimed to have increased sales significantly [SimplyZesty 2011]. Such “social commerce” has also been prominent on daily deal sites such as Groupon, leading some to refer to daily deal sites as “social couponing websites.” Yet to date, we know of no nonanecdotal, empirical

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DOI: <http://dx.doi.org/10.1145/2764919>.

investigation of the relationships among deal characteristics, usage of social media links, and deal outcomes.

Consider Groupon, the acknowledged daily deal industry leader. As many retailers do, Groupon prominently displays a clickable “Like” icon to link to a consumer’s Facebook postings. Once a consumer clicks the icon on a Groupon deal’s webpage, information about the deal, including the title, a picture, and a link to the deal, is shared with all of the individual’s Facebook friends, which may number in the thousands. This Facebook like (hereafter *FL*) spreading of a deal can positively impact the number of coupons sold for the deal and thus increase total deal revenue. In addition, some Groupon deals have included a minimum coupon sales requirement, a specified number of coupons that must be sold before any coupon is authorized for use. If the minimum requirement (hereafter *MR*) is 50 for a given deal, that deal would not become valid until 50 coupons have been sold. If the deal period ends before 50 coupons are sold, no one can take advantage of the deal (the deal becomes null and void). In legal terminology, an *MR* deal is a “contingent offer” that takes effect when and if at least a certain number of coupons are sold within a specified period.

Until an *MR* deal is confirmed (meets the required number of sales), customers have two incentives to hit the “Like” icon and share that deal with their Facebook friends. The first is what we term a social sharing incentive (hereafter *SI*), and the second is a personal incentive (hereafter *PI*) linked to helping ensure that the *MR* is met and the deal confirmed. Once the *MR* is met and the deal confirmed, customers still have the *SI*, but no longer the *PI*. Moreover, for Groupon deals that do not include an *MR* (“no *MR*” or *NMR* deals), customers have the *SI* but not the *PI*.

What is the effect of the *MR* and the associated *PI* to share the deal on deal performance (quantity of coupons sold and revenue from coupon selling)? If the *MR* only makes deals get confirmed more rapidly, then the true impact may be negligible. Over 99% of deals meet their *MR*, on average, in roughly 8 hours. However, if the *MR* results in a significant increase in sales and revenues across the whole promotion period, then *MR* matters. Practically, this issue has a particular poignancy. Groupon has stopped using *MR* in their deals. From the perspective of generating revenue from the promotion, Groupon and the retailers have apparently overlooked the positive effect of having an *MR*. Our analysis suggests that returning to using an *MR* could significantly increase the quantity of coupons sold and deal revenues from coupons sold.

To investigate possible causal impacts of the *MR* on *FL*, quantity of coupons sold, and total revenue, we use a propensity score analysis (hereafter *PSA*) [Mithas and Krishnan 2009] utilizing deal data we collected for three major cities, Chicago, Boston, and New York, running across Groupon’s four largest retail categories, enabling analysis of possible categorically differential relationships. Our analysis includes comparisons at 2-hour intervals from the time when *MRs* are met until the end of a deal. The time dimensionality of our investigation sets it apart from previous *PSA*. To the best of our knowledge, our research is the first to study the causal impact of the *MR* feature on consumer responses on Groupon using longitudinal data. We find that the presence of an *MR* results in increased *FL*, greater quantity of coupons sold, and higher total deal revenue both when the *MR* is achieved and every 2 hours subsequently until the end of the deal promotion. More interestingly, we find that the initial differences in *FL*, quantity of coupons sold, and total revenue caused by the *MR* do not just maintain after the *MR* is met, but actually increase over subsequent time intervals until the end of a deal. Additionally, the longer it takes for the *MR* to be met, the longer the *PI* exists, leading to a greater impact of *PI*, which in turn results in greater differences in *FL*, quantity of coupons sold, and total revenue. As explained later, our results have important managerial implications for retailers and Groupon.

The remainder of this article is organized as follows. Section 2 briefly summarizes related work to date, differentiates our analysis from previous work, and sets forth the scope of this research. Section 3 provides essential details on Groupon and our data collection process. Section 4 provides an initial data summary and a PSA to assess causal effects. Section 5 offers concluding remarks and next steps in our continuing analysis of the daily deal industry.

2. LITERATURE REVIEW

2.1. Electronic Word of Mouth

On Groupon, a consumer can share the information about a deal with his or her Facebook friends by clicking the *FL* icon, providing electronic word of mouth (hereafter e-WOM) on that specific deal. Given the large body of literature on e-WOM, we limit our review to recent papers about the impact of e-WOM on product sales. Liu [2006] collected e-WOM messages on movies released during May and September in 2002 from Yahoo! Movie, finding, in a cross-sectional study, that most of the explanatory power of e-WOM information came from WOM volume, not its valence. In another analysis of e-WOM on movie box office revenues, Rui et al. [2013] collected data on movies from Twitter. While previous literature measured e-WOM through volume or dispersion, Rui et al. [2013] directly measured the number of recipients of each tweet using the unique social structural information on Twitter. The authors argued that their evidence indicated a causal effect of WOM on product sales. Other researchers have examined the effect of e-WOM on the sales of products such as books [Chevalier and Mayzlin 2006], music [Dhar and Chang 2009], craft beers [Clemons et al. 2006], and digital cameras [Zhang et al. 2013]. Through an experimental study, Benlian et al. [2012] examined the direct and positive influence of e-WOM on four consumer beliefs (perceived usefulness, perceived ease of use, perceived affective quality, and trust), which can further increase sales for e-retailers. To date, research in this stream has focused on attempting to identify the influence of social media on product sales in a single retail category, with no analysis across categories.

2.2. Social Promotion

Our work is also related to the growing literature on social promotion. With the development of IT facilitation of online collaboration through social media, such as Facebook, YouTube, and blogs, consumers now have the ability to spread ideas and recommendations more quickly, widely, and cheaply than ever before [Ferguson 2008]. Byers et al. [2012] empirically analyzed e-WOM (in this case, social sharing through Facebook) in the daily deal Groupon setting. They found that daily deal sites benefit from word-of-mouth effects during sales events, but did not examine underlying deal characteristics or differences across retail categories. Grounded in observational learning theory, Luo et al. [2014] empirically examined the influence of deal popularity on a consumer's deal purchase and redemption time decisions. Using consumer-level data, the authors found that deal popularity increased consumers' purchase likelihood and decreased redemption time. Li and Wu [2014] utilized aggregate-level data from Groupon and found a positive influence of observational learning and social media word of mouth on the quantity of coupons sold.

2.3. Summary

Our analysis differs from previous research in at least three key respects. First, we present a set of structured hypotheses concerning the relationships among deal characteristics, usage of social media links, and deal outcomes. Utilizing PSA that enables the investigation of causal relationships, each hypothesis is empirically tested

using timestamped data we gathered electronically. Second, the empirical analysis and hypothesis testing are conducted for separate retail categories. Third, using timestamped data, we completed our analysis at specified time points until the deals ended.

3. INTRODUCTION TO GROUPON AND DATA COLLECTION

3.1. Introduction to Groupon

Groupon was an early entrant into and is the current leader of the daily deal industry [Yipit Report 2011]. Groupon began selling daily deal coupons for local retailers in Chicago in November 2008 and has continued to expand, now offering daily deals in 175+ geographic markets spanning North America. Every day in each geographic market, Groupon provides multiple deals from multiple retailers dedicated to that geographic market. Individual deals can also specify an *MR* that must be reached for the deal to be valid, a unique characteristic of Groupon deals. Each Groupon deal page includes an *FL* icon through which consumers can share the deal information (including title, picture, and link to the deal) with all their Facebook friends.

Groupon's revenues come from its share (approximately half) of the coupon price [The Washington Times, July 2009].¹ There are at least two reasons for local retailers to share so much of the coupon price with Groupon. First, Groupon promotions provide opportunities for price discrimination, a new marketing tool for exposure to new customers, and a potential "advertising" effect [Edelman et al. 2014]. Second, compared with traditional TV advertising and Yellow Page advertising, Groupon promotions offer retailers a direct and immediate influx of customers [Dholakia 2011].

3.2. Data Collection

We collected longitudinal data from Groupon through its public API² for three major cities (Chicago, Boston, and New York) from September 13, 2011, until July 31, 2012.³ We monitored all deals in the three cities during the data collection period. However, to be sure that we captured the entire sales and revenue stream from the deals we studied, we focused on local deals. We operationally defined local deals as coupon offers with two key characteristics: (1) the offer is only provided to a specific region or market, and (2) the coupon can only be redeemed at the seller's physical store (no online redemption). In making this choice, we ignored two other sets of Groupon deals: (1) "getaway deals" involving coupons for discounts on flights, hotel rooms, and/or cruise packages, deals provided by a nationwide partnering of Groupon and Expedia; and (2) "online deals" involving coupons that can only be redeemed online, deals that are likely nationwide rather than local. Both excluded deal types that likely had sales beyond those in the three cities.

Each deal has a set of characteristics including deal description, original or retail price, discount rate, discounted price (i.e., coupon price), the length of promotion on Groupon (promotion length), whether the deal is featured (featured), coupon duration, whether there is an *MR*, and whether the deal has a limited number of coupons for sale (limited supply). Each deal is associated with a retail category, such as "Arts & Entertainment" or "Beauty & Spas."

¹According to various ad hoc discussions, including one with a Boston-based merchant who had used Groupon, the actual percentage of coupon revenue that Groupon shares is negotiable. Because the actual percentage of the share varies, we analyze total revenue. Thus, the size of the split is not relevant to our analysis.

²An application programming interface (API) is a source-code-based specification intended to be used as an interface by software components to communicate with each other.

³From December 23, 2011, to January 9, 2012, coupon sold information is not available, because Groupon changed its deal display policy. From February 17, 2012, to April 12, 2012, *FLs* are not available in our dataset, again because of a shift in API policy. We excluded deals in those date ranges and obtained data covering approximately 10 months.

The data collection period was a transition time in which Groupon moved from all *MR* deals to all *NMR* deals, with the middle months having both *MR* and *NMR* deals.⁴ Our focus in this article is on the deal decision (whether or not to have *MR*) itself, not the characteristics of the retailer making the deal with Groupon. We do consider the retailer's business category, which we discuss later. Our analyses used the six deal decision characteristics that are objective and available: coupon price, discount rate, promotion length, featured, coupon duration, and limited supply. Thus, we assume that *MR* and *NMR* deals do not differ across other retailer characteristics, an assumption we test in our robustness checks. We had two other observable deal characteristics: (1) the city where the deal was offered and (2) the day of the week the deals were offered. However, analyses including them indicated no significant difference in results, and thus, for simplicity, these variables were dropped.

During a deal's promotion period, Groupon displayed the amount of coupons that had been sold up to any given moment in time. With coupon price and the amount of coupon sales, we also obtained total deal revenue at each time point. Groupon also showed the number of users who had clicked the *FL* button to express their positive feedback at any given point during each deal's life, yielding the number of *FL* for that deal at each time point. We monitored each deal's cumulative sales and *FL* every hour over the duration of the deal, although for brevity and clarity, all of our reporting in this manuscript is done for 2-hour periods.

We focused on four major categories for our analysis: "Arts & Entertainment" (A&E), "Beauty & Spas" (B&S), "Health & Fitness" (H&F), and "Restaurant" (REST). These categories were chosen because they accounted for (1) roughly 80% of total local deals, each with a minimum of 10%, and (2) about 75% of total Groupon revenue from local deals. Over the data collection period, 79.1% of all local deals were from these four categories. During our entire data collection period, only 0.021 (23 out of 1,082) of *MR* deals in the four categories failed to meet the *MR*. In the results presented later, we excluded failed deals. For completeness, we redid the analysis with all such deals included and report the results in Appendix D. In all but one statistically insignificant instance, in the A&E category, results are consistent with those where failed *MR* deals are not included.

4. ANALYSIS

4.1. Minimum Requirement Versus No Minimum Requirement Deals

We suggest that there are two incentives for consumers desiring an *MR* deal. First, there is the *SI* (social incentive) of wanting their friends to have the opportunity to get a good deal. But second, until the *MR* is satisfied, consumers wanting to take advantage of the Groupon deal also have a *PI* (personal incentive) to trigger the contingency (i.e., get enough people to buy so that the *MR* is met). *NMR* deals also have the *SI* but not the *PI*. We examine *SI* and *PI* in turn.

We are not the first to suggest a social incentive for sharing. Snyder and Omoto [2000] and Peddibhotla and Subramani [2007] divide a person's incentives to share into "other-focused" incentives (including what they label as social affiliation, altruism, and reciprocity) and "self-focused" incentives (including what they label as self-expression, personal development, and enjoyment). We included both categories in *SI*, because both are associated with the pleasure received from sharing with a friend.

In discussing self-interest, altruism, and incentives, Jensen [1994] (also see Jensen and Meckling [1994]) put it another way:

⁴Groupon appeared to completely abandon *MR* after January 2013. We contacted Groupon about the stop of usage of *MR*. They responded that most of the deals had no problem meeting the *MR* since Groupon had grown its consumer base very fast. It seems Groupon did not need to have the *MR*.

“It is inconceivable that purposeful action on the part of human beings can be viewed as anything other than responses to incentives. Indeed, the issue of incentives goes to the heart of what it means to maximize or optimize, indeed to the very core of what it means to choose. Rational individuals always choose the option that makes them better off as they see it. . . . As Meckling and I make clear in our article, there is nothing inconsistent between self-interested and altruistic behavior. . . . To find extensive evidence of altruism, we need only look to the willingness of people to give to charity, and to help family, neighbors and even strangers.”

Using Jensen’s terminology (and that of economics), we argue that altruism, while it may contain, as Jensen suggests, self-interested motivation based on a positive response to the individual from others who note the altruistic behavior or good feelings from having acted altruistically, exists throughout the deal offer period.

For *MR* deals, what we call the *PI* to share exists until the *MR* is satisfied and the deal is confirmed. *PI* relates to ensuring that the deal “makes” so that the individual is able to benefit from the deal. This additional, and self-interested, motive exists only for *MR* deal offers and only up to the point in time at which the *MR* is met. Thus, we separated our deals into *MR* deals and *NMR* deals and analyzed the time-linked patterns in deal sales and overall outcomes. Our first set of hypotheses (H1, H2, and H3) suggest that, because of the extra incentive (i.e., *PI*), *FL*, quantity of coupon sales, and total revenue will be higher for *MR* deals than for *NMR* deals at the time equivalent to when the *MR* deal is confirmed. However, there would be little value to *MRs* if they only resulted in *MR* deals being confirmed a bit sooner, particularly when the vast majority of *MR* deals are confirmed quickly. We suggest that *MR* deals will have a long-term advantage over *NMR* deals because of a social contagion effect. After the *MR* is met, more *FL* will result in more people being aware of and (likely) positively disposed toward the deal, leading to more sales and revenue. These additional sales also suggest additional people will make their friends aware of and (likely) positively disposed toward the deal, increasing the *FL*, coupon sales, and revenue in the next period. This pattern will continue in future periods until the deal reaches its endpoint, either its sales limit or its time limit. Thus, the “Ha” hypotheses listed later add a “virtuous” cycle of *FL*, coupon sales, and revenue that continue across the entire deal. Thus, all other factors equal the following:

H1: When the *MR* is met, *MR* deals have more *FL* than do *NMR* deals.

H1a: The advantage in *FL* for *MR* deals over *NMR* deals continues over subsequent time intervals.

H2: When the *MR* is met, *MR* deals have more coupons sold than do *NMR* deals.

H2a: The advantage in coupons sold for *MR* deals over *NMR* deals continues over subsequent time intervals.

H3: When the *MR* is met, *MR* deals have greater total revenue than do *NMR* deals.

H3a: The advantage in total revenue for *MR* deals over *NMR* deals continues over subsequent time intervals.

Before we proceed to causal analysis and testing, we first examine the attribute means to see if direct comparisons might suffice.

4.2. Attribute Mean Comparisons for *MR* and *NMR* Deals

We first tested for normality across the characteristics. Normality was rejected for all characteristics for all four retail categories; thus, we used the Wilcoxon nonparametric test for differences. Table I summarizes median values with mean values in parentheses, and median comparisons for *MR* deals versus *NMR* deals on the six deal characteristics for the four retail categories. For example, in the A&E category, the median price of *MR* deals was \$20, significantly lower than the median price, \$25, of *NMR*

Table I. Summary of Wilcoxon Rank Sum Test for Larger Median of Two Groups of Deals (Group Means in Parentheses)

	A&E		B&S		H&F		REST	
	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>
# of deals	216	494	295	413	195	313	353	325
Price (\$)	20 (29.42)	25*** (37.87)	39 (61.14)	45*** (83.87)	45 (127.04)	40 (357.08)	20 (22.19)	20 (23.93)
Discount rate (%)	51 (53.26)	51 (52.97)	56 (60.38)	58 (61.51)	64 (66.27)	67 (67.63)	51 (53.71)	51 (54.30)
Promotion length (days)	3 (3.38)	3*** (3.81)	3 (3.36)	4*** (3.97)	3 (3.48)	4*** (4.05)	3 (3.10)	4*** (3.73)
Featured	0 (0.14)	0 (0.11)	0 (0.10)	0 (0.08)	0** (0.10)	0 (0.05)	0 (0.10)	0 (0.08)
Coupon duration (days)	124*** (131.84)	61 (95.94)	187*** (232.84)	186 (199.69)	186*** (200.15)	185 (179.24)	185*** (169.81)	152 (151.42)
Limited supply	1 (0.78)	1** (0.85)	1 (0.76)	1 (0.80)	1 (0.69)	1*** (0.81)	1*** (0.79)	1 (0.70)

deals. In all tables, significance levels are indicated using asterisks (*), with *** indicating significance greater than .01; ** significance greater than .05; and * significance greater than 0.10. As Table I shows, 14 points of significant difference exist among the 24 possible comparisons (six characteristics by four retail categories), suggesting that these factors differ across categories and deal characteristics.

This led us to seek an appropriate method to perform *MR/NMR* deal comparisons. Recently, Mithas and Krishnan [2009], henceforth M&K, demonstrated the use of a causal analysis approach involving matching cases based on propensity scores. In the approach, a case from a control group (for us, an *NMR* deal) is matched with a case from the treatment group (for us, an *MR* deal), where the matching is based on the similarity of their propensity scores, defined as the likelihood of being in the treatment group. The next section explains the process and illustrates our utilization in the Groupon setting. As explained in detail later, our setting had a time dynamic that sets it apart from M&K's approach. This time dynamic aspect allowed us to observe changes in patterns of similarities or dissimilarities over time.

4.3. Propensity Score Approach and Causal Analysis

4.3.a. Propensity Score Analysis. The six characteristics listed in Table I are the observable characteristics for each deal. Consistent with previous literature, we utilized a strong *ignorability* assumption “that underpins the *PSA*.” This assumption implies that the observed characteristics are all that matter. However, unlike the M&K context, our context had few previous research efforts against which our variable set could be compared. Our variable set is consistent, however, with those used in the few studies reported in Section 2. Later, we report a sensitivity analysis that examined the effect of possible variable omission.

As noted earlier, we collected data each hour over the life of a deal. Due to occasional server glitches, outages, and/or downtime, missing values occurred for some deals. To avoid issues with interpolating or estimating missing values, we deleted any deal with one or more missing hourly observations from our analysis. Table II lists the number of *MR* and *NMR* deals in each category that had complete hourly data.

Analysis using propensity scores strives to compare two similar deals, one from the treatment group and one from the control group. The similarity is based on a probability estimate (or the propensity score) obtained using the six deal characteristics

Table II. Number of Deals (2,604) with Complete Hourly Observations

	A&E	B&S	H&F	REST
<i>MR</i>	216	295	195	353
<i>NMR</i>	494	413	313	325

Table III. Common Support of Propensity Score Before Matching and Number of Matched Pairs

	A&E	B&S	H&F	REST
Common range (called the “support”) of propensity score	(0.196, 0.862)	(0.078, 0.881)	(0.056, 0.859)	(0.058, 0.917)
Number of matched pairs	194	219	169	221

as predictive variables. The propensity score is defined as “the conditional probability that a subject with $X = x_i$ will be in the treatment group, where x_i is the observed vector of background variables” [Mithas and Krishnan 2009]. We employed a caliper matching approach with the caliper set at 0.05.⁵ The steps in caliper matching are as follows:

- Step 1: sort *MR* and *NMR* deals in a given retail category according to estimated propensity score (from lowest to highest).
- Step 2: determine the common range of propensity score for *MR* and *NMR* and discard deals outside the common range.
- Step 3: begin with the lowest propensity score deal, say, MR_i , from the propensity-score ordered list of *MR* deals; identify the *NMR* deal with propensity score closest to and within 0.05 of the propensity score of MR_i . If a match is found, select the two deals (i.e., matched pairs are one-to-one). If no match within the caliper range is found, remove MR_i from the analysis.
- Step 4: repeat step 3 until no *MR* deal remains on the ordered list.
- Step 5: repeat steps 1 through 4 for each retail category.

Table III provides the common range (termed “support”) for each category and the number of matches obtained within each category across the relevant range. Referring back to Table II, we can see that the largest possible number of matched pairs for A&E is 216, for B&S is 295, for H&F is 195, and for REST is 325. The actual matches obtained were 194, 219, 169, and 221, respectively, which we viewed as a reasonable proportion of possible matches for all four retail categories.⁶

The *PSA* method relies critically on the ignorability assumption. Based on this assumption, we estimated propensity scores from observable factors. Our matching method enabled us to find the closest matches for *MR* deals. After matching, the following percentages of *NMR* deals were included: 39.3% for A&E, 53.0% for B&S, 54.0% for H&F, and 68.0% for REST. Though, as is typical in *PSA*, some observations are lost, we argue that the included deals are neither a trivial set of deals nor a small outlier subset. In addition, as shown in Table IV, there is no statistical difference for

⁵Though Mithas and Krishnan [2009] utilized a kernel matching estimator, we employed a caliper matching process, that is, a technique with a defined distance measure between an *MR* deal and a matching *NMR* deal. We investigated both a kernel matching process and a nearest-neighbor estimation. Finding no significant difference, we report only the caliper matching process because, in our view, it is the clearest and easiest to understand.

⁶The use of *PSA* typically entails the loss of some observations. Increasing the size of the caliper will tend to increase the number of matches, but the matches are not as close or as tight. We doubled the size of the caliper (from .05 to .1), but this resulted in only one more match for A&E, B&S, and REST, and two more matches for H&F. Thus, we stayed with the .05 caliper, choosing the better-matched pairs rather than adding a few but less-well-matched additional pairs.

Table IV. Summary of Wilcoxon Rank Sum Test of Two Groups of Deals After Matching (Group Means in Parentheses)

	A&E		B&S		H&F		REST	
	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>
# of matched pairs	194		219		169		221	
Price (\$)	20 (30.26)	23.5 (31.11)	40 (65.54)	40 (67.01)	49 (140.09)	49 (162.47)	20 (23.21)	20 (23.04)
Discount rate (%)	51 (53.02)	51 (53.35)	56 (60.80)	58 (61.05)	67 (67.11)	64 (66.15)	54 (54.75)	51 (54.25)
Promotion length (days)	3 (3.40)	3 (3.43)	3 (3.61)	3 (3.63)	3 (3.57)	3 (3.63)	3 (3.53)	3 (3.52)
Featured	0 (0.14)	0 (0.15)	0 (0.11)	0 (0.10)	0 (0.07)	0 (0.08)	0 (0.09)	0 (0.09)
Coupon duration (days)	99 (110.14)	90 (115.30)	186 (208.90)	187 (220.32)	186 (186.68)	186 (194.51)	185 (156.47)	185 (157.24)
Limited supply	1 (0.84)	1 (0.77)	1 (0.74)	1 (0.77)	1 (0.72)	1 (0.70)	1 (0.72)	1 (0.76)

observable deal characteristics between the included pairs of *MR* deals and *NMR* deals. The only difference between the two groups is that one has *MR* (treatment group), whereas the other one (control group) does not (*NMR*). The purpose of matching is to limit observable differences in characteristics within each matched pair to *MR* or *NMR*. If we compared without matching, the influence of *MR* could be confounded with differences in the observable deal characteristics.

Earlier we indicated that our analysis had the added feature of a time dimension. Until an *MR* deal actually becomes valid (i.e., the *MR* is met), we explained earlier that there is both an *SI* and a *PI*. Once the *MR* is satisfied, only an *SI* remains. For *NMR* deals, there is only the *SI* throughout the time periods. Thus, for each matched set of an *MR* and an *NMR* deal, we began our comparisons at the point in time when the *MR* deal became valid (termed “time point 0”). The first point or “0” time comparison represents the endpoint of the period during which an *MR* deal involves both an *SI* and *PI* while its matching *NMR* deal involves only *SI*. We continued our comparisons of paired deals every 2 hours across the next 40 hours (see discussion below on this choice of duration). This allowed us to analyze whether there are observed differences at the end of the period in which both *SI* and *PI* were present for the *MR* deals but only *SI* was present for the *NMR* deals, and whether any such differences continue, diminish, or expand over the period in which only an *SI* exists for both the *MR* and *NMR* deals. For thoroughness, we also completed our analysis using time 0 as 2 hours after the deal begins. Appendix C provides the tables for that analysis (corresponding to Tables V to VIII). We found no significant differences. We note that, for retailers and for Groupon, the differences at the end of the deal are the ones that matter for their bottom line. These are the same under either starting point.

In analyzing the data across the various 2-hour periods, we completed a test for symmetry [Mira 1999], an assumption inherent in the Wilcoxon test. The results were mixed in the sense that for 45 of the periods, symmetry was not rejected, but for 115 periods, symmetry was rejected. We decided to report the Wilcoxon test results but also to include test results for the nonparametric sign test, a test that does not assume symmetry. In Tables V to VIII that follow, we used the following format for each data cell (shown in Figure 1):

We use asterisks to indicate levels of significance for the Wilcoxon test, and plus signs (+) to indicate the corresponding significance levels for the sign test.

median	(mean)
significance of Wilcoxon test	significance of sign test

Fig. 1. Example of cell structure for Tables V to VIII.

Table V. Comparison Results Over Time for A&E Deals (Median Values with Mean Values in Parentheses)

Time Point (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (194)	3 (6.34) * ++	2 (5.75)	15 (24.75) *** +++	6 (27.46)	306 (675.41) ** +++	135 (640.77)
2 (194)	10 (17.06) ** +++	5 (13.28)	33 (66.52) * +++	20 (71.80)	724 (1,877.64) ++	551 (1,668.76)
4 (194)	18 (28.79) *** ++	8 (19.66)	63 (119.59) ** +++	30 (104.42)	1363 (3,136.39) * +++	910 (2,451.47)
6 (194)	23 (38.62) *** +++	10 (24.09)	88 (159.89) *** +++	40 (126.56)	1800 (4,317.52) ** +++	1200 (2,993.52)
8 (194)	27 (47.29) *** +++	13 (27.45)	100 (190.25) *** +++	60 (161.90)	2088 (5,187.85) ** ++	1400 (3,688.21)
10 (194)	30 (54.09) *** +++	15 (30.18)	110 (232.00) *** +++	60 (174.25)	2375 (5,939.69) ** +++	1600 (4,020.59)
12 (194)	32 (58.96) *** +++	17 (32.70)	120 (248.61) *** +++	70 (185.09)	2563 (6,395.95) ** +++	1800 (4,314.63)
14 (194)	35 (63.42) *** +++	19 (35.04)	130 (263.70) *** +++	70 (195.73)	2875 (6,815.11) ** ++	2000 (4,588.40)
16 (194)	37 (66.39) *** +++	19 (36.32)	140 (274.01) *** +++	80 (202.32)	3045 (7,076.64) ** +++	2065 (4,757.62)
18 (194)	38 (67.98) *** +++	20 (37.29)	140 (279.12) *** +++	80 (205.13)	3120 (7,210.75) ** +++	2225 (4,817.96)
20 (194)	38 (68.93) *** +++	20 (37.69)	145 (281.62) *** +++	80 (206.46)	3120 (7,265.95) ** +++	2225 (4,853.66)
22 (194)	38 (69.80) *** +++	21 (38.02)	150 (283.56) *** +++	85 (208.35)	3120 (7,324.94) ** +++	2225 (4,894.57)
24 (194)	40 (71.79) *** +++	21 (39.33)	150 (289.35) *** +++	85 (214.77)	3170 (7,530.16) ** ++	2245 (5,072.18)
26 (194)	43 (75.72) *** +++	22 (41.77)	160 (326.07) *** +++	90 (226.43)	3465 (8,663.37) ** ++	2400 (5,401.41)
28 (194)	44 (79.87) *** +++	22 (44.07)	170 (341.98) *** +++	100 (235.07)	3725 (9,131.25) ** ++	2610 (5,637.28)
30 (194)	45 (83.32) *** +++	23 (45.61)	180 (355.02) *** +++	105 (243.84)	3900 (9,476.21) ** ++	2790 (5,880.81)
32 (194)	47 (86.29) *** +++	23 (46.93)	190 (365.54) *** +++	110 (250.21)	4150 (9,736.28) ** ++	2890 (6,054.76)
34 (194)	47 (88.57) *** +++	24 (48.12)	200 (373.68) *** +++	110 (256.03)	4350 (9,964.07) ** ++	2913 (6,225.46)
36 (194)	48 (90.76) *** +++	25 (49.55)	205 (380.78) *** +++	110 (262.72)	4400 (10,173.04) ** ++	3175 (6,423.99)
38 (168)	51 (97.70) *** +++	26 (51.62)	220 (418.73) *** +++	130 (285.71)	4940 (11,273.62) ** ++	3390 (6,982.30)
40 (138)	53 (102.45) *** +++	29 (56.07)	240 (448.82) *** +++	140 (299.79)	5235 (12,035.22) * +	3600 (7,701.41)
End of promotion length (194)	55 (111.23) *** +++	30 (68.23)	265 (496.50) ** ++	170 (360.41)	6170 (14,074.00) * +	4935 (9,487.40)

Table VI. Comparison Results Over Time for B&S Deals (Median Values with Mean Values in Parentheses)

Time Point (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (219)	1 (1.24) * ++	0 (0.95)	13 (17.38) ** +++	8 (19.30)	594 (906.82) *** +++	300 (842.94)
10 (219)	6 (10.29) *** +++	4 (6.29)	100 (170.30) ** ++	82 (144.68)	4900 (8,476.73) *** +++	3700 (6,107.05)
20 (219)	8 (13.12) *** +++	5 (7.70)	120 (216.39) ** ++	110 (176.49)	6240 (10,648.07) *** +++	4830 (7,501.72)
30 (219)	10 (15.16) *** +++	6 (9.01)	150 (252.44) ** +	120 (206.49)	7650 (12,444.93) *** +++	5880 (8,923.71)
40 (196)	12 (17.24) *** +++	6 (10.17)	180 (309.03) ** ++	140 (228.25)	9035 (15,967.07) *** +++	6410 (9,769.00)
End of promotion length (219)	13 (20.57) *** +++	8 (12.24)	230 (365.95) ** +++	200 (286.40)	11200 (19,502.10) **	9360 (13,074.30)

Table VII. Comparison Results Over Time for H&F Deals (Median Values with Mean Values in Parentheses)

Time Point (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (169)	1 (3.72) *** +++	0 (2.37)	14 (17.88) *** +++	5 (15.40)	704 (1,127.98) *** +++	190 (606.37)
10 (169)	10 (21.97) *** +++	5 (11.20)	84 (134.72) *** +++	50 (93.12)	4480 (6,984.37) *** +++	2030 (4,101.17)
20 (169)	12 (27.51) *** +++	6 (14.41)	110 (173.07) *** +++	60 (116.27)	5340 (8,952.73) *** +++	2700 (5,087.53)
30 (169)	15 (32.38) *** +++	7 (17.18)	140 (213.59) *** +++	80 (147.30)	6670 (11,274.24) *** +++	3430 (6,343.08)
40 (134)	16 (40.11) *** +++	7 (17.31)	145 (254.27) *** +++	90 (154.10)	7770 (13,533.80) *** +++	3920 (7,060.08)
End of promotion length (169)	20 (44.99) *** +++	10 (29.47)	220 (318.15) *** +++	140 (232.81)	11040 (23,399.60) *** +++	6860 (12,006.80)

Table VIII. Comparison Results Over Time for REST Deals (Median Values with Mean Values in Parentheses)

Time Point (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (221)	2 (2.58)	1 (3.15)	25 (35.34) +++	20 (73.30)	506 (781.95) +++	336 (1,237.25)
10 (221)	17 (21.87) *** +++	10 (19.24)	260 (344.70)	240 (346.17)	5,600 (7,577.81)	4,900 (6,912.62)
20 (221)	22 (28.51) *** +++	13 (23.12)	330 (432.75)	300 (409.64)	7,350 (9,546.90) ** +	6,380 (8,368.10)
30 (221)	26 (33.32) *** +++	15 (26.32)	410 (503.30)	360 (456.26)	8,640 (11,218.04) ** ++	7,500 (9,423.83)
40 (199)	28 (37.55) *** +++	17 (28.41)	460 (573.26) **	390 (480.60)	10,080 (12,809.79) *** +	8,400 (10,350.04)
End of promotion length (221)	32 (44.05) *** +++	21 (33.13)	570 (654.18) *	510 (560.77)	12,000 (14,909.40) *** +++	10,000 (12,038.70)

Tables V to VIII provide results for each of the four retail categories and run up to 40 hours after the *MR* deal met its minimum. The tables also include the “final results” at the end of the promotions. For A&E deals, Table V presents details on all of the 2-hour periods. For brevity, Tables VI to VIII (B&S, H&F, and REST, respectively) report results for periods 0, 10, 20, 30, and 40. Since some 2-day deals might not meet the minimum until several hours have elapsed, some deals are over before the “deal makes plus 40 hours” time is reached. This resulted in a somewhat lower number of

matched-pair observations for the last two periods. A&E, for example, had 194 observations through the 36th period, but 168 at the end of the 38th hour and 138 at the end of the 40th hour after the *MR* deal makes. Consider Table V, which reports the set of average values on the output variables for *MR* and *NMR* matched deals for A&E deals. Time “0” is the point in time when the *MR* deal becomes valid. Time “2” is 2 hours after time “0” and so on through time “40.” We stop at 40 because, in many cases, this would be at or near the endpoint of a 2-day deal. After this point (see previous discussion), the number of (open) deals drops off sharply as many deals end. In the last row, we report the results at the end of the deal promotion.

For A&E deals, the significant difference on *FL* favoring the *MR* deals existed when *MR* levels are met (period 0) and continued to spread and be significant across the remainder of the periods. The numerical differences were significant for both mean and median values and expanded across the observed periods. The differences in coupons sold and revenue were also significant at period 0 and expanded until the 40th period and the end of the promotions. The results were consistent for B&S and H&F deals. Thus, for A&E, B&S, and H&F deals, H1, H1a, H2, H2a, H3, and H3a are all supported.

REST deals showed a slightly different pattern. The significant difference of *FL* favoring the *MR* deals began in the 2-hour period after the *MR* levels were met and continued to spread and be significant across the remainder of the periods. The difference in the number of coupons sold did not show as significant until quite late (just prior to period 40), when there was a significant positive difference for the *MR* deals. Total revenue, however, showed a significant difference favoring the *MR* deals starting in the 12th period and expanded until the 40th period and until the end of the promotions. Thus, for REST deals, H1a, H2a, and H3a were all supported, whereas H1, H2, and H3 were not. The results suggest that the advantages of having the *MR* feature for restaurant deals was not significant until the *MR* is met, but they became significantly positive toward the end of the deal period.

After *PSA* matching, deal characteristics (including coupon price) of the *MR* deals were not statistically significantly different from the deal characteristics of matched *NMR* deals. Hence, the greater revenues that *MR* deals generated resulted from the greater quantity of coupons sold. We used sensitivity analysis with respect to the *PSA* matching technique to test the possibility of significant impact from unobservable (or not included) variables. Our sensitivity analysis found that our results have low sensitivity to unobservable factors (in Section 4.3.c).

Figures 2(a) to 2(d) graphically illustrate the movement over time for *FL* and total revenue *after* the *MR* had been met (after time 0). For example, values at $T = 4$ represent average values at the end of 4 hours after the *MR* deal had met the *MR*. We note the close tracking between *FL* and total revenue for both the *MR* and *NMR* deals across time and retail category. Importantly, the figures also show that the gaps (for *FL* and total revenue) between *MR* and *NMR* deals all got larger over time for the four categories.

After an *MR* is met, the *PI* no longer exists. Only the *SI* remains for both the *MR* deals and the *NMR* deals. However, as Figures 2(a) to 2(d) show, the initial impacts of the *PI* were magnified over time until the end of the deal promotion. We suggest two likely reasons. First, because of the *PI*, the *MR* deals acquired a larger group of seed consumers than the *NMR* deals until the *MR* was met. This larger base of seed consumers provided more individuals who might have acted based on the *SI* and also shared the deal with more friends through Facebook. This social media contagion tended to reinforce deal purchases in a “snowball” fashion over time [Kempe et al. 2003].

Second, later consumers may have used observational learning to infer the quality of the offers based on previous consumers’ purchasing decisions [Hu et al. 2013]. When

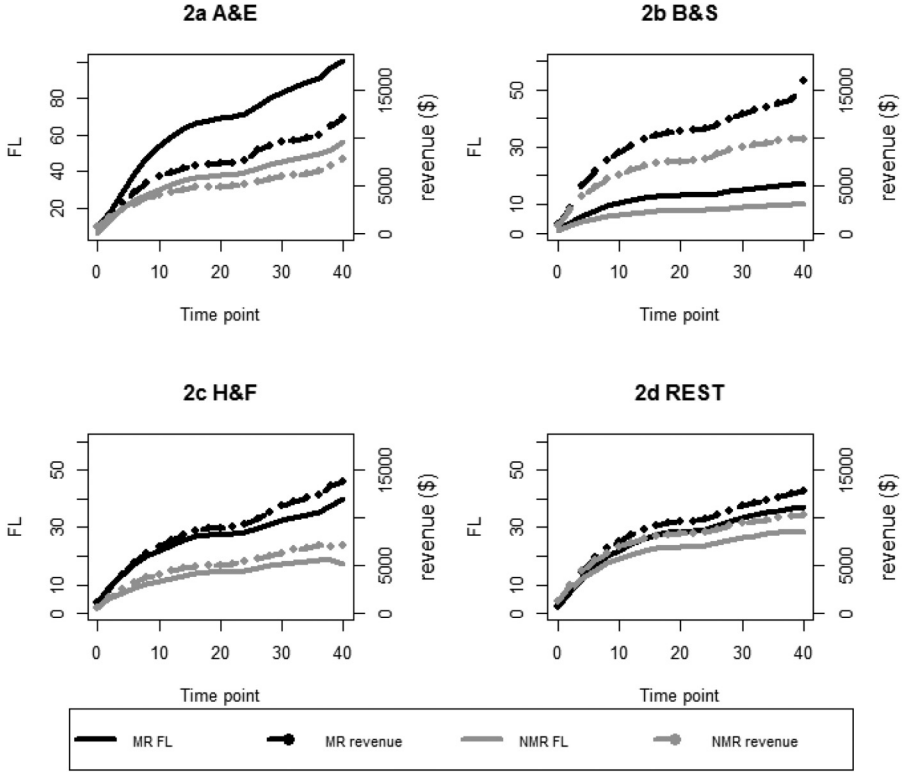


Fig. 2a–2d. Average *FL* and total revenue plotted across time for matched *MR* and *NMR* ($T = 0$ represents the time at which the *MR* deal is triggered, that is, *PI* ceases).

consumers arrived at the Groupon site after the *MR* had been met, they likely took a positive view toward the deal from observing more *FL* and a greater quantity of coupons sold for *MR* deals. The positive impression could have strengthened their *SI* to share the deals and further facilitate purchasing decisions, perhaps resulting in a herding effect [Li and Wu 2014].

We also noticed that the *MR* had the smallest impact on REST deals in terms of increased *FL* and total revenue. *MR* deals for A&E acquired about 82.7% more *FL* and 45% more total revenue than A&E *NMR* deals. B&S *MR* deals totaled 69.5% more *FL* and 50% more total revenue than their matched B&S *NMR* deals. The figures for H&F had *MR* deals with a 131.7% advantage in *FL* and a 98.2% advantage in total revenue. However, for REST deals, *MR* deals had 32.2% more *FL* and 20% greater total revenue. As we discussed in Section 4.1, *PI* only exists until the *MR* is met. Thus, the longer it is from the time the deal is posted until the *MR* is met, the longer the *PI* exists, which, in turn, should lead to a greater impact of *PI*. We note that the average time to reach the *MR* was shortest for REST deals, 7.3 hours, compared with 8.3 hours for A&E, 8.0 hours for B&S, and 8.4 hours for H&F. Thus, the *MR* for REST deals was reached most quickly and, therefore, the impact of *PI* was likely to be the smallest. This is consistent with Figures 2(a) to 2(d), in that the increases of Facebook likes and revenue for REST deals were the smallest. Our results should encourage restaurants to consider raising their *MR* level, providing a longer period for the *PI* and, in turn, improved deal outcomes.

The results show that the *MR* has a causal influence on *FL* and on total revenue. The results suggest that, for a local retailer considering Groupon as a promotion and advertising tool, the *MR* is clearly an element to include. We should note that, while we observed similar movements over time in *FL* and total revenue in response to the presence or absence of *MR*, our analysis was not able to imply a causal link between *FL* and revenue.

In the next two sections, we examine the robustness of our results. In the first section, we consider issues related to heterogeneity, that is, whether the results noted earlier hold consistently across the different levels of propensity scores. In the second, we analyze the sensitivity of estimated causal effects to potential violations of the strong *ignorability* assumption.

4.3.b. Heterogeneity Analysis. To test whether our results hold consistently across various levels of propensity scores, we divided deals into subgroups according to the estimated propensity score, with each subgroup covering 0.15 of the range of the propensity scores (i.e., $0 < 0.15$, $0.15 < 0.30$, $0.3 < 0.45$, and so on). For each of the intervals within each of the four retail categories, we conducted Wilcoxon signed rank tests again for *FL*, quantity of coupons sold, and total revenue for time points 0, 20, and 40. For brevity, we summarize the results here, with the tables provided in Appendix A:

1. For each time point, the conclusions for subgroups are not always the same as the overall results shown in Tables V to VIII. However, for the three or four subgroups in each category that included the larger numbers of deals, we found general consistency with the overall results.
2. Similar to the overall results discussed earlier, the effects of *MR* grew stronger over time. In the heterogeneity analysis, the number of range groups with significance increased over time and increased in level of significance over time.

The patterns of observed differences between *MR* and *NMR* deals across propensity-level groupings supported the potential importance of *MR* to advertisers across the retail categories.

4.3.c. Sensitivity Analysis. Our *PSA* utilized the strong assumption that the observed deal characteristics fully accounted for differences between treatment group (*MR*) deals and control group (*NMR*) deals. Yet the decision whether to include an *MR* in a particular deal may have been based on retailer characteristics as well as the deal—that is, be endogenous. So, if the treatment and control groups actually differ on important unobservable factors, the *ignorability* assumption was not met and the strength of our conclusions about the impacts of *MR* on *FL*, quantity of coupons sold, and revenue may be restricted. However, retailer characteristics were not readily available in our dataset. Thus, we performed an analysis to determine how sensitive our estimated causal effects were to potential violations of the assumption. We refer the reader to detailed discussions of sensitivity analysis in M&K [2009] and in Rosenbaum [1999] and summarize our results for the sake of brevity. Following M&K [2009], we use Γ to indicate “the log odds of differential assignment to treatment because of unobserved factors.” A larger value of Γ means that unobservable factors would need to have had a larger effect to undermine the influence of *MR*; that is, the initial outcomes are less sensitive to possible unobserved variables.

In Appendix B, we summarize the values of Γ , where the observed significant positive effect of *MR* would become insignificant (at the .01 level). In both analyses, we see that in all or almost all cases, there is significance at levels above the initial level with larger values of Γ at the end of the promotion period providing the retailers’ final coupon sales and revenue. Together, these results suggest that, for the large majority of our results,

missing variables must have a relatively large effect to nullify the importance of *MR*. Thus, the calculated importance of *MR* does not appear to be an artifact of missing variables.

5. SUMMARY, CONCLUSIONS, AND IMPLICATIONS

In the context of Groupon's promotions, we studied causal relations among *MR*, *FL*, quantity of coupons sold, and total revenue. We gathered data hourly, enabling a time-linked analysis of the persistence of differences between *MR* deals and *NMR* deals.

5.1. Summary and Conclusions

With a time dimension added, we utilized a *PSA* to analyze causality. Our results indicated that, consistent with our hypotheses, *MR* deals outperform matched *NMR* deals. *MR* deals had more coupons sold and greater total revenue. In addition, *MR* deals had significantly more *FL*, with the total revenue pattern closely following the *FL* pattern for the entire time periods studied. For three of the four retail categories, the differences were all significant when the *MR* was met and continued to be significant (or significant at higher levels) across the time period studied. The one exception, restaurants, did not have significant differences when the *MR* was met, but did so later in the promotion period.

Though we utilized only a 10-month data period, it is possible that consumers' interests or attention on Groupon faded or altered over that time. If so, this could influence our conclusions. To check for any possible time trend, we analyzed the demeaned (subtracting values for each *MR* (*NMR*) deal from the mean of all *MR* (*NMR*) deals) time trend for *FL* and for quantity of coupons sold for all four categories over the 10-month period. We found no significant overall trend or month-by-month difference.

Our research demonstrates, in the context studied, the existence of a *PI* before the *MR* is met. The extra incentive provided consumers more motivation to share a deal through social media and before the *MR* is met. Our analysis shows that the initial advantage from *PI* continued its impact until the promotion end, a type of social contagion or observational learning effect [Li and Wu 2014]. We do not know why Groupon decided to end the use of *MR*. Perhaps this decision was based on the company's observation that virtually all *MRs* were met and thus *MRs* were viewed as unnecessary. Our results do raise questions about the wisdom of Groupon's decision and suggest a reconsideration of that decision. The evidence indicates positive causal impacts of an *MR* on coupon sales and revenue, both important to retailers and Groupon.

5.2. Generalizations and Implications

Our research has important theoretical implications in the e-WOM arena. While numerous studies have documented positive influences of e-WOM on sales or revenue, few studies have examined factors driving the generation of e-WOM (one example is Godes and Silva [2012]). Our research (1) found that the presence of *MR* drives increasing social media sharing (*FL*) across the entire length of such deals and (2) demonstrated the importance of *PI* for increasing *FL*, coupon sales, and total revenue.

Our results have two significant areas of generalization. First, for daily deal sites that do not diverge significantly from the Groupon format, the results should directly generalize. Second, the demonstrated importance of *PI* should carry over to myriad market settings. We currently see many firms assimilating social media. Given what we found about the importance of *PI*, we posit that these firms should utilize some form of *PI* appropriate for their market activities. People do act altruistically in sharing, but we should not forget that they also can act in their own personal interest through sharing.

The impact of *PI* leads to an important managerial insight, but we offer a much broader and likely more important managerial insight. In terms of generating sales and revenue, Groupon apparently overlooked the positive effect of using *MR*. Perhaps because virtually every *MR* was met, Groupon might have thought the effort of tracking and reporting on the *MR* to be unnecessary. Interestingly, Groupon had all the data to analyze the value of *MR*, but there is no indication that it performed the analytics to do so. Our results offer a cautionary tale to those pondering an abrupt alteration of a market process: *do the analytics before you leap!*

As in all studies, there are certainly caveats. Our data, although a fairly large dataset, was gathered from three cities over approximately 10 months. Second, our data only included Groupon deals. Third, our analysis covered just four retail categories, albeit some 80% of Groupon's local deals. Finally, the utilization of *PSA* enabled us to analyze the causal relation between *MR* and *FL*, and the causal relationship between *MR* and deal outcomes (quantity of coupons sold and total revenue), but not the causal relationship between *FL* and deal outcomes. Given the consistency in patterns among *FL* and the outcome variables, we see this as an interesting direction for a theory article in future work.

APPENDIX A

Tables for Heterogeneity Analysis

A&E

Table A1. Heterogeneity Analysis at Time Point 0 for A&E Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (11)	4 (10.73)	3 (7.82)	15 (19.91)	4 (46.18)	1,170 (2,043.55)	447 (1,607.91)
0.15–0.30 (55)	3 (5.09)	2 (6.07)	12 (16.67) ** ++	5 (23.07)	340 (559.18) * +++	90 (562.53)
0.30–0.45 (101)	3 (7.22) ** +++	1 (5.21)	15 (30.35) *** +++	5 (23.46)	228 (649.86) *** +++	117 (506.95)
0.45–0.60 (27)	3 (3.81)	3 (6.26)	17 (22.26)	20 (43.78)	343 (450.37)	236 (906.70)
0.60–0.75 (0)	–	–	–	–	–	–
>0.75 (0)	–	–	–	–	–	–

Table A2. Heterogeneity Analysis at Time Point 20 for A&E Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (11)	59 (144.00) ***	24 (31.64)	100 (211.91)	90 (166.91)	11,060 (22,485.36)	4,900 (6,626.73)
0.15–0.30 (55)	32 (60.53) *	15 (43.18)	106 (198.07) ** ++	50 (154.02)	3,015 (8,132.67) ** +++	1,450 (4,296.42)
0.30–0.45 (101)	38 (69.27) *** +++	18 (32.64)	170 (345.45) *** +++	80 (202.44)	2,800 (6,027.78) ** +	2,000 (4,207.22)
0.45–0.60 (27)	34 (54.19)	31 (47.81)	160 (241.44)	260 (344.48) * +	3,480 (3,931.56)	5,200 (7,684.59) **
0.60–0.75 (0)	–	–	–	–	–	–
>0.75 (0)	–	–	–	–	–	–

Table A3. Heterogeneity Analysis at Time Point 40 for A&E Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (11)	103 (202.55) ***	37 (48.82)	220 (322.00)	110 (249.18)	20,826 (34,850.18)	7,450 (10,297.18)
0.15–0.30 (51)	41 (90.47) *	20 (59.84)	154 (279.90) * ++	80 (215.59)	3,900 (10,177.37) * ++	2,159 (6,182.22)
0.30–0.45 (61)	52 (96.70) ** +	29 (49.48)	300 (625.84) *** +++	160 (340.16)	5,250 (10,751.61)	4,000 (7,291.85)
0.45–0.60 (15)	30 (93.13)	43 (75.40)	220 (396.27)	430 (459.00)	5,220 (6,841.00)	12,000 (12,628.67) *
0.60–0.75 (0)	–	–	–	–	–	–
>0.75 (0)	–	–	–	–	–	–

B&S

Table A4. Heterogeneity Analysis at Time Point 0 for B&S Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (6)	2 (1.17)	0 (1.17)	8 (9.50)	4 (8.33)	693 (1,482.17) *	225 (735.00)
0.15–0.30 (33)	0 (1.30)	0 (1.00)	10 (12.06) * ++	4 (9.09)	825 (948.09) *** +++	180 (386.82)
0.30–0.45 (73)	1 (1.58) *** +++	0 (0.60)	16 (17.59) *** +++	7 (16.14)	590 (836.37) *** +++	273 (628.11)
0.45–0.60 (86)	1 (1.13)	0 (1.08)	14 (18.36) +	10 (20.65)	536 (819.59)	350 (1,039.03)
0.60–0.75 (19)	0 (0.37)	0 (1.37)	17 (24.11)	20 (39.58)	750 (1,289.63)	490 (1,403.68)
>0.75 (2)	0 (1.00)	2 (3.00)	15 (15.00)	50 (85.00)	875 (1,185.00)	1,950 (2,775.00)

Table A5. Heterogeneity Analysis at Time Point 20 for B&S Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (6)	5 (5.67)	5 (8.83)	56 (87.67)	40 (60.00)	9,453 (10,097.67) *	3,447 (3,842.33)
0.15–0.30 (33)	10 (12.58) *** +++	3 (4.45)	90 (135.06) ** +	50 (82.27)	9,000 (10,607.03) *** +++	2,400 (3,947.30)
0.30–0.45 (73)	7 (11.78) *** ++	4 (6.64)	150 (189.90) *** +++	80 (140.62)	4,640 (9,427.96) *** +++	3,960 (5,729.11)
0.45–0.60 (86)	9 (13.28) *** +++	6 (8.52)	140 (246.86)	135 (211.33)	5,805 (10,953.47)	5,390 (9,621.45)
0.60–0.75 (19)	13 (21.21)	9 (12.32)	220 (350.21)	190 (312.00)	8,250 (13,563.63)	7,410 (10,826.42)
>0.75 (2)	2 (9.50)	8 (17.00)	39 (329.50)	210 (605.00)	11,661 (16,680.50)	8,199 (19,095.00)

Table A6. Heterogeneity Analysis at Time Point 40 for B&S Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (6)	7 (9.67)	5 (11.50)	72 (117.17)	70 (96.00)	12,637 (13,489.50) *	4,822 (6,027.33)
0.15–0.30 (33)	12 (15.45) ** ++	4 (6.79)	132 (177.64) ** +	70 (117.36)	12,250 (14,918.27) *** +++	3,400 (5,633.76)
0.30–0.45 (72)	13 (15.53) *** +++	5 (8.53)	185 (253.51) *** ++	120 (185.57)	6,633 (12,626.42) *** +++	5,630 (7,829.57)
0.45–0.60 (71)	11 (17.46) ** ++	9 (11.89)	210 (344.77)	240 (294.00)	7,840 (15,861.58)	8,400 (13,102.11)
0.60–0.75 (13)	18 (33.38)	12 (16.00)	220 (794.08)	280 (388.69)	10,050 (37,521.62)	10,780 (12,974.38)
>0.75 (1)	20	34	950	1000	33,250	30,000

H&F

Table A7. Heterogeneity Analysis at Time Point 0 for H&F Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (1)	6	0	3	0	8985	0
0.15–0.30 (35)	1 (3.03)	0 (2.94)	10 (13.00) ** +++	3 (9.14)	714 (1,636.74) *** +++	147 (496.80)
0.30–0.45 (63)	1 (4.49)	1 (2.21)	12 (17.52) *** +++	4 (8.71)	500 (797.32) *** +++	160 (325.05)
0.45–0.60 (59)	1 (2.90) ** +	0 (1.98)	16 (20.14)	8 (24.80)	725 (1,058.88) *** +++	300 (873.31)
0.60–0.75 (11)	2 (5.73) * +	0 (3.82)	18 (24.73)	20 (24.64)	900 (1,059.36)	1,290 (1,189.55)
>0.75 (0)	–	–	–	–	–	–

Table A8. Heterogeneity Analysis at Time Point 20 for H&F Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (1)	12	0	7	1	20,965	2,999
0.15–0.30 (35)	12 (19.06) ** ++	4 (13.71)	77 (124.54) * +	41 (76.71)	5,070 (11,457.03) ** ++	2,610 (7,053.29)
0.30–0.45 (63)	12 (33.24) *** +++	6 (11.70)	110 (165.16) *** +++	50 (103.29)	4,818 (6,973.52) *** +++	2,450 (3,725.03)
0.45–0.60 (59)	11 (26.95) *** ++	6 (16.03)	140 (213.31) **	100 (145.86)	5,880 (9,684.80) *** +++	3,000 (5,060.54)
0.60–0.75 (11)	16 (26.00)	5 (24.73)	160 (172.09)	60 (168.27)	5,950 (7,301.36)	6,650 (6,970.82)
>0.75 (0)	–	–	–	–	–	–

Table A9. Heterogeneity Analysis at Time Point 40 for H&F Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (1)	12	0	7	1	20,965	2,999
0.15–0.30 (34)	16 (23.88) ** +++	5 (19.09)	115 (178.74) *	70 (128.53)	8,060 (16,705.09) *** ++	3,765 (10,530.68)
0.30–0.45 (55)	13 (44.91) *** ++	9 (16.04)	150 (244.51) *** +++	80 (149.93)	6,840 (10,245.04) *** +++	3,510 (5,432.27)
0.45–0.60 (39)	19 (47.21) *** ++	8 (18.36)	190 (326.08) *	130 (195.13)	8,400 (15,003.23) *** +	4,200 (6,637.08)
0.60–0.75 (5)	8 (48.00)	8 (14.40)	260 (364.60) +	92 (84.40)	11,700 (15,197.60) *	5,200 (5,477.60)
>0.75 (0)	–	–	–	–	–	–

REST

Table A10. Heterogeneity Analysis at Time Point 0 for REST Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (4)	4 (4.25) ** +	0 (0.25)	41 (47.25) * +	9 (9.50)	1,383 (1,452.50) * +	145 (181.25)
0.15–0.30 (18)	2 (3.17)	1 (1.44)	24(35.39)	25 (30.28)	433 (839.44)	475 (1,002.56)
0.30–0.45 (54)	2 (2.94) *	0 (1.76)	25 (35.93) +++	10 (44.96)	500 (731.33) +	200 (949.72)
0.45–0.60 (86)	1 (2.29)	1 (2.19)	21 (33.71) ++	13 (58.03)	466 (714.71) * ++	320 (940.29)
0.60–0.75 (55)	2 (2.40)	2 (6.82) **	25 (36.93)	37 (141.89) **	620 (841.20)	600 (2,116.98)
>0.75 (4)	2 (2.25)	1 (3.00)	22 (28.50)	89 (98.25)	2,216 (1,167.25)	851 (1,519.25)

Table A11. Heterogeneity Analysis at Time Point 20 for REST Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (4)	26 (45.00) * +	10 (8.75)	575 (625.00) * +	290 (242.50)	17,100 (17,860.00) * +	5,150 (4,750.00)
0.15–0.30 (18)	15 (20.89)	12 (15.17)	388 (404.89)	260 (356.89)	8,425 (8,581.17)	6,815 (12,452.78)
0.30–0.45 (54)	18 (27.46) ** +	13 (17.17)	330 (465.26) *	250 (320.91)	6,910 (9,680.02) *	5,675 (7,436.56)
0.45–0.60 (86)	22 (28.57) ** +	13 (20.51)	325 (436.48)	260 (395.30)	6,750 (9,444.34)	6,195 (7,861.80)
0.60–0.75 (55)	26 (31.02) +	23 (36.69)	320 (398.15)	430 (538.93) *** ++	7,000 (9,222.75)	8,340 (8,816.36)
>0.75 (4)	22 (24.75) *	24 (23.00)	285 (322.50)	645 (542.50)	10,050 (10,445.00)	10,930 (10,902.50)

Table A12. Heterogeneity Analysis at Time Point 40 for REST Deals

Propensity Score Range (No. of Matched Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
<0.15 (4)	37 (58.00) * +	13 (11.00)	970 (907.50) * +	375 (325.00)	24,750 (27,302.50) * +	6,700 (6,437.50)
0.15–0.30 (18)	19 (27.61)	16 (19.33)	500 (524.94)	315 (440.28)	10,750 (11,252.83)	9,408 (15,328.72)
0.30–0.45 (54)	24 (36.06) *** ++	16 (21.56)	497 (594.50) **	349 (399.63)	10,040 (12,711.17) *** +	7,455 (9,444.78)
0.45–0.60 (83)	27 (37.90) ** ++	20 (26.41)	460 (576.88) *	377 (476.70)	8,960 (12,598.13) *	8,400 (9,887.46)
0.60–0.75 (28)	34 (42.13) +	22 (49.00)	453 (534.87)	610 (640.58) *	10,400 (12,943.13)	10,000 (10,560.47)
>0.75 (2)	25 (24.50)	22 (21.50)	345 (345.00)	464 (463.50)	6,750 (6,750.00)	13,008 (13,007.50)

APPENDIX B**Sensitivity Analysis Tables**

Table B1. The Value of Γ Where Positive Effect of the *MR* Becomes Insignificant
(Based on Wilcoxon Signed Rank Test)

	<i>FL</i>	Quantity of Coupons Sold	Total Revenue
Time point when deals meet the <i>MR</i>			
Arts & Entertainment	1.1	1.3	1.2
Beauty & Spas	1.2	1.2	1.3
Health & Fitness	1.3	1.7	2.3
Restaurant	–	–	–
20 hours after meeting the <i>MR</i>			
Arts & Entertainment	1.6	1.3	1.2
Beauty & Spas	1.7	1.2	1.4
Health & Fitness	1.9	1.7	2.2
Restaurant	1.5	–	1.1
40 hours after meeting the <i>MR</i>			
Arts & Entertainment	1.5	1.3	1.1
Beauty & Spas	1.7	1.2	1.6
Health & Fitness	2.0	1.8	2.6
Restaurant	1.6	1.1	1.3
At the end of promotion length			
Arts & Entertainment	1.5	1.5	1.5
Beauty & Spas	1.8	1.8	1.8
Health & Fitness	1.5	1.5	1.5
Restaurant	1.5	1.5	1.5

Table B2. The Value of Γ Where Positive Effect of the *MR* Becomes Insignificant
(Based on Sign Test)

	<i>FL</i>	Quantity of Coupons Sold	Total Revenue
Time point when deals meet the <i>MR</i>			
Arts & Entertainment	1.2	1.6	1.4
Beauty & Spas	1.2	1.4	1.6
Health & Fitness	1.3	1.7	2.1
Restaurant	–	1.2	1.3
20 hours after meeting the <i>MR</i>			
Arts & Entertainment	1.3	1.3	1.2
Beauty & Spas	1.5	1.1	1.4
Health & Fitness	1.6	1.5	1.6
Restaurant	1.3	–	1.1
40 hours after meeting the <i>MR</i>			
Arts & Entertainment	1.2	1.4	1.1
Beauty & Spas	1.6	1.1	1.4
Health & Fitness	1.7	1.5	1.6
Restaurant	1.4	–	1.1
At the end of promotion length			
Arts & Entertainment	1.4	1.2	1.1
Beauty & Spas	1.6	1.2	–
Health & Fitness	1.4	1.4	1.9
Restaurant	1.3	–	1.2

APPENDIX C

Tables for Sarting Time Point Set at 2 Hours after Deal Offer Begins (Same Starting Point for All)

Table C1. Comparison Results for A&E Deals Based on Hours After a Deal Being Posted
(Median Values with Mean Values in Parentheses)

Hours After a Deal Being Posted (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
2 (194)	0 (0.63)	0 (0.74)	1 (3.19) **	0.5 (2.74)	12 (66.05) **	3 (67.14)
12 (194)	16 (31.05) *** +++	8 (17.63)	57 (134.9) *** +++	30 (97.65)	1,202 (3,543.16) ** +++	800 (2,188.80)
24 (194)	36 (67.43) *** +++	19 (36.45)	140 (274.15) *** +++	80 (200.74)	2,980 (7,070.67) ** ++	2,065 (4,694.65)
36 (194)	43 (79.84) *** +++	23 (43.24)	170 (340.59) *** +++	100 (231.92)	3,707 (8,947.76) ** ++	2,580 (5,533.32)
48 (183)	48 (95.06) *** +++	28 (52.84)	210 (392.38) *** +++	130 (280.92)	4,600 (10,668.68) ** +++	3,600 (6,938.58)
60 (122)	50 (104.6) **	30 (63.7)	225 (424.69) +	165 (337.15)	5,050 (14,014.87)	4,535 (8,935.2)
72 (113)	54 (118.19) ** +	31 (71.92)	250 (478.69)	200 (422.43)	6,110 (16,360.54)	5,510 (10,793.73)
End of promotion length (194)	55 (111.23) *** +++	30 (68.23)	265 (496.50) ** ++	170 (360.41)	6,170 (14,074.00) * +	4,935 (9,487.40)

Table C2. Comparison Results for B&S Deals Based on Hours After a Deal Being Posted
(Median Values with Mean Values in Parentheses)

Hours After a Deal Being Posted (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
2 (219)	0 (0.27)	0 (0.32)	1 (1.70)	1 (1.75)	16 (71.17)	34 (65.80)
12 (219)	3 (6.22) *** +++	2 (3.82)	61 (103.08) ** +++	50 (93.60)	2,750 (4,981.47) * +	2,100 (3,759.63)
24 (219)	8 (12.71) *** +++	4 (7.42)	120 (207.85) ** +++	100 (171.30)	6,000 (10,098.37) **	4,500 (7,279.40)
36 (219)	10 (14.62) *** +++	5 (8.56)	140 (241.68) ** +++	120 (197.98)	7,020 (11,695.48) **	5,520 (8,522.13)
48 (212)	12 (17.23) *** +++	6 (9.9)	175 (272.79) ** +++	140 (228.15)	8,457 (14,055.09) ** +	6,750 (10,063.35)
60 (187)	12 (17.8) *** +++	6 (10.33)	180 (292.7) ** +	150 (229.9)	9,360 (16,319.47) *** +++	6,900 (10,366.34)
72 (164)	14 (19.67) *** +++	7 (11.74)	200 (325.72) ** ++	170 (252.85)	10,245 (18,520.41) *** +++	7,595 (10,879.98)
End of promotion length (219)	13 (20.57) *** +++	8 (12.24)	230 (365.95) ** +++	200 (286.40)	11,200 (19,502.10) **	9,360 (13,074.30)

Table C3. Comparison Results for H&F Deals Based on Hours After a Deal Being Posted
(Median Values with Mean Values in Parentheses)

Hours After a Deal Being Posted (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
2 (169)	0 (0.37) *** +++	0 (0.60)	1 (3.63) ** +++	0 (1.21)	39 (143.34) *** +++	0 (41.06)
12 (169)	6 (13.04) *** +++	3 (6.56)	49 (81.82) *** +++	20 (55.51)	2,520 (3,981.93) *** +++	1,110 (2,219.35)
24 (169)	11 (26.91) *** +++	5 (13.79)	100 (166.22) *** +++	50 (111.89)	5,040 (8,552.69) *** +++	2,610 (4,900.76)
36 (169)	14 (31.04) *** +++	6 (16.30)	120 (201.32) *** +++	70 (136.17)	6,321 (10,499.31) *** +++	3,190 (5,903.80)
48 (165)	16 (37.30) *** +++	8 (20.05)	150 (248.97) *** +++	90 (169.12)	8,000 (12,964.89) *** +++	4,100 (7,408.88)
60 (133)	16 (42.96) *** +++	8 (18.78)	160 (271.8) *** +++	100 (168.27)	8,260 (14,410.67) *** +++	4,410 (7,549.46)
72 (118)	16 (46.71) *** +++	9 (20.33)	185 (300.69) *** +++	120 (197.78)	10,195 (17,031.96) *** +++	5,305 (9,013.44)
End of promotion length (169)	20 (44.99) *** +++	10 (29.47)	220 (318.15) *** +++	140 (232.81)	11,040 (23,399.60) *** +++	6,860 (12,006.80)

Table C4. Comparison Results for REST Deals Based on Hours After a Deal Being Posted
(Median Values with Mean Values in Parentheses)

Hours After a Deal Being Posted (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
2 (221)	0 (0.56) *** +++	0 (0.38)	3 (5.23)	3 (5.93)	66 (102.95)	60 (111.65)
12 (221)	10 (13.88) *** +++	6 (11.98)	160 (217.77)	150 (249.96)	3,300 (4,706.82)	3,200 (4,769.99)
24 (221)	22 (27.89) *** +++	13 (22.73)	320 (416.12)	290 (401.45)	7,000 (9,237.98) ** ++	6,240 (8,171.81)
36 (221)	24 (32.45) *** +++	15 (25.52)	390 (483.91)	350 (445.62)	8,320 (10,824.43) *** ++	7,200 (9,175.31)
48 (218)	29 (37.61) *** +++	17 (28.92)	460 (559.22) **	400 (484.82)	9,850 (12,608.39) *** +++	8,405 (10,240.41)
60 (191)	28 (37.98) *** +++	19 (30.24)	500 (592.38) **	410 (493.66)	10,650 (13,473.44) *** ++	8,800 (10,835.13)
72 (164)	31 (41.57) *** +++	20 (32.34)	525 (635.8) ***	435 (509.21)	11,450 (14,917.04) *** ++	9,000 (11,487.32)
End of promotion length (221)	32 (44.05) *** +++	21 (33.13)	570 (654.18) *	510 (560.77)	12,000 (14,909.40) *** +++	10,000 (12,038.70)

APPENDIX D**Tables for Analysis of All Deals Including Failed *MR* Deals**

Table D1. Summary of Wilcoxon Rank Sum Test for Larger Median of Two Groups of Deals (Group Means in Parentheses) with Failed Deals Included

	A&E		B&S		H&F		REST	
	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>	<i>MR</i>	<i>NMR</i>
# of deals	228	494	303	413	197	313	354	325
Price (\$)	20 (34.26)	25*** (37.87)	39 (63.19)	45*** (83.87)	45 (126.91)	40 (357.08)	20 (22.17)	20 (23.93)
Discount rate (%)	51 (53.00)	51 (52.97)	56 (60.24)	58 (61.51)	64 (66.21)	67 (67.63)	51 (53.70)	51 (54.30)
Promotion length (days)	3 (3.43)	3*** (3.81)	3 (3.34)	4*** (3.97)	3 (3.47)	4*** (4.05)	3 (3.11)	4*** (3.73)
Featured	0 (0.14)	0 (0.11)	0 (0.10)	0 (0.08)	0** (0.10)	0 (0.05)	0 (0.10)	0 (0.08)
Coupon duration (days)	111*** (129.21)	61 (95.94)	187*** (231.87)	186 (199.69)	186*** (200.03)	185 (179.24)	185*** (169.84)	152 (151.42)
Limited supply	1 (0.77)	1** (0.85)	1 (0.76)	1 (0.80)	1 (0.69)	1*** (0.81)	1*** (0.79)	1 (0.70)

Table D2. Comparison Results Over Time for All A&E Deals Including Failed Deals (Median Values with Mean Values in Parentheses)

Hours After Meeting <i>MR</i> (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (201)	3 (6.19) * ++	2 (5.61)	15 (24.16) *** +++	5 (26.77)	300 (658.44) ** +++	126 (624.67)
10 (201)	29 (52.95) *** +++	14 (29.37)	100 (225.25) *** +++	50 (169.4)	2,241 (5,761.5) ** ++	1,535 (3,915.39)
20 (200)	38 (68.02) *** +++	19 (36.9)	140 (273.42) *** +++	80 (201.31)	2,930 (7,047.97) ** ++	2,030 (4,751.89)
30 (199)	44 (82.46) *** +++	23 (44.84)	180 (346.30) *** +++	100 (238.61)	3,700 (9,238.12) ** +	2,720 (5,769.23)
40 (143)	52 (100.8) *** ++	28 (54.84)	220 (433.41) ** ++	130 (291.2)	4,977 (11,614.41) *	3,600 (7,505.77)
End of promotion length (201)	54 (109.31) *** +++	30 (66.96)	250 (479.20) ** ++	170 (353.28)	5,890 (13,583.90)	4,920 (9,375.40)

Table D3. Comparison Results Over Time for All B&S Deals Including Failed Deals
(Median Values with Mean Values in Parentheses)

Hours After Meeting <i>MR</i> (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (225)	1 (1.20) * ++	0 (0.93)	13 (16.92) ** +++	8 (18.80)	585 (882.64) *** +++	290 (821.31)
10 (225)	6 (10.04) *** +++	4 (6.16)	100 (165.84) ** ++	80 (141.69)	4,800 (8,250.68) *** ++	3,570 (5,985.68)
20 (225)	8 (12.81) *** +++	4 (7.53)	120 (210.80) ** +	100 (173.97)	5,976 (10,364.12) *** +++	4,810 (7,402.78)
30 (225)	10 (14.80) *** +++	5 (8.81)	150 (245.90) **	120 (203.39)	7,200 (12,113.07) *** ++	5,880 (8,798.63)
40 (202)	11 (16.79) *** +++	6 (9.95)	175 (300.16) ** +	140 (225.10)	8,695 (15,492.8) *** +++	6,410 (9,646.59)
End of promotion length (225)	13 (20.08) *** +++	8 (12.00)	220 (356.19) ** ++	200 (282.85)	10,890 (18,982.04) *	9,360 (12,959.08)

Table D4. Comparison Results Over Time for All H&F Deals Including Failed Deals
(Median Values with Mean Values in Parentheses)

Hours After Meeting <i>MR</i> (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (171)	1 (3.68) *** +++	0 (2.35)	14 (17.67) *** +++	5 (15.22)	700 (1,114.79) *** +++	190 (599.27)
10 (171)	10 (21.73) *** +++	5 (11.08)	84 (133.20) *** +++	48 (92.06)	4,350 (6,902.68) *** +++	2,030 (4,057.15)
20 (171)	12 (27.20) *** +++	6 (14.30)	110 (171.12) *** +++	60 (115.03)	5,340 (8,848.02) *** +++	2,610 (5,043.11)
30 (171)	14 (32.06) *** +++	7 (17.05)	130 (211.18) *** +++	80 (145.69)	6,650 (11,142.37) *** +++	3,330 (6,283.98)
40 (136)	15 (39.61) *** +++	7 (17.16)	140 (250.65) *** +++	85 (152.05)	7,445 (13,334.77) *** +++	3,920 (6,986.92)
End of promotion length (171)	19 (44.54) *** +++	10 (29.23)	210 (314.43) *** +++	140 (230.44)	11,040 (23,125.95) *** +++	6,670 (11,915.12)

Table D5. Comparison Results Over Time for All REST Deals Including Failed Deals
(Median Values with Mean Values in Parentheses)

Hours After Meeting <i>MR</i> (Number of Pairs)	Facebook Likes <i>MR</i>	Facebook Likes <i>NMR</i>	Quantity of Coupons Sold <i>MR</i>	Quantity of Coupons Sold <i>NMR</i>	Total Revenue <i>MR</i>	Total Revenue <i>NMR</i>
0 (222)	2 (2.57)	1 (3.14)	25 (35.18) +++	20 (72.97)	503 (778.43) +++	336 (1,231.74)
10 (222)	17 (21.77) *** +++	10 (19.19)	260 (343.29)	240 (344.96)	5,550 (7,543.68)	4,900 (6,886.75)
20 (222)	22 (28.38) *** +++	13 (23.09)	330 (431.15)	300 (408.69)	7,185 (9,503.90) ** +	6,370 (8,343.91)
30 (222)	26 (33.17) *** +++	15 (26.28)	405 (501.41)	360 (455.28)	8,633 (11,167.51) ** ++	7,470 (9,397.60)
40 (200)	28 (37.37) *** +++	17 (28.36)	460 (570.84) **	390 (479.65)	10,040 (12,745.74) *** +	8,300 (10,320.03)
End of promotion length (222)	32 (43.86) *** +++	22 (33.09)	570 (651.23) *	505 (559.96)	11,950 (14,842.20) *** ++	10,000 (12,010.14)

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Received March 2014; revised March 2015; accepted April 2015