Is that Deal Worth My Time? The Interactive Effect of Relative and Referent Thinking on Willingness to Seek a Bargain

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Web Appendix

This appendix consists of three sections. In Section A, we revisit the assumption (considered in the main body of the paper) that the availability of promotion is certain. We show that the results do not change when the availability of promotion is assumed to be uncertain. In Section B, we revisit the assumption (considered in the main body of the paper) that the monetary saving is smaller than the deviation from the reference price. We show that the results do not change when the saving is assumed to be larger than the deviation. In Section C, we provide a numerical calibration of the reference-price deviation within which the relative-thinking effect reverses.

A. ANALYSIS FOR THE CASE OF UNCERTAIN PROMOTION AT STORE 2

In the main body of the paper, we assumed that the consumer at Store 1 considers the promotion (x) at Store 2 to be certain. Here, we briefly consider the case where the availability of promotion at Store 2 is uncertain, and let us denote this uncertainty by ψ. (Uncertainty in the magnitude of the promotion can also be considered similarly.) A customer at Store 1 believes that with probability $\psi < 1$, there exists a promotion x at Store 2, and with probability (1-ψ), that there is no promotion. If $a \leq 0$, that is, when faced with a lower-than-expected price at Store 1, the customer would go to Store 2 to receive an (uncertain) saving of x if:

$$\underbrace{\psi[-(p_r - |a| - x)^{\beta} + (|a| + x)^{\alpha}]}_{\text{Store 2 offers promotion}} + \underbrace{(1-\psi)[-(p_r - |a|)^{\beta} + (|a|)^{\alpha}]}_{\text{Store 2 does not offer promotion}} - c > -(p_r - |a|)^{\beta} + (|a|)^{\alpha}, \text{ or if}$$

$$c < \psi[(p_r - |a|)^{\beta} - (p_r - |a| - x)^{\beta}] + [(|a| + x)^{\alpha} - (|a|)^{\alpha}].$$

In other words, if $a \leq 0$, the probability that the consumer will go to Store 2 will be:

$$\text{(W1)} \quad \Pr(\text{Purchase at Store 2} / a \leq 0) = F(\psi\underbrace{[(p_r - |a|)^{\beta} - (p_r - |a| - x)^{\beta}}_{\text{Price Saving}} + \underbrace{(|a| + x)^{\alpha} - (|a|)^{\alpha}]}_{\text{Gain Enhancement}}).$$

Notice that (W1) is analogous to equation (8) in the paper except for the scaling by uncertainty factor ψ. That is, the probability of traveling to Store 2 decreases if uncertainty exists regarding the availability of promotion.

Similarly, if *a > 0*, that is, when faced with a higher-than-expected price at Store 1, the customer would go to Store 2 to receive a saving of x if:

(W2) $$\Pr(\text{Purchase at Store } 2 / a > 0) = F(\psi\underbrace{[(p_r + |a|)^\beta - (p_r + |a| - x)^\beta}_{\text{Price Saving}} + \lambda\underbrace{((|a|)^\beta - (|a| - x)^\beta)}_{\text{Loss Attenuation}}]) .$$

Again, (W2) is analogous to equation (9). Therefore, both equations above are similar to the ones in the paper, except for the scaling factor ψ. In fact, when faced with uncertainty ψ, the range (x, $|a|^*$] in which the referent-thinking effect is dominant would be exactly the same as in the case when no uncertainty exists. In Section (C), we rely on equations (8) and (9) from the paper to numerically calibrate $|a|^*$, the point at which relative thinking reverses to referent thinking. The same $|a|^*$ will be obtained using the above equations (W1 and W2) because the scaling factor ψ is common across the two equations.

B. ANALYSIS FOR THE CASE OF X > A

As explained in the main body of the paper, our focus has been on the case of $x \le a$, that is, when the monetary saving accrued to a consumer is small compared to the deviation from the reference price. For this case, we showed that the relative-thinking effect—consumers being more willing to seek a bargain on low rather than high prices—can be reversed. Specifically, when actual prices are in the region around the reference price (i.e., deviation occurs but is not extreme), the referent-thinking effect arises. In this section, we show that this reversal replicates even when x > a, that is, when the monetary saving accrued to a consumer is large compared to the deviation from the reference price.

The overall utility associated with a purchase involving an actual price payment of p_a at Store 1 is given by:

(W3) $$u_1(a, p_r) = \begin{cases} -(p_r - |a|)^\beta + (|a|)^\alpha & \text{for } a \le 0 \\ -(p_r + |a|)^\beta - \lambda(|a|)^\beta & \text{for } a > 0 \end{cases} \cdot$$

If the consumer buys from Store 2, her overall utility is given by:

(W4) $$u_2(a, p_r, x) = \begin{cases} -(p_r - |a| - x)^\beta + (|a| + x)^\alpha - c & \text{for } a \le 0 \\ -(p_r + |a| - x)^\beta + (x - |a|)^\alpha - c & \text{for } a > 0 \end{cases} .$$

Equation W4 is analogous to the equation 6 in the paper. But notice here that since x is greater than a, the consumer who was incurring a loss at Store 1 (*a>0*) would now be in the gain condition at Store 2.

Using the analysis performed in the paper, we can derive the probability that the consumer will go to Store 2 as follows:

(W5) $$\Pr(\text{Purchase at Store } 2 / a \le 0) = F(\underbrace{[(p_r - |a|)^{\beta} - (p_r - |a| - x)^{\beta}]}_{\text{Price Saving}} + \underbrace{[(|a| + x)^{\alpha} - (|a|)^{\alpha}]}_{\text{Gain Enhancement}}).$$

(W6) $$\Pr(\text{Purchase at Store } 2 / a > 0) = F(\underbrace{[(p_r + |a|)^{\beta} - (p_r + |a| - x)^{\beta}]}_{\text{Price Saving}} + \lambda \underbrace{(|a|)^{\beta} + (x - |a|)^{\beta}]}_{\text{Loss Attenuation}}).$$

As before, let us define the following for clear exposition:

$$\Delta_{11} \equiv (p_r - |a|)^{\beta} - (p_r - |a| - x)^{\beta} \quad \text{(Price saving in the gain domain)},$$

$$\Delta_{21} \equiv (|a| + x)^{\alpha} - (|a|)^{\alpha} \quad \text{(Gain enhancement in the gain domain)},$$

$$\Delta_{31} \equiv (p_r + |a|)^{\beta} - (p_r + |a| - x)^{\beta} \quad \text{(Price saving in the loss domain), and}$$

$$\Delta_{41} \equiv \lambda(|a|)^{\beta} + (x - |a|)^{\alpha} \quad \text{(Loss attenuation in the loss domain).}$$

As before, $\Delta_{11} - \Delta_{31}$ denotes the relative-thinking effect and $\Delta_{41} - \Delta_{21}$ denotes the referent-thinking effect. Note that, as before, $\partial(\Delta_{11} - \Delta_{31}) / \partial|a| > 0$. That is, the relative-thinking effect *increases* as the difference between prices increases. On the other hand, diminishing sensitivity and loss aversion imply that $\Delta_{41} \ge \Delta_{21}$. Moreover, as $|a|$ goes up, in contrast to the case analyzed in the paper, Δ_{21} goes down but Δ_{41} goes up, $\partial(\Delta_{41} - \Delta_{21}) / \partial|a| > 0$. That is, the referent-thinking effect *increases* as the difference between prices increases. But notice that the referent-thinking effect increases *faster* than the relative-thinking effect. And hence there exists a value of $|a|$ denoted by $|a_1|^*$ above which consumers faced with a high price ($p_r + |a|$) are more likely to seek a saving than consumers faced with a low price ($p_r - |a|$), representing a reversal of the relative-thinking effect. In other words, we hypothesize that there exists an $|a| = |a_1|^*$ such that we have the following for $|a| \in (|a_1|^*, x]$:

(W7) $$\Pr(\text{Purchase at Store } 2 / a > 0) > \Pr(\text{Purchase at Store } 2 / a \le 0).$$

The reversal denoted by equation W7 holds even deviations are very small. Consider a small deviation of say $|a| = \varepsilon$ which is very close to zero. In that case we have:

$$\Pr(\text{Purchase at Store 2} / a > 0) \approx F[(p_r)^\beta - (p_r - x)^\beta + \lambda\varepsilon^\beta + x^\alpha], \text{ and}$$

$$\Pr(\text{Purchase at Store 2} / a \le 0) \approx F[(p_r)^\beta - (p_r - x)^\beta + x^\alpha - \varepsilon^\alpha].$$

Clearly, in this case, $\Pr(\text{Purchase at Store 2} / a > 0) > \Pr(\text{Purchase at Store 2} / a \le 0)$ since $\lambda > 0$. Also, because we have shown that the referent effect increases faster as $|a|$ goes up, this reversal continues to hold as $|a|$ goes up. Notice that the upper bound of $|a|$ is *x*, so we can say that for $|a| \in (0, x]$, the relative-thinking effect is dominated by the referent-thinking effect.

Taking the above results together with the results presented in the main body of the paper, we conclude that the referent-thinking effect dominates the relative-thinking effect in the region around the reference price, irrespective of whether x is smaller than a, or larger.

C. NUMERICAL CALIBRATION OF $|a|^*$

In this section, we show how a numerical expression of the $|a|^*$ hypothesized in the paper can be calculated. Recall that we defined $|a|^*$ as a value of $|a|$ below which consumers faced with a high price ($p_r + |a|$) are more likely to seek a saving than consumers faced with a low price ($p_r - |a|$), representing a reversal of the relative-thinking effect. In other words, we hypothesize that there exists an $|a| = |a|^*$ such that we have the following for $|a| \in (x, |a|^*]$:

$$\Pr(\text{Purchase at Store 2} / a > 0) > \Pr(\text{Purchase at Store 2} / a \le 0).$$

The cut-off point $|a|^*$ that determines the reversal is given by the following equation:

$$\text{(W8)}\quad [(p_r - |a|^*)^\beta - (p_r - |a|^* - x)^\beta] + [(|a|^* + x)^\alpha - (|a|^*)^\alpha] = [(p_r + |a|^*)^\beta - (p_r + |a|^* - x)^\beta] + \lambda[(|a|^*)^\beta - (|a|^* - x)^\beta].$$

The above equation, W8, is highly non-linear and a closed form solution for this is not feasible, but a close approximation of the solution can be obtained using Taylor's series. Recall that:

$$\Delta_3 \equiv (p_r + |a|)^\beta - (p_r + |a| - x)^\beta.$$

This can be written as:

$$\Delta_3 \equiv (p_r)^{\beta}[(1+\frac{|a|}{p_r})^{\beta} - (1+\frac{|a|-x}{p_r})^{\beta}].$$

Since $\frac{|a|}{p_r} < 1$ and $\frac{|a|-x}{p_r} < 1$, we use Taylor Series to expand this expression as well as other expressions, which yields (ignoring terms higher than second order) the following:

$$\Pr(\text{Purchase at Store } 2 / a > 0) > \Pr(\text{Purchase at Store } 2 / a \le 0) \text{ if:}$$

$F(\Delta_3 + \Delta_4) > F(\Delta_1 + \Delta_2)$, which implies:

$$(\Delta_3 + \Delta_4) > (\Delta_1 + \Delta_2).$$

This yields:

$$\underbrace{\Delta_4 - \Delta_2}_{\text{Referent-Thinking Effect}} > \underbrace{\Delta_1 - \Delta_3}_{\text{Relative-Thinking Effect}}.$$

This immediately implies at $|a|^*$:

$$\underbrace{\Delta_4 - \Delta_2}_{\text{Referent-Thinking Effect}} = \underbrace{\Delta_1 - \Delta_3}_{\text{Relative-Thinking Effect}}.$$

Hence, we get the following implicit equation (after Taylor Series expansion) whose solution yields the value of the cut-off $|a|^*$:

(W9) $$\frac{2|a|^* x\beta(1-\beta)}{(p_r)^{2-\beta}} = \frac{\lambda x\beta}{(|a|^*)^{1-\beta}}\left[1+\frac{x(1-\beta)}{2(|a|^*)}\right] - \frac{\alpha x}{(|a|^*)^{1-\alpha}}\left[1-\frac{x(1-\alpha)}{2(|a|^*)}\right].$$

Note that since RHS decreases in $|a|$, for $(x, |a|^*]$,

$$(\Delta_3 + \Delta_4) \ge (\Delta_1 + \Delta_2).$$

Furthermore, since the lower support of $|a|$ is x, a necessary condition for $|a|^*$ to exist is:

(W10) $$\frac{\lambda\beta}{x^{2-\beta}}\left[1+\frac{(1-\beta)}{2}\right] - \frac{\alpha}{x^{2-\alpha}}\left[1-\frac{(1-\alpha)}{2}\right] > \frac{2\beta(1-\beta)}{p_r^{\,2-\beta}}.$$

Formally stated, if *x* is sufficiently small relative to p_r in that it satisfies the condition W10, then for $x \le |a|$, there exists an $|a|^*$ such that for $|a| \in (x, |a|^*]$, the probability that a consumer incurs effort to obtain a saving *x* is higher at a price $(p_r + |a|)$ compared to a consumer facing a price $(p_r - |a|)$. The approximate value of $|a|^*$ is given by the solution of the implicit equation W9. Inserting the numerical values of the parameters, the equation can solved using standard numerical equation solving methods.

An examination of the solution contained in equation W9 sheds light on the trade-off between the relative-thinking effect and referent-thinking effect. The relative-thinking effect is captured by the left hand side. It strengthens as $|a|$ goes up, and the difference between the two prices ($p_r - |a|$ and $p_r + |a|$) increases. On the other hand, the referent-thinking effect is captured by the right hand side. It weakens as $|a|$ goes up, and the two prices diverge farther away from the reference point. At a point $|a|^*$, the two effects become equal, and when $|a| < |a|^*$, the referent-thinking effect dominates, leading to a reversal of the relative-thinking effect.