Consumption Effects of Bundling: Consumer Perceptions, Firm Actions, and Public Policy Implications

Kathryn M. Sharpe and Richard Staelin

The authors investigate consumer, firm, and policy implications of the fast-food marketing practice of bundling a soft drink and French fries with an entrée (i.e., "the combo meal") and then offering these three items at a discount. The authors first demonstrate that this practice increases the customer's perceived value of the bundled items. In addition to the traditional economic rationale for consumer purchases of bundles, the authors find that consumers view the bundle as having value beyond the notion of a discount or the perception of the items as complements. The authors attribute this increased value to both the reduction in ordering costs and the promotional effects associated with purchasing the bundle. They also find that consumers become more price sensitive to all goods offered when bundled goods are offered. The authors use this knowledge to determine the impact of several public policy strategies that are focused on reducing consumers' caloric intake. They demonstrate that proposed taxation on soft drinks has little effect on reducing overall caloric consumption when a bundle is present. They also show that it is possible to maintain profits while reducing caloric consumption by at least 10% if the industry as a whole reduces the portion sizes of drinks and fries associated with the combo meals.

Keywords: bundling, fast food, price sensitivity, product promotions, policy optimization, hierarchical Bayes

Over the past five decades, Americans have been consuming more calories, have been gaining weight, and are now more likely to become obese (Carangelo 1995; Cutler, Glaeser, and Shapiro 2003; Popkin and Nielsen 2003; Young and Nestle 2002). These changes in eating habits can be attributed to many sources. However, given the magnitude of fast-food consumption (a $154.7 billion global industry; Datamonitor 2009b), this article examines one possible source of increased consumption: the marketing practice introduced by fast-food restaurants of bundling an entrée, a soft drink, and French fries at a price discount (i.e., "the combo meal" or " the value meal"). We chose this particular marketing practice for two reasons: (1) First, the magnitude and growth of the fast-food industry globally merited special attention, and second, (2) the drink and French fry portions normally found in a combo bundle represent approximately 530 calories (not including the entrée), a figure that is approximately 25% of the recommended daily caloric intake of an adult.

We begin our discussion by noting that when bundling items together, firms often find that consumers purchase items that they would not ordinarily purchase if the items were only available individually (Stremersch and Tellis 2002). For example, in a study, which we describe subsequently, that uses the fast-food industry as the context, we find that the demand for French fries increases when a bundle is offered. More specifically, 15% of customers who did not purchase fries in an à la carte–only offering purchased fries when a bundle was present; furthermore, 26% of the sample who had originally purchased fries à la carte increased their portion sizes when a bundle was offered.

We study the implications of this bundling practice on food consumption by first investigating several influences that might affect the consumer's valuation of a bundle and how this valuation affects the pricing and bundling practices of the firm. We then use this knowledge to investigate the effects of possible public policy solutions that take into consideration both consumer and firm behavior. We do this by explicitly recognizing the following four stylized facts pertaining to current bundling practices in the fast-food

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industry: First, many bundles are sold at a discount relative to the prices of the individual items that make up the bundle. This may lead consumers to view bundles as price promotions. Second, firms often "feature" the bundle in the information provided to the consumer. It is well known that featured items often result in increased sales, even when there is no change in price (Inman, McAlister, and Hoyer 1990). Third, firms use different information formats to feature the bundle, thereby varying the degree to which they make the bundle and its price more salient. For example, in some cases, firms place the bundle price and information near the price of the major item within the bundle, while in other cases, they place this bundle information in an area separate from information about the individual items (see Figure 1). In line with Harlam and colleagues (1995), who study the impacts of format on complementarity, we examine how different menu formats can lead to different consumer behavior. Fourth, by bundling several related items, firms can make it easier for consumers to find, consider, and order the collection of items than to find, select, and order each of the individual items. This reduction in ordering and search costs could alter consumers' valuation of the bundle net of all costs.

We use these four stylized facts to generate a series of hypotheses and corresponding models to determine how consumers value a bundle. We test each of the models using data obtained from a national sample of adults who were asked to participate in several virtual shopping experiences. Next, we use these data to estimate (1) participants' value of the individual items, (2) their price sensitivity, and (3) the value of possible bundle-specific effects, such as reducing consumers' ordering costs or increasing their price sensitivity. We then use the results of this estimation to develop a firm demand function, which in turn enables us to evaluate the optimality of different firm pricing strategies and, thus, proposed public policies, such as taxation and size standards, directed at fast-food firms to reduce caloric consumption.

Figure 1. Combo Meal Menu Examples

A: Combo Separate

B: Combo Together

Literature Review

Most of the initial work on bundling comes from the economics literature and takes the perspective of the firm. The overarching objective of this literature is to determine the conditions under which a firm should offer a bundle of products instead of, or in addition to, selling these products separately (Adams and Yellen 1976; Bakos and Brynjolfsson 1999; Guiltinan 1987; Matutes and Regibeau 1992; McAfee, McMillan, and Whinston 1989; Salinger 1995; Schmalensee 1982). This literature examines three different product offering strategies. In the first, only bundles of goods are offered; no items are offered individually. This situation is referred to as a "pure bundling" strategy. In the second, individual items along the bundled offerings are available. This is referred to as a "mixed bundling" strategy. These two strategies are contrasted with the third case in which firms do not bundle goods or services—that is, an "unbundled" or "pure component" strategy (Stremersch and Tellis 2002).

The traditional justification found in this literature for bundling is that the bundle "transfers" some of a consumer's surplus associated with one item in the bundle to another item that initially has a negative surplus, thus making the overall bundle have positive consumer utility. Firms can then extract some of this surplus by adjusting prices to make the bundle more attractive, thus increasing its sales. Other researchers have extended this explanation by noting that consumers may view the bundled items as synergistic (complementary). This implies that consumers value the bundle more than the sum of the values of the individual items and thus will have a positive incentive to purchase the bundle (e.g., Venkatesh and Kamakura 2003).

Several researchers have developed methods for a firm to determine the optimal mixed bundling pricing scheme for a particular portfolio of product offering, conditional on the firm knowing its consumers' evaluations for each product and bundle (e.g., Jedidi, Jagpal, and Manchanda 2003; Venkatesh and Kamakura 2003). This literature is empirical and is concerned with both measuring consumers' valuations of each item being sold and solving for the optimal set of prices. A general observation that comes from this literature (and the examples used in the initial bundling literature) is that the bundled price under the mixed bundling solution tends to be lower than the sum of the individual products—that is, the bundle is sold at a "discount." However, this discount can be illusionary because firms may find that it is in their best interest to increase the prices of the individual items in the mixed bundling condition relative to the prices in the unbundled condition.

A parallel stream of bundling research focuses on the consumer and the psychological effects associated with bundling. Instead of assuming that consumers behave as postulated in the traditional economically oriented work, this research stream uses consumer behavior paradigms, such as anchoring and adjusting (Tversky and Kahneman 1974), prospect theory (Kahneman and Tversky 1979), mental accounting (Thaler 1985), and the cost of thinking (Shugan 1980), to posit how consumers aggregate their valuations for the individual items to form an evaluation of the bundle. In general, this behavioral work is conceptual and/or experimental and uses choice data (or some relevant surrogate, such as purchase intentions) to explore issues such as (1) how consumers integrate information about the items within a bundle (e.g., Janiszewski and Cunha 2004; Yadav 1994), (2) why a single bundle price increases the likelihood to purchase (e.g., Drumwright 1992; Gaeth et al. 1990; Yadav and Monroe 1993), (3) why consumers low on the need for cognition tend to prefer a bundled option (Harris and Blair 2006), (4) how consumers are affected by different presentations of each individual item's price and the discount (Johnson, Herrmann, and Bauer 1999; Soman and Gourville 2001; Yadav and Monroe 1993), and (5) why consumers might decrease their consumption of items purchased in a bundle compared with items purchased separately (Prelec and Lowenstein 1998; Soman and Gourville 2001).

Given our overarching goal of determining empirically which of the many bundling effects actually affect the consumer's valuation of the bundle and the magnitude of these effects, we sequentially develop (and estimate) a model that captures both the economic and the behavioral effects. We begin with a traditional rational utility model and then augment this model to capture other hypothesized effects. This nested modeling approach helps us (1) isolate factors that affect a consumer's choice between buying a bundle of items sold, possibly at a discount, and purchasing just a subset of these items at list prices; (2) measure the magnitude of each of these effects; and (3) determine how this magnitude might be altered by the particular purchasing environment.

Although we address these issues within the context of the fast-food industry and the practice of offering a combo meal, we believe that our findings generalize to other industries. For example, it should be a trivial extension to apply our findings to the practice found in many metropolitan restaurants of bundling an entrée with two or more side dishes. More distant extensions might include the bundling of cosmetics (skin care and makeup) or entertainment (e.g., season tickets). In any case, the fast-food industry is significant in its own right, with $68.2 billion in sales in the United States and $154.7 billion globally (Datamonitor 2009a, b). From a policy perspective, the major health implications of the caloric content of the food served by the industry is reason enough to explore this context further.

In the next section, we provide an overview of the empirical study used to obtain the data we need to estimate our nested models. We then sequentially discuss each model used to capture the factors that might influence participants' decision to buy a soft drink and fries. This discussion is followed by a brief synopsis of how we estimate the models, and then we present our study results. Finally, we use these results to explore the implications of several approaches that could be used to alter firm and/or customer behavior, with the overarching goal of reducing the consumer's caloric consumption.

Study Design

The purpose of our empirical study is to better understand the purchase behavior of consumers who obtain meals at fast-food outlets, with the ultimate goal of using this knowledge to explore the implications of different policies aimed at curbing the caloric intake associated with the fast-food industry. To study this behavior, we used an experimental setting similar to our previous work (Sharpe, Staelin, and Huber 2008), in which we estimated the impact of extremeness aversion (Kivetz, Netzer, and Srinivasan 2004; Simonson 1989) among soft drink consumers and, in the process, provided strong evidence for the external validity of the general experimental approach. The idea used in both studies was to have participants imagine that they were going on a cross-country road trip and that along the way they would be "visiting" nine different fast-food outlets. Before beginning their virtual road trip, participants viewed pictures of the types of items they could choose at each of the restaurant stops. At each outlet, the participants were asked to choose from a menu of items (i.e., entrées, drinks, and fries), and then they were shown the amount they spent on their selected meal.

In our new study, the main manipulation is the menu format. The first two menu formats include bundles (the entrée, drink, and fries) and separate items. In one of these mixed bundling menus, the price of the bundle and the price of the entrée alone are in close proximity—we refer to this as the "Combo Together" format (see Figure 2, Panel A)[1]—while in the other mixed bundling context, the price of the entrées are separate from the relevant combo price—we refer to this as the "Combo Separate" format (see Figure 2,

[1]Note that none of the menus in our study contain pictures of the entrées offered. Instead, participants only saw pictures of some of the entrées before launching their road trip. Thus, our menus deviate somewhat from standard industry practice of featuring each bundled combo with a picture. This difference may reduce the saliency of the bundle. Thus, the magnitudes of our bundle-specific estimates are conservative.

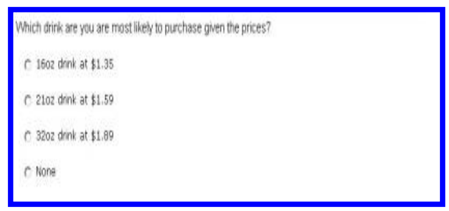
Figure 2. Menu Examples

A: Combo Together

B: Combo Separate

C: À la Carte Menu

D: Conjoint Question Example



Panel B). In the third format, the menu only includes individual items—we refer to this as the "À la Carte" format (see Figure 2, Panel C). However, note that all the menus allow the participants to choose à la carte options (entrées, fries, and drinks). Thus, the variation is whether bundled meals are offered and, if so, how the bundles are formatted. In addition to the three menu formats, each participant saw three price levels, three different food types, and three different drink size offerings. The prices on a particular menu were the base prices, a 9% reduction ("low" price) from the base price, or a 9% increase ("high" price) from the base price. The food type manipulation varied the entrées (chicken, grill, and beef) to increase realism and to provide variation across the different road trip visits. As we found in our previous research (Sharpe, Staelin, and Huber 2008), this variation does not affect drink and fry purchase behavior. The drink sizes manipulation varied the sizes of drinks available; we included this to determine whether it was possible to replicate the extremeness aversion results in our previous research. In the current study, participants always viewed 16-ounce, 21-ounce, and 32-ounce drink sizes (i.e., "core" drink size offering); however, on occasion, we also added a 12-ounce size to the core offering (i.e., "low" drink size offering) or a 44-ounce size to the core offering (i.e., "high" drink size offering). This drink size manipulation implies that, at times, the 16-ounce drink was the smallest drink size available, while at other times, the 12-ounce was the smallest. Likewise, at times, the 32-ounce drink was the largest drink available, and at other times, the 44-ounce drink was the largest.

Our $3 \times 3 \times 3 \times 3$ design yields 81 conditions with varying menu formats, food types, drink choice sets, and price levels. Each participant saw 9 conditions (of the possible 81), selected using an orthogonal, one-ninth fraction Graeco-Latin square design (Winer et al. 1991). This enabled us to estimate each main effect for each participant. Across participants, there were 9 possible Graeco-Latin squares, and we randomly assigned participants to one of these conditions, thus allowing interactions to be estimated across participants (more details on the specific Graeco-Latin square design of this study are available on request). Finally, 11% of the combo meal stops had no price reduction for the combo meal, while the remaining stops had a 5% discount from the individual item prices.

After the road trip, participants were asked to complete 24 choice tasks. These tasks varied price and included 6 tasks in which participants chose among three or four different drink sizes (for an example, see Figure 2, Panel D), 6 tasks in which participants chose among three different fry sizes, and 12 tasks in which participants chose between two complete meals (a drink size, a fry size, and the person's favorite entrée), all at different prices. In each case, we also gave participants a no-purchase option. These 24 choices along with the 9 road trip choices made 33 choices in all for each participant.

Note that this design enables us to isolate several different effects. Thus, the latter 24 choices provide additional data to isolate price sensitivities and to better assess the participant's valuation of each drink size and fry size. By using a within-subject design in which each participant purchases from both combo menus and the à la carte menu, we are able to estimate the effects of each format on the person's purchase behavior, after controlling for the person's valuations. In addition, by including situations in which a person can "bundle" the two items together without buying the combo meal, we are able to estimate the person's assessment of whether the two products are complements or substitutes. We take advantage of these variations when discussing our proposed model and how we might identify the many factors that could influence a consumer's purchase behavior.

Model Development

Our goal in this section is to develop sequentially a series of models that capture the important factors that influence a consumer's decision to buy a soft drink and/or fries and, if so, which sizes.[2] We begin this development with a rational utility model that includes the context-free valuation for each of the available items in the choice option as well as the listed prices of these items. Specifically, we assume that consumers maximize their individual utility when they choose a fry size and drink size pair:

$$(1) \qquad U_{ijk} = Drink_{ij} + Fry_{ik} + G_i + \varepsilon_{ijk}, \quad \text{subject to } p_j + p_k + G_i = I_i,$$

where U_{ijk} is individual i's utility of choosing options j and k, $Drink_{ij}$ is the value of a drink size j, Fry_{ik} is the value of a fry size k, G_i is the value of all other goods purchased by person i, and ε_{ijk} is the assumed error not captured in the estimation of the utility model. The combined price of drink j (p_j), the price of fry size k (p_k), and the price of all other goods (G_i) equals individual i's expendable income (I_i). Next, we make several nonrestrictive assumptions. First, we scale utility by assuming that the price of the outside goods is $1/\tau_i$. Second, we do not assume a specific functional form for the utility of drinks and fries. Instead, we treat these as discrete utilities that are captured with size dummy variables, one for each size (including the no-purchase option). Third, we acknowledge that consumers might be influenced by the actual portfolio of drink sizes available and the identity of the smallest and largest drink sizes available. This leads us to specify the drink utility in terms of the specific choice set, S, of drinks available. Finally, we assume that there is no income effect and, thus, that this variable can be absorbed (ignored). This leads to the following:

$$(2) \qquad U_{ijk|S} = D_{ij|S} + \upsilon_{ik}F_k + \tau_i(p_j + p_k) + \varepsilon_{ijkS},$$

where $D_{ij|S}$ captures the value of a drink size j, including any extremeness aversion effects associated with being the smallest or largest drink size in drink set S (for more details, see the Appendix); F_k is a dummy-coded variable denoting the size of fries k; υ_{ik} is the individual-level parameter value for size k; and τ_i can be interpreted as person i's price sensitivity, which we constrain to be negative to represent people's disutility for higher prices.

Note that this model formulation assumes that person i's valuation of any combination of drink size and fry size is equal to the sum of the individual item valuations and is independent of whether the person purchases the combination as a bundle. In addition, the effect of price is the total amount spent on the two items regardless of whether these two items are purchased as a bundle or separately. This represents the baseline valuation of the pair of items before any other possible effects are taken into consideration. We denote this as Model 1 in Table 1.

Next, we extend this baseline model to acknowledge that the choice of the pair could be driven not only by the value of the individual items but also by the bundling context. For example, consumers may value a bundle more because it is faster and cognitively easier to select and ask for a "Number 1" than to decide first on the appropriate drink and fry sizes and then order the three items individually (Bettman, Luce, and Payne 1998; Shugan 1980). If so, the total cognitive cost of choosing a bundle is less than if the items are ordered separately (regardless of whether there is a discount). This reduced ordering cost effect should be particularly true in contexts in which consumers are mostly convenience driven, as in the case of fast food (Jekanowski, Binkley, and Eales 2001). The net effect is that a person's costs associated with ordering are lowered, thus increasing the bundle's value proposition (i.e., benefits less costs). We capture this fixed effect in Model 2 by including the term $\delta_i B_{jk}$, where B_{jk} is a dummy variable equal to 1 if drink j and fries k are in the featured bundle and 0 if otherwise, and δ_i is the estimate of the effect associated with this pair of items when they are included in the featured bundle (for the specific model formulation, see Table 1). Greater estimates of δ_i will increase the likelihood of the combo meal being purchased.

Note that the preceding explanation results in an increase in the overall bundle net utility, assuming no change in the consumer's evaluation of price. If the cognitive ordering costs of choosing a bundle decreases, and if search costs are embedded in these cognitive costs, in line with Lynch and Ariely's (2000) work in a unbundled context, we hypothesize that price will become more important—that is, price sensitivity will increase in a bundling context. Furthermore, if consumers view a bundled offering as a price promotion, there is strong evidence that price sensitivity for all the items being considered will increase. For example, Boulding, Lee, and Staelin (1994) and Mela, Gupta and Lehmann (1997) show that price promotions make price more salient, thus leading to increased price sensitivity within the prod-

[2]By centering our attention on just the soft drink and fries and ignoring the entrée, we are implicitly assuming that (1) consumers always buy an entrée when they go to the fast-food outlet and (2) this choice does not affect the purchase decision of whether to buy the combo or any size drink or fries. Note, however, that any interaction between a person's preference for a given entrée (e.g., a salad) and the choice of a soft drink size and fries would be reflected in the person's coefficient estimates for $Drink_{ij}$ and Fry_{jk} as well as any other parameter estimates. Thus, although we do not estimate the size of this interaction, we account for it in our model estimation.

Table 1. Model Formulations

Model Number	Additional Effects	Model Formulation	Variable and Parameter Descriptions	Hypothesis
1	Null hypothesis	$U_{ijk\|S} = D_{ij\|S} + \Sigma\upsilon_{ik}F_k + \tau_i(p_j + p_k) + \varepsilon_{ijkS}$	•$D_{ij\|S}$ = value of a drink (size j) given drink choice set S •υ_{ik} = parameter value for fries (size = k) •F_k = dummy-coded variable for size of fries •τ_i = overall price sensitivity parameter •p_j = price of fries •p_k = price of fries	
2	Ordering cost	$U_{ijk\|S} = D_{ij\|S} + \Sigma\upsilon_{ik}F_k + \tau_i(p_j + p_k) + \delta_i B_{jk} + \varepsilon_{ijkS}$	•δ_i = fixed effect parameter of bundling •B_{jk} = dummy-coded variable equal to 1 if sizes j and k are in the bundle and 0 if otherwise	$\delta_i > 0$
3	Price promotional effects	$U_{ijkm\|S} = D_{ij\|S} + \Sigma\upsilon_{ik}F_k + (\tau_i + \Sigma\alpha_{im}M_m)(p_j + p_k) + \delta_i B_{jk} + \varepsilon_{ijkmS}$	•α_{im} = the parameter indicating the change in price sensitivity due to one of the mixed bundling formats (α_{ib}) or the À la Carte formats ($\alpha_{ià}$) •M_m = dummy-coded variable denoting whether the menu includes bundles	$\alpha_{ib} < \alpha_{ià}$
4	Complementarity/ substitutability	$U_{ijkm\|S} = D_{ij\|S} + \Sigma\upsilon_{ik}F_k + (\tau_i + \Sigma\alpha_{im}M_m)(p_j + p_k) + \delta_i B_{jk} + \Sigma\mu_{ijk}D_j \times F_k + \varepsilon_{ijkmS}$	•μ_{ijk} = the parameter for complementarity or substitutability •$D_j \times F_k$ = interaction of drink and fry size	+/–
5	Feature effect	$U_{ijkmn\|S} = D_{ij\|S} + \Sigma\upsilon_{ik}F_k + (\tau_i + \Sigma\alpha_{im}M_m)(p_j + p_k) + \Sigma\delta_{in}B_{jk} + \Sigma\mu_{ijk}D_j \times F_k + \varepsilon_{ijkbfS}$	•δ_{in} = format-specific menu (n) fixed-effect parameter of bundling, where $\delta_{ià}$ is set to 0	$\delta_{iT} > \delta_{iS} > \delta_{ià}$ $\delta_{iT} > \delta_{iS} > 0$
6	Search costs	$U_{ijkn\|S} = D_{ij\|S} + \Sigma\upsilon_{ik}F_k + (\tau_i + \Sigma\alpha_{in}M_n)(p_j + p_k) + \Sigma\delta_{in}B_{jk} + \Sigma\mu_{ijk}D_j \times F_k + \varepsilon_{ijknS}$	•α_{in} = bundle format specific parameter (n) change in price sensitivity	$\alpha_{iT} < \alpha_{iS} < \alpha_{ià}$
7	Deal value overestimation	$U_{ijkn\|S} = D_{ij\|S} + \Sigma\upsilon_{ik}F_k + (\tau_i + \Sigma\alpha_{in}M_n)(p_j + p_k) + \Sigma\delta_{in}B_{jk} + \Sigma\mu_{ijk}D_j \times F_k + \ell_i \text{Discount} + \varepsilon_{ijknS}$	•ℓ_i = the coefficient denoting the additional value attributed to the discount •Discount = dummy-coded variable denoting whether the combo meal has a discount	$\ell_i > 0$

Notes: The term α_{iT} refers to the Combo Together format, and α_{iS} refers to the Combo Separate format. The term δ_{iT} refers to the Combo Together Menu format, and δ_{iS} refers to the Combo Separate format.

uct class. We conjecture that consumers will view a bundled offering in our context as a price promotion (regardless of whether there is a discount), making prices more salient. Consequently, the price sensitivity for all items being offered will increase. This leads to Model 3, which allows price sensitivity to vary (through the α_{im} parameter) depending on whether a bundle is offered or not.[3] To the degree that consumers become more price sensitive, consumption will decrease (when we hold all other effects and prices constant).

Thus far, our modeling has assumed that consumers' valuation of the two food items (drink plus fries) is the sum of the individual items. However, it is possible that consumers view drinks and fries as complements or, if there is some monetary or calorie constraint, as substitutes. Such an effect would also appear as a fixed effect (either positive or negative) and might confound any estimate of the fixed bundling effect. Consequently, in the next model extension, we include the interaction between the fry size choice and the drink size choice. Note that this effect occurs only when the consumer purchases both items. Moreover, it will occur regardless of whether the pair of items is purchased in the bundle. In addition, the interaction effect between portion sizes may be nonlinear—that is, there may be an optimal amount of drinks and fries that is less than the maximum amount. Consequently, we model this complement/substitute effect using dummy variables for each possible combination of drink size and fry size in Model 4. At the individual level, this captures whether consumers view the particular sizes of the two food items as complements or substitutes.

Models 1–4 assume the same fixed effect and price sensitivity of bundling regardless of the format used to display the combo meal and the respective entrée. It is difficult to imagine how the different price formats might alter the consumers' ordering costs or complementary/substitution evaluation heuristics as captured by the two fixed effects. Still, it is possible that the way the bundle is featured (i.e., displayed on the menu board) could affect the likelihood of the combo meal being purchased. This conjecture of a feature effect is compatible with the observation that featured items in a grocery setting often experience increased sales, independent of any price reduction (Inman, McAlister, and Hoyer 1990). If this feature effect occurs, consumers will give bundles greater value than the individual items. In this way, the feature effect will be captured in the previously defined fixed effect (δ_i). However, unlike the reduced ordering cost effect, we hypothesize that this extra value will be larger when the firm more clearly draws attention to the featured bundle. Because the Combo Together format forces consumers to view the section of the menu containing the combo information even when they are only interested initially in the à la carte menu items, we would expect the Combo Together format to incrementally increase the value of the bundle over the Combo Separate format if there is any feature effect associated with a bundle. Therefore, we can detect if this effect exists by testing whether the fixed effect differs by combo meal format. This changes the model slightly by denoting a menu-specific format effect (δ_{in} in Model 5). If placing the entrée price in the same visual space as the featured combo meals (i.e., the Combo Together menu) indeed increases the impact of any feature effect, the likelihood of purchasing a combo meal will increase.

Following the same logic, we next allow the price sensitivity parameter to vary by format (Model 6). We expect any price sensitivity effect, if it exists, to be greater (more negative) when consumers are exposed to the Combo Together format than when they are exposed to the Combo Separate format. This expectation is based in part on the belief that this format may cause consumers to notice the bundled option and in part on the notion that the proximity of the two prices (the entrée-only price and the respective bundle price) makes it easier to compare prices, which in turn lowers consumers' search costs. Thus, we make parameter α_{im} format specific in Model 6 (i.e., α_{in}).[4]

Finally, we note that bundles are often sold at a discount. This may affect the way consumers view the bundle independent of any actual price decrease. Thus, it is possible that consumers overvalue the discounted value relative to any normal price decrease (Heeler, Nguyen, and Buff 2007; Nguyen, Heeler, and Buff 2009; Yadav and Monroe 1993). If this occurs, the bundle would have extra value. To test for this possible effect, we include in Model 7 a term that captures the incremental effects of the consumers' perceptions of the discount on the bundled meal (after adjusting for any price reduction). In this way, our approach is similar to that of Gaudagni and Little (1983), who allow for different price effects for regular and promoted prices.

For each parameter in the models, we summarize our hypotheses regarding the signs or relationships of given parameters in Table 1. We summarize these relationships in the following seven points:

1. *Rational utility model*: We reject the null hypothesis that purchase behavior is not affected by the bundling context. Thus, we expect at least one other model to fit the data better than Model 1 (after controlling for any differences in the number of parameters).
2. *Ordering cost*: Bundles reduce the consumer's ordering costs and cognitive effort needed to select and order the bundle relative to ordering the items individually. Both effects lead to an increased valuation of the bundle over the sum of the individual item valuations. The net effect of this increased evaluation is that consumers are more likely to purchase a bundle (i.e., fries and a soft drink) than in an à la carte situation, and this leads to greater caloric intake.
3. *Perceived price promotional effect*: Whenever a consumer is in a mixed bundling situation, the price promotional effect associated with the bundle increases his or her sensitivity to the prices of all available items. This greater price sensitivity leads to a decrease in consumption, all else being equal. (In

[3]Note that in Table 1, we allow for a separate parameter for the à la carte menu. We do this because we expect the price sensitivity associated with the à la carte menu to differ from the conjoint price sensitivity. This difference is due to the virtual trips being viewed as more "realistic" than the conjoint tasks and thus will be more likely to decrease the hypothetical bias in price sensitivity often noted in standard conjoint tasks (e.g., Ajzen, Brown, and Carvajal 2004).

[4]We note that by making the combo price more salient, it might cause consumers to treat this price as a reference price. A possible consequence would be to increase Thayer's (1985) transaction utility to become more important. If so, this effect would show up in our model as an increase in the fixed bundling effect. We thank a reviewer for suggesting this interpretation.

equilibrium, the firm reacts to this decrease and lowers its prices.)

4. *Complementarity*: Because we are agnostic in terms of whether fries and drinks are viewed as complements or substitutes, we control for both possible effects in our model.
5. *Feature effect*: In addition to any value associated with lower ordering costs, featuring a bundle increases the saliency of the bundled items and causes the consumer to attribute extra value beyond that associated with the sum of the individual item valuations. The magnitude of this effect increases in information environments that make the featured bundle more salient. Specifically, the fixed effect is greater in the Combo Together format than in the Combo Separate format, and thus the likelihood of a bundle being ordered increases in the Combo Together format.
6. *Search cost*: In mixed bundling situations, increasing the ease of being able to compare the bundle price options with the individual item prices further increases price sensitivity. This effect is due to the lowering of search costs. Specifically, the price sensitivity in the Combo Together format is greater than that in the Combo Separate environment.
7. *Deal value overestimation*: Consumers increase the value of a bundle because they perceive a greater discount on a bundle than there actually is—that is, a consumer views a bundle discount differently from a standard price reduction.

Next, we test these hypotheses using the data obtained from the virtual shopping study.

Study Results

Participants were 215 U.S. adults over the age of 21 (54% were women, and the average age was 41.8 years) who indicated that they ate at a fast-food restaurant at least once a month. A national market research firm that maintains online panels recruited and compensated the participants. They were selected from a demographically diverse sample of the U.S. population. The average time spent on the study was 17.4 minutes.

Before presenting our model results, we briefly discuss the observed differences in aggregate behavior depending on which information condition the participants were in during their nine different purchasing experiences. We found substantial variation in the proportion of people in our study who bought both drinks and fries, just a drink, or just fries depending on whether the participants were in one of the mixed bundling scenarios or in the À la Carte condition. Thus, the percentage of people who purchased fries increased by 15% when they were in one of the mixed bundling situations. However, the percentage of participants who purchased a drink was unaffected by the menu format, though consumers who chose one of the smaller drink options (either the 12-ounce or the 16-ounce drink) or small fries in the À la Carte condition were more likely in the bundle condition to choose the featured bundled option rather than maintaining their smaller sizes preferences. Similarly (but to a lesser extent), participants who chose a larger drink size (either the 32-ounce or the 44-ounce drink) or large fries in the À la Carte condition were more likely to choose the featured bundle option when offered rather than maintaining their previously revealed preferences for a larger drink size and/or fries size. However, the net effect of all these different changes was that overall soft drink and fry consumption increased.

These results indicate that "featuring" a pair of items as a bundle can increase sales. When the bundle is offered, more consumers purchase fries, and consumers move up in size for both drinks and fries more often than down in size. However, such observations do not provide any deep understanding of what is driving such changes. Are consumers attracted to the bundle because of the discount? Is the increase in sales due to consumers finding it "easier" to order the combo meal? More generally, which of the identified forces is affecting consumer behavior? Next, we use the series of models described in the previous section to isolate the impact of each of the previously discussed influences. We do this by estimating each of these models and comparing the results to determine the magnitude of each factor.

Model Estimations

For each of the previously described models, we estimate the posterior distribution for each of the coefficients for each of our study participants using a hierarchical Bayesian approach (Rossi, Allenby, and McCulloch 2005).[5] Such an approach yields more valid and reliable estimates than running separate ordinary least squares analyses for each individual person. However, it does not yield point estimates but rather distributions for each parameter. We use these posterior distributions to test the hypothesized relationships summarized in Table 1.

The dependent variable for each model analysis is the participant's choice from among the set of possible discrete choice options. We assume a logit choice model in which the error term is assumed to be Weibull. We then approximate the marginal likelihood for each model (Newton and Raftery 1994) and the associated Bayes scores (Kass and Raftery 1995). We report these Bayes scores along with the marginal likelihood approximations in Table 2. We use these scores to determine when adding additional variables no longer improves the model fit relative to the prior model.[6] This leads us to rule out Model 7 (i.e., the model that captures the possible increase in value associated with the combo discount rather than a normal price discount). This null effect for a difference in price sensitivity between the regular price and the discount associated with the bundle is similar to Guadagni and Little's (1983) finding that consumers' price sensitivity was the same for regular price reductions and deal price reductions.

Next, we note that our estimation approach for any given model does not impose any restrictions on the hypothesized relationships, as stated in Table 1. For example, Model 6 allows for differences in price sensitivity across the two

[5]Using normal priors, we ran 50,000 iterations. We found that convergence for all our parameters occurred before 10,000 iterations or less. To ensure independence of our draws from these iterations, we used the last 9000 (saving every hundred) to obtain our sample posterior distribution. We obtained similar results when we sampled from the last 20,000 iterations.

[6]This procedure is somewhat analogous to an ordinary least squares analysis in which an F-test is conducted to determine whether the inclusion of several parameters increases the fit enough to justify the loss of the degrees of freedom.

Table 2. Model Selection Data Based on Bayes Score and Hypothesis Testing

Model Number	Additional Effects	Marginal Likelihood Approximation[a]	Bayes Score[b]	Hypothesis	Individual-Level Hypothesis Testing at the .05 Level[c]	Hyperparameter Hypothesis Testing[c]
1	Null hypothesis	–7780	0			
2	Ordering cost and heuristics	–6891	889	$\delta_i > 0$	97%	100%
3	Price promotional effects	–6529	362	$\alpha_{ib} < \alpha_{ià}$	4%	100%
4	Complementarity/ substitutability	–5203	1326	+/–	N.A.	
5	Feature effect	–5172	31	$\delta_{iT} > \delta_{iS} > 0$	13%	100%
6	Search costs	–5105	67	$\alpha_{iT} < \alpha_{iS} < \alpha_{ià}$	0%	36%
7	Deal value overestimation	–5154	–49	$\ell_i > 0$	model rejected	0

[a]This is based on the fourth approximation $\acute{p}4$ in Newton and Raftery (1994). Our results are not sensitive to the proportion of the prior used for approximation. Here, we assume that the proportion of the prior is equal to .01.
[b]Bayes score = 2 ln (Bayes factor); for Bayes factor formulation, see the Appendix.
[c]Each hypothesis test is done on the corresponding model and not on the final model (Model 5).
Notes: N.A. = not applicable.

menu formats. However, during estimation, we do not restrict the price sensitivity for the Combo Together format to be greater than that for the Combo Separate, as H_6 states. Consequently, we perform two tests to assess the validity of each of the hypotheses associated with a given model. In one test, we calculate the percentage of time the focal hyperparameter met the hypothesized relationship (we take the percentage over the saved iterations). For example, for Model 6, we determined the percentage of time over the saved iterations that the hyperparameter for the Combo Together format was less (i.e., more negative) than the hyperparameter for the Combo Separate format. In the other test, we examined the percentage of people who had parameter estimates that followed the hypothesized direction at least 95% of the time.

As Table 2 shows, there is considerable variation at the individual level. However, when we examine the results at the population (hyperparameter) level, the data are strongly compatible with H_1, H_2, H_3, and H_5, but not H_6 and H_7 (we did not postulate a relationship for the complementarity effect [i.e., H_4]). This leads us to select Model 5—the formulation that, for each person, includes the context-free utilities for (1) each drink size (along with an adjustment if the size is the largest or smallest drink size available) and each French fry size, (2) bundle and à la carte price sensitivities, (3) a specific fixed effect for each bundle format, and (4) a fixed interaction effect that applies to each choice pair that includes the purchase of both a drink and a fry size but does not include any incremental discount effect associated with a given bundle:

$$(3)\ U_{ijkmn|S} = D_{ij|S} + \Sigma\upsilon_{ik}F_k + (\tau_i + \Sigma\alpha_{im}M_m)(p_j + p_k) + \Sigma\delta_{in}B_{jk} + \Sigma\mu_{ijk}D_j \times F_k + \varepsilon_{ijkmnS}.$$

Because we do not have point estimates, but rather a distribution of estimates for each participant, we report in Table 3 the mean of (1) the hyperparameters and (2) the standard deviation of each of these parameters across the saved draws. In the last column in Table 3, we report the standard deviation of posterior means across the 215 participants in the sample (individual-level standard deviation), which reflects the (large) amount of heterogeneity across participants.

In accordance with the reported hyperparameters in Table 3, we note positive fixed effects for both the bundle menu formats, though as we hypothesize in Table 1 (and test in Table 2), there is a stronger effect for the Combo Together format than for the Combo Separate format. Table 3 also shows that the average magnitude of price sensitivity is greater (in absolute terms) for the two combo meal formats than for the À la Carte format.[7] We did not postulate the sign for the hyperparameters for complementarity. However, almost all our estimates for these hyperparameters are negative, indicating that participants viewed drinks and fries as substitutes, not complements.

Finally, we note in passing that the extremeness aversion results previously noted in Sharpe, Staelin, and Huber (2008) also hold in the presence of bundles. We take this as further validity of the experimental stimulus. We also note that there is considerable heterogeneity among those who are averse (attracted) to the smallest size. For example, we find that 19% of the population was averse to the smallest drink size, while 33% of our sample was attracted to whichever size was denoted as the smallest in the set. Our estimates for the remaining 48% were not significantly different from zero. With regard to the largest drink size, 51% of the population was averse to the largest size offered, while 1% was attracted to the largest size offered. We

[7]We note that the price sensitivity is more negative for the À la Carte (and bundle) conditions than the more standard conjoint conditions. This is one more example of the hypothetical bias and the ability to decrease it simply by calling attention the total budget.

Table 3. Model Mean Values and Standard Deviations

Estimates		Hyperparameter Mean[a]	Hyperparameter Standard Deviation	Individual-Level Standard Deviation
Fry Sizes				
Small (F_S)		3.869	.306	2.462
Medium (F_M)		4.421	.298	2.186
Large (F_L)		3.932	.381	2.974
Drink Sizes	**(Value[b])**			
12 ounces (B_{12})	(D_{12} = 3.87)	1.348	.114	1.033
16 ounces (B_{16})	(D_{16} = 4.60)	–.335	.171	1.422
21 ounces (B_{21})	(D_{21} = 4.70)	–2.323	.290	2.455
32 ounces (B_{32})	(D_{32} = 4.73)	–3.744	.307	2.187
44 ounces (B_{44})	(D_{44} = 4.74)	–4.316	.323	2.870
Extremeness Aversion				
$\lambda\ min_{jS}$		.517	.189	2.555
$\gamma\ max_{jS}$		–2.392	.300	2.896
Bundling Fixed Effects				
$\delta_{Combo\ Together}$		7.252	.310	2.784
$\delta_{Combo\ Separate}$		6.291	.265	2.448
Price	**(Value[c])**			
t	($\tau = -1.48$)	.386	.136	.979
$\alpha_{À\ la\ Carte}$		–.571	.207	1.773
α_{Bundle}		–1.333	.257	1.662
Complementarity				
Drink Size	**Fry Size**			
12 ounces	Small	–.807	.314	3.377
12 ounces	Medium	–1.439	.403	3.900
12 ounces	Large	–1.099	.442	3.537
16 ounces	Small	.352	.322	3.221
16 ounces	Medium	–1.366	.360	3.876
16 ounces	Large	–2.461	.445	4.156
21 ounces	Small	–2.246	.339	3.315
21 ounces	Medium	–2.059	.361	3.969
21 ounces	Large	–5.796	.505	4.366
32 ounces	Small	–3.705	.502	3.958
32 ounces	Medium	–3.055	.379	3.910
32 ounces	Large	–4.343	.438	4.403
44 ounces	Small	–4.571	.377	3.313
44 ounces	Medium	–3.246	.354	3.740
44 ounces	Large	–3.750	.384	3.989

[a]This is over the last 9000 iterations, where every 100th draw is used to approximate the mean and standard deviation.
[b]D_j is the context-free value of a drink size (for formulation, see the Appendix).
[c]Price is constrained to be negative, implying that people receive disutility from higher prices. Thus, for estimation purposes, $\tau = -e^t$.

return to these stylized facts when we discuss possible policy implications.

Taken together, these results imply the following with regard to bundling and our hypothesized effects:

1. *Rational utility model*: We reject the null hypothesis that the bundling context does not affect purchase behavior. More specifically, we demonstrate that the presence of a bundled offering alters people's utilities and, thus, their choice behavior.
2. *Ordering cost*: Bundling provides extra utility beyond the value of individual products themselves or any discount offered on the bundle. We attribute this value to the lowering of consumers' ordering costs, thus increasing the bundle's perceived value.
3. *Perceived price promotional effect*: Offering a bundle increases consumers' price sensitivity for all the items offered, independent of whether the item is in the bundle, an effect that is consistent with price becoming more salient.
4. *Complementarity*: We controlled for the possibility that items in the bundle are considered complements. Although the magnitude and direction of these variables differ by person, we observe that the population overall tends to behave as if these items are economic "substitutes."
5. *Feature effect*: Not only does the presence of a bundle attract greater value (Point 2), but different bundled menu formats also alter the magnitude of this value. In our context, the Combo Together format provides greater attention to the

bundled meal than the Combo Separate format; thus, for the population, the Combo Together value is greater overall than the Combo Separate value.

6. *Search cost*: Although offering a bundle increases consumers' price sensitivity, we do not find any significant differences between the two bundling formats.
7. *Deal value overestimation*: Consumers do not perceive the discount offered on the combo meal as greater than the actual monetary value of the discount.

We find the results in Point 4 (i.e., the noncomplementarity results) noteworthy, if not downright surprising. The extra utility from choosing a bundled offering is separate from and generally counteracts the perceived noncomplementary of combining, in our example, fries and a soft drink. Thus, it appears that consumers view drinks and fries as economic substitutes.[8] Although our study design does not provide any insights into why this stylized fact occurs, it is possible that this represents an implicit calorie constraint or budget constraint. This led us to analyze the individual-level estimates of μ_{ijk} to determine whether participants who normally bought diet soft drinks tended to constrain their consumption of drinks and fries more or less. We might postulate that diet drinkers are less calorie constrained and thus more willing to buy fries. Alternatively, a diet drinker may be more diet conscious and be less likely to purchase fries. However, we found no relationship between the tendency to buy a diet drink and the person's value of μ_{ijk}. This leads us to suspect that these estimates are due to a budget constraint. Although participants were not required to pay for their meals, they were shown the amount they hypothetically spent each time they selected a meal. We believe that this price information could have caused them to form an implicit budget constraint. Noting this possibility, we leave determination of the underlying reason to further research.

Finally, because we are using a logit formulation, differences in the error variance across the different choice tasks might affect the price sensitivity results (Guadangi and Little 1983; Swait and Louviere 1993). For example, it might be easier to select a drink size when the choice task has only three drink sizes than in a situation in which there are four drink sizes, three sizes of fries, and multiple entrées. If so, the estimated coefficient on price sensitivity would be larger in absolute terms in the simpler choice task solely because of the smaller variance in the error term. Although we have no measure of the consumers' uncertainty in these different choice task situations, we note that the price coefficients are actually higher in absolute terms when the participants made choices in the nine different full-menu environments than in the 24 simpler choice tasks at the end of the study, a finding that is not compatible with the premise that our price sensitivity results are due to differences in error variances across the different choice environments. Thus, we are willing to assume that any differences in the parameter values are capturing true differences in effect and not differences in the participant's uncertainty about a particular choice task.

Public Policy Optimizations

Up to this point, our emphasis has been on determining how consumers value bundles. We now turn our attention to the overarching purpose of this study—namely, to investigate the impact of proposed policies on consumer and firm behavior. We do this with a series of "policy experiments" using the Model 5 estimates for the sample of 215 participants to derive the demand function facing the retailer. We then use this demand function to explore the profit implications if the retailer decides to offer bundles under several different environments. We then compare the predicted retail profits and average number of calories associated with the particular mixed bundling conditions with those coming from a baseline condition that is intended to capture current conditions within the fast-food industry.

More specifically, each simulation begins with a specific environment (i.e., a set of drink and fry prices, the portfolio of available drink sizes, and a menu format). We use a nonlinear optimization method (i.e., generalized reduced gradient method; Lasdon et al. 1978) to determine the optimal set of drink and fry size prices given our sample of each participant's parameters as determined from each participant's posterior distributions. Having obtained the optimal set of prices, we predict each person's drink size and fry size choices for each saved iteration. Finally, using the predicted choices, we calculate the expected profits and consumption for a given environment. In other words, we assume that firm pricing behavior is endogenous and is a function of the particular environment.

As with most simulations, our results are contingent on our underlying assumptions. First, we assume that our sample is representative of the population that eats fast food and that the menu format or soft drink assortment does not alter the likelihood that a person will enter the restaurant. Furthermore, we assume that each respondent chooses the option (including the no-drink and no-fry option) that maximizes his or her utility. If customers do not purchase a drink, we assume that they will choose a cup of water, for which there is no charge to the customer, though there is the cost of the cup to the firm.

At the time of this research, the majority of the major fast-food chains were offering 21-ounce, 32-ounce, and 44-ounce drink sizes, without offering a 12-ounce or a 16-ounce drink size.[9] Thus, we use this predominant setting as our base case. Similar to our previous work (Sharpe, Staelin, and Huber 2008), we let the firm set the price for each size subject to constraints that reflect our knowledge of the current marketplace and the internal cost structure of fast-food establishments. We assume at least a $.20 increase in price between drink sizes. Furthermore, we constrain the price of the 44-ounce drink to be no higher than $1.89 because we did not observe prices higher than this in

[8]We tested the robustness of this finding by reestimating our model after dropping the six "combo" choice sets. We still found negative coefficients for the 15 complementary/substitutability parameters. Thus, these parameters do not capture any omitted variable associated with bundles. (We thank a reviewer for this suggestion.)

[9]However, McDonald's still offered the 16-ounce to 32-ounce options. After we began this research, many firms changed the definition of a "small" drink by dropping the 16-ounce size and labeling the 21-ounce size a "small." Similarly, what is now the "small" fries was formerly the "medium" fries.

the local fast-food marketplace. Similarly, we assume $.20 increases between fry sizes and that the largest fry size is not priced higher than $1.74. These constraints are market specific, and thus absolute results may differ in accordance with market constraints. Still, overall implications should be directionally the same.

We make the combo meal price a function of the individual item prices and assumed a discount for the bundle. For example, if the optimal à la carte price for a 21-ounce drink was $1.45, the optimal medium fry price was $1.50, and the bundle was priced at a 10% discount, the bundle price would be $2.66 (i.e., .9 × [1.45 + 1.50]) plus the cost of the entrée. These assumptions mimic the behavior of a profit-maximizing firm acting as a partial monopolist (i.e., one facing pricing constraints brought on by competition, internal costs, and possible government policy). We follow current industry practice and assume that the combo meal includes a 21-ounce drink and medium fries. Consequently, we use this choice environment as our base to determine firm profits and then evaluate different contexts that are estimated to lower caloric consumption. In addition, we use a combo discount rate of 30%, the combo discount rate of a leading hamburger fast-food restaurant at the time of the study. However, the results are qualitatively similar as long as the discount rate is greater than 20% off of the fries and drink in the bundle.

We begin by noting that the dominant historical policy approach to reducing fast-food consumption has been to educate consumers with nutritional information. Given the low response to providing nutritional information to curb consumption, some policy makers are now proposing taxation of soft drinks and fast food. Another possible approach is outlined in our previous research (Sharpe, Staelin, and Huber 2008). This approach, which we borrowed from the automotive industry, suggests the establishment of a CAFE-type standard (in reference to the Corporate Average Fuel Economy standard). In our case, firms would be required to reduce the average caloric content associated with the drinks (or drinks and fries) they sold, but they would be free to decide on the assortment of drinks they would offer and the prices they would charge. In our previous work, we examined soft drinks in the fast-food context using an à la carte menu and showed that by reintroducing the 12-ounce drink and dropping the 44-ounce size, the firm could meet a 10% calorie reduction associated with soft drinks, with a slight reduction in outlet profits (1.7%). This was a more attractive option for the firm than a proposed tax policy, which resulted in a 7.5%–11.7% profit reduction, depending on the form of the tax. However, we did not investigate this CAFE approach in a bundling context. Thus, we extend the research by applying the CAFE approach as well as different taxation policies in cases in which the firm has a mixed-bundling strategy.

Taxation

We begin our analysis by singling out soft drink consumption because this is the food type most often targeted for food taxation. In the upper section of Table 4, we present the baseline condition that we use to compare all our analyses. In this condition, the firm offers a mixed bundle (we use the Combo Together format because this is currently the industry trend) composed of the portfolio of drinks most often found in fast-food establishments (i.e., 21-ounce, 32-ounce, and 44-ounce sizes). Prices are set to maximize total profits associated with these two food types. As would be expected from our sample results, consumers in this base condition show a strong preference for the 21-ounce drink and the medium fries. The non–diet drink consumer purchases, on the average 184 soft drink calories and 350 French fry calories, totaling 534 calories attributable to these two items alone. Under this condition, the firm profits attributed to drinks and fries average $1.72 per person served.

We first investigate the implications of placing an 18% sales tax on soft drinks, a figure that has been proposed in New York (Kava 2009). With this strategy, consumers would pay between $.27 and $.34 in tax for the soft drinks if they continued to buy the same portfolio of food items. The net result is that consumers choose smaller portion sizes given the increase in prices. This leads to a 4.7% reduction in firm profits but an overall caloric consumption reduction of only 26 calories. This is due to the substantial value associated with the bundle, causing little change in overall preferences. Thus, there is only some minor switching away from buying either a drink or fries. This is strong evidence for why it is important to understand both firm and consumer behavior before instituting any regulatory solution aimed at curbing some undesirable behavior.

A second proposal put forward to curb soft drink consumption is an excise tax based on the volume of the drink sold. An excise tax would be a tax on the distributors of soft drinks; thus, the supply cost to the fast-food firm would increase. Because the fast-food firm variables are factored into the profit maximization procedure used to set prices, prices increase to offset higher costs. In the bottom half of Table 4, we consider an excise tax of $.01 per ounce (as well as the $.02 per ounce) proposed by some nutritionists, physicians, and policy makers (Brownell et al. 2009). Simulating this taxation, we note a small effect on consumption (a 4% reduction for the $.01 excise tax and a 5% reduction for the $.02 tax) but a 6%–9% reduction in firm profits and an average consumer spend increase of 13%–17%. Again, we find that higher taxes cause some consumers to reduce soft drink and fry consumption at a cost to both the consumer and the firm.

Given that the combo meal is central in terms of what consumers are buying, for comparison, we explore the implications of imposing a tax on the combo meal rather than just the soft drink. As Table 5 shows, it is possible to achieve a 3% reduction in total caloric content associated with fries and soft drinks by imposing a $.25 tax on the combo meal. By increasing it to $.39, it is possible to achieve a 5% reduction in consumption, and a $.52 tax yields a 7% reduction. As would be expected, such a tax causes some consumers to move away from the combo meal, thus reducing the amount of fries being purchased. Some consumers who also like large drinks switch from the combo meal (and the 21-ounce drink) and to a larger drink (i.e., a 32-ounce or 44-ounce drink). Thus, there is little change in soft drink calories. Instead, the only real change is in the purchase of fries. The net result is that firm profits

Table 4. Soft Drink Tax Strategies and Estimated Firm Profits and Consumption in the Combo Together Format

Drink size offerings = 21 ounces to 44 ounces
Combo drink = 21 ounces
Combo fries = medium

Market Share

Base

Average profit per person	$1.72
Average drink calories	184
Average fry calories	350
Average spend[a]	$2.07
Average spend/calorie	$.0039

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	5%	88%	5%	2%
French Fries	**None**	**Small**	**Medium**	**Large**
	8%	2%	88%	2%

18% Soft Drink Sales Tax ($.27–$.34 per drink)

Average profit per person[a]	$1.54
% change in profits[a]	–10%
Average drink calories	175
Average fry calories	333
% change in calories[a]	–4.7%
Average spend[a]	$2.39
% change in spend[a]	15%
Average spend/calorie	$.0047

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	10%	83%	5%	2%
French Fries	**None**	**Small**	**Medium**	**Large**
	12%	3%	83%	2%

$.01/Ounce Soft Drink Excise Tax ($.16–$.33[b] per drink)

Average profit per person[a]	$1.63
% change in profits[a]	–6%
Average drink calories	177
Average fry calories[a]	335
% change in calories[a]	–4.1%
Average spend[a]	$2.34
% change in spend[a]	13%
Average spend/calorie	$.0046

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	9%	84%	5%	2%
French Fries	**None**	**Small**	**Medium**	**Large**
	11%	3%	84%	2%

$.02/Ounce Soft Drink Excise Tax ($.32–$.66[b] per drink)

Average profit per person[a]	$1.57
% change in profits[a]	–9%
Average drink calories	173
Average fry calories	334
% change in calories[a]	–5.0%
Average spend[a]	$2.42
% change in spend[a]	17%
Average spend/calorie	$.0048

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	10%	83%	4%	2%
French Fries	**None**	**Small**	**Medium**	**Large**
	12%	3%	83%	2%

[a]Attributed to drinks and fries.
[b]Assumes that 25% of cup volume is ice.

decrease, albeit less than in the soft drink–only tax cases, and on average consumers spend 8%–15% more.

From these results, we do not believe that taxing either soft drinks or bundles is the way to address overconsumption, given the proportionally small change in purchase behavior compared with the increase in consumer spending and the decrease in firm profits. We attribute these findings to the positive utility of the bundle and the notion that (1) the bundle is discounted and (2) firms modify their pricing behavior, thereby moderating any desired effect associated with the price increase caused by taxes. In addition, consumers are less well off with these tax solutions because they must pay higher average prices. This is particularly relevant to the many low-income consumers who frequent fast-food outlets for many of their meals. Likewise, firms are less profitable. Perhaps the strongest positives for these tax proposals are that they might result in more tax revenue to be used to offset some of the obesity-related health care costs imposed on society—an argument the supporters of taxation have proposed.

Size Standards

Next, we investigate instituting a CAFE-like standard with the goal of reducing caloric consumption. Thus, instead of imposing a tax, we let the firms take whatever actions they deem best to meet the proposed reduction of the average calories sold for drinks and fries per entrée sold. In Table 6, we examine four actions the firm might take: (1) change

Table 5. Combo Meal Tax Strategies and Estimated Firm Profits and Consumption in the Combo Together Format

Drink size offerings = 21 ounces to 44 ounces
Combo drink = 21 ounces
Combo fries = medium

Market Share

Base

Average profit per person[a]	$1.72
Average drink calories	184
Average fry calories	350
Average spend[a]	$2.07
Average spend/calorie	$.0039

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	5%	88%	5%	2%
French Fries	**None**	**Small**	**Medium**	**Large**
	8%	2%	88%	2%

$.25 Combo Meal Sales Tax (3% targeted overall calorie reduction)

Average profit per person[a]	$1.69
% change in profits[a]	–2%
Average drink calories	182
Average fry calories	335
% change in calories[a]	–3%
Average spend[a]	$2.23
% change in spend[a]	8%
Average spend/calorie	$.0067

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	7%	85%	6%	2%
French Fries	**None**	**Small**	**Medium**	**Large**
	12%	3%	84%	2%

$.39 Combo Meal Sales Tax (5% targeted overall calorie reduction)

Average profit per person[a]	$1.67
% change in profits[a]	–3%
Average drink calories	181
Average fry calories	326
% change in calories[a]	–5%
Average spend[a]	$2.31
% change in spend[a]	12%
Average spend/calorie	$.0071

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	8%	83%	7%	3%
French Fries	**None**	**Small**	**Medium**	**Large**
	14%	3%	81%	2%

$.52 Combo Meal Sales Tax (7% targeted overall calorie reduction)

Average profit per person[a]	$1.65
% change in profits[a]	–4%
Average drink calories	180
Average fry calories	316
% change in calories[a]	–7%
Average spend[a]	$2.37
% change in spend[a]	15%
Average spend/calorie	$.0075

Soft Drinks	None	21 Ounces	32 Ounces	44 Ounces
	9%	81%	8%	3%
French Fries	**None**	**Small**	**Medium**	**Large**
	17%	3%	78%	2%

[a]Attributed to drinks and fries.

prices on the soft drinks (and, thus, the combo meal), (2) add a 16-ounce drink to the portfolio of drinks, (3) change the drink size associated with the combo meal to a 16-ounce drink, and (4) keep the 16-ounce drink as the combo meal standard and also drop the 44-ounce drink from the menu. These latter two options are not too far-fetched, because we find in our à la carte environment that the 16-ounce drink is the most popular drink and that the 44-ounce drink is the least popular drink size.

As Table 6 shows, firms can simply lower the prices for small drinks to dampen the demand for higher-calorie items and achieve a 3% decrease in overall caloric consumption. This results in the average amount spent on drinks and fries decreasing by 9% ($.19), reflecting the decrease in the firm's prices. However, firm profits also go down by $.15 per person ($1.57 compared with $1.72 in the base condition). A much more logical and profit-maximizing reaction would be to bring the 16-ounce drink back to the menu. Depending on the overall calorie goal, firms could achieve up to a 7% decrease in average caloric consumption, but this would also result in a 4% decrease in firm profits ($1.65 versus $1.72).

An even better alternative would be to substitute the popular 16-ounce drink for the 21-ounce drink in the combo meal. With this change, profits are not adversely affected (and could even increase if this policy softened competition), and average caloric consumption goes down by 7% because this substitution greatly increases the purchase of the smaller drink size. If, in addition, the restaurant drops the 44-ounce drink from the menu, the calorie reduction due

Table 6. CAFE Standard on Meals in the Combo Together Format

Fries + Drinks		Firm Actions			
Base Calories 533		Change Prices Only	Add a 16-Ounce Size to the Menu	Change Combo Drink Size	Drop the 44-Ounce Size from the Menu
Base Profits $1.72					
	Drink size offerings	21 to 44 ounces	16 to 44 ounces	16 to 44 ounces	16 to 32 ounces
Calorie	Combo drink	21 ounces	21 ounces	16 ounces	16 ounces
Reductions[a]	Combo fries	Medium	Medium	Medium	Medium
3%	Average profit per person[a]	$1.57	$1.70	$1.74	$1.73
	Average drink calories	171	175	151	144
	Average fry calories	346	336	344	345
	% change in calories[a]	–3%	–4%	–7%	–8%
	Average spend[a]	$1.89	$2.03	$2.06	$2.04
	% change in spend[a]	–9%	–2%	–1%	–2%
	Average spend/calorie	$.0055	$.0060	$.0060	$.0059
5%	Average profit per person[a]	Not possible	$1.69	$1.74	$1.73
	Average drink calories		174	151	144
	Average fry calories		331	344	345
	% change in calories[a]		–5%	–7%	–8%
	Average spend[a]		$2.02	$2.06	$2.04
	% change in spend[a]		–3%	–1%	–2%
	Average spend/calorie		$.0061	$.0060	$.0059
7%	Average profit per person	Not possible	$1.65	$1.74	$1.73
	Average drink calories		173	150	144
	Average fry calories		321	344	345
	% change in calories[a]		–7%	–7%	–8%
	Average spend[a]		$1.98	$2.06	$2.04
	% change in spend[a]		–5%	–1%	–2%
	Average spend/calorie		$.0062	$.0060	$.0059

[a]Attributed to drinks and fries.

to the extremeness aversion effect, which causes some people not to buy the 32-ounce (largest) drink size, would increase to 8%.

Finally, in Table 7, we examine the case of substituting the small fries for the medium fries in the combo. Again, we find almost no change in firm profits, but total caloric consumption is reduced by 19%–26% depending on which soft drink is included in the combo and whether the 44-ounce drink is available. Notably, consumers spend less, but the cost of a calorie goes up by more than 34%. Thus, this change is not costless to the consumer if his or her objective is to obtain calories as cheaply as possible. Still, it appears that the most efficient way for the firm to achieve calorie reduction, and thus the easiest way of getting firms to alter consumer behavior, is to reestablish a new standard for what constitutes the acceptable sizes within a featured bundle.

In making this suggestion, we note that over the past few years, fast-food outlets have been redefining sizes and standards, albeit in the opposite direction. For example, what is now the "small" fries at Wendy's was formerly the

Table 7. Possible Cross-Selling Opportunities in the Combo Together Format

	Base	Drink Size Reduction		Fry Size Reduction		
Drink size offerings	21 to 44 ounces	16 to 44 ounces	16 to 32 ounces	21 to 44 ounces	16 to 44 ounces	16 to 32 ounces
Combo drink	21 ounces	**16 ounces**	**16 ounces**	21 ounces	16 ounces	16 ounces
Combo fries	Medium	Medium	Medium	**Small**	**Small**	**Small**
Average profit per person[a]	$1.72	$1.74	$1.73	$1.73	$1.73	$1.71
Average drink calories	184	151	144	186	150	145
Average fry calories	350	344	345	248	248	248
% change in calories[a]		–7%	–8%	–19%	–25%	–26%
Average spend[a]	$2.07	$2.06	$2.04	$2.00	$1.97	$1.95
% change in spend[a]		–1%	–2%	–3%	–5%	–6%
Average spend/calorie	$.0059	$.0060	$.0059	$.0080	$.0079	$.0079

[a]Attributed to drinks and fries.
Note: Bold represents the size that changed.

"medium" size. Following the lead of Hardee's, Wendy's also now calls a 21-ounce drink a "small." An incentive is needed to reduce size growth. If a CAFE-like standard were to be put in place, firms would need to develop a strategy that would allow them to meet this average caloric reduction standard. In the presence of bundled offerings, firms would be unable to meet any significant reduction in the average calorie levels unless they modified what they included in their combo meal. Consumers who favored the combo meal would be purchasing a 16-ounce drink rather than a 21-ounce drink and/or a small versus a medium fries. Not only would this stop the "calorie/dollar" inflation, but it would also do so without adversely affecting firm profits. In this way, the policy would help firms cooperate without price collusion, and by establishing a new standard, they would be able to lower the average caloric consumption.

It could be argued that our CAFE suggestions are unmanageable and/or would not result in the anticipated results because firms would find ways to meet the new standards without really changing consumer behavior or they would obtain the needed results by targeting only "thin" people (i.e., people who are already weight conscious). We acknowledge that measuring the average calorie consumption per person might be difficult because there is not a one-to-one mapping of an order and one person's consumption. However, as long as the ratio of entrées sold divided by customers is stable for a given outlet, we can use the ratio of calories sold divided by entrées sold to track changes in the caloric consumption of the average consumer. Thus, a firm would be required first to establish a baseline measure of average calories sold per entrée. Then, using this ratio, the firm would need to document the specified reduction in this ratio. As we showed previously, firms could get this reduction by altering prices on individual items and/or altering the items available in the à la carte menu or the combo meal bundle.

Another concern might be that firms would "play games." For example, firms could try to realize their reductions by targeting efforts to thin people. We acknowledge that this market segment may be more receptive to obvious marketing efforts. However, many of the actions available to the firm, such as altering the portfolio of drink sizes or changing the standard for a combo meal, are subtle, and yet our results show significant changes in behavior. In addition, we note that 65% of the U.S. population is classified as overweight, and 31% are classified as obese. Thus, it would be difficult for a firm to get the needed reductions by only relying on the thin market segment. Finally, we note that though it is possible for firms to achieve the specified reduction in the ratio by increasing the denominator versus decreasing the numerator (e.g., selling "minimeals," encouraging people to eat two or more entrée meals), there is little incentive to do so because our results indicate that firms can get substantial reductions without such actions and still maintain their current profit levels.

Conclusion

Diverse groups of researchers from many different disciplines have addressed the topic of bundling. The initial research was economically based and analytic in nature. The work was then augmented by empirical marketers who developed methods for determining the actual pricing schemes for a given target audience and by consumer behavior researchers who put forth various behaviorally oriented theories to explain why bundles might increase sales.

We use the findings and theories from the prior research streams along with four stylized facts associated with most bundles sold in the fast-food industry to develop a series of hypotheses on how a mixed bundling situation might affect the consumer's utility function. We find that bundling has several different effects beyond the most commonly accepted reason—namely, the bundle "transfers" some of a consumer's surplus utility associated with one item in a bundle to another item that has negative surplus utility. These effects include (1) a positive fixed effect associated with reducing the costs of ordering for the consumer, (2) an increase in utility associated with the firm featuring the bundled items, and (3) an increase in price sensitivity due to bundles being viewed as a price promotion. These findings differ from those reported by Soman and Gourville (2001), who find, albeit in a different situation, that consumers actually decrease their consumption when they purchase a bundle. (In their case, there is a significant amount of time between the purchase and the consumption occasion.)

Although these findings are conditional on the studied industry and we obtained the estimates from a sample of adults who participated in a virtual purchase experiment rather than from actual purchase behavior, we believe that the general conclusions are applicable to a variety of real-world situations. We make this statement for two reasons. First, prior research has shown that this method of collecting data has strong external validity. Second, many of the reported effects should transfer to other bundling situations, especially if the firm decides to feature only a few bundled items (e.g., specific stockkeeping units of computers, monitors, and printers).

We also note that similar to many of the analytic examples found in the literature, our results indicate that participants increased their purchases when ordering from a mixed bundling menu. For example, we empirically find an average increase of 110–130 calories per meal. We examine strategies (i.e., taxation and size standards) to reverse this trend that bundles have on consumption. We acknowledge that there are possibly other policies that could reduce consumption in the bundling context. One such strategy would be to leverage the bundling feature effect to reduce consumption. For example, further research might examine the effect of bundling the calorie information to the combo meal displays and possibly not to the à la carte items to determine whether this drives lower consumption.

Further research might also evaluate other contexts of bundling to determine whether this common marketing practice has, in general, contributed to greater consumerism and materialism in society (Abela 2006). For example, has the bundling of digital media services (e.g., cable, Internet, and telephone) led to greater media consumption and, thus, less time for physical activity, family, and friends? We acknowledge that there are many contributing factors to increased consumption, but it may be useful to use our basic approach to understand the negative (and possibly positive) societal consequences of bundling. Even the public sector may be able to use bundling to increase the likelihood of compliance with public policy initiatives, such as environmental regulations.

What we know from our research is that a bundle offered in a fast-food context increases the purchase of calories, which ultimately leads to greater consumption. This latter result rests on numerous research findings that demonstrate that consumers tend to eat what is in front of them; in other words, what they purchase, they eat (see Fisher, Rolls, and Birch 2003; Sobal and Wansink 2007; Wansink and Kim 2005). Because fast-food consumers (and consumers in general) are constantly faced with choosing between bundled options and purchasing products à la carte, our research has significant relevance to consumers, firms, and policy makers, especially given the recently proposed soft drink taxation. Furthermore, the impact of bundled meals on children (e.g., a "happy meal," which bundles an entrée, fries, drink, and a toy) has recently caught U.S. and international policy makers' attention (Webley 2010). With the ever-increasing awareness of childhood obesity and prevention, it is important for further research to examine the impact of bundled meals on children. This area of research is particularly relevant to economists and behaviorists, given that the effects go beyond the impact of pricing and thus provide a much more nuanced understanding of these additional effects on firm and consumer behavior.

Appendix

Specific Estimation Details

For the estimation of drink size in each of the models, we follow the approach that Sharpe, Staelin, and Huber (2008) take and define the value of drink size j for individual i as follows:

(A1) $$D_{ij|S} = D_{ij} + \lambda_i \times \min_{j|S} + \gamma_i \times \max_{j|S},$$

where D_{ij} is the context-free value for a drink size j for individual i; λ_i and γ_i are the smallest and largest extremeness parameters, respectively; and $\min_{j|S}$ and $\max_{j|S}$ are dummy variables that equal 1 if the drink size is, respectively, the smallest or the largest drink size available in drink set S and 0 if otherwise. For example if the drink options were 12 ounces to 32 ounces (the "low" set), the 12-ounce drink would be coded as the smallest drink size available, and the 32-ounce drink would be coded as the largest drink size available. Similarly, if the drink options were 16 ounces to 44 ounces, the 16-ounce drink would be coded as the smallest, and the 44-ounce drink the largest. Next, we follow the lead of Kivetz, Netzer, and Srinivasan (2004) and assume that the context-free valuations, D_{ij}, are vector attributes and thus must be monotonically increasing in drink size. Because we use hierarchical Bayesian techniques to estimate these context-free valuations, we use the following formulation to constrain an increasing monotone relationship:

(A2) $$D_{ij} = \sum_{t=12}^{j} x_t e^{B_{it}},$$

where $e^{B_{it}}$ is the value for drink size t, x_t is a dummy-coded variable denoting the incremental size t, and B_{it} is the parameter to be estimated. The summation is equivalent to the incremental value of size j greater than 0 (the "none" option).

Just as drink size is constrained to be increasing in j, we constrain the effect of price (τ_i) to be decreasing in j reflecting greater disutility for higher prices. Thus, for estimation purposes, we define price sensitivity (τ_i) as follows:

(A3) $$\tau_i = -\exp(t_i),$$

where τ_i is estimated and may take any positive or negative number.

Model Comparison

We define the Bayes factor as follows:

(A4) $$B_{z-1,z} = p(x|L_z)/p(x|L_{z-1}),$$

where $p(x|L_z)$ is the marginal likelihood approximation of the data under a particular incremental model z (Kass and Raftery 1995) and $p(x|L_{z-1})$ is the marginal likelihood approximation of the data under the previous incremental model. We use the approximations for the marginal likelihood described by Newton and Raftery (1994). We evaluate each model using each of the approximations from Newton and Raftery with the fourth approximation reported in Table 2. This estimator assumes a mixture of the prior and posterior means p(estimates|data), where .01 is the proportion of the prior assumed.

Table 2 reports the Bayes score, equivalent to twice the natural log of the Bayes factor (Equation A4). When the Bayes score is less than zero, there is significant evidence against adding the incremental factor in the model—that is, the marginal likelihood actually decreases when the incremental factor is included. Likewise, a Bayes score greater than 3 indicates strong evidence for the additional factor being added to the model (Kass and Raftery 1995).

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