The Impact of Regulation on Strategic Positioning: Self-Regulation in the RTE Cereal Industry

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Research summary:

In this paper we exploit a natural experiment resulting from self-regulation adopted in the ready-to-eat (RTE) breakfast cereal industry. This event induced product repositioning which compressed the relevant product space and increased competition. Through this lens, we assess specific performance impacts associated with the regulation and develop links between product positioning and product brand equity resources. The latter results provide dynamic connections between positioning choices and the value of resources as determined by consumer demand and market competition. As a group, products constrained by regulation perform relatively poorer than unconstrained products, though unconstrained products are also negatively affected by the increased competition caused by the regulation-induced compression. Among other results, we also find that higher brand equity is not always relatively more valuable than lower brand equity when products are forced to reposition.

Managerial summary:

This article illustrates how firms respond to newly-imposed regulatory constraints. The analysis is an empirical examination of a self-regulation initiative that placed advertising restrictions on high sugar U.S. ready-to-eat breakfast cereal products targeted toward children. We explore both short-term and long-term responses designed to adjust the product mix to fit the new market environment. Short-term responses included product reformulation to comply with the initiative and some exit. Longer-term responses included further exit, increasing investments in differentiation, and voluntary repositioning.

Keywords: self-regulation, positioning, resources, competitive dynamics, non-market strategy

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1. Introduction

Regulation frequently alters competitive conditions in an industry resulting in differential performance impacts across products and firms. These impacts are themselves worthy of study, but the strategic changes induced by regulation also create opportunities to learn about relationships among strategic variables and competitive performance. To explore these relationships, we exploit a natural experiment resulting from self-regulation adopted in the U.S. ready-to-eat (RTE) breakfast cereal industry intended to improve the nutrition of foods consumed by children. This natural experiment has the attractive features that the regulation affected key product and marketing choices with tightly circumscribed constraints and occurred within a narrow time frame. Collectively, these features ease the difficult empirical problem of relating choices to consequences, and allow us to explore, among other things, how performance is affected by positioning and product-level brand equity resources and how subsequent choices and performance are driven by these factors.

The RTE breakfast cereal industry (henceforth, cereal industry) is an oligopoly with four dominant firms each of which sells products differentiated by characteristics such as taste, nutrition, and image. Differentiation is reinforced through heavy advertising with industry expenditures running well above ten percent of sales (Nevo, 2001). In the children’s segment of the market, taste and in particular sweetness, is especially important and has resulted in sugar being characterized as the “magic fairy dust” of the age.¹ But excessive sugar in a child’s diet has a big nutritional downside because it contributes to childhood obesity.

In the mid-2000s growing societal concern about the problem of childhood obesity led to calls for action. In response, all of the dominant cereal firms joined a cross-industry initiative

¹ Traig (2019). Many prominent cereals previously featured sugar in their brand names. These included Sugar Crisp (now Golden Crisp), Sugar Frosted Flakes (now Frosted Flakes), and Sugar Chex (now Honey Nut Chex).
(Children’s Food and Beverage Advertising Initiative or CFBAI) and agreed not to advertise to children cereal products containing more than 12 grams of sugar per serving. This self-regulatory agreement had first-order consequences because it implicated advertising, the primary marketing lever for selling those products, and sugar, the most important ingredient generating sweetness. The impacts of the regulatory constraints on sugar differed across products depending on whether the pre-regulation product exceeded the 12g sugar standard. Some products required at least a 25 percent reduction of sugar to meet this standard. The chief immediate responses to CFBAI regulation were product reformulations to reduce sugar and some product exit. In aggregate, these responses led to what we term a “compression” of the product space associated with children’s RTE cereal products, causing increased competition for both rival and own products and declining performance. From the viewpoint of the firm as a whole, the differences in individual products and product portfolios implied that firms differed in terms of their vulnerability to CFBAI regulation. Over time, the discontinuous change to the competition space led firms to alter their product portfolio and even to reposition some products that were only indirectly affected by the self-regulation. These subsequent changes allow us to gain insight into the interplay between product-level positioning (as represented by sugar levels) and product-level resources (as represented by brand equity) which gives us traction on the dynamics of strategic repositioning (Menon & Yao, 2017).

For empirical analysis, self-regulation usually presents a more complicated setting than regulation because self-regulation is typically voluntary. In this setting, however, all firms complied with the terms of CFBAI (Lee, Kolish, & Enright, 2010; Enright, 2018).\footnote{There were strong incentives to comply with their self-regulatory promises because of the reputational costs to violating public commitments that were easily observable. As part of this project, we also examined compliance and concluded that firms exhibited near perfect compliance with their self-regulatory pledges.} Hence, for
purposes of examining performance impacts given a particular set of constraints on firm action, the analysis of CFBAI is no more complicated than an analysis of a regulatory setting. In fact, because of full compliance, the insights from the CFBAI natural experiment generalize to formal regulatory settings. As such we discuss the restrictions as “regulatory” rather than as “self-regulatory.”

Empirical analysis of relationships among positioning, resources, management choices, and performance is normally quite challenging given the difficulties in obtaining a sufficient number of observations at an appropriate level of granularity, as well as the complications of attribution raised if the observed changes take place over time. Here, both the characteristics of the industry—a large number of differentiated products offered by relatively few firms—and the regulatory natural experiment are extremely helpful. We observe individual details regarding positions, resources, and competitive performance of competing products and several near-simultaneous choices regarding those products induced by the CFBAI. As a result we can explore the impact of heterogeneous positions and resources, better understand the specific characteristics that may make a product (or a firm) more competitively vulnerable to various types of environmental or competitive shifts, and examine subsequent strategic choices based on product positions, product resources, and firm product portfolios.

Using a difference-in-differences empirical approach, we examine the uneven impact of regulation on individual firm performance (Oberholzer-Gee & Yao, 2018). We find that the constrained products—those with pre-initiative sugar levels exceeding the 12g threshold

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1 This generalization applies to the impact given the self-regulatory scheme. If we focused instead on the shaping of the self-regulatory scheme, we would need to worry about the effect of voluntary rather than mandatory compliance.
2 We do not assess the social welfare impacts of CFBAI or address questions raised in the voluminous literature on the social impacts of regulation, see, e.g., (Hahn & Hird, 1991; Armstrong & Sappington, 2007).
established in the initiative—on average experienced negative sales and price performance relative to unconstrained products that experienced positive performances. Kellogg’s, the firm with the highest percentage of constrained products, was more negatively impacted than its primary rivals. We also show that a firm’s prospective vulnerability is not tied solely to products directly affected by the regulations, because even products not explicitly targeted by the regulations are indirectly affected by changes in competition associated with changes to directly-targeted products, and that the regulatory impact is moderated by a product’s brand equity, though not always positively.

We then examine tactical and strategic adjustments made to individual products. One adjustment was the net exit of products from the children’s segment of the cereal market. After regulation, the number of advertised product and product variants per year decreased from 26 to 19 compared with a 58 to 75 increase in the adult segment. Firms also responded to increased product space compression by increasing average per product advertising from $5.5 million to $6.6 million in the children’s segment, compared with a slight decrease in the adult segment. We interpret these responses in part as attempts to “expand” the customer-perceived product space by creating increased image differentiation. Finally, firms responded by repositioning some products toward adult segments. We speculate that business economics now favored a strategy weighted towards “harvesting” existing brand-loyal consumers over investing in acquiring new (very young) consumers—and that the repositioned products had suitable characteristics and brand equity to support their new positions. For some cereals, this repositioning also took advantage of a trend towards the consumption of cereals as a snack rather than as breakfast (Owen, 2017).
Interestingly, prices in the children segment increased post-regulation while overall sales and advertising declined for constrained products and increased for unconstrained products. While the limitations of our data prevent us from distinguishing among various mechanisms that are candidate explanations for these outcomes (e.g., changes in the structure of market competition or in the emphasis on harvesting loyal customers) and for assessing actual profit, the evidence is suggestive that the strategic changes substantially mitigated the regulatory impact on the firms.

Our analysis looks at the relationship between positioning (Porter 1979) and resources (Wernerfelt, 1984; Barney, 1991), first, in terms of the impact of repositioning forced by regulation and second, in terms of subsequent repositioning chosen by the firms. In either case, the performance effect of positioning is driven by the implications of compression in terms of own and rival products on competition and cannibalization (Ghemawat & Nalebuff, 1985; Judd, 1985). Other types of regulatory interventions have been used to explore firm responses to increased competition, e.g., decline in tariffs leading to increased investment in corporate social responsibility (Flammer 2015).

In addition to the competition and cannibalization effects, forced repositioning decreases the value of brand equity resources (Grant, 1991; Aaker, 1997) by reducing the resources’ rent earning capabilities (Amit & Schoemaker, 1993). Among other factors, the value of brand equity resources is linked to the relative positioning of products just as the performance impact of changes in position may be affected by the strength of brand resources. Links between the relative value of resources in light of demand-side changes in positioning have been traditionally treated as “exogeneous to the [resource-based view] model… [which] makes implicit assumptions about product markets, just as earlier environment-based models made implicit
assumptions about resources” (Priem & Butler, 2001). The product market and brand equity relationship has been explored in contexts involving tariff changes, as discussed above, and in acquisitions where, for example, a business with a “craft” brand is acquired by mainstream brand (Frake, 2017). Similarly, environments that are rapidly changing would increase the relative value of dynamic capabilities (Eisenhardt, 1989; Helfat et al., 2007; Macher & Mowery, 2009). Our contribution along these lines is to offer insight into the direct performance impact of resources under forced repositioning and the indirect value of these resources for subsequent repositioning.

Repositioning beyond that required to gain compliance provides a dynamic perspective on the relationship between positioning and brand equity resources. Such “voluntary” repositioning actions depend on forced repositioning on previously non-complying products, current strategic resources, and the anticipation of the costs and benefits to future repositioning (Menon & Yao, 2017), a topic that has been relatively unexplored in the literature. Given our level of analysis and data availability regarding firm-level resources, we focus on changes in product-level resource values, that may cause exit, increased investment, or repositioning at the product level.

Exit, which in our setting is both a response to forced repositioning and a form of subsequent strategic repositioning, is driven primarily by changes in competition, cannibalization, and changes in the value of a product’s existing resources rather than by factors such as lack of synergy or misfit between operations within firms (Chang & Singh, 1999; Feldman, Amit, & Villalonga, 2016). Specifically, we evaluate how repositioning, forced by the regulatory constraints, changed the level of competition in terms of the closeness among own-
firm and rival-firm products and affected the value of brand equity resources. We then observe firm choices resulting from these changes. Our empirical analysis supports an economic competition mechanism for decisions regarding mix and management of their product portfolio.

Finally, because our study takes the outcome of self-regulation as given, we do not directly address the full range of market and nonmarket choices that together constitute “integrated” strategies (Baron, 1995; de Figueiredo, 2009; Jia & Mayer, 2018). Of course, firm responses to regulatory constraints, as studied in this paper, inform the direction and intensity of efforts to influence regulation.

The remainder of the paper is organized as follows. We begin with a description of the self-regulatory initiative the major RTE cereal manufacturers adopted and then provide some background about the RTE cereal market. Section 3 discusses a market competition-driven theory of industry regulation and applies that theory to the RTE cereal industry setting. Section 4 describes the data which is followed in Section 5 with an empirical analysis of performance impacts and an analysis of strategic responses to regulation by the firms. Section 6 concludes.

2. The Childhood Obesity Problem and the RTE Cereal Market

Childhood obesity, as a major public health threat, has been characterized as “a massive tsunami headed for the United States” (Ludwig 2005). Since 1980, the rate of obesity in the United States has more than doubled in preschool children and tripled in adolescents and by 2005 about nine million young people in the U.S. were thought to be overweight (Kennedy, 2005). The impact of childhood obesity is long-lived with some estimating that it has a bigger negative effect on life

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5 Marketing research has long studied brand equity developed with consumers (Farquhar, 1989; Erdem & Swait, 1998). The children’s segment of the RTE cereal market provides a somewhat different situation than typically analyzed because of the disconnect between the purchaser (parent) and the consumer (child) and because the child’s preferred choices cannot be viewed as (actually) utility maximizing.
span than that caused by cancer or coronary heart disease (Olshansky, Passaro, & Hershow, 2005). One cause of childhood obesity is the poor nutritional content of the food children are eating.

Concerns about childhood obesity have attracted governmental attention. In the years immediately preceding the creation of CFBAI, legislation was introduced to increase funding and coordination of programs addressing childhood obesity and the FTC and HHS held an influential public workshop to examine what the private sector might do to combat this crisis (Majoras et al., 2006). Industry, for the most part, questioned the potential effectiveness of governmental regulation, raised free speech concerns (Majoras et al., 2006), and lobbied to defend the food industry’s right to advertise to children (Ellison, 2005). Such efforts played a major role in forestalling governmental regulation. But firms also worked towards their own solutions either individually or through industry self-regulation.

The Children’s Food and Beverage Advertising Initiative (CFBAI)

In contrast to governmental regulation, industry self-regulation is typically less invasive. Self-regulation has preempted governmental regulation, collectively protected a “reputation common” (Olson, 1971; Ostrom, 1990; King, Lenox, & Barnett, 2002; Barnett & King, 2008; Dorobantu, Kaul, & Zelner, 2017), and led to agreements on technical standards (Katz & Shapiro, 1985; Saloner & Farrell, 1985; Leiponen, 2008). Such collective action serves as a middle way between governmental regulation and the free market. But a key difference—and a key weakness—is that self-regulation is typically voluntary and lacks effective sanctions. Industry self-regulation is also limited by antitrust law because of self-regulation’s potential to facilitate collusion.
The Council of Better Business Bureaus (CBBB) was well-positioned to facilitate industry efforts to address childhood obesity because of its long history of self-regulation involving marketing to children. In 2005, CBBB formed a working group which ultimately led to the launch of CFBAI in November 2006. Under CFBAI, the participating firms set nutrition criteria to govern the foods they advertise to children under the age of twelve. Three of the ten founding firms were major cereal manufacturers: General Mills, Kellogg’s, and PepsiCo (parent of Quaker Oats, henceforth referred to as Quaker Oats). Others included Coca-Cola, Hershey, and McDonalds. After Post joined in October 2009 (Lee, Kolish, & Enright, 2010) CFBAI member firms accounted for over 80 percent of industry sales. Participation in the program was fully voluntary and, until 2011, participating firms had discretion over what constituted children’s cereal and child-directed advertising (Kolish, 2011).

The nutrition guidelines for RTE cereal were focused predominantly on sugar content. General Mills, Kellogg’s, and Post committed not to advertise children’s cereal products that exceeded 12 grams of sugar per serving. Initially, Quaker Oats did not explicitly set a compliance level for sugar content (Kolish, 2008) and in 2010 set its sugar level at “≤ 25 percent of kcal added” (Kolish, 2008), consistent with its parent’s snacks and beverage products targeted to children. General Mills initially set the most aggressive self-regulation policy (e.g., initiated compliance for some products up to a year or more before Kellogg’s implementation date of December 31st 2008). Through the period of this study, the branded RTE manufacturers were in near perfect compliance with their self-regulatory commitments, in part, because the commitments were easily observable and because of the costs of being depicted as a corporate

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6 PepsiCo’s definition of its self-regulation sugar restriction was inconsistent with the other major manufacturers (i.e. PepsiCo distinguished between added sugar and naturally occurring sugar). However, all of the Quaker Oats children’s cereals met the 12g threshold used by the other firms.
villain who profits on helpless children in an environment sensitive to childhood obesity (Ellison, 2005). In 2011 CFBAI announced a further reduction of the standard to 10 grams of sugar per serving with implementation set for 2013 (Kolish, 2011). This reduction took place outside our study period.

The RTE cereal industry and marketing to children

Though initially fragmented, the RTE cereal industry became sufficiently concentrated to attract regulatory attention from the FTC which alleged in 1978 that Kellogg’s, General Mills, Quaker Oats, and Post’s control of the industry constituted a monopoly (Santlofer, 2007). This suit was dropped in 1982. In 2006 the top four manufacturers controlled over 80 percent of the market with the remaining sales coming from private labels and smaller manufacturers who either do not advertise or do minimal advertising.

To fend off competition from new entrants and private label products, manufacturers employ strategies involving continual differentiation, product proliferation, and heavy advertising. Hundreds of different cereal products were produced in a given year, each with only a very small share of the market, typically under one percent (Price, 2000). The cost of launching a new product was significant in comparison to the expected revenue and most new products failed quickly (Hitsch, 2006). Advertising plays a huge role in differentiation. In 2001, the advertising-to-sales ratio for the RTE cereal industry was around 13 percent, much higher than the typical two to four percent in other food industries. Nevo (2001) argues that RTE cereal firms

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Several studies in the food policy and medical literature examined the effectiveness of the RTE cereal portion of CFBAI. Berning, Huang, & Rabinowitz (2013) find that CFBAI did not result in a significant reduction in advertising exposure of non-healthy cereals to children from 2006 to 2008. Yale’s Rudd Center for Food Policy & Obesity reported that some cereal companies have taken positive steps to improve the nutritional content of their cereals marketed directly to children (LoDolce, Harris, & Schwartz, 2013).
enjoyed a high price-cost margins mainly due to their ability to differentiate their products and influence perceived product quality.

Cereals targeted to consumers under 12 years of age account for about one-third of sales and about one-quarter of advertising expenditures. These cereals are advertised directly to children who, unsurprisingly, respond to taste and cues other than nutrition. For example, LoDolce, Harris, & Schwartz (2013) found that 91 percent of high-sugar cereal ads viewed by children caused the children to ascribe extraordinary powers to these products. Furthermore, even if parent purchasers have an accurate understanding of a nutritious diet and information on a cereal’s nutritional content, they heavily weigh the benefits of keeping children happy and getting them to eat cereal. The final decision, therefore, is partially driven by children who exert “pester power” (Lawlor & Prothero, 2011).

3. The Impact of CFBAI: Theory and Hypotheses

In general, increased regulation of product quality may narrow the range covered by product characteristics. For example, minimum safety standards may eliminate potentially lower-priced, lower-quality products which pose an unacceptable safety risk (Ronnen, 1991). Alternatively, such products may be modified to meet the minimum standard leading to two effects. First, the product itself may experience a deterioration in its brand equity because of the change in the product’s positioning (Aaker, 1997) which potentially creates a mismatch between consumer brand expectations and actual product performance. Second, repositioned products crowd the product space populated by incumbent products, creating increased competition (Crampes & Hollander, 1995). Increased competition resulting from compression of the product space

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1 In the case of safety standards, there may also be a positive offset to the loss of brand capital because the regulation leads consumers to worry less about product safety.
combined with some deterioration of brand equity due to repositioning could reduce the market performance of the repositioned products post regulation. Compression may also negatively affect the market performance of incumbent products (Ronen, 1991; Lutz, Lyon, & Maxwell, 2000).

**Performance Impact of CFBAI**

The 12 gram standard imposed through CFBAI self-regulation greatly increased the cost of marketing high-sugar cereals to children. While nominally less rigid than a product ban, the restriction on advertising was so constraining that almost all high-sugar cereals were either reformulated to meet the standard or discontinued. Cereals with sugar content exceeding the standard, the constrained products, are likely to incur brand equity and reformulation costs as well as increased competition. The costs imposed on constrained products are greater than imposed on unconstrained products, so we expect a relative reduction in profits for constrained products versus unconstrained products post-regulation. Though ideally we would measure the profit change directly, cost information is unavailable to us, so we focus on changes in sales. A relative decrease in sales translates to a relative decrease in profitability if the relative change in costs of producing and marketing the constrained cereals weakly increases while relative prices of constrained products do not increase relative to the prices of unconstrained products. The former seems likely given the added costs of reformulation and repositioning incurred by the constrained products, while the latter is consistent with the empirical evidence.

These arguments suggest that the average change in performance due to regulation will be relatively poorer for constrained versus unconstrained products.

*Hypothesis 1a: Regulation results in a relative reduction in sales performance for constrained versus unconstrained products.*
Assuming constrained products were almost always reformulated, the compressed product space increased competition for both constrained and unconstrained products holding other factors constant. To be sure, the overall level of compression depended on factors such as possible entry, exit, or repositioning of products, as well as changes in advertising, pricing, and consumer responses. Actions such as repositioning and even exit, which are driven in part by existing brand equity considerations, unfold over time, making it possible to identify some short-run effects of regulation relating to the compression mechanism. Most compression will occur around the regulatory standard, hence, we hypothesize that at least early in the regulatory period, the compression effects will intensify competition leading to sales effects, especially for products that just meet the regulatory standard.

**Hypothesis 1b:** Regulation results in a relative reduction in sales performance for unconstrained products at the regulatory standard versus unconstrained products below the regulatory standard.

Hypotheses 1a and 1b examine the average impacts on sales of induced repositioning. Might product-level brand equity moderate the impact of competition? Presumably, greater brand equity generates more perceived differentiation which, in turn, effectively creates more distance between products, somewhat alleviating increased compression. Hence, one might expect that the compression effect reducing sales will be less for unconstrained products with greater brand equity than for unconstrained products with less brand equity. But the resultant effect of brand equity on constrained products is theoretically unclear. If repositioning of a product leads to deterioration of brand equity and this deterioration is greater for high versus low brand equity products, the net impact of brand equity on the change in sales could be minor or even negative.¹

¹ If the deterioration is only continuously proportional to the stock of brand equity, this effect would only work to reduce the beneficial effect of differentiation. Because the effect is complex, we state the hypothesis in its most negative form.
Here, we hypothesize that the moderating effect of brand equity as positive for both constrained and unconstrained products, recognizing that the effect may be different for each group.

**Hypothesis 1c:** Regulation results in a relative increase in sales performance for constrained products with high brand equity versus constrained products with low brand equity.

**Hypothesis 1d:** Regulation results in a relative increase in sales performance for unconstrained products with high brand equity versus unconstrained products with low brand equity.

Hypotheses 1a and 1b, adapted to the firm level suggests that firms with more constrained products will perform less well than their less constrained rivals.

**Hypothesis 2:** Regulation results in a relative reduction in aggregate sales performance for firms with more constrained products compared to firms with less constrained products.

An implicit assumption underlying Hypotheses 1a, 1b, and 2 is that firms took some time to fully adjust their product and market strategies to the new regulatory setting and, therefore, that compression was the dominant short-term force affecting competition. Over a longer period, these adjustments will likely include exit, additional investment in differentiation, and further repositioning. We consider these strategic responses next.

**Strategic Responses to Regulation**

At a high level, a firm’s portfolio of differentiated products is determined through its entry, exit, and repositioning choices. These choices are affected by a number of factors. Judd (1985), for example, highlights the cannibalization of own products while Seamans (2012) explores entry deterrence. Exit, entry, and repositioning decisions also depend on the various resources (Wernerfelt, 1984; Barney, 1991) associated with each product and with each firm.

The technical and brand positioning costs of reformulating a cereal suggest that regulatorily-constrained higher sugar cereals are more likely to exit than their lower sugar counterparts. Exit is particularly likely with high sugar variants (e.g., Kellogg’s Froot Loops Starberry) of lower sugar cereals (e.g., Kellogg’s Froot Loops) whose primary differentiating
characteristic from their “parent” is sweetness. Such variants, if forced to drop sugar, would cannibalize the parent and, if held at higher sugar levels, would need to rely on spillovers from the parent’s advertising. Based on these arguments, we expect post-regulation exit to be positively related to the amount a pre-regulation product exceeds the 12 grams sugar level.

**Hypothesis 3:** For pre-regulation products that exceed the regulation sugar standard, the probability of post-regulation exit increases with the amount by which the product exceeds the standard, ceteris paribus.

There are many forces influencing a product repositioning decision. The level of competition is critical: the stronger the competition facing a product, the greater the incentive for the firm to reposition that product whether the product is constrained or unconstrained. For a given level of general competition, exit or repositioning, incentives are further increased when there is proportionately more cannibalization (i.e., own) competition (Judd, 1985; Moorthy, 1992). These arguments lead to

**Hypothesis 4a:** As competition increases, actual repositioning post regulation increases.

**Hypothesis 4b:** As cannibalization increases, actual repositioning post regulation increases.

For products that have been in existence for several years, a firm’s marketing investments create a number of product-level resources, e.g., brand equity and a base of loyal consumers. These resources allow the firm to make future sales even absent further investments (Mizik & Jacobson, 2008; Vomberg, Homburg, & Bornemann, 2015). Even when advertising is limited, brand strength encourages retailers to carry and favorably position products that have significant numbers of loyal customers, thereby enabling sales of “go to” cereals. This “added utility” (Farquhar, 1989) of brands creates value above that of the direct product features. Reducing advertising risks losing new customers as well as the deterioration of brand recall and recognition (Vomberg, Homburg, & Bornemann, 2015). Given the value of product-level brand
equity, firms might prefer a slow product exit which milks existing brand loyalty. Brand equity may also encourage entry by making it easier to launch and market a closely related variant of a product with a strong brand.

When resources that are closely tied to the product have substantial value, repositioning may be more attractive than exiting because repositioning allows some of the value of the resources to be continuously exploited (Sutton, 1991). In the children’s segment of the cereal market, repositioning might involve targeting older customers, perhaps by harvesting a product’s (older) brand loyal customers and not further investing in attracting new (younger) customers.

How might the strength of a product’s brand equity affect repositioning? Products with little brand equity are, of course, good candidates for exit. A product with substantial brand equity should compete relatively well in its current product space, but might still be a candidate for repositioning if its existing brand asset makes it relatively more attractive to other market segments. For example, a lower-sugar children’s product may be better positioned to attract adult consumers because its taste is less sweet and the product has a less intensely children-oriented brand image. These arguments suggest brand equity and repositioning are linked.

_Hypothesis 4c: The greater the level of underlying brand equity resources, the greater the actual repositioning post regulation._

Finally, compression could lead firms to increase product differentiation through increases in advertising and other forms of marketing, especially persuasive marketing (Boulding, Lee, & Staelin, 1994; Nils-Henrik M. & Stevik, 1998). Essentially, firms combat compression by trying to expand the product space in a consumer’s mind. This strategy appears more effective in cases where a product’s attractiveness is less determined by its physical or functional characteristics. In the case of cereal, where some children attribute “superpowers” to eating particular cereals, such magical qualities would seem important.
Hypothesis 4d: As compression in a segment increases, firms increase their advertising expenditures.

4. Data

We utilize three main sources of data: advertisement information from Nielsen, nutrition information from Mintel, and sales information from IRI. Nielsen provides monthly national television advertisement data from 2004 at the product level, including advertisement units, expenditures, impressions generated for each age group, and characteristics such as program type and program name. Mintel provides cereal nutrition information as reported on the box label (e.g., sugar content, calories) over the period 2001 to 2012. Changes in this information (or in product availability) are identified by “shoppers” hired by Mintel who then send these changed products to Mintel. Since Mintel only makes a report when there are changes to a product or when a new product is introduced, we assume that the cereal characteristics are unchanged absent a new Mintel entry. This information is consistent with nutrition data provided by the manufacturers to the U.S. Department of Agriculture.

IRI Infoscan provides sales and price information obtained from checkout scans at individual stores across 50 U.S. cities from 2001 to 2012. When a purchase is made, information such as product name, price, quantity, and rebates are recorded. We aggregate this data by product, market, and year. Cereals are offered in many different packages but about 94 percent of all sales are packaged in a box and most of those sales are in 15 oz boxes. We limit our sample to box cereals and standardize the weight per box which averaged just over 15 oz.

Defining children’s cereal

Since the regulation at issue is directed towards children, our first step is to define what constitutes a children’s cereal. We adopt the CFBAI audience-based definition of children’s cereal: a cereal whose advertising is directed to an audience in which “35 percent or more…is
composed of children under 12.” To identify children’s cereals, we first aggregate by product-year total impressions generated in each age category. Next, for each product-year, we calculate the percent of impressions generated on children (ages 2–11) relative to impressions on all audiences. We identify 73 products that had at least 35 percent of the total impressions generated in the (2–11) age category for at least one year between 2004 and 2012 and categorize them as children’s cereals. For example, General Mills Cinnamon Toast Crunch is categorized as a children’s cereal because it generated more than 36 percent of all their ad impressions in the (2–11) age range from 2004 to 2008 even though that percentage dropped below 33 percent after 2009. We identify one outlier (Kellogg’s Rice Krispies) and remove it from the sample because it was a very low sugar cereal (4g) which was also repositioned away from the children’s segment well before CFBAI was implemented.

Firms generate impressions on children by advertising on programs primarily watched by children and on programs appealing to more general audiences. For the 73 identified children’s products, firms generated between 85 to 100 percent (mean of 97) of all children’s impressions from programs directed toward children. That is, for our defined children’s products, the manufacturers gain impressions from programs primarily watched by children (e.g., cartoons and not news) and there is a relatively strong distinction between adult and children’s segments.

We begin with the IRI database which contains sales and prices. While about 40 percent of the children’s products are missing from this database, they are of relatively limited

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*a* As part of its commitment, each CFBAI participating member provided their definitions of child-directed advertising and children’s cereal. Although these initial definitions differed somewhat across firms, the differences are not material to our analysis. The 35 percent definition was the original General Mills definition and later became the generally used definition (Lee, Kolish, & Enright, 2010).

*b* Changing the definition around 35 percent does not make substantial difference in the identified subset.

*c* Kellogg’s Rice Krispies never contained more than 4 grams of sugar and it therefore is not a high sugar cereal targeted by CFBAI. We test our findings both with and without its inclusion, finding no major differences.
consequence. The missing products combine for only 5.85 percent of the total advertising spending on children’s cereals, usually appear for one to two years, and are mostly variants of a primary product brand. Next, we merge Nielsen advertising information and Mintel nutrition information into the IRI data. The merged data cover 50 cities and span 2004 to 2012. Summary statistics are provided in Table 1.

‘Insert Table 1 here,’

The heterogeneity of product-level positions and resources suggests that the impact of the CFBAI regulation will vary across products and firms. To give a sense of the differences in vulnerability to the regulation, consider Figure 1 which plots advertising versus sugar content of major children’s cereal products in 2005 prior to the formation of CFBAI. We note several key features. First, the northeast quadrant (high sugar, high advertising) is occupied by both Kellogg’s and General Mills. However, Kellogg’s products tend to have higher sugar compared to that of General Mills. Moving to the northwest quadrant (low sugar, high advertising), we find General Mills Cinnamon Toast Crunch and Kellogg’s Frosted Flakes, the bestselling children’s products for General Mills and Kellogg’s, respectively. Comparing Cinnamon Toast Crunch with Frosted Flakes, we note that Cinnamon Toast Crunch occupies a more regulation favorable resource position with a lower sugar content (10g) than Frosted Flakes (12g). Post and Quaker Oats are better positioned than General Mills and Kellogg’s.

‘Insert Figure 1 here,’

Figure 1 suggests that the sugar-based advertising regulation hit Kellogg’s the hardest as it required the biggest changes to comply. The figure does not provide a clear basis for assessing which firm’s products will encounter the largest increase in competition as a result of regulation. But, because sugar level is a key ingredient affecting a cereal’s taste, assuming limited exit and
full compliance, the market space would be compressed post-regulation especially for products at the maximum of the (advertising) permitted range. Figure 2 provides some evidence of this compression when compared to Figure 1.

‘Insert Figure 2 here,’

5. Empirical Models and Results

Impact on product performance (constrained vs. unconstrained)

The impact of product compression can be seen in Figure 3 which plots national sales volume in our 50-city sample for the categories of unconstrained and constrained products over time. The y-axis and x-axis measure the number of cereal boxes sold and time from self-regulation implementation (e.g., where 0 indicates the first year of implementation), respectively. The figure shows that the sales of each group followed roughly parallel tracks before diverging after the implementation of CFBAI.

‘Insert Figure 3 here,’

To examine market outcomes more rigorously, we use a difference-in-differences approach to compare the sales impact of regulation on constrained (above 12 grams prior to regulation) versus unconstrained products. Reformulated cereals that subsequently meet the sugar standard are not reclassified. Because the implementation date varied slightly across firms, we define the implementation date as the self-regulation implementation year.\(^\text{1}\)

The empirical specification is of the following form:

\[
Y_{it} = \beta_0 + \beta_1 \times \text{constrained}_i + \beta_2 \times \text{post}_it + \beta_3 \times \text{constrained}_i \times \text{post}_it + X_{it}b + \phi_i + \gamma_j + \eta_t + \varepsilon_{it} \tag{1}
\]

Where \(Y_{it}\) is the standardized sales volume for product \(i\) at time \(t\). Variable \(\text{constrained}_i\) is a

\(^{1}\) Since our data is aggregated by year, we identify constrained years as those years after the implementation date. Implementation dates are: GM (July 2007), KL (December 2008), PepsiCo (January 2008), Post (October 2009). We identify constrained years for each company as beginning on the year of implementation: GM 2008, KL 2009, PepsiCo 2008, Post 2010 (Kolish, 2008).
dummy variable that take on the value of 1 if the product is constrained, \( post_{it} \) is a dummy variable that takes on the value of 1 after the relevant firm’s self-regulation implementation date, \( X_{it} \) is a vector of control variables (e.g., advertising spending, price, sugar), \( \phi_t \) is a product fixed effect, \( \gamma_j \) is a fixed effect for city market \( j \), and \( \eta_t \) is a year fixed effect. Inclusion of product and market fixed effects control for fixed differences across products and markets, while the year fixed effect controls for common macroeconomic shocks. Given potential endogeneity concerns regarding the price variable, we instrument price by 2-stage least squares estimates using prices from the other 49 cities. Standard errors are clustered at the market level.

Table 2 summarizes our empirical results regarding product-level sales performance. Models (1) to (3) address relative sales changes with the variable \( constrained_i \times post_{it} \). In all models, sales decreased post regulation more for constrained products than for unconstrained products, supporting Hypothesis 1a.\(^{14}\) For model 3, our preferred specification, post regulation, constrained products suffered a relative decrease in sales of just over four thousand units per product-market-year compared to unconstrained products. The mean sales per product-market-year for constrained products prior to regulation is about 25 thousand units, so the relative decrease is about 16 percent of sales. Assuming that the relative costs of manufacturing and marketing are the same or greater for the newly reformulated and repositioned cereals, this sales decrease is necessarily a decrease in profitability if the relative price decline (increase) of constrained products is greater (less) than that of unconstrained products. An analysis of relative prices (available from the authors), finds that on average price decreased for constrained products relative to unconstrained products by \$0.128 per box.

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\(^{14}\) We also ran our specification with firm fixed effects. Results do not differ for our coefficient of interest.  
\(^{15}\) Though the total effect for constrained products (e.g., adding the coefficients for \( constrained_i \times post_{it} \) and \( post_{it} \)) appears to be close to zero, our focus, of course, is on the performance changes due to regulation for constrained products with respect to unconstrained products.
Model 4 restricts the data to unconstrained products only and explores the relative performance of products at the 12g standard versus products below the standard by replacing $\text{constrained}_i \times \text{post}_it$ in (1) with $\text{standard}_i \times \text{post}_it$, where $\text{standard}_i$ takes on the value of 1 for products with 12g of sugar and 0, otherwise. Mean sales decreased roughly 6,500 units more post regulation for products at the standard versus products with sugar levels less than the standard, providing support for Hypothesis 1b. Based on a mean sales of about 66 thousand units for unconstrained products at the standard prior to the regulation, this decrease represents 10 percent of sales.

To examine the effect of brand equity on performance, we divide our sample into two subsamples of constrained and unconstrained products which spanned the entire time frame and modify equation (1) to include brand equity interactions ($\text{high equity}_i$ with $\text{post}_it$):

$$Y_{it} = \beta_0 + \beta_1 \times \text{high equity}_i + \beta_2 \times \text{post}_it + \beta_3 \times \text{high equity}_i \times \text{post}_it + X_{it}B + \gamma_j + \eta_i + \varepsilon_{it} \quad (2)$$

where $\text{high equity}_i$ indicates whether the product is above the median equity level in the three years prior to the self-regulation (proxied with the average yearly advertising spending). We chose to compare group averages above and below the median because of the roughness of our measure of equity and to avoid imposing a linear structure on the mediating effect.

Using the constrained product sample, Model 2 in Table 3 shows that regulation results in a relative decrease in sales of 1,700 units for constrained products with high brand equity versus constrained products with low brand equity, rejecting Hypothesis 1c and suggesting that repositioning not only decreases the value of brand equity but could even negate the relative

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* An additional analysis was undertaken to assess whether constrained and unconstrained cereals exhibited different trends prior to regulation being implemented. No evidence of different time trends was found.
value. Based on mean sales of about 33 thousand units for high-equity constrained products prior to the regulation, this decrease represents a modest negative 5 percent of sales. In contrast, model 4, which is limited to unconstrained products, shows that brand equity has a positive mediating effect post-regulation, supporting Hypothesis 1d. Based on a 62,000 mean sales volume for high-equity unconstrained products prior to the regulation, the 9,500 unit average increase represents 15 percent of sales.

Next, to empirically assess CFBAI’s effects on short-run performance of firm $k$, we modify equation (1) to replace product interactions with firm interactions ($firm_k$ with $post_{it}$):

$$Y_{it} = \beta_0 + \beta_1 \times firm_k + \beta_2 \times post_{it} + \beta_3 \times firm_k \times post_{it} + X_{it}B + \gamma_j + \eta_t + \epsilon_{it} \quad (3)$$

Table 4 displays the results for this analysis with General Mills as the reference firm. All three models estimate Kellogg’s change in sales after regulation to be worse than that of General Mills, while Post and Quaker Oat’s post-regulation change is better. Given that Kellogg’s had more, and Post and Quaker Oats had fewer, constrained products than General Mills, Hypothesis 2 is supported.

‘Insert Table 4 here,’

**Impact on exit and entry**

The average number of (advertised) product and product variants per year in the children’s segment of the RTE cereal industry decreased from 26 before regulation to 19 after regulation. Four of the exiting products were variants of a main brand, two were variants associated with cartoon characters (e.g., Shrek and Neopet) and one was a main brand product (Kellogg’s Mini Swirlz). Using a Cox proportional hazards model, we estimate the likelihood of exit based on how much a constrained product exceeded the 12g sugar standard prior to regulation:

$$h(t) = h_0(t) \exp(\beta_0 + \beta_1 \times sugar\ distance_{it} + X_{it}B + \pi_k + \epsilon_{it}) \quad (3)$$
where $h(t)$ is the hazard function for product $i$ at time $t$ given covariate vector $X_{it}$, $sugar distance_{it}$ is the number of grams of sugar above the 12 grams level, $X_{it}$ is a vector of control variables (e.g., advertising spending, price), and $\pi_k$ is a company fixed effect. We define survival length as the number of years survived after regulation. Model 3 in Table 5 shows that the estimated coefficient for $sugar distance$ is 0.426 and is statistically different from zero, offering support for Hypothesis 3, which posits the hazard rate of discontinuation for constrained products increases with the increase in sugar content. In contrast, sugar content does not appear to affect the probability of discontinuation for adult cereals.

‘Insert Table 5 here,’

**Impact on product repositioning**

Compliance with the sugar standard through product reformulation effectively compresses the children’s cereal product space and increases competition by forcing products to become more similar on the key taste dimension of sweetness. Visually, this effect can be seen by comparing the spacing of products before CFBAI (Figure 1) with that after CFBAI (Figure 2).

We hypothesize that an increase in competition caused by compression increases the probability that a product will be repositioned to appeal to a broader or different segment of customers (Hypothesis 4). To examine this hypothesis, we construct a measure of compression based on the “distance” between product $i$ and its close competitors in terms of the product characteristics of sugar, sodium and protein. Specifically, for products which spanned the entire time frame, we calculate $distance_{i,j} = characteristics_i - characteristics_j$ where $distance_{i,j}$ is the distance between the characteristics of product $i$ which is reduced to a single dimension using the
propensity score method minus the (equivalently reduced) characteristics of \( product_j \). The distance measure ranges from 0 to 1, with 1 indicating the largest distance between two products. We use this measure to develop a proxy for the overall level of competition (\textit{number all competitors}) faced by the product by counting the number of other products within a given distance of the focal product. The count is further divided into the number of own-firm competitors (\textit{number own competitors}) and the number of rival competitors (\textit{number other competitors}). We choose a cutoff distance of 0.2 for our analysis because it produces a reasonable variability in levels of competition, though our results are not particularly sensitive to the cutoff choice.\(^a\)

As an example, consider General Mills Reese’s Puffs Cereal which contained 13g of sugar, 195mg of sodium, and 1.9g of protein per serving and, using our distance cutoff of 0.2, had no close competitors in 2007. Reese’s Puff was reformulated in 2008 to contain 12g of sugar, 180mg of sodium, and 2g of protein per serving. It then faced three competitors: Post Honeycomb (sugar 10g, sodium 170mg, protein 2g), General Mills Trix (sugar 13g, sodium 180mg, protein 2g), and General Mills Lucky Charms (sugar 11g, sodium 190mg, protein 2g).

As a measure of repositioning, we focus on changes in consumer segment targeting which can be seen in changes in the ratio of adult to children programming advertising spending (e.g., \( \frac{\text{adult}}{\text{children}} \)). For most of the advertised products in the children’s segment of the market, the

\(^a\) We decompose all products (e.g., \( product_{it} \)) into three product characteristics (e.g., \( \text{sugar}_{it}, \text{sodium}_{it}, \text{protein}_{it} \)). To measure how close each of the other products (e.g., \( product_j \)) is from \( product_{it} \), we create a dummy variable that equals 1 for \( product_j \) and 0 otherwise. Using the three decomposed product characteristics for each year, we calculate for each product an estimated probability (e.g., propensity score) that its three characteristics predicts the product to be \( product_{it} \), denoting this estimate as \( \text{characteristic}_{it} \) for \( product_{it} \), \( \text{characteristic}_{j} \) for \( product_j \) etc.

\(^b\) The smaller the cutoff the more similar the included competitors are to the focal firm. 0.2 was the smallest cutoff that still produced significant variability in the number of competitors, e.g. a very small cutoff would result in each focal firm having no competitors. Varying the level from 0.2 to 0.5 did not significantly change the results.
ratio of adult programming advertising spending is relatively low. For example, Lucky Charms in 2006 had a ratio of 0.01, Apple Jack’s 0.18, Froot Loops 0.31, and Frosted Flakes 0.38. Our interpretation is that an increase in the ratio represents a repositioning towards (or to include) a different (adult) market segment. We also considered an alternative interpretation that firms may reposition their advertising toward adults as a means to indirectly target children. But an analysis of the Nielsen Consumer Panel Data provides evidence against this interpretation: while sales of repositioned products to households with children experienced a sales decline post regulation, sales to households without children experienced a modest increase.

Our empirical examination of the relationship between product competition and product repositioning uses the following specification:

\[
reposition_{it} = \beta_0 + \beta_1 \times competition_{it} + X_{it}B + \phi_i + \varepsilon_{it}
\]

(4)

where \(reposition_{it}\) and \(competition_{it}\) measure the repositioning efforts and the competition level of product \(i\) at time \(t\) respectively.

The results shown in Table 6 generally support the hypothesis that products that face increased competition are more likely to be repositioned. In model 1 the coefficient on \(number\ all\ competitors\) indicates that when the number of close competitors increases by one, the ratio of \(\frac{adult_{it}}{children_{it}}\) advertising spending increases by 0.014 which represents 21 percent of the mean \(\frac{adult}{children}\) ratio in our data.\(^a\) Furthermore, models 2–4 show both increases in other competition and increases in own competition increase efforts to reposition, with evidence that hints that cannibalization effects may be greater than that of other (rival) competition.\(^b\) The

\(^a\) Mean \(\frac{adult}{children}\) programming advertising = 0.068.

\(^b\) Because of large standard errors in model 4, we cannot statistically distinguish the other competition and cannibalization effects from zero. But in models 2 and 3 (where the variables are entered separately, e.g., without controlling for cannibalization effect when measuring other competition effect and vice versa), we see that the
disparity may reflect the benefits of business stealing that exist against rival products but not against a firm's own products. These results support Hypothesis 4a and 4b and are consistent with the economics and business strategy literatures regarding the management of product portfolios. When rival and own competitor variables are included in the same regression (model 4), coefficient estimates are similar to those in the other regressions in terms of magnitude and direction but are not significant, likely due to the relatively small number of observations. However, likelihood ratio testing between (model 4) and its model without the two competition variables indicates that the combined effect of the two variables is different from zero.\(^1\)

‘Insert Table 6 here,’

In model 5 we explore whether there is a difference in repositioning for constrained versus unconstrained products by interacting variable constrained\(_{i}\) with number all competitors but find inconclusive results.\(^2\) The lack of statistical significance may merely reflect a lack of power in the test, but is also consistent with the possibility that repositioning is not a significantly stronger force acting on constrained products versus unconstrained products, despite a relative undermining of a constrained product’s previous brand equity, since the competition effects of compression affect both groups equally. Some limited support for the latter possibility is provided in Figure 4 which plots the distribution of the number of cannibalization effect is larger than the other competition effect, albeit for regressions that are not directly comparable. These results are robust to sales-weighted competition over products that spanned our time frame as well as competition counts that included products that appeared for only a portion of the time frame.

\[ F = \frac{(SSE_0 - SSE_1)/(p1-p0)}{SSE_1/(n-p1)} = \frac{(10.337-9.803)/(18-16)}{9.803/(116-18)} = 2.67, \text{ under } H_0 \text{ follows } F_{2,98}, \text{ p-value 0.0763.} \]

\(^1\)Results from (model 5 in Table 4) show that an increase in competition is positively associated with unconstrained products’ efforts to reposition. A positive coefficient 0.017 on number all competitors for (model 5 in Table 4) reveals a positive relationship between number all competitors and unconstrained products’ repositioning effort. Our results show a slightly negative coefficient (-0.003) on number all competitors \(\times\) constrained\(_{i}\) (model 5 in Table 4), though it is statistically indistinguishable from zero.
advertisement units for both constrained and unconstrained products and shows no major differences.

‘Insert Figure 4 here,‘

Individual data points also provide some corroboration. Of the three products that were repositioned the most based on ratios of adult to children’s spending, two (General Mills Cinnamon Toast Crunch and Kellogg’s Frosted Flakes) were unconstrained, while one, Kellogg’s Froot Loops, was constrained. One potential explanation for this outcome is that firms trade off product maximization with portfolio maximization. When constrained products are forced to lower sugar, manufacturers alleviate cannibalization by repositioning some strong unconstrained products that are relatively more attractive to the adult palate such as products with lower sugar content.

These three examples, because they involve strong brands, are supportive of Hypothesis 4c which posits a positive relationship between brand equity and (unforced) repositioning. This relationship is examined more rigorously in Table 6 where all of the models show statistically significant effects of brand equity as measured by the cumulative moving average for total television advertising spending. How does this result square with the Table 3 result of a negative effect of high brand equity for repositioning constrained products? Repositioning was endogenous for cereals that are unconstrained, whereas repositioning was exogenous for the constrained cereals. Hence, unforced repositioning involved products whose brand equity was reasonably suited to the change, whereas that was not necessarily the case for the constrained products that were forced to reposition.

Earlier we examined the benefits of high brand equity to relatively offset the negative consequences of increased competition brought on by the sugar level regulation. This logic
suggests that firms might find it valuable to build the stock of brand equity post-regulation as a strategy to reduce the effects of increased competition. Along these lines, we examine the incentives for firms facing increased competition to invest in advertising to build a product’s brand equity by replacing the repositioning dependent variable in the empirical specifications described in Table 6 with the year-to-year change in advertising spending for each product. These results, shown in Table 7, suggest that as local competition increases (due to either competition from own products or competitors’ products), firms increased their advertising expenditure for each product, perhaps to increase perceived differentiation over time, providing some support for Hypothesis 4d, though increased advertising may also result for current-period competitive reasons. We think both factors are in play, especially as children are likely to be more responsive to non-functional product attributes than adults, but cannot determine the relative sizes of the effects.

‘Insert Table 7 here,’

6. Discussion and Conclusions

In this paper we take advantage of a regulatory natural experiment created by CFBAI that allows us to use a difference-in-differences model to evaluate a regulation’s impact at the product and the firm levels. Our general thesis is that regulatory constraints on products compress the product space by forcing differentiated products to become more similar. This compression increases competition which affects near-term performance. In addition to allowing for an assessment of regulatory impact, the natural experiment provides a means to examine the relationships between product positioning and product-level resources in the form of brand equity.

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Robustness test shows that removing the major repositioned brands, General Mills Cinnamon Toast Crunch and Kellogg’s Frosted Flakes, does not change either the direction or significance of our results.
Our focus on a particular industry allows us to explore nuances associated with product decisions and exploit some of the details one gains in a case study, but it has the disadvantage of limiting the amount of data. This data limitation weakens the power of our tests and limits our ability to distinguish among alternative hypothesis. Though we attempt to control for unobserved firm heterogeneity, we are unable to fully discount the potential for time-varying changes in characteristics. For example, we cannot control for differences across firms in how strategies are formulated and how effectively they are implemented. Nonetheless, despite these and other challenges, the analysis of the RTE cereal self-regulatory event offers a number of insights into the performance impacts of regulation and some interesting evidence on how firms adapt and formulate their strategies.

When differences in product and firm-level resources combined with differing relative market positions both before and after regulation results in a regulation unequally impacting the affected firms, we expect firms to utilize regulation strategically not just as a group, but also individually. Examining the strategic use of regulation is beyond the scope of this paper, in part, because a full examination of this subject calls for an underlying model of the political economy of regulation. For that purpose the differences between industry self-regulation and governmental regulation are important. Both settings have the feature that the changes in constraints are typically known in advance, so they can be anticipated by the affected firms, though in the regulatory case, the constraints are not typically controlled by the affected parties as they would be in the self-regulation context. This difference suggests that self-regulation may lead to

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24 In addition, though we control for time fixed effects, our sample does include the financial crisis which has short-term demand effects for which we cannot fully account.

25 Firms sometimes exploit regulatory loopholes by complying with the letter, but not necessarily the spirit of the regulation. For example, in the CFBAI setting firms might shift advertising to “adjacent” programming (e.g., children 12 and older) which has a sizeable audience of children below age 12 or decrease serving size to make it easier to meet the 12 grams standard. In other analysis we find support for the later, but not the former.
strategic choices that take place along a path more congenial to the firms. With self-regulation, then, there is planning and control, whereas with regulation there is planning with less control.

Given the potentially strategic use of regulation, whether the regulation in question is on net beneficial or harmful to the industry and to consumers in any given case is an open question. In the CFBAI setting, our data did not allow a full investigation of this question, but we conducted a first-order examination of the impact of strategic responses on market structure using the adult segment as a benchmark. As discussed above, regulation appears to have induced significant exit of products. From 2006 to 2010, for example, children-targeted products decreased from 26 to 19 compared to a slight increase in adult products. Overall, the children’s segment experienced a post-regulation sales decline while average prices increased (Figure 5).

‘Insert Figure 5 here,’

These outcomes are consistent with a decrease in competitiveness for structural reasons or possibly because self-regulation may have allowed the market participants to find themselves in a less competitive equilibrium.

We also speculate that the relative positions of the General Mills and Kellogg’s products may have set most of the products on different courses in response to self-regulation. General Mills seemed to be better positioned to make tactical changes to most of its products, Kellogg’s seemed pushed to make more strategic repositioning choices. This increased differentiation could be one mechanism that would explain the apparent price increase post-regulation. There are, of course, many benign alternative explanations for this outcome that deserve further analysis including changes in demand and changes in firm strategy which are unrelated to competitive interaction.
References


Owen, J. (2017). From the Breakfast Table to Snacking Staple: 43% of US Cereal Consumers Eat Cereal As a Snack at Home.


Figures and tables

Figure 1: Product positioning of children's cereal: 2005.

Figure 2: Product positioning of children's cereal: 2009.
Figure 3: Sales volume comparison for constrained versus unconstrained products.

Figure 4: Advertising distribution by program audience.
Figure 5: Children's cereal price over time.

Table 1: Summary statistics on children’s cereals.

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<th>St. Dev.</th>
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<td>Revenue (million dollars)</td>
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Summary statistics for children’s products. Sales is the number of boxes sold standardized at 15.16 oz per box. Revenue in millions of dollars. Advertising spending is the total advertising spending on television programs. Unit price and ounce price are in dollars. In store display is the number of in store advertisement displays, discount is the number of coupons or rebates used. Mean represents simple averages (not weighted by sales) of all product-year combinations. Data merged at product-year-national level from 2004 - 2012 across 50 U.S. geographic areas.
Table 2: Difference-in-differences results explaining sales.

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<td>−1.381</td>
<td>−1.763</td>
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Observations: 9,850
R²: 0.789

Dependent variable is number of boxes sold (thousands) standardized at 15.16 oz per box. Constrained indicates products that contained more than 12 grams of sugar per serving prior to regulation. Standard is a dummy variable that subsets the unconstrained products where 1 indicates unconstrained products that contained 12 grams of sugar per serving the year prior to regulation and 0 indicates unconstrained products that contained less than 12 grams of sugar. Price is two-stage least squares price in cents per oz using other geographical markets as instruments, advertising spending in millions, in store display is the number of in store advertisement displays, discount is the number of coupons or rebates used. Nutrition content are per serving, sugar in grams. Models (1) - (3) include product, year and market fixed effects. Model (4) include year and market fixed effects. Standard error clustered at the market level. Model (4) repeats model (3) replacing constrained with standard dummy. We remove sugar variable in model (4) as sugar is used to identify the standard dummy variable and have a limited variation from 9 to 12 grams per serving.

Table 3: Effect of brand equity on sales.

<table>
<thead>
<tr>
<th></th>
<th>Constrained</th>
<th>Unconstrained</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(1)</td>
<td>(2)</td>
</tr>
<tr>
<td>High equity × post</td>
<td>−3.383</td>
<td>−1.747</td>
</tr>
<tr>
<td></td>
<td>(1.034)</td>
<td>(0.845)</td>
</tr>
<tr>
<td>High equity</td>
<td>11.178</td>
<td>8.965</td>
</tr>
<tr>
<td></td>
<td>(1.222)</td>
<td>(1.074)</td>
</tr>
<tr>
<td>Post</td>
<td>−0.392</td>
<td>−2.522</td>
</tr>
<tr>
<td></td>
<td>(1.101)</td>
<td>(0.782)</td>
</tr>
<tr>
<td>Price</td>
<td>−2.957</td>
<td>−3.094</td>
</tr>
<tr>
<td></td>
<td>(0.294)</td>
<td>(0.301)</td>
</tr>
<tr>
<td>Adv. spending</td>
<td>0.911</td>
<td>0.946</td>
</tr>
<tr>
<td></td>
<td>(0.109)</td>
<td>(0.115)</td>
</tr>
<tr>
<td>In store display</td>
<td>0.058</td>
<td>0.058</td>
</tr>
<tr>
<td></td>
<td>(0.007)</td>
<td>(0.007)</td>
</tr>
<tr>
<td>Discount</td>
<td>0.034</td>
<td>0.032</td>
</tr>
<tr>
<td></td>
<td>(0.012)</td>
<td>(0.012)</td>
</tr>
<tr>
<td>Sugar</td>
<td>−1.608</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.427)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>56.538</td>
<td>82.182</td>
</tr>
<tr>
<td></td>
<td>(6.700)</td>
<td>(8.639)</td>
</tr>
</tbody>
</table>

Observations: 3,600
R²: 0.809

Dependent variable is number of boxes sold (thousands) standardized at 15.16 oz per box. High equity is a dummy variable that takes the value of 1 when the average yearly advertising spending for the 3 years prior to self regulation is above the median. Price is two-stage least squares price in cents per oz using other geographical markets as instruments, advertising spending in millions, in store display is the number of in store advertisement displays, discount is the number of coupons or rebates used, sugar in grams. All models include year and market fixed effects. Standard error clustered at the market level.
Table 4: Difference-in-differences results explaining firm performance.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kellogg's × post</td>
<td>-2.023</td>
<td>-2.350</td>
<td>-2.526</td>
</tr>
<tr>
<td></td>
<td>(0.653)</td>
<td>(0.648)</td>
<td>(0.655)</td>
</tr>
<tr>
<td>Post Cereals × post</td>
<td>13.312</td>
<td>13.662</td>
<td>15.771</td>
</tr>
<tr>
<td></td>
<td>(0.673)</td>
<td>(0.462)</td>
<td>(2.124)</td>
</tr>
<tr>
<td>Quaker × post</td>
<td>1.220</td>
<td>1.866</td>
<td>11.533</td>
</tr>
<tr>
<td></td>
<td>(0.346)</td>
<td>(0.469)</td>
<td>(2.981)</td>
</tr>
<tr>
<td>Post</td>
<td>-1.847</td>
<td>-2.143</td>
<td>-3.588</td>
</tr>
<tr>
<td></td>
<td>(0.506)</td>
<td>(0.385)</td>
<td>(1.188)</td>
</tr>
<tr>
<td>Price</td>
<td>-2.029</td>
<td>-2.008</td>
<td>-1.849</td>
</tr>
<tr>
<td></td>
<td>(0.364)</td>
<td>(0.366)</td>
<td>(0.504)</td>
</tr>
<tr>
<td>Adv. spending</td>
<td>1.481</td>
<td>1.476</td>
<td>1.450</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.022)</td>
<td>(0.034)</td>
</tr>
<tr>
<td>In store display</td>
<td>0.112</td>
<td>0.110</td>
<td>0.114</td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td>(0.005)</td>
<td>(0.005)</td>
</tr>
<tr>
<td>Discount</td>
<td>0.052</td>
<td>0.046</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td></td>
</tr>
<tr>
<td>Sugar</td>
<td></td>
<td>-2.144</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(1.000)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>30.754</td>
<td>30.642</td>
<td>53.256</td>
</tr>
<tr>
<td></td>
<td>(9.413)</td>
<td>(9.377)</td>
<td>(21.422)</td>
</tr>
</tbody>
</table>

| Observations | 9,850   | 9,850   | 9,250   |
| R²           | 0.738   | 0.739   | 0.745   |

Table 5: Cox proportional hazards model for children’s cereal.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sugar distance</td>
<td>0.097</td>
<td>0.379</td>
<td>0.426</td>
</tr>
<tr>
<td></td>
<td>(0.146)</td>
<td>(0.217)</td>
<td>(0.215)</td>
</tr>
<tr>
<td>Price</td>
<td>-6.069</td>
<td>-23.828</td>
<td>-25.530</td>
</tr>
<tr>
<td></td>
<td>(12.055)</td>
<td>(16.270)</td>
<td>(16.571)</td>
</tr>
<tr>
<td>In store display</td>
<td>-0.076</td>
<td>-0.102</td>
<td>-0.109</td>
</tr>
<tr>
<td></td>
<td>(0.026)</td>
<td>(0.030)</td>
<td>(0.033)</td>
</tr>
<tr>
<td>Adv. spending</td>
<td>0.449</td>
<td>0.443</td>
<td>0.263</td>
</tr>
<tr>
<td></td>
<td>(0.263)</td>
<td>(0.278)</td>
<td></td>
</tr>
</tbody>
</table>

The hazard is the probability that if a product survives to year $t$, it will experience exit in the next year. Survival event is defined as product exit between 2004 and 2012. Survival length measured as number of years the product variant survived after the implementation date until 2012. Sugar distance in grams per serving is the sugar content of the product in its last year prior to regulation implementation less the regulation constraint level of 12 grams per serving. Model (3) includes additional company fixed effects.

| Observations | 37      | 37      | 37      |
| R²           | 0.624   | 0.655   | 0.671   |

Dependent variable is number of boxes sold (thousands) standardized at 15.16 oz per box. Price is two-stage least squares price in cents per oz using other geographical markets as instruments, advertising spending in millions, in store display is the number of in store displays, discount is the number of coupons or rebates used. Nutrition content are per serving, sugar in grams. All models include company, year and market fixed effects. Standard error clustered at the market level. Reference company is General Mills.
Table 6: Effect of product competition on repositioning.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number all competitors</td>
<td>0.014</td>
<td></td>
<td></td>
<td>0.022</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.006)</td>
<td></td>
<td></td>
<td>(0.009)</td>
<td></td>
</tr>
<tr>
<td>Number own competitors</td>
<td>0.045</td>
<td>0.021</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.022)</td>
<td>(0.032)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number other competitors</td>
<td>0.018</td>
<td>0.012</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.008)</td>
<td>(0.012)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number all competitors  x constrained</td>
<td></td>
<td></td>
<td>-0.014</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>(0.012)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Brand equity</td>
<td>0.049</td>
<td>0.049</td>
<td>0.048</td>
<td>0.049</td>
<td>0.047</td>
</tr>
<tr>
<td></td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
<td>(0.015)</td>
</tr>
<tr>
<td>Constant</td>
<td>-0.654</td>
<td>-0.677</td>
<td>-0.619</td>
<td>-0.666</td>
<td>-0.625</td>
</tr>
<tr>
<td></td>
<td>(0.323)</td>
<td>(0.330)</td>
<td>(0.321)</td>
<td>(0.330)</td>
<td>(0.324)</td>
</tr>
<tr>
<td>Observations</td>
<td>116</td>
<td>116</td>
<td>116</td>
<td>116</td>
<td>116</td>
</tr>
<tr>
<td>R²</td>
<td>0.406</td>
<td>0.400</td>
<td>0.404</td>
<td>0.406</td>
<td>0.414</td>
</tr>
</tbody>
</table>

Dependent variable is the ratio of advertising spending on adult programs over children’s programs. Number all competitors, number own competitors, and number other competitors measure the number of cereal products within a propensity score of 0.2 from product, that is a children’s cereal, a children’s cereal from the same firm as product, and a children’s cereal from a different firm than product. Correlation coefficient between number own competitors and number other competitors is 0.68. Brand equity measures the cumulative moving average for total advertising spending (mhn) on television programs.

Table 7: Effect of product competition on advertising spending.

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
<th>(5)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number all competitors</td>
<td>0.167</td>
<td></td>
<td></td>
<td>0.051</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.079)</td>
<td></td>
<td></td>
<td>(0.110)</td>
<td></td>
</tr>
<tr>
<td>Number own competitors</td>
<td>0.692</td>
<td>0.580</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.298)</td>
<td>(0.410)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number other competitors</td>
<td>0.185</td>
<td>0.054</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.099)</td>
<td>(0.135)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Number all competitors  x constrained</td>
<td></td>
<td></td>
<td></td>
<td>0.239</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(0.157)</td>
<td></td>
</tr>
<tr>
<td>Constant</td>
<td>-0.200</td>
<td>-0.725</td>
<td>-0.033</td>
<td>-0.613</td>
<td>-0.084</td>
</tr>
<tr>
<td></td>
<td>(1.597)</td>
<td>(1.617)</td>
<td>(1.602)</td>
<td>(1.647)</td>
<td>(1.596)</td>
</tr>
<tr>
<td>Observations</td>
<td>127</td>
<td>127</td>
<td>127</td>
<td>127</td>
<td>127</td>
</tr>
<tr>
<td>R²</td>
<td>0.094</td>
<td>0.101</td>
<td>0.086</td>
<td>0.163</td>
<td>0.113</td>
</tr>
</tbody>
</table>

Dependent variable is year to year change in advertising spending in millions. Number all competitors, number own competitors, and number other competitors measure the number of cereal products within a propensity score of 0.2 from product, that is a children’s cereal, a children’s cereal from the same firm as product, and a children’s cereal from a different firm than product. Correlation coefficient between number own competitors and number other competitors is 0.68.