Nonlinear Pricing Under Regulation: Comparing Cap Rules and Taxes in the Laboratory

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Abstract

We report an experiment contrasting the impacts of a tax and a cap rule in a market with privately-informed buyers. Relying on standard nonlinear pricing theory, we evaluate the degree to which consumer choice and well-being are impacted by these measures. In our experiment, single-product sellers face demand from two types of buyers with private preferences. We manipulate the policy environment across treatments. With regulations, we aim to reduce the size of the large option by about half the original large quantity. Compared to the regulation-free baseline, sellers facing a cap attempt to separate types with similar frequency. With a tax, subjects are less likely to offer menus with two alternatives. Additionally, we find that consumer surplus remains unaffected under a cap rule, while buyers with high willingness to pay for the product see their surplus diminished by the tax. These results have implications for policy making in the food retail industry and others where authorities aim to regulate consumption while protecting consumer surplus.

Keywords: cap rule, experiment, nonlinear pricing, quantity cap, tax

JEL classification: C9, D82, L51

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1 Introduction

Cap rules (caps) set an upper limit on the default quantities at which goods can be offered for sale. Caps and and taxes are alternatives to regulate markets where sellers practice second-degree price discrimination. In settings where the regulator aims to discourage consumption but consumer surplus is a primary consideration, taxes are frequently implemented while caps are often dismissed because intuition suggests that they are particularly harsh on buyers. However, comparing the effects of both interventions is not a straightforward exercise. This is because taxes and caps affect the seller's pricing scheme in different ways, with results difficult to anticipate. When caps are proposed, opponents dismiss them because they ostensibly disproportionately hurt consumers and reduce choice; however these blames are not raised against taxes or, at least, are not considered to be fatal to their enactment. We aim to evaluate the degree to which these accusations hold for both caps and taxes. To this end, we use a stylized nonlinear pricing model with one product and discrete privately-informed buyers to derive hypotheses about the regulatory impacts. We evaluate these with data from a laboratory experiment. Compared to a regulation-free baseline, both consumer surplus and the proportion of two-option menus submitted by subjects taking the role of sellers remain unchanged when a cap is enforced. With a tax, consumer surplus is lower and subjects are more likely to submit single-option offers excluding consumers with low willingness to pay for the good. In other words, in the environment we study, we find that taxes are more likely to cause the ills attributed to caps.

Sellers use nonlinear prices to mitigate the asymmetric information problem resulting

from private preferences.[1] In the canonical case, one buyer (he) holds private information regarding a contractual variable under control of the seller (she); the realization of this information determines his type, and marginal utility of consumption increases with the type. Under these circumstances, it is in the seller's best interest to offer a menu with differentiated price-quantity options so that the buyer voluntarily reveals his type. The sellers' optimal price schedule is concave, implying lower per-unit prices for larger options. The highest type buys his first-best quantity; quantity exhibits downward distortion; the participating buyer with the lowest type is held at his reservation value, and higher types enjoy weakly increasing rents (Maskin and Riley 1984; Myerson 1979; Mussa and Rosen 1978). Examples of industries where nonlinear prices are common include cable television services with "premium" services with substantially more channels than "basic" options and where the price of the alternatives does not increase directly with the number of channels; package delivery services where the per-kilogram fare diminishes as the total weight to be shipped augments, and the consumer packaged goods industry, where "large" choices feature quantity discounts compared to the "small" options of the same product.

One example where caps and taxes have been either proposed or implemented is found in the food retail industry. In this industry, both casual observation and academic research suggest that price discrimination is rampant (Bonnet and Réquillart 2013, Hendel and Nevo 2013, and Holton 1957). The motivation of the interventions is to discourage consumption of products deemed unhealthy when consumed liberally. Specific taxes are often the first -and sometimes the only- option discussed when authorities in health-conscious localities

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[1]With this framework, prices are said to be nonlinear with respect to quantity. To segment demand, large options feature quantity discounts compared to smaller alternatives.

plan their food policy. Take "soda taxes" as an example. In 2013, there were no cities in the United States with an approved tax exclusively targeting sugar sweetened beverages (SSB). Following the first soda tax in Berkeley in 2015, Oakland, Philadelphia, and Seattle enacted their own. Mexico adopted a national tax on SSB in 2014.

Because a number of studies link increased consumption to portion sizes, caps have arisen as an alternative to regulate these products (Rolls et al. 2006; Flood et al. 2006; Ledikwe et al. 2005; Young and Nestle 2002). One prominent example is the 2013 New York City's so-called "soda ban". The plan intended to prohibit the sale of SSB in containers exceeding 16 ounces.[2] The measure was struck down in court. At the time, debates around its potential benefits were contentious. Opponents argued that caps are particularly harmful to consumers and reduce choice.[3]

We contrast caps and specific taxes in a setting characterized by adverse selection. If one policy is more likely to cause our sellers to offer a lower number of options compared to our baseline, we argue that the policy reduces consumer choice.[4] In addition, if consumer surplus is negatively impacted by a given intervention, we submit that the policy hurts buyers. If one has a larger effect we conclude it hurts consumers more than the alternative.

Compared to the baseline, the tax is found to reduce consumer surplus and the number of alternatives submitted by sellers. These effects are absent with a cap. Two factors explain

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[2] As a reference, the "small" and "large" cup sizes typically found in popular American quick-service restaurants contain around 16 and 32 ounces correspondingly.

[3] Versions of this argument can be found both in media (e.g. Grynbaum 2012 and Grynbaum and Connelly 2012) and proposed policies; for example, Mississippi's Bill 2687 (2013) interdicts against rules that restrict of food sales based upon the product's nutrition information or upon its bundling with other items (Bourquard and Wu, 2020).

[4] We adopt this metric to evaluate impacts on choice because we take as given that both interventions will eliminate the largest unregulated alternative. Thus, we see a reduction in the number of alternatives as an impact beyond the intended effect.

the outcomes. First, the influence of the regulations on the pricing problem is different. The cap limits the seller's choice space, while the tax is akin to a increase in marginal cost of production. Intuitively, with a cap, the seller modifies the per-package price of the large option to keep surplus constant maintaining the incentive compatibility needed to separate types. With a tax, no buyer receives his firs-best quantity and this translates into lower consumer surplus for the H-type. Second, the tax reduces the set of incentive-compatible menus with high expected profit. Thus, in the experiment, subjects shift from separating types to submit simpler single-option offers even though they are associated with slightly lower expected profit.[5]

We remain agnostic about the effectiveness of either taxes or caps to fight obesity. We do not advocate for the implementation of either regulatory alternative in the food retail industry. Our objective is to use an economic experiment, informed by a stylized model, to find whether the ills of reduced choice sets and diminished consumer rents, often used to dismiss cap rules, can also be produced by taxes. The experimental evidence clarifies the manner in which price-discriminating vendors endogenously adapt their pricing schemes under different policy environments. To the degree that sellers in food retailing and other industries adopt nonlinear pricing, and a main concern of authorities is the protection of consumer surplus, the present study can be informative.

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[5]This echoes the documented regularity whereby multi-product sellers simplify their bundling strategies to facilitate menu design even at the cost of some expected profit (Chu et al., 2011).

2   Related literature

We complement findings by Bourquard and Wu (2020) who study the effect of quantity limits leveraging a nonlinear pricing model. In their study, one retailer offers a single good to two buyers with private preferences (high and low). They find that moderate caps do not affect surplus earned by the low-type, while the higher type is not impacted as long as the limit does not modify the portion immediately below that of their choice. We take Bourquard and Wu (2020) framework to explore the degree to which these outcomes hold when incorporating taxation. Additionally, we test the model's main predictions with data from a controlled experiment.

The model we use to aid experimental design implies that taxes reduce consumption; this relationship has been documented by observational studies (e.g. Grogger 2017; Silver et al. 2017; Colchero et al. 2017). However, most of these studies remain silent regarding the underlying mechanisms driving changes in pricing and allocation. Our study offers empirical evidence in support of one such mechanisms: the endogenous response of price-discriminating sellers to accommodate the mandates while maintaining incentive-compatibility.[6]

Our study also speaks to the empirical literature documenting how buyers respond to quantity limits (Ahn and Lusk 2021; John et al. 2017; Wilson et al. 2013). In essence, these studies implicitly assume a passive seller and adopt the point of view of buyers to study different effects, including potential framing and reactance (customers "pushing back"

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[6]The body of works looking at the impact of these taxes on weight shows mixed results. Some suggest that there are small impacts contingent on severity of the tax and potential consumer substitution (Aguilar et al. 2019; Fletcher et al. 2014;Fletcher et al. 2010a; Fletcher et al. 2010b). Other research points out that the effects may vary depending on key demographic variables (Sturm et al., 2010). We are not concerned with demonstrating the effectiveness of either regulation on health outcomes. Important in our case is the consensus that taxes seem *not to cause an increase* in consumption.

against the policy and trying to undermine its main goal). In these works, the researchers design the alternatives to be presented to subjects across treatments. Implicitly, the seller is assumed not to try to adapt her pricing strategies to the new regulatory environment while losing as little profit as possible. A more complete explanation of the consequences of these interventions should include analyses of the reactions of both buyers and sellers. In the present document, we concentrate on the retailer's response to the measures.

Additionally, we contribute to the set of studies reporting laboratory experiments evaluating conclusions derived from principal-agent models (Hoppe and Schmitz 2018; Hoppe and Schmitz 2015; Huck et al. 2011).

3   Theory

In this section we describe the model we use to derive our hypotheses. We show the characterization of the seller's optimal separating pricing strategies in three policy environments: an unregulated baseline; a scenario with a moderate portion cap, and a third setting where a tax is enforced.[7] The baseline and cap subsections rely on work by Bourquard and Wu (2020), where proofs and details can be found. We dedicate more time to discuss the seller's pricing strategies in the taxed environment.

We primarily focus on consumer welfare from consumption and do not account for potential health benefits from reduced consumption that would be relevant for an application to the case of regulating SSBs. This means that we assume potential health benefits to be null. We maintain this assumption for three reasons. First, much of the opposition against

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[7]For completeness, we show the characterization of single-package schemes in appendix A. We also discuss the issue of segmentation policy-switching in appendix B.

these regulations focused on how they might hurt consumers via reduced choice. Second, to incorporate health benefits to the model, we would need to adopt a precise measure of welfare improvement attributable to the measures. To do so, we would be required to accept arbitrary assumptions delineating how exactly lower consumption translates into health benefits. These assumptions could be strategically chosen to produce any outcome. Finally, omitting health benefits makes our results robust to substitution effects in that, even if consumers shift to other unhealthy beverages, we do not run the danger of over-estimating consumer benefits.[8] In sum, we take consumer welfare to be gross utility from consumption net of price because this simple definition requires the least number of assumptions. With our framework, then, changes in consumer surplus across environments can be safely attributed to the way the seller maintains incentive compatibility while abiding to the regulations without the confounding effects brought about by health considerations.

3.1 Model Baseline Without Regulations in Effect

We begin by establishing a benchmark for the retailer's pricing behavior in the absence of regulation. This allows us to make subsequent comparisons with respect to the impact of the regulations. The seller (she) offers a menu of different price-quantity combinations of a product to a privately informed buyer (he). There are two types of consumers. With probability $\beta \in [0, 1]$, he is a low-type (L-type). With probability $(1 - \beta)$, the buyer is a high-type (H-type). The types are characterized by a taste parameter θ_i for $i = H, L$ such that $\theta_H > \theta_L$. At a given price, the H-type consumes more than the L-type because the

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[8]Indeed, one way to interpret our findings is how consumers might be impacted even if the regulations yield little to no health benefits.

former has higher willingness to pay.

When an i-type purchases a package with q_i units of the good (e.g. q_i number of ounces in the cup) and pays a price $p_i \equiv p(q_i)$, he earns surplus $U_i = \theta_i u(q) - p_i$, where $u(\cdot)$ is a well-behaved utility function.[9] Note that price p_i refers to the serving price, as opposed to per-unit (e.g. per ounce) price. Seller and buyer have reservation values of zero. Cost of production is $c(q) = cq$, where $c'(q) = c > 0$. The seller maximizes her expected profit subject to incentive-compatibility (IC) and participation (PC) constraints:

$$\underset{(p_H, q_H, p_L, q_L)}{\text{maximize}} \quad \mathbb{E}[\pi] = (1 - \beta)\big[p_H - cq_H\big] + \beta\big[p_L - cq_L\big]$$

subject to:

PC: $\theta_L u(q_L) - p_L \geq 0$

IC: $\theta_H u(q_H) - p_H \geq \theta_H u(q_L) - p_L$

$q_i \geq 0, \quad i = H, L$

$$(1)$$

The seller's objective function weights the profit contribution (price net of cost of production) of a given serving size by the probability of the customer she faces being of the corresponding type. As we will show, taxes and caps modify the optimization program in different ways: taxes distort cost of production, while caps reduce the seller's choice space.

Because the IC and PC restrictions play an important role on the outcomes of the interventions, we briefly discuss them. PC ensures that all buyers are at least indifferent between not participating or purchasing one of the options. To serve both consumer types, only the participation constraint of the L-type is relevant: its satisfaction implies that the H-type

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[9]Throughout the paper, we use the words "cup", "serving" and "package" interchangeably.

finds it individually rational to buy an alternative.

The IC restriction provides incentives for self-selection. We say a menu of two packages is incentive-compatible if the i-type buyer prefers package (p_i, q_i) over an alternative (p_j, q_j) $i \neq j$. In an incentive-compatible mechanism, the quantity increases with the value of the taste parameter θ_i, satisfying the monotonicity condition $q_H > q_L$.

Depending on the likelihood of the buyer being an L-type and how large the taste dispersion $(\theta_H - \theta_L)$ is, there are occasions where single-package strategies are preferable to separating schemes. Conditions where single-packages are preferable with and without a size restriction are discussed in Bourquard and Wu (2020). Here we discuss only the separating strategy. The quantities that satisfy the problem's first order conditions are the following:[10]

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\text{Baseline-separating-quantities} \begin{cases} \theta_H u'(q_H^{*1}) = c \\ \\ \theta_L u'(q_L^{*1}) = \dfrac{c}{\left[1 - \left(\frac{1-\beta}{\beta} \right) \left(\frac{\theta_H - \theta_L}{\theta_L} \right) \right]} \end{cases} \tag{2}
$$

With these outcome, the L-type buyer is held at his reservation value, which we assume to be null ($U_L = 0$). While the High-type buyer receives positive surplus $U_H^{*1} = (\theta_H - \theta_L)u(q_L^{*1})$. The sellers' expected profit is $\mathbb{E}[\pi^{*1}] = \beta[\theta_L u(q_L^{*1}) - cq_L^{*1}] + (1-\beta)[\theta_H u(q_H^{*1}) - (\theta_H - \theta_L)u(q_L^{*1}) - cq_H^{*1}]$. Therefore, total surplus is $T.S. = \mathbb{E}[\pi^{*1}] + U_H$. The profit-maximizing schedule allocates larger quantity to the buyer with higher willingness to pay, granting him positive surplus. The L-type is held at his reservation value. The solution allocates to the H-type his

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[10]We use superscripts throughout the theory section to denote solutions to endogenous variables as follows. The stars refer to the policy environment: one star (*) refers to the baseline, two to the market with a cap, and three to the taxed environment. The numbers correspond to the segmentation strategy: number one (1) marks the separating scheme; number two labels the pooling scheme outcomes (when the seller offers one option to serve both types), and the number three denotes results when the seller adopts an exclusive strategy (an option designed to serve H-types only, excluding L-types from participation).

first best quantity because this type's marginal willingness to pay equates marginal cost of production. On the other hand, the L-type buyer receives less than his first-best quantity.

3.2   Model With Cap Rule

With a cap limiting the maximum quantity to an arbitrary level $\hat{q}$, such that $q_L^{*1} \leq \hat{q} \leq q_H^{*1}$, the seller's problem is still 1, but with an additional portion cap rule (PCR):

$$\text{(PCR)}: q_i \leq \hat{q} \ \text{ for } \ i = L, H \tag{3}$$

We consider this range of regulations because only restrictions where $\hat{q} \leq q_H^{*1}$ are of economic interest. We assume that the regulation is set at a level larger than or equal to the unregulated small size (i.e. $q_L^{*1} \leq \hat{q}$). Our analysis is consistent with moderate restrictions that do not set the limit below the quantity contained in the small regulation-free alternative. At the solution, the quantities satisfy:

$$\text{Cap-separating-quantities} \begin{cases} \theta_H u'(q_H^{**1}) \geq c, \text{ where } q_H^{**1} = \hat{q} \\[2ex] \theta_L u'(q_L^{**1}) = \dfrac{c}{\left[1 - \left(\frac{1-\beta}{\beta}\right)\left(\frac{\theta_H - \theta_L}{\theta_L}\right)\right]} \end{cases} \tag{4}$$

With a menu of two packages, the L-type buyer gains no rents. The H-type consumers earn $U_H^{**1} = (\theta_H - \theta_L)u(q_L^{**1})$. Expected profit is $\mathbb{E}[\pi^{**1}] = \beta[\theta_L u(q_L^{**1}) - cq_L^{**1}] + (1 - \beta)[\theta_H u(\hat{q}) - (\theta_H - \theta_L)u(q_L^{**1}) - c\hat{q}]$. Total surplus is $\beta[\theta_L u(q_L^{**1}) - cq_L^{**1}] + (1 - \beta)[\theta_H u(\hat{q}) - (\theta_H - \theta_L)u(\hat{q}) - c\hat{q}] + (\theta_H - \theta_L)u(\hat{q})$.

In brief, if the size restriction limits the H-type's serving but not the L-type's. There

is no impact on consumer surplus. Profit is negatively impacted. The cap will reduce the quantity offered to the H-type but not the portion size served to the L-type. Intuitively, as the regulation moves the size of the large package down, the seller adjusts the price of the large package accordingly in an effort to keep incentive compatibility and continue to separate buyers by their taste.

3.3 Incorporating Taxation into the Model

We expect a tax to have two effects. First, it could directly impact package sizes and prices. Second, it may indirectly cause the retailer to change her segmentation strategy (separating, pooling or exclusive). We start by analyzing the direct effects on quantities and prices.

Let us define a tax regime (τ_s, τ_v) as any mixture of specific $(\tau_s \geq 0)$ and *ad valorem* $(\tau_v \in [0,1))$ taxes, such that both of them are not zero at the same time. To avoid divisions by zero later on, we exclude combinations where $\tau_v = 1$. Specific taxes modify the objective function in a way akin to a change in the cost function. *Ad valorem* taxes alter the objective function in two ways: by modifying the cost function and scaling down expected profit. Under taxation, the seller solves:

$$\max_{q_L, q_H} \mathbb{E}[\pi] = (1 - \tau_v)\Big\{(\beta)\big[\theta_L u(q_L) - \Psi_L\big] + (1 - \beta)\big[\theta_H u(q_H) - (\theta_H - \theta_L)u(q_L) - \Psi_H\big]\Big\} \quad (5)$$

where $\Psi_i \equiv (\tau_s q_i + c q_i) \div (1 - \tau_v)$ is the effective cost function under taxation. Let $\psi \equiv \frac{d\Psi_i}{dq_i} = (\tau_s + c) \div (1 - \tau_v)$ denote effective marginal cost. First order conditions are:

$$\text{FOC}[q_H] : \frac{\partial \mathbb{E}[\pi]}{\partial q_H} = (1 - \tau_v)(1 - \beta)[\theta_H u'(q_H) - \psi] \leq 0$$

$$\text{where} \quad q_H \geq 0 \quad \text{and} \quad \frac{\partial \mathbb{E}[\pi]}{\partial q_H} \cdot q_H = 0 \tag{6}$$

$$\text{FOC}[q_L] : \frac{\partial \mathbb{E}[\pi]}{\partial q_L} = (1 - \tau_v)\{\beta(\theta_L u'(q_L) - \psi) + (1 - \beta)[-(\theta_H - \theta_L)v'(q_L)]\} \leq 0$$

$$\text{where} \quad q_L \geq 0 \quad \text{and} \quad \frac{\partial \mathbb{E}[\pi]}{\partial q_L} \cdot q_L = 0 \tag{7}$$

These equations characterize the optimal solution with taxation. We proceed with a delineation of the outcomes under different segmentation strategies.

Separating Pricing Strategy with Taxation

When the seller aims to serve both buyer types, they are offered options such that $q_i > 0$, $i = H, L$. Thus, equations 6 and 7 hold with equality:

$$\text{Tax-separating-quantities} \begin{cases} \theta_H u'(q_H) = \psi \\ \\ \theta_L u'(q_L) = \psi + \left(\frac{1-\beta}{\beta}\right)(\theta_H - \theta_L)u'(q_L) \end{cases} \tag{8}$$

The *effective* marginal cost of supplying a large package equals the H-type's marginal utility of consumption. Thus, while there is distortion relative to the baseline case, there is "no distortion at the top" relative to the effective marginal cost. Note however, that, in effect, the higher type is receiving a quantity below his first-best. The seller continues to distort the size of the option for the L-type. Relative to the baseline, both buyer types get less than their first-best optimal quantities because the effective marginal cost is altered by the tax so that $\psi > c$. The price rules associated with this case are $p_L^{***1} = \theta_L u(q_L^{***1})$, and

$p_H^{***1} = \theta_H u(q_H^{***1}) - (\theta_H - \theta_L)u(q_L^{***1})$. Earnings are:

$$\text{Tax-separating-information rents} \begin{cases} U_L^{***1} = 0 \\ \\ U_H^{***1} = (\theta_H - \theta_L)u(q_L^{***1}) \end{cases} \tag{9}$$

$$\pi^{***1} = (1 - \tau_v)\Big\{(\beta)[\theta_L u(q_L^{***1}) - \psi q_L^{***1}] + (1 - \beta)\big\{[\theta_H u(q_H^{***1}) - (\theta_H - \theta_L)u(q_L^{***1})] - \psi q_H^{***1}\big\}\Big\} \tag{10}$$

In sum and compared to the unregulated benchmark, the size of both packages is smaller. H-type consumers still receive rents, although these are smaller so there is welfare loss. L-types are held at their reservation values, and the seller sees her expected profit unambiguously diminished. While it may seem counter-intuitive that prices are lower after a tax, keep in mind that we focus on per-serving size prices as opposed to per-unit prices (e.g. price per-ounce).[11]

Pooling Strategy with Taxation

Recall that to accommodate the intervention, the seller can modify both the endogenous variables (prices and quantities) and/or the segmentation scheme. The question arises, then, as to whether the seller will maintain a separating strategy following the tax or if she will pivot to a single-option type of strategy. We first consider the case where the seller offers one option to serve both consumer types with a "one-size-fits-all" type of strategy. The retailer's optimization problem can be written as follows:

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[11]In the textbook problem, a tax causes the demand function to shift downward and lead to a higher uniform price for all units. However, in the nonlinear pricing problem, a serving size price is designed to extract as much consumer surplus as possible. As such, the implicit unit price may vary across different units.

$$\max_{p,q} \ \mathbb{E}\left[\pi\right] = (1 - \tau_v)t_L - (\tau_s + c)q_L$$

subject to: (11)

$$\mathrm{IRL} : \theta_L u(q) - t_L \geq 0$$

The optimization conditions imply:

$$\text{Tax-pooling-quantity} \begin{cases} \theta_L u'(q^{***2}) = \psi \end{cases} \tag{12}$$

While equation 12 implies marginal benefits are equal to the effective marginal cost, recall that ψ is the effective marginal cost post-tax. Thus, the L-type does not get his first-best level of consumption. The value functions for the seller and buyers are:

$$\text{Tax-pooling-payoffs} \begin{cases} \pi^{***2} = (1 - \tau_v)[\theta_L u(q^{***2}) - \psi \cdot q^{***2}] \\ \\ U_L^{***2} = 0 \\ \\ U_H^{***2} = (\theta_H - \theta_L)u(q^{***2}) \end{cases} \tag{13}$$

Armed with this characterization we are now able to compare expected profits from the separating and pooling strategies. The seller's decision depends on the distribution of types. The model suggests that separation of types continues to be preferred.

Claim 1. *The separating strategy is more profitable than the pooling scheme if and only if $\beta \geq \underline{\beta}_O = \frac{(\theta_H - \theta_L)u(q_L^{***1}) + \theta_L u(q^{***2}) - \psi q^{***2} - [\theta_H u(q_H^{***1}) - \psi q_H^{***1}]}{\theta_H u(q_L^{***1}) - \psi q_L^{***1} - [\theta_H u(q_H^{***1}) - \psi q_H^{***1}]}$*

All proofs are in the appendix. The above claim pins down the minimum threshold ($\underline{\beta}_O$) that β must exceed for the separating strategy to remain more profitable than the

one-size-fits-all strategy.

Proposition 1.   *Suppose that a tax regime (τ_s, τ_v) comes into effect. Then, $\underline{\beta}_O$ decreases. This increases the range of β for which the separating strategy is more profitable than the pooling scheme.*

The model suggests that a tax makes it *less* likely that the seller will switch from a separating strategy to a one-size-fits-all scheme. Intuitively, the single option has to be priced reasonably low to ensure that the L-type participates. Thus, it is a relatively low profit margin strategy that relies on the already low margins. The key point is that, according to the model, if the retailer chooses the separating strategy pre-tax, then the retailer will not switch to a pooling pricing scheme post-tax.

Exclusive Strategy with Taxation

We now explore whether, according to the model, the seller will change her segmentation strategy to a single-option scheme excluding the L-type. To serve the H-type exclusively, $FOC[q_L]$ in 7 needs not to bind with equality. Using $FOC[q_H]$ from 6, pricing rule $p_H = \theta_H u(q_H) - (\theta_H - \theta_L)u(q_L)$, and the normalizing assumption $u(0) = 0$, we obtain:

$$\text{Tax-exclusive-quantity} \left\{ \theta_H u'(q^{***3}) = \psi \right. \tag{14}$$

L-type buyers drop out of the market because they would earn negative utility given the price. H-types are held at their reservation value. Expected earnings are:

$$\text{Tax-exclusive-payoffs} \left\{ \begin{array}{l} \pi^{***3} = (1 - \tau_v)(1 - \beta)[\theta_H v(q^{***3}) - \psi q^{***3}] \\[2ex] U_i^{***3} = 0 \ \text{for} \ i = H, L \end{array} \right. \tag{15}$$

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Whether the seller moves to an exclusive scheme depends on β, the probability of a given buyer being an L-type. The model suggests that the seller is more likely to adopt an exclusive segmentation strategy following the enactment of a tax.

Claim 2. *The separating pricing strategy is more profitable than excluding the L-type buyer to serve the H-type if and only if $\beta \geq \underline{\beta}_E = \frac{(\theta_H - \theta_L)u(q_L^{***1})}{\theta_H u(q_L^{***1}) - cq_L^{***1}}$*

The above claim pins down a threshold $(\underline{\beta}_E)$ that β must exceed for the separating strategy to be more profitable than an exclusive scheme.

Proposition 2. *Assume that a tax regime (τ_s, τ_v) comes into effect. Then, $\underline{\beta}_E$ increases. This reduces the range of β for which the separating strategy is more profitable than serving H-types exclusively.*

Because a tax reduces the range of β for which the separating strategy is more profitable than the H-exclusive scheme, it increases the possibility that retailers might endogenously switch to the H-exclusive strategy.

4   Experimental Design and Hypotheses

We conduct our experiment with university students taking the role of sellers. Three main reasons support the choice of this subject pool. First, college students follow abstract instructions more precisely relative to field professionals (Alatas et al. 2008; Cooper et al. 1999). Second, we are interested in testing predictions derived from economic theory. College student are relatively more homogeneous than professionals and other populations, this allows the experimenters to exert more control in the laboratory. As a result, students are an appropriate subject pool when addressing research questions closely tied to theory (Cason

and Wu, 2019). Finally, their homogeneity is a feature that facilitates statistical estimations. Inference is easier when nuisance variation across treatments stemming from factors irrelevant to the main question is minimized (Cason and Wu, 2019).

Table 1 shows the parameters used in the experiment. We choose specific parameter values to evaluate the impacts of reducing the quantity of the large option from 31 units to 17. It is to the advantage of the sellers to offer a menu with two incentive-compatible packages in all treatments.[12] We chose the intervention levels (cap and tax) to be equivalent by the theoretical impact they would have on the size of the large unregulated package. We use a per-unit tax because it is the most common way to regulate consumption, including in the food and soda retail industries.[13]

[Table 1 about here]

There are three treatments. In our *Baseline*, there is no intervention; in treatment *Cap*, there is a limit on the maximum quantity sellers are allowed to offer per package, and in treatment *Tax*, a per-unit fee is charged to sellers. Because the experimental interface allows sellers to choose the number of packages to offer (from zero to two), they could engage in the three segmentation strategies already discussed: separating, pooling and exclusive. This degree of flexibility is important to maintain because it would allow to contrast the frequency with which sellers attempt separation under different regulatory environments. It is possible that more than one menu could result in the same expected profit. Table 2 presents figures

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[12]This is an important modelling choice because if subjects are less likely to offer two-option menus under any regulated treatment, this would be strong evidence in support of a choice-reducing impact of the given intervention. This is because subjects would be switching to one-package schemes even though it is more profitable to attempt separation.

[13]All localities within the U.S. with a "soda tax" enacted by the end of 2019, levied a per volume excise tax. This form of taxation is prevalent in other jurisdictions as well, for example, Mexico implemented a specific tax of one peso per litre in 2014.

describing the contracts that result in the maximum expected profit for a given segmentation strategy.

[Table 2 about here]

The purported objective of caps is to restrict the largest option available with the hope of diminishing consumption. Translated to our experimental setting, a cap rule should limit the size of the largest alternative when sellers price discriminate. The quantity limit in *Cap* is set to 17 units, which is close to half the size of the optimal size of large option in the *Baseline* treatment (about 31 units). The per-unit tax in the *Tax* treatment was set at a level such that, in theory, it would cause sellers to reduce the quantity of the large option in the menu from about 31 to about 17 units.[14]

4.1 Hypotheses

Before discussing the general patterns and findings from the experiment, in this subsection we proceed to organize the outcomes from the model in testable hypotheses. Later, we will structure the discussion of the empirical results around these hypotheses.

Because we chose parameters such that expected profit from separating strategies dominate the alternatives, we expect our sellers to mostly attempt to segment demand with two-option menus. However, our subjects can still choose to submit single-item offers. From propositions 1 and 2, we expect two-option menus, as a proportion of total submissions, to

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[14]An alternative design would have been to match the restriction by the portion cap rule to the reduction in size induced by current levels of taxes. If we take soda taxes as our benchmark, current taxes are small, thus the cap needed to equate their effect on portions would have been barely noticeable. Because one of our results is that taxes hurt consumers more than caps, we decided to implement a severe portion cap rule. It is reasonable to deduce that if the impact on consumer surplus is null with a very restrictive cap, it would also be absent in more lenient cases.

decrease with an active tax in favor of exclusive offers. With a cap, we do not expect sellers to offer two-package menus at different rate compared to the baseline.

Hypothesis 1 - Separation of types: *Two-package menus will be more common than single-item offers in all treatments. Compared to the baseline group, the proportion of two-option offers will not decrease in the* Cap *treatment, and will decrease in the* Tax *treatment in favor of exclusive offers.*

Because we expect most offers to feature two alternatives, in hypothesis 2 we present the anticipated regulatory effects on quantities and consumer surplus when our subjects separate types with menus.

Hypothesis 2 - Effects when subjects separate demand: *When two-package menus are offered, the cap rule will only reduce the size of the large package, while the tax will result in smaller serving sizes for both small and large alternatives. Regarding earnings, the surplus of the L-type buyers will not be affected by either intervention. On the other hand, the payoff earned by the H-type will be reduced in the* Tax *treatment, but not in the* Cap *treatment. Expected profit will be lower under both interventions.*

For completeness we also look at the impacts on quantities and payoffs under single-item strategies. The testable hypotheses for these offers are listed below.

Hypothesis 3 - Effects when subjects pool demand: *When sellers pool demand with "one-size-fits-all" offers, the quantity of the package is smaller only in the* Tax *treatment, and remains unchanged with a cap rule. Consumer surplus earned by the H-type is reduced only in the* Tax *treatment. The L-type is not impacted by either intervention. Expected profit*

is lower under both regulations.

Hypothesis 4 - Effects when subjects exclude the L-type buyer: *When subjects submit offers to serve H-types exclusively, the quantity of the only package will be smaller in both* Cap *and* Tax *treatments, compared to the baseline. Regarding payoffs, the H-type is not affected by either intervention. Expected profit is lower with both regulations.*

Recall that most arguments raised against cap rules accuse them of hurting consumers and reducing consumer choice. The hypotheses we just listed suggest that these ills are more likely to be attributable to the per-unit tax than to the cap. As we discuss in the following section, this is largely corroborated by the data.

4.2 Procedures and the Experimental Task

Three sessions per treatment were conducted at a large American public university. Each session had twelve participants drawn from a subject pool managed with ORSEE (Greiner, 2015). Participants were university students. In total, 108 subjects participated in the experiment. Subjects did not participate in more than one session. The interface was implemented using oTree (Chen et al., 2016).

The structure of all sessions was the same. Subjects were handed printed copies of the experimental instructions. After the experimenter read the instructions aloud, subjects answered a pre-experimental quiz to make sure they understood them; then, there were six non-paying trading periods for subjects to become familiar with the computer interface; afterwards, there were twelve paying trading rounds; lastly, the subjects were ask to answer a post-experimental survey.[15]

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[15]Feel free to contact the corresponding author to get copies and examples of the experimental material.

All human subjects took on the role of a seller and interacted exclusively with their assigned computer. A computer program imitated the role of a rational buyer. Earnings for both seller and buyer were denominated in an experimental currency called "points." At the end of the session, points were converted into cash at the rate of 100 points per US dollar. Seller and buyer earned points during trading periods. All trading periods went as follows: the seller first decided whether to offer one, two or no packages; in a subsequent decision screen, she specified price and quantity for each of the packages to offer; then, the buyer was privately assigned a type and proceeded to purchase the package that maximized his payoff; lastly, the seller observed a screen displaying the characteristics (quantities and prices) submitted, the buyer's purchase decision, period and accumulated earnings. For every trading period, the buyer taste parameter was randomly assigned to be θ_L or θ_H with equal probability. This assignment was not revealed to the seller. The buyer would reject any package resulting in negative surplus. If the buyer was presented with two options resulting in the same non-negative payoff, then the purchase decision is random with both options equally likely. In the event of rejection of the entire menu, zero points were earned by both seller and buyer. Similarly, if the seller decides not to offer a package, then seller and buyer earn zero points. Subjects had access to an on-screen calculator where they could explore different price-quantity combinations before submitting a final offer. The calculator showed, for a given quantity and price, both buyers' surplus, cost of production, and the profit the seller would earn if the package were purchased. To keep relatively similar final monetary earnings across treatments, sellers started the session with a balance of 500 points in the *Tax* treatment. Subjects had no starting balance in the other treatments. Average earnings in U.S. dollars, including a $5.00 participation fee, were $28.03, $25.72, and $23.17 in the

Baseline, *Cap*, and *Tax* treatments correspondingly.

The buyer's role is automated to remove two possible distortions. Firstly, an automated buyer eliminates uncertainty regarding the buyer's decision process. This is because the seller knows that the buyer is programmed to purchase the package that maximizes his payoff. The seller can be sure that the computer program does not make mistakes, is memory-less, and his decisions are not explained by any strategic behavior beyond utility maximization. Secondly, by automating the consumer's role, we exclude the confounding effect of inequity aversion. This is the regularity observed in several economic experiments wherein participants give up some of their own payoff to avoid inequitable outcomes between human players (Fehr and Schmidt, 1999).[16] Thus, the laboratory conditions are such that the seller can explore with different strategies without worrying about possible interpretations that a human buyer could give to her decisions.

4.3 Results: Impacts on the number of options

Subjects submit two-option menus more often than single-package offers in all treatments. Table 3 presents descriptive figures from within treatment outcomes.[17] The majority of offers submitted by sellers in the laboratory, are two-package menus. To the degree that our subjects' objective is to segment demand, they do so successfully. The majority of large

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[16]The final original database contains 1296 observations. We organized the observations as follows: 1) When the subject submitted two packages, but these had identical prices and quantities, we consider this offer to be a single-option offer. In total, we re-classified 7 offers in this way; 4 from *Baseline*, 1 from *Cap*, and 2 from *Tax*. 2) In 23 trading periods, subjects incurred in losses, that is the cost of the purchased package exceeded its price. The median loss was 2600 points ($26.00 usd). We removed the observations of any subject that incurred in a loss of at least 2600 points. In total, the observations of 5 subjects were removed; 2 from *Baseline*, 2 from *Cap*, and 1 from *Tax*. After trimming these, we are left with 1236 observations.

[17]To classify packages as either small or large, we look at quantities. If a seller offered a menu, the option with larger quantity is assigned to be the large package. If the two options have the same quantity, then the alternative with larger price is assigned to be the large package.

packages are bought by H-type customers, while small packages are regularly acquired by L-type buyers. This pattern grants a degree of confidence on our data set because it suggests that subjects understood the nature of the game, actively attempted to separate demand, and their offers were not aimless and/or arbitrary.

[Table 3 about here]

Further analysis corroborates this finding. In table 4, we present the results from logistic models where we estimate the probability of subjects offering two-package menus, and the likelihood of subjects submitting one-item offers that exclude the L-type (H-exclusive offers). An offer is classified as exclusive if it satisfies the H-type's but not the L-type's participation constraint. We observe that subjects are 17% less likely to submit menus in the *Tax* treatment compared to the baseline. Likewise, subjects in the taxed group are 15% more likely to offer H-exclusive packages. The effects are statistically significant.

Result 1 - *In accordance with hypothesis 1, the majority of offers submitted by our subjects are two-option menus. In the* Cap *treatment, subjects are not statistically less likely to offer two alternatives. On the other hand, in the* Tax *group, subjects are statistically less likely to submit two-options menus and more likely to submit H-exclusive offers.*

[Table 4 about here]

One of the arguments usually raised against portion cap rules is that they reduce consumer choice. Our data suggests that sellers offer two options in the *Cap* treatment at, on average, the same frequency compared to the *Baseline*. On the other hand, sellers are less likely to offer menus with two alternatives in the *Tax* group. Thus, beyond the intended

23

reduction in consumption common to both interventions, the tax causes a greater impact on the consumer choice set in our experiment.

4.4   Results: Impacts when subjects offer two alternatives

We proceed now to discuss impacts of the regulations when subjects submitted menus with two packages. Table 5 shows econometric estimates of the impacts on the quantities consumed by each buyer type (q_H and q_L), per-period expected profit ($\mathbb{E}[\pi]$), consumer utility per type (U_H and U_L), and total surplus (including tax revenue when appropriate).

[Table 5 about here]

We start by looking at the effects on purchased sizes. The coefficients on both treatment dummy variables are negative and significant. This is the case for both buyer types. We include a time trend (period) and interact it with the treatment dummy variables to control for possibly different rates of learning. In the case of quantities, if the coefficient on the time trend is positive and significant, it would imply that subjects offer larger quantities as the session progresses. A significant coefficient on the interaction between a given active treatment and the trend would imply that. To the degree that learning was present in the baseline, the rate at which subjects learned differed in the regulated treatment and is more pronounced in the *Cap* treatment.

Result 2 - Effects when subjects separate demand: *In accordance with hypothesis 2, the average purchased quantity of the large alternative is smaller in both regulated treatments. Unlike what we expected, the size of the small serving size is smaller, not only in the* Tax *group, but with the* Cap *as well. Regarding payoffs, consumer surplus is affected in the*

24

anticipated manner. Surplus earned by the L-type is unaffected, while the H-type is only affected by the tax. Expected profit is impacted only with a Tax.

The cap rule does not impact consumer surplus, while the tax reduces the earnings accruing to the H-type buyer. The cap rule seems not to reduce expected profit sensibly. For completeness, we look at the impacts on total surplus which is negatively affected by both interventions.

The intuition behind the outcome with cap rule is the following. With a cap limiting the maximum quantity the sellers are allowed to offer, subjects adjust prices in a way that maintains profit contributions constant for both small and large options. Evidence in support of this is shown in the appendix.

Results: Impacts when sellers adopt single-package strategies

Not all offers submitted by our subjects contained two alternatives. A significant proportion of submissions featured only one option. This means that our sellers engaged in sub-optimal segmentation strategies. We anticipated this event for two reasons. First, proposition 2 already suggests that subjects would adopt exclusive segmentation strategies at a higher rate. Second, recent findings from the empirical literature on screening theory suggests that it is common for sellers to favor the design of simpler sub-optimal pricing schedules at the cost of some expected profit (Chu et al., 2011). Similarly, experimental work testing outcomes from canonical contract-theoretic models document that subjects often construct simple non-optimal contracts (Hoppe and Schmitz, 2015). Because the adoption of sub-optimal segmentation is observed even in highly controlled environments, it is reasonable to

assume that sellers in the field also engage in similar strategies.

We classify single-package offers as either pooling or exclusive according to the following heuristic: if the offer satisfies the low-type participation constraint, we consider it to be a pooling offer; on the other hand, if the offer satisfies only the participation restriction of the high-type buyer, then we consider it to be exclusive.

We find that both regulations reduce the quantity purchased by consumers; the portion cap rule does not impact consumer surplus, the tax does affect the rents earned by the H-type, and expected profit is lower only with a tax.

Result 3 - Impacts on serving sizes (Pooling): *In accordance with hypothesis 3, the* Tax *reduces the size of the serving portion when sellers pool the demand. However, sizes in the* Cap *treatment are also smaller. Regarding payoffs, the* Tax *affects the surplus earned by the H-type buyers only, while the* Cap *does not impact consumers. Expected profit is smaller only with a Tax.*

Both interventions reduce the serving size sold when sellers adopt an H-exclusive scheme. Additionally, and as we expected it, the surplus earned by the H-type buyer is not affected.

Result 4 - Impacts on serving sizes (Exclusive): *As delineated in hypothesis 4, both interventions reduce the quantity of the exclusive offers. Neither intervention affects the surplus earned by the H-type. Both regulations reduce profit.*

5   Conclusion

We report a laboratory experiment on nonlinear pricing with contracting restrictions. We compare two interventions that have been proposed as alternatives to restrict the consump-

tion of foods judged to have deleterious effects on human health: portion cap rules and taxes. Our goal is not to advocate for or against these measures as effective tools to either combat obesity or foster healthy alimentary habits. We outline the economic effects of both regulations in a controlled environment and contrast them. Opponents to caps often argue that they are particularly harmful to consumers and reduce choice. Instead, taxes are commonly favored to discourage consumption. However, in our analytical and experimental analyses, taxes are more to blame for the effects intuitively associated with caps.

Within our framework, low-type buyers are not impacted by either intervention. Moderate portion cap rules do not distort the surplus earned by the higher-type consumer. On the other hand, a tax does reduce surplus for the high-type types regardless of its severity. This is because the seller sets allocation for the higher type at a level equating marginal utility from consumption to marginal *effective* cost of production which includes the tax.

We find evidence suggesting that taxes reduce the likelihood with which sellers offer two-package menus. Unlike with a cap, with a tax the set of separating menus that maximize expected profit is smaller compared to the baseline. This makes it more likely for sellers to pivot and adopt single-alternative offers that exclude the lowest type. This implies that, for a given quantity-reduction goal, taxes are more likely to reduce the *number* of alternatives offered to buyers. This effect on choice is on top of the quantity-reducing goal aimed by the regulator and shared by both caps and taxes.

The analysis we present stems from a partial equilibrium model without significant market failures. This restricts the extent to which the outcomes can be applied to normative questions regarding whether governmental intervention is granted on grounds of social welfare. However, as one of the first empirical investigations comparing caps and taxes, our

work provides a starting point to asses claims that seem plausible but lack empirical basis. For example, the intuitive idea that caps are necessarily more harmful for consumers than excise taxes. This is important because successful normative argumentation in pro or against a policy depends on the clarity with which proponents delineate its benefits and costs.

The external validity of our experiment is limited. However, by abstracting away from institutional details, the experiment allows us to concentrate on the question at hand: how do caps and taxes compare in a setting characterized by adverse selection. The laboratory provides the first environment where the model is stress-tested against actual human behavior. This is essential because a model that does not survive tests in a highly controlled environment is unlikely to explain behavior in the field (Cason and Wu, 2019). Future studies that gradually incorporate specific attributes of given industries will aid to the understanding of food vendors and other retailer's behavior under different policy contexts. Researchers interested in particular markets can conduct studies that incorporate particular considerations and institutional details relevant to specific applications.

Behavioral theories of consumer choice and psychological theories of food consumption do not inform our design. We compare the impacts of the regulation relying on utility theory and a classical definition of consumer surplus. As a first empirical study comparing taxes and caps in a setting with heterogeneous buyers, this is beneficial rather than detrimental, to our work. We provide an early study based on orthodox assumptions and principles. This can serve as a baseline foundation for researchers interested in extending the design to better fit the particular needs of their field of interest.

Tables

Table 1: Parameter values used in the experiment

Variable or function	Value or form	Description
β	0.5	Probability of the buyer being high type.
p	$[0, 1, \ldots, 25000]$	range of possible prices.
q	$[0, 1, \ldots, 90]$	range of possible quantities.
c	240	Unitary cost of production.
$v(q)$	$q^{0.95}$	Buyer's unscaled utility of consumption.
θ_H	300	High-type buyer's taste parameter.
θ_L	290	Low-type buyer's taste parameter.
$\hat{q}$	17	Maximum size allowed under portion cap rule.
t_s	7.35	Per-unit fee active under taxation.

Table 2: Description of screening contracts that maximize seller's expected profit

		Menu			Pooling			Exclusive		
Variable	Treatment	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
Large quantity	Baseline	30.88	30	32	15.5	15	16	31.78	30	34
	Cap	17	17	17	15.5	15	16	17	17	17
	Tax	17.2	16	18	9	9	9	17	17	17
Large price	Baseline	7727.25	7509	7999	3919	3799	4039	8018.11	7591	8551
	Cap	4353.33	4345	4362	3919	3799	4039	4426	4426	4426
	Tax	4410.8	4114	4609	2338	2338	2338	4426	4426	4426
Small quantity	Baseline	8.13	7	9						
	Cap	8	7	9						
	Tax	7	7	7						
Small Price	Baseline	2120.5	1840	2338						
	Cap	2089.67	1841	2338						
	Tax	1841	1841	1841						
U_H	Baseline	75.38	64.53	83.76	135.39	131.14	139.64	0.9	0.08	1.76
	Cap	73.04	64.37	81.37	135.39	131.14	139.64	0.37	0.37	0.37
	Tax	64.82	64.37	65.37	81.09	81.09	81.09	0.37	0.37	0.37
U_L	Baseline	0.96	0.45	1.90	0.24	0.13	0.35	0	0	0
	Size-cap	0.72	0.45	0.90	0.24	0.13	0.35	0	0	0
	Tax	0.79	0.79	0.79	0.45	0.45	0.45	0	0	0
$\mathbb{E}[\pi]$	Baseline	244	244	244	199	199	199	196	196	196
	Size-cap	222	222	222	199	199	199	173	173	173
	Tax	133	133	133	112	112	112	111	111	111

In *Baseline*, 32 two-package menus maximize seller's expected payoff; 2 offers result in the maximum expected payoff from pooling; 9 offers render the maximum expected payoff possible for exclusive contracts. In *Cap*, 3 menus maximize seller's expected profit; 2 offers render the maximum expected payoff for pooling strategies; 1 offer results in the maximum expected profit possible for exclusive schemes. In *Tax*, 5 two-options menus produce the maximum expected profit; 1 offer achieves the maximum expected seller's payoff for pooling strategies; 1 offer results in the maximum payoff for exclusive strategies.

Table 3: Submitted offers and consumption decisions by buyer type

	Baseline		Cap		Tax	
	Menu	Single	Menu	Single	Menu	Single
Offers submitted:						
# Obs/Total (%)	277/408 (67.9)	131/408 (32.1)	254/408 (62.2)*	154/408 (37.7)	221/420 (52.6)***	197/420 (46.9)
Mean large quantity	29.685	21.305	14.956***	14.402***	19.131***	12.781***
Mean large price	7379.407	5341.167	4155.440***	4334.551***	4990.936***	3464.604***
Mean small quantity	14.104		10.771***		9.986***	
Mean small price	3587.909		3007.763***		2895.280***	
High type:						
Buy large offer	223/277 (80.5)	130/131(99.2)	190/254 (74.8)	138/154 (89.6)***	125/221 (56.6)***	185/197 (93.9)***
Buy small offer	51/277 (18.4)		56/254 (22.1)		83/221 (37.6)	
Reject	3/277 (1.1)	1/131 (0.8)	8/254 (3.1)*	16/154 (10.4)***	13/221 (5.9)***	12/197 (6.1)**
Mean consumed quantity	26.350	21.430	14.536***	15.260***	13.418***	11.367***
Mean paid price	6536.372	5370.715	3662.528***	3853.775***	3414.701***	2942.037***
Low type:						
Buy large offer	26/277 (9.4)	90/131 (68.7)	88/254 (34.6)***	115/154 (74.7)	13/221 (5.9)***	97/197 (49.2)***
Buy small offer	215/277 (77.6)		143/254 (56.3)***		157/221 (71.0)*	
Reject	36/277 (13.0)	41/131 (31.3)	23/254 (9.1)	39/154 (25.3)	51/221 (23.1)***	100/197 (50.8)***
Mean consumed quantity	14.286	16.866	12.545***	15.147	8.882***	8.226***
Mean paid price	3594.958	4215.077	3166.844***	3814.478	2268.500***	2132.958***

The stars indicate whether there are significant difference (* at the 10%, ** at the 5%, and *** at the 1%) between the relevant treatment and the baseline. Differences between ratios tested with χ^2 independence tests. Differences between averages of quantities and prices tested with Mann-Whitney tests.

Table 4: Probability of submitting two-package and exclusive offers

Dependent variable:	Two-options menu		H-exclusive offer	
	Model	Marginal effect	Model	Marginal effect
Cap	-1.116	-0.078	1.009	0.005
	(0.760)	(0.063)	(0.998)	(0.049)
Tax	-2.071**	-0.170*	2.820***	0.150***
	(0.893)	(0.087)	(0.798)	(0.051)
Period	-0.086*	-0.005***	0.080	-0.000
	(0.047)	(0.002)	(0.052)	(0.002)
Cap*Period	0.043		-0.144***	
	(0.055)		(0.054)	
Tax*Period	0.045		-0.105	
	(0.065)		(0.099)	
Constant	2.748***		-5.008***	
	(0.798)		(0.688)	
N	1236	1236	1236	1236

∗ Pr < 0.1, ∗∗ Pr < 0.05, ∗∗∗ Pr < 0.01. Robust standard errors clustered at the session level in parentheses.
Marginal effects: standard errors estimated with delta method in parentheses.

Table 5: Impacts of the regulations on quantity and per-period payoffs - Menus

	Dependent variable					
	q_H	q_L	$\mathbb{E}[\pi]$	U_H	U_L	Total Surplus
Cap	-9.366***	-2.657***	-38.521	3.238	30.548	-44.294*
	(1.259)	(0.678)	(26.110)	(32.294)	(26.293)	(25.660)
Tax	-11.119***	-5.790***	-97.378***	-53.176***	8.782	-37.897*
	(1.051)	(0.680)	(16.283)	(14.457)	(12.035)	(19.756)
Period	0.341***	-0.056	1.085***	-0.662	0.157	1.217***
	(0.040)	(0.043)	(0.206)	(1.066)	(0.339)	(0.265)
Cap*Period	-0.238***	0.107**	1.773	-1.662	-3.461	1.539
	(0.080)	(0.051)	(2.268)	(3.110)	(2.978)	(2.126)
Tax*Period	-0.094	0.063	-0.241	-0.624	-0.508	0.167
	(0.102)	(0.047)	(0.349)	(1.363)	(0.552)	(0.680)
Constant	23.220***	14.920***	165.234***	157.963***	19.635***	182.857***
	(0.689)	(0.233)	(13.773)	(2.436)	(6.694)	(14.321)
N	728	642	752	752	752	752

∗ Pr < 0.1, ∗∗ Pr < 0.05, ∗∗∗ Pr < 0.01. Robust standard errors clustered at the session level in parentheses. Marginal effects: standard errors estimated with delta method in parentheses.

Table 6: Impacts of the regulations on quantity and per-period payoffs - Pooling

	Dependent variable				
	q	$\mathbb{E}[\pi]$	U_H	U_L	Total Surplus
Cap	-4.920*	-31.527	-7.851	36.240	-36.557
	(2.562)	(27.810)	(20.783)	(26.304)	(29.002)
Tax	-8.506***	-71.579***	-83.510***	-13.467	-5.997
	(2.634)	(4.938)	(16.320)	(9.368)	(11.581)
Period	-0.109	1.308***	-1.562***	-0.662**	1.189***
	(0.079)	(0.396)	(0.333)	(0.296)	(0.310)
Cap*Period	0.249***	1.298***	0.643	-1.386***	1.562***
	(0.080)	(0.494)	(0.630)	(0.465)	(0.424)
Tax*Period	-0.023	-0.739	0.041	0.292	-1.822***
	(0.109)	(0.494)	(0.917)	(0.364)	(0.584)
Constant	18.375***	164.302***	177.446***	19.139**	182.693***
	(2.327)	(4.744)	(10.601)	(8.997)	(6.432)
N	302	302	302	302	302

∗ Pr < 0.1, ∗∗ Pr < 0.05, ∗ ∗ ∗ Pr < 0.01. Robust standard errors clustered at the session level in parentheses. Marginal effects: standard errors estimated with delta method in parentheses.

Table 7: Impacts of the regulations on quantity and per-period payoffs - Exclusive

	Dependent variable				
	q	$\mathbb{E}[\pi]$	U_H	U_L	Total Surplus
Cap	-20.403***	-60.784***	-7.464	-	-74.336***
	(5.585)	(20.903)	(17.628)	-	(23.964)
Tax	-22.125***	-80.296***	-8.411	-	-56.184***
	(5.755)	(8.666)	(12.367)	-	(14.235)
Period	-0.533	2.474***	-3.196**	-	2.323***
	(0.407)	(0.733)	(1.468)	-	(0.798)
Cap*Period	0.565	-2.362***	4.924**	-	1.974**
	(0.407)	(0.741)	(1.902)	-	(0.870)
Tax*Period	0.797	-0.683	3.090*	-	1.662
	(0.498)	(0.866)	(1.696)	-	(1.328)
Constant	36.043***	141.557***	39.311***	-	158.698***
	(5.551)	(8.590)	(1.775)	-	(11.333)
N	151	180	180	-	180

∗ Pr < 0.1, ∗∗ Pr < 0.05, ∗ ∗ ∗ Pr < 0.01. Robust standard errors clustered at the session level in parentheses. Marginal effects: standard errors estimated with delta method in parentheses.

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Appendix for online publication

Proof of Claim 1

Proof. We will show that $\mathbb{E}[\pi^{***1}] \geq \mathbb{E}[\pi^{***2}]$ is equivalent to

$\beta \geq \underline{\beta}_O = \frac{[\theta_H-\theta_L]u(q_L^{***1})+\theta_L u(q^{***2})-\psi q^{***2}-[\theta_H u(q_H^{***1})-\psi q_H^{***1}]}{\theta_H u(q_L^{***1})-\psi q_L^{***1}-[\theta_H u(q_H^{***1})-\psi q_H^{***1}]}$. .

Using the profit expressions under the taxed separating and one-size-fits-all strategies, note

that $\pi^{***1} \geq \pi^{***2}$ can be expressed as

$(1-\tau_v)\Big\{(\beta)[\theta_L u(q_L^{***1})-\psi q_L^{***1}]+(1-\beta)\big\{[\theta_H u(q_H^{***1})-(\theta_H-\theta_L)u(q_L^{***1})]-\psi q_H^{***1}\big\}$

$\geq (1-\tau_v)[\theta_L u(q^{***2})-\psi q^{***2}]$

Solving for β yields $\beta \geq \frac{[\theta_H-\theta_L]u(q_L^{***1})+\theta_L u(q^{***2})-\psi q^{***2}-[\theta_H u(q_H^{***1})-\psi q_H^{***1}]}{\theta_H u(q_L^{***1})-\psi q_L^{***1}-[\theta_H u(q_H^{***1})-\psi q_H^{***1}]}=\underline{\beta}_O$ □

Proof of Proposition 1

Proof. Recall that $\psi \equiv \frac{d\Psi_i}{dq_i} = (\tau_s + c) \div (1 - \tau_v)$. The no taxation case is nested within ψ

when $\tau_s = \tau_v = 0$. When there is no tax, $\psi = c$ but if either τ_s or $\tau_v > 0$, then $\psi > c$. Thus,

taxation effectively increases marginal cost.

By Claim 1, $\frac{[\theta_H-\theta_L]u(q_L^{***1})+\theta_L u(q^{***2})-\psi q^{***2}-[\theta_H u(q_H^{***1})-\psi q_H^{***1}]}{\theta_H u(q_L^{***1})-\psi q_L^{***1}-[\theta_H u(q_H^{***1})-\psi q_H^{***1}]} = \underline{\beta}_O$.

Applying the quotient rule, we have $\frac{\partial \underline{\beta}_O}{\partial \psi} = \frac{q_L^{***1}-q^{***2}}{\theta_H u(q_L^{***1})-\psi q_L^{***1}-[\theta_H v(q_H^{***1})-\psi q_H^{***1}]}$. Note that

the denominator is squared and therefore must be positive. To sign the numerator, comparing

the first order conditions characterizing quantities, it is obvious that $q^{***2} > q_L^{***1}$. Hence,

$\frac{\partial \underline{\beta}_O}{\partial \psi} < 0$. □

Proof of Claim 2

Proof. We will show that $\mathbb{E}[\pi^{***1}] \geq \mathbb{E}[\pi^{***3}]$ is equivalent to $\beta \geq \frac{[\theta_H-\theta_L]u(q_L^{***1})}{\theta_H u(q_L^{***1})-\psi q_L^{***1}} = \underline{\beta}_E$.

Using the profit expressions under the taxed separating and H-exclusive strategies, note that

$\pi^{***1} \geq \pi^{***3}$ can be expressed as $(1 - \tau_v)\Big\{(\beta)[\theta_L u(q_L^{***1}) - \psi q_L^{***1}] + (1 - \beta)\{[\theta_H u(q_H^{***1}) - (\theta_H - \theta_L)u(q_L^{***1})] - \psi q_H^{***1}\Big\} \geq (1 - \tau_v)(1 - \beta)[\theta_H u(q^{***3}) - \psi q^{***3}]$. Using the fact that the H-type first order conditions are identical, we have $q_H^{***1} = q^{***3}$. This allows us to simplify the inequality to obtain $\beta[\theta_H u(q_L^{***1}) - \psi q_L^{***1}] \geq [\theta_H - \theta_L]u(q_L^{***1})$. Solving for β yields

$\beta \geq \frac{[\theta_H - \theta_L]u(q_L^{***1})}{\theta_H u(q_L^{***1}) - \psi q_L^{***1}}$ □

Proof of Proposition 2

Proof. Recall that $\psi \equiv \frac{d\Psi_i}{dq_i} = (\tau_s + c) \div (1 - \tau_v)$. The no taxation case is nested within ψ when $\tau_s = \tau_v = 0$. When there is no tax, $\psi = c$ but if either τ_s or $\tau_v > 0$, then $\psi > c$. Since c is the lower bound of ψ, it follows that any positive tax implies an increase in ψ. One can easily see from $\beta_E = \frac{[\theta_H - \theta_L]u(q_L^{***1})}{\theta_H u(q_L^{***1}) - \psi q_L^{***1}}$ that an increase in ψ implies an increase in β_E. □

What are the effects of taxation holding the pricing strategy constant?

Here we show the work that results in our testable hypotheses. We concentrate first on the impacts of taxation.

Proposition 3. Suppose that a tax regime (τ_s, τ_v) is implemented. Then, serving sizes for both types of consumers decline.

Proof. Suppose that a tax a tax regime (τ_s, τ_v) is implemented. A simple comparison can show that $q_H^{*1} > q_H^{***1}$ and $q_H^{*1} > q^{***3}$. Therefore, regardless of whether the retailer continues with the separating strategy or switches to the H-exclusive strategy, the H-type serving will decline.

Also, $q_L^{*1} > q_L^{***1}$ so the L-type serving size declines if the retailer continuous with the separating strategy post tax. If the retailer switches to the H-exclusive strategy, then by proposition 3, L-type consumers are excluded so that serving size trivially declines to zero. In either case, L-type serving size declines. □

Proposition 4. Suppose that a tax regime (τ_s, τ_v) is implemented. Then consumer surplus for H-types declines. Consumer surplus for L-types is unaffected.

Proof. Suppose that a tax regime (τ_s, τ_v) is implemented. Smaller quantities with regulations imply $U_H^{*1} > U_H^{***3}$. Therefore, the H-type buyer's surplus declines.

Also, the L-type buyer is always held at his reservation utility. Thus, a tax does not affect the L-type's consumer surplus as his utility remains at the reservation both pre and post-tax. □

Intuitively, if a tax does not cause the retailer to switch away from a separating strategy, the tax still causes the L-type serving size to drop, which lowers the H-type information rent. Thus, H-type consumer welfare decreases.

Proposition 5. Suppose that a tax regime (τ_s, τ_v) is implemented. Then, retailer surplus unambiguously declines.

Proof. Suppose that a tax regime (τ_s, τ_v) is implemented. If the retailer continues to use the segmentation strategy post-tax, then by proposition 2, $\pi^{*1} > \pi^{***3}$.

If instead, the retailer switches to a the H-exclusive strategy, then the retailer's post-tax value function is $\pi^{***3} = (1 - \tau_v)(1 - \beta)[\theta_H v(q^{***3}) - \psi q^{***3}]$. Note that if the retailer had adopted a H-exclusive strategy pre-tax, then the retailer's value function would be

$\pi^{*3} = (1-\beta)[\theta_H u(q^{*3}) - \psi q^{*3}]$ where q^{*3} is the optimal H-type serving size in the absence of a tax. This would be determined by the first order condition $\theta_H u'(q^{*3}) = c$. However, note that Taxed Case Exclusive that the same condition for the post-tax H-exclusive strategy is $\theta_H u'(q^{***3}) = \psi$. Because $\psi > c$, it follows that $q^{***3} < q^{*3}$ and therefore $\pi^{*3} > \pi^{***3}$. However, we know that, by assumption, the retailer adopts a separating strategy pre-tax so it must be the case that $\pi^{*1} > \pi^{*3}$. Hence, by transitivity, $\pi^{*1} > \pi^{***3}$. $\square$

Proposition 6. *Assume that the government enforces a tax regime (τ_s, τ_v) with at least one type of tax strictly positive. Suppose that the retailer decides to offer one single cup size designed to serve H-type buyers solely. Then:*

1. *$\theta_H u'(q^{***3}) = \psi > c$. There is a tax induced reduction in q^{***3} below first best. Thus,*

   $q^{***3} < q_H^{*1}$

2. *L-type buyers are excluded and do not engage in trade.*

3. *The serving price is $p^{***3} = \theta_H v(q^{***3})$ which does not include an information rent.*

4. *Expected profit is lower.*

5. *Both buyer types are held at their reservation values; i.e. $U_H = U_L = 0$.*

The proof is just a straightforward comparison so we exclude it.

Proposition 7. *Assume the government enforces a tax regime (τ_s, τ_v) with at least one type of tax strictly positive. If the retailer decides not to screen the market and offers a one-size-fits-all package designed to serve both types of buyers, then:*

1. $\theta_L u'(q_L^{***2}) = \psi$ *so that buyers are provided with a quantity,* q_L^{***2}, *that is smaller than the L-type first best.*

2. *The price per serving is* $p^{***2} = \theta_L u(q^{***2})$.

3. *The seller's value function is reduced.*

4. *The L-type consumer value function is* $U_L^{***2} = 0$.

5. *The H-type consumer value function is* $U_H^{***2} = (\theta_H - \theta_L)u(q^{***2}) > 0$.

The proof is straightforward and therefore excluded. Note that H-type buyers still earn excess rents though this is not due to screening driven information rents.

What are the effects of the size cap holding the pricing strategy constant?

We present the work that results in the comparison between cap rule and the baseline just for completeness. For more details and a longer exposition, we direct the reader to Bourquard and Wu (2020).

Consider the set of possible discrete pricing strategies:

- Case ib: Sell to both types of consumers with a menu of differentiated H-type and L-type price-size options.

- Case iib: Sell exclusively to H-types.

- Case iiib: Sell to all types using one-size-fits-all pricing.

Case ib: Sell to both types with a menu of H-type and L-type options.

Assuming that the size-restriction only caps the H-type serving so that the restriction has an upper corner solution, $0 \leq q_H \leq \hat{q}$, then the K-T conditions are

$$\theta_H u'(q_H) \geq c \quad where \quad q_H = \hat{q} \tag{16}$$

$$\beta \left[\theta_L u'(q_L) - c\right] + (1 - \beta)\left[-(\theta_H - \theta_L)u'(q_L)\right] \leq 0 \quad where \quad q_L \geq 0 \quad \& \quad \frac{\partial \pi}{\partial q_L}q_L = 0 \tag{17}$$

These conditions imply that $q_H = \hat{q}$ and $\theta_L u'(q_L) = c + \frac{(1-\beta)}{\beta}\left[\theta_H - \theta_L\right]u'(q_L)$. But the latter is identical to the unregulated case. so that a beverage size-restriction would have no impact on q_L if the separating strategy is used post-regulation.

Furthermore, because $\tilde{q}_L$ is unchanged, and q_H^* decreases to $\hat{q}$, this suggests that p_H drops but p_L remains the same.

Lemma 1 - Suppose that there is a size-restriction $q_H \leq \hat{q}$ such that the retailer continues to use a separating pricing strategy where $0 < q_L < q_H = \hat{q}$. Then

1. The H-type's serving size declines to $q_H = \hat{q} < q_H^*$ and p_H drops from $t_H = \theta_H u(q_H^*) - (\theta_H - \theta_L)u(\tilde{q}_L) - \bar{u}$ to $\hat{t}_H = \theta_H u(\hat{q}) - (\theta_H - \theta_L)u(\tilde{q}_L) - \bar{u}$,

2. The L-type's serving size, $\tilde{q}_L$, and price, p_L, remain unchanged.

3. The retailer's profit declines to: $\Pi_{ib} = \beta\left[\theta_L u(\tilde{q}_L) - c\tilde{q}_L - \bar{u}\right] + (1 - \beta)\left[\theta_H u(\hat{q}) - c\hat{q} - (\theta_H - \theta_L)u(\tilde{q}_L) - \bar{u}\right]$

4. The H-type's welfare (utility) remains unchanged at $U_{Hib} = \bar{u} + [\theta_H - \theta_L]u(\tilde{q}_L)$ (earns information rents).

42

5. The L-type's welfare remains unchanged at $U_{Lib} = \overline{u}$ (earns no excess surplus).

Proof of Lemma 1

Proof. The proof for part (1) follows from the binding size-restriction, which yields K-T condition 16 and thus, $q_H = \hat{q}$. Also, p_H drops because q_H^* is replaced with the smaller $\hat{q}$ in the the the optimal price function. Since the price function is a function of $p(q_H)$ and $p(q_H)$ is increasing in q_H $\forall$ $q_H < q_H^*$, it must be true that the new price $\hat{t}_H < t_H$ since $\hat{q} < q_H^*$.

Part (2) follows from the first order condition for q_L (17), which is unchanged from the unregulated case. Hence, the retailer will still offer the same $\tilde{q}_L$ as the unregulated case. Serving price p_L is unchanged because the L-type price is a function of only q_L (and not q_H).

The proofs for parts (3), (4), and (5) are easy to show by substituting the optimal prices and quantities into the objective functions of the retailers and consumers. □

Case iib: Sell to only high types with $q_L = 0$

Here, the seller only serves H-type consumers because it is too costly in terms of information rents to also serve L-types. Neither 16 nor 17 hold with strict equality so $q_H^* = \hat{q}$ and $\tilde{q}_L = 0$. Because the size-restriction causes q_H^* to drop to $\hat{q}$, $p_H^* = \theta_H u(q_H^*) - \overline{u}$ (from case ii) drops to $\hat{p}_H = \theta_H u(\hat{q}) - \overline{u}$.

Lemma 2 - Suppose that there is a regulatory restriction of the form $q_H \leq \hat{q}$ and the retailer serves only H-type consumers. Then

1. The H-type's serving size declines to $q_H = \hat{q} < q_H^*$ and p_H drops from $p_H^* = \theta_H u(q_H^*) - \overline{u}$ to $\hat{p}_H = \theta_H u(\hat{q}) - \overline{u}$.

2. The retailer's profit declines to: $\Pi_{iib} = (1 - \beta)[\theta_H u(\hat{q}) - c\hat{q} - \overline{u}]$

43

3. The H-type's consumer welfare is: $U_{Hiib} = \overline{u}$ (no excess rents).

Proof of Lemma 2

Proof. Part (1) follows from the assumption of a binding restriction, $\hat{q}$, which yields K-T condition 16 so $q_H = \hat{q}$. The serving price, p_H, drops because q_H^* is replaced with the smaller $\hat{q}$ in the the optimal price function. Since the price function is a function of $u(q_H)$ and $u(q_H)$ is increasing in $q_H \ \forall \ q_H < q_H^*$, it follow that $\hat{p}_H < p_H$ since $\hat{q} < q_H^*$.

The proofs for parts (2) and (3) follow from substituting the optimal prices and quantities into the objective functions for the retailer and consumers. □

Case iiib: Sell to both types with a one-sized fits all package

The optimal one-size-fits-all strategy under a size restriction is generated by solving:

$$\max_{p,q} [p - cq] \quad s.t. \tag{18}$$

$$\theta_L u(q) - p \geq \overline{u} \tag{19}$$

$$0 \leq q \leq \hat{q} \tag{20}$$

Because $\theta_L < \theta_H$, the H-type participation constraint is always satisfied so long as L-type constraint is satisfied. The binding participation constraint 19 can be substituted into the objective function to get:

$$\max_q] [\theta_L u(q) - cq - \overline{u}] \tag{21}$$

$$0 \leq q \leq \hat{q} \tag{22}$$

which yields the Kuhn-Tucker conditions:

$$\theta_L u'(q) \geq c \quad \& \quad q \leq \hat{q} \quad \& \quad \frac{\partial \pi}{\partial q}(\hat{q} - q) = 0 \tag{23}$$

Solving the K-T conditions yields the following proposition.

Lemma 3 - Suppose that there is a restriction of the form $q \leq \hat{q}$ and the retailer uses a one-size-fits-all strategy for both types of consumers. Then

1. The quantity offered to both types of consumers is $q = min\{q_L^*, \hat{q}\}$ where q_L^* is the first-best quantity for the L-type consumer.

2. The price is $p = \theta_L u(q) - \overline{u}$.

3. The retailer's profit is: $\Pi_{iiib} = \theta_L u(q) - cq - \overline{u}$.

4. The H-type's consumer welfare is: $U_{Hiiib} = \overline{u} + [\theta_H - \theta_L]u(\hat{q})$ (excess rents).

5. The L-type's consumer welfare is: $U_{Liiib} = \overline{u}$ (no excess rents).

Proof of Lemma 3

Proof. Part (1) follows from K-T condition 23. That is, if the size-constraint is not binding so that $q < \hat{q}$, then the first order is $\theta_L u'(q) = c'(q)$ so the solution to 23 is clearly equal to the first best level of quantity for L-types, q_L^*. If the size constraint is binding, then, $\hat{q} \leq q_L^*$ in which case $q = \hat{q}$. Hence, $q = min\{q_L^*, \hat{q}\}$

Part (2) follows easily from the optimal q and the binding participation constraint.

Parts (3)-(5) follow from substituting the optimal q and t into the objective functions of the retailer, and consumers. $\square$

Impacts to profit contributions

In the main text, we mention that the observed effect on the seller's expected earnings in the *Tax* treatment aligns with our hypothesis. However we observe no change in expected earnings in *Cap* treatment. An explanation of why expected profit does not change in this case, is that sellers adjusted their prices in such a way that the profit contributions made by selling large and small packages remained equal across the unregulated and quantity-limited treatments. The profit contribution of a sold package is the difference between its price and its cost of production. In the table below, we present econometric estimates of the impact of regulations on the profit contributions of large and small options and their sum. Profit contributions of both types of packages decreased in *Tax*. In *Cap*, the fall in profit contributions made by the large packages is barely significant; while the contributions of small options are statistically equivalent to the baseline. This suggests that under a portion cap, sellers adjust both quantity and prices so that the sum of profit contributions remains unchanged compared to the *Baseline* treatment.

We find similar patterns when looking at profit contributions in single-package offers, as can been seen in the second table below.

Estimated Impacts of the Regulations on Profit Contributions - Menus

	Dependent variable: Profit contribution		
	Large Package	Small Package	Sum of Profit Contributions
Cap	-48.252*	-33.096	-78.960
	(28.259)	(28.359)	(56.654)
Tax	-108.643***	-93.318***	-202.278***
	(14.140)	(17.299)	(35.894)
Period	2.315***	0.068	2.220***
	(0.769)	(0.315)	(0.127)
Cap*Period	1.396	3.396	4.987
	(2.296)	(2.840)	(5.228)
Tax*Period	0.062	0.241	-0.814
	(1.012)	(0.600)	(1.206)
Constant	188.588***	162.509***	347.589***
	(12.835)	(14.541)	(28.258)
N	728	642	642

∗ Pr < 0.1, ∗∗ Pr < 0.05, ∗ ∗ ∗ Pr < 0.01. Robust standard errors clustered at the session level in parentheses. Marginal effects: standard errors estimated with delta method in parentheses.

Estimated Impacts of the Regulations on Profit Contributions - Single option

	Dependent variable: Profit contribution	
	Pooling	Exclusive
Cap	-31.527	-40.954
	(27.810)	(25.118)
Tax	-71.579***	-170.800***
	(4.938)	(17.467)
Period	1.308***	4.411***
	(0.396)	(1.433)
Cap*Period	1.298***	-6.179***
	(0.494)	(2.012)
Tax*Period	-0.739	-2.382
	(0.494)	(1.595)
Constant	164.302	317.186***
	(4.744)	(16.520)
	302	151

∗ Pr < 0.1, ∗∗ Pr < 0.05, ∗ ∗ ∗ Pr < 0.01. Robust standard errors clustered at the session level in parentheses. Marginal effects: standard errors estimated with delta method in parentheses.