Reducing Consumer Inertia in Tobacco Markets *

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Abstract

We study the equilibrium effects of tobacco control policies. To curb tobacco consumption, regulators are currently proposing policies to reduce smokers' addiction and others that lower customers' brand loyalty–jointly known as *consumer inertia*. Although such policies would directly impact consumers, there are concerns about firms' responses undermining the effect on consumption through increased competition and product availability. We develop an empirical dynamic oligopoly model to analyze the equilibrium effects of lowering inertia. Consumers have addiction and loyalty, and firms choose prices and product portfolios. Companies are forward-looking since they internalize that, under consumer inertia, future demand depends on current purchases. We propose a tractable equilibrium definition and estimate the model using rich variation from the Uruguayan cigarette market. In particular, we leverage tax fluctuations and a policy that removed 40% of the products to show that both addiction and loyalty are significant and document pricing patterns suggesting firms are indeed forward-looking. We show that firms' responses are unlikely to *backfire* even though reducing inertia makes demand up to three times more elastic and increases the expected number of products by as much as 30%. The reason is that firms also price less aggressively to attract consumers because they cannot retain them in the future, a compensating factor that arises from firms' dynamic incentives. This dynamic effect dominates in our setting, *reinforcing* the efficacy of the policies to reduce consumption.

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1 Introduction

Tobacco kills eight million people every year. Although governments have discouraged tobacco consumption through taxation and regulation for decades, the industry remains resilient due to smokers' dependence on the products they consume. Indeed, smokers face two well-known sources of inertia. They become *addicted* to tobacco due to nicotine intake and develop persistent *brand loyalty* to the products they smoke. Recently, authorities have been considering innovative policies that directly reduce consumer inertia. In 2022, the Food and Drug Administration (FDA) proposed a plan to develop a product standard that would establish a maximum nicotine level to reduce the addictiveness of cigarettes [FDA, 2022]. In addition, several countries have started implementing uniform packaging to reduce the appeal of cigarettes, which is known to weaken consumers' loyalty [WHO, 2022].[1] While these strategies target consumers, understanding how tobacco companies will respond is crucial to anticipating policies' impact on consumption. Echoing this concern, a UK government review highlighted that a primary argument against uniform packaging is its potential to *"reduce brand loyalty, causing smokers to switch to cheaper brands and encouraging price competition between manufacturers"* [Chantler, 2014, pp. 5].

This paper studies whether firms' responses to reduced consumer inertia amplify or undo the direct impact of tobacco control policies on consumers. The industrial organization literature has long noted that consumer inertia introduces dynamic incentives for firms. Under inertia, future consumption becomes a function of current purchases. This intertemporal link induces firms to consider the long-term implications of their decisions, which modifies how they price and offer products. Klemperer [1987a] highlighted that with consumer inertia, companies would be willing to lower prices to attract a larger customer base and then raise them to profit from the locked-in consumers. In addition, the profit sacrifice required to lure customers into a new product can deter their introduction. Indeed, since Bain [1956]'s seminal work, economists have identified consumer inertia as a major barrier to entry. Although the theoretical literature has made substantial progress in characterizing firm behavior under inertia, its effects on equilibrium prices, product availability, and consumption are ambiguous [Farrell and Shapiro, 1988, Dubé et al., 2009].

To empirically assess the equilibrium effect of lowering inertia in tobacco markets, we develop and estimate a dynamic competition model that accounts for consumers' and firms' responses. Consumers exhibit addiction and brand loyalty, while forward-looking firms choose prices and product portfolios. We then leverage rich variation in the Uruguayan tobacco market to identify and estimate addiction and brand loyalty. In addition, we suggest that firms' pricing strategies are consistent with forward-looking behavior at the estimated levels of inertia, which validates our model. Finally, we enable the empirical analysis of equilibrium effects by adopting a computationally tractable equilibrium notion. We use this framework to simulate industry dynamics under several addiction and brand loyalty levels. Our results indicate that, once we account for firms' dynamic incentives, their responses tend to *reinforce* the direct effect of the policies.

We demonstrate that incorporating firms' dynamic incentives significantly influences policy analysis. Our

[1] Australia was the first country to pass plain packaging legislation in 2012. Since then, France (2017), United Kingdom (2017), New Zealand (2018), Norway (2018), Ireland (2018), Hungry (2019), Thailand (2019), Uruguay (2019), Saudi Arabia (2020), Slovenia (2020), Turkey (2020), Belgium (2021), Canada (2022), Singapore (2020), Israel (2020), Netherlands (2021), and Denmark (2022) have enacted some form of plain packaging policy.

findings highlight that policies that encourage product switching may cut smoking rates even if they do not make cigarettes less appealing–like when they *just* reduce brand loyalty.[2] This occurs despite demand elasticity increasing substantially and barriers to entry declining. Although such conditions generally lead to lower prices and more consumption, firms' dynamic incentives counter these effects. This offsetting force arises because firms have less incentive to lower prices to attract consumers when they cannot lock them in. Indeed, when brand loyalty is high, firms can efficiently lock in buyers and secure profits over time, turning customers into a valuable asset. Less loyalty means companies cannot retain customers as easily, reducing consumers' long-term value to the firm. Significant loyalty reductions from our baseline estimates result in lower consumption. In that case, firms' dynamic considerations *reverse* the effect of expanded product availability and companies' incentives to reduce prices due to increased elasticity.

Similarly, we find that firms' responses *increase* the efficacy of lowering addiction. In this case, the policy's direct effect is to decrease smokers' demand for cigarettes. If firms do not adjust their strategies, they will resist the policy by trying to recapture lost smokers. However, this is not their optimal response. Firms recognize that because addiction decreased, they cannot lock customers into their products. Therefore, the policy discourages firms from investing in turning individuals into smokers. This change in strategies induces further decreases in smoking rates.

Next, we describe each step of our analysis in detail. Our first contribution is to account for the rich interaction between firm strategies and consumer inertia. We model industry dynamics in a discrete-time, infinite-horizon setting in the spirit of Besanko et al. [2014]. Firms compete by choosing prices and product portfolios. We model demand using a differentiated product specification [Berry et al., 1995], which includes dynamic elements of consumer choice, such as addiction and brand loyalty. Our model has two innovations relative to the previous literature. First, it combines entry/exit decisions with consumer inertia in an infinite-period model, allowing for a complex interplay between prices and industry dynamics. Second, our equilibrium notion makes our model suitable for empirical analysis. We propose a tractable equilibrium definition that builds on Fershtman and Pakes [2012] and Ifrach and Weintraub [2017] and restricts firms' information to their own states and some aggregate market moments instead of tracking all payoff-relevant variables. Our equilibrium is easy to compute, which allows us to solve the model for several addiction and brand loyalty levels, beyond traditional comparisons between the baseline and no-inertia scenarios.

We use rich variation from the Uruguayan tobacco industry to identify and estimate the model's primitives. The Uruguayan experience is an ideal case study. First, we document persistent consumption choices. On average, less than 12% of smokers quit between years, and more than 80% of smokers repeat exactly the same product choice. Second, the Uruguayan industry presents significant variation in prices and choice sets, which considerably affected smoking rates and help to separately identify consumer inertia (addiction and loyalty) from persistent preferences [Heckman, 1981]. Persistent choices reflect both inherent preferences and state-dependent utility influenced by previous behavior, termed consumer inertia. Differentiating between inertia and persistent preferences is relevant for firm behavior. Under consumer inertia, past pur-

[2]From the policy perspective, this is considered a worst-case scenario for the effect of uniform packaging policies. Studies have shown that plain packaging makes health warnings more salient [Harris et al., 2018], potentially increasing the likelihood of quitting.

chases shape future demand, guiding firms' pricing strategies; persistent preferences, however, limit firms' influence on future choices.

We leverage two primary sources of variation to identify inertia and persistent preferences separately. First, we document notable tax oscillations. These fluctuations arise from 1) governmental priority shifts on tobacco control and 2) the setting of specific taxes at nominal values. Tax-driven price swings help study quitting behavior across tax rates to learn about addiction, following the intuition in Pakes et al. [2021]. Second, a regulation forbade firms from offering multiple products under the same brand name. This policy forced approximately 40% of the products out of the market. For example, Philip Morris discontinued Marlboro sub-varieties, representing over 25 % of total sales. Hence, the choices from customers who "lost" their products help identify the preferences of consumers who are not attached to any particular product but still face addiction, similarly to Handel [2013]. The policy also triggered substantial, transitory, relative price changes following product re-introductions, aiding in studying consumer loyalty [Dubé et al., 2010].

Estimates suggest a high degree of consumer inertia. Current smokers are willing to pay nearly two times the observed average price for any cigarette, and more than three times to repeat their product choice. The mean own-price elasticity is around -1.0, which is low compared with other industries but consistent with the scarce literature treating cigarettes as differentiated products [Ciliberto and Kuminoff, 2010, Liu et al., 2015]. Finally, the implied aggregate market elasticity is close to 0.4, in line with a large body of work in the health literature and recent estimates in the Uruguayan market.

Focusing on the supply side, we estimate fixed and marginal costs using the Method of Simulated Moments (MSM).[3] Although our equilibrium notion makes the MSM computationally feasible, we must overcome a few hurdles. First, we discuss how to address the potential equilibrium multiplicity using the absorbing steady state of the game without product assortment. Then, we observe that prices depend on fixed costs through the next period's portfolio probabilities. Thus, we cannot split the problem into two steps, recovering marginal cost from static first-order price conditions and then estimating fixed costs solving the entry/exit dynamic game, as in Igami [2017], Igami and Uetake [2020], Elliott [2022]. However, participation choices and prices define *distinct* combinations of marginal cost and continuation probabilities that could rationalize them. Therefore, conduct still aids identification. Our results show that estimated production costs are small, implying that taxes represent more than 90 % of firms' total marginal costs. Following, Besanko et al. [2010], we define marginal virtual costs as the actual marginal costs minus the added value of an additional customer to long-term company profits. In simple terms, marginal virtual costs are the cost of serving a customer during this period once companies account for the *long-term* value of consumers to firms. In our setting, customers' long-term value substantially decreases the virtual cost of cigarettes. Interestingly, while firms have similar marginal costs (due to the high tax incidence), virtual costs vary widely across products.

Next, we show that firms' pricing strategies suggest they consider the long-term implications of their actions under the estimated levels of consumer inertia. Our model explains two market features that would be hard to capture if firms did not account for inertia. First, it explains why firms set low markups despite highly inelastic demand. Demand elasticity, determined empirically by the demand response to prices, can arise from

[3]Our approach applies to cases where standard solution-free methods are not feasible [Bajari et al., 2007], a situation we encounter as firms operate nationally.

either consumers' low disutility from prices or high inertia. If firms were myopic or believed consumers' mild response to prices was not due to consumer inertia, they would have set prices much higher than observed. We reach the same conclusion even if we assume firms do not face any pre-tax costs.[4] Second, under the estimated levels of inertia, the model generates significant price discounts when introducing a new product. We observe that predicted and observed introductory pricing strategies–which, on occasions, implied setting prices at cost for months–are similar and not caused by cost changes or consumer preferences.[5]

Moving into the counterfactual analysis, we first establish the effect of reducing brand loyalty from our baseline estimates. This analysis is equivalent to evaluating a hypothetical policy that makes consumers more price-sensitive and less likely to repeat their choices, without lowering their overall cigarette valuation.[6] This direct effect triggers two equilibrium responses that would lead to higher consumption. First, the demand becomes more elastic. Indeed, when we completely eliminate brand loyalty, the elasticity is three times higher, going from around 1 to 3. If firms were myopic, this would lead to substantially lower prices. In addition, reducing brand loyalty facilitates entry since smaller products can steal buyers from their rivals at a lower cost. According to our estimates, this leads to an increase of around 30% in the expected number of products when we eliminate loyalty. Despite these effects, we observe a meager increase in consumption if loyalty reductions are small and even a decrease for more significant drops. The reason is that firms cannot keep customers captive as efficiently as before loyalty declined. Thus, they lack incentives to lower prices to lock customers in. We estimate this effect is equivalent to increasing firms' costs by a factor of 3.5 when we eliminate loyalty. This rise in *virtual* costs largely offsets and even reverses the increased demand elasticity and product variety.

Our previous result demonstrated that reducing firms' motivation to attract consumers can decrease overall cigarette consumption, even as consumers do not value cigarettes less, become more price-sensitive, and product availability increases. We then examine a policy aimed at substantially lowering cigarette valuation: reducing addiction. We assume such counterfactual preferences can be implemented through nicotine caps, as proposed by the FDA. The direct effect on consumers is substantial because smoking in the past would not make smoking today any more enjoyable for consumers. Therefore, if firms continued to play the same strategies as in the pre-policy, eliminating addiction leads to an approximately 30 % reduction in smoking rates. Firms' responses reinforce this effect. As policies lower addiction, they reduce the long-term value a smoker has for the firm because it increases the probability that they will switch to the outside option (quitting). Consequently, firms are less aggressive in rebuilding their lost customer base, further lowering consumption. Concretely, firms' strategy adjustment reduces smoking rates 25% more than we would have observed in a counterfactual long-run steady state where firms did not adjust their strategies.

[4] If consumers are unresponsive because they are inert, they also provide a long-term value for the firm. Customers' long-term value, in turn, decreases the virtual cost of selling cigarettes, and firms are not compelled to raise prices as much.

[5] To make sure that other mechanisms do not drive the changes, we force product-specific costs to be constant over time. Our approach is reminiscent of Benkard [2004], which estimates all primitives of the model without ever solving the equilibrium. Although we use the equilibrium computation to estimate firms' costs, we do so in a way that does not fully rationalize the data, letting us test the model's predictive power.

[6] We assume regulators can implement these counterfactuals by limiting firms' ability to hold consumers captive once they try the product, as is the case with uniform packaging. Recall that our analysis serves as a worst-case scenario for the impact of uniform packaging.

Finally, we study the interaction between consumer inertia and taxation. We argue that reducing inertia can help governments achieve target smoking rates without increasing the burden on consumers as much. Regulators often aim to discourage the consumption of sin goods like tobacco, alcohol, and sugar by making these goods less affordable. However, evidence exists that this approach has negative distributional consequences, as recently highlighted by Conlon et al. [2022]. Significant reductions of inertia can achieve the joint effect of lowering the cost for smokers *and* reducing smoking rates. We believe our results are relevant for other sin goods markets where consumer inertia is significant, such as gambling or opioids. Our results demonstrate that inducing more competition and facilitating customer switching can be a valuable tool to limit consumption once we account for firms' dynamic incentives.

Related Literature We build on three strands of the literature. First, our paper contributes to the literature on tobacco control. While many studies have investigated the effect of multiple policies to reduce tobacco consumption, we are one of the few studies that account for firm responses and industry dynamics [Levy et al., 2019]. A few exceptions are Ciliberto and Kuminoff [2010], which evaluates the effect of the 1997 Master Settlement Agreement (MSA) on firms' ability to collude, and Qi [2013]'s study about industry dynamics following the 1971 cigarette advertising ban in the United States. In addition, our analysis of the interaction between consumer inertia and taxes relates to the literature on tax design in industries with market power Anderson et al. [1992], Weyl and Fabinger [2013], Miravete et al. [2018]. Our work also relates to Barahona et al. [2020], which accounts for firms' responses to evaluate the equilibrium effect of food labeling policies.

Our paper also advances the understanding of industry dynamics under consumer inertia. We build on the modern research on dynamic price competition in this context [Dubé et al., 2009, Arie and E. Grieco, 2014, Fabra and García, 2015], and introduce entry and exit considerations following the framework laid out by Benkard [2004], Farrell and Katz [2005], Besanko et al. [2014, 2019], Sweeting et al. [2020] to study games of dynamic competition under learning-by-doing, network externalities and limit-pricing. This approach allows us to highlight additional implications of the investing-and-harvesting tradeoff.

Our results capture Bain [1956]'s intuition of brand loyalty as a barrier to entry and are in the same spirit as Fleitas [2017]'s findings. These results differ from the few papers exploring the relationship between inertia and participation choices in simple theoretical frameworks [Farrell and Shapiro, 1988, Beggs and Klemperer, 1992, Gabszewicz et al., 1992], which suggest that higher inertia would facilitate entry due to increased industry profits. Likewise, we find that under our baseline estimates, firms do not have incentives to induce rivals' exit or deter entry. Evaluating this possibility is particularly relevant since there were actual predation allegations during our study period, and our competition model can endogenously create incentives to predate [Klemperer, 1987b, Fumagalli and Motta, 2013].[7] According to our estimates, firms' incentives to capture new consumers were sufficiently strong to generate the aggressive discounts observed in the data, providing evidence against anticompetitive behavior. We also find a non-monotonic relationship between prices and brand loyalty. This relation appears to be a robust feature of competition under inertia and aligns with most of the literature [Dubé et al., 2009, Arie and E. Grieco, 2014, Fabra and García, 2015].

[7] Philip Morris was sued for predatory pricing due to its aggressive pricing strategy, following the policy that eliminated multiple products.

Our work suggests this pattern remains even after introducing entry and exit decisions.

Third, we contribute to expanding the empirical tools available to analyze dynamic oligopolies. Our approach constructs an empirically tractable equilibrium notion that relies on limiting firms' information as in Fershtman and Pakes [2012], and leverage Ifrach and Weintraub [2017]'s moment-based Markov Equilibrium intuition to circumvent the issues created by the introduction of persistent asymmetric information. While building on Ifrach and Weintraub [2017], our equilibrium handles continuous states and interactions between dynamic controls and rivals' states, inherent to competition under inertia. Our approach relates to several recent papers that use similar computationally tractable equilibrium notions, such as Gowrisankaran et al. [2022]. We also use polynomial approximation to reduce the computational burden of solving the model, an approach previously used to solve dynamic oligopoly models by Doraszelski [2003], Sweeting [2013], Fowlie et al. [2016]. Finally, we show how to use the solution of the model to estimate firms' primitives. While there is an increasing number of studies characterizing, identifying, and evaluating consumer inertia through a variety of methods [Dubé et al., 2010, Handel, 2013, Shcherbakov, 2016, Illanes, 2017, Pakes et al., 2021, Kong et al., 2022], the literature on estimating firms' costs in such contexts remains limited. The recent empirical work on price competition under inertia generally takes firms' costs as given [Dubé et al., 2009, MacKay and Remer, 2021] or uses solution-free approaches to estimate them [Fleitas, 2017].

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