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' addictiveness and other policies to lower customers' brand loyalty, which we refer to as *consumer inertia*. Although such policies would directly impact consumers, there is concern that firms' responses could undermine the effect on consumption. We develop an empirical dynamic oligopoly model to analyze these policies' equilibrium effects and estimate it using variation from the cigarette industry. Companies are forward-looking, since they internalize that, under consumer inertia, future demand depends on current purchases. Leveraging tax fluctuations and a policy that forced 40% of products out of the market, we show that addiction and loyalty are both significant. We also document pricing patterns that suggest firms are indeed forward-looking. Lastly, we use a tractable equilibrium notion to simulate industry dynamics under alternative levels of inertia. Our results indicate that these policies could backfire because reducing inertia increases demand elasticity up to three times and expands the expected number of products by as much as 30%. However, these policies also reduce firms' benefit from attracting consumers since it is harder to retain them in the future, which leads to less aggressive pricing. This compensating factor is equivalent to increasing marginal costs by a factor of up to 3.5. Once we account for this dynamic effect, we conclude that firms' responses tend to reinforce the efficacy of the policies designed to reduce consumption.

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1 Introduction

Tobacco kills 8 million people every year. Although governments have discouraged its consumption through taxation and regulation for decades, the industry remains resilient due to smokers' dependence on the products they consume. 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. Authorities are now considering innovative policies that directly reduce consumer inertia. In 2022, for instance, 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] Whereas these strategies target consumers, understanding how tobacco companies will respond is crucial for anticipating such policies' impact on consumption. Echoing this concern, a UK government review highlighted a primary argument against uniform packaging: 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 established 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] found that given 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. Also, the profit sacrifice required to lure customers to a new product can deter their introduction. Since Bain [1956]'s seminal work, economists have identified consumer inertia as a major barrier to entry. Although the theoretical literature has characterized 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 effects 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 document firms' pricing strategies that are consistent with forward-looking behavior at the estimated levels of inertia, which validates our model. We also conduct empirical analysis of equilibrium effects by adopting a computationally tractable equilibrium notion. We use this framework to simulate industry dynamics under several levels of addiction and brand loyalty. Our results indicate that whereas lowering inertia can increase competition and favor new entry, it reduces firms' incentives to attract new consumers. Ultimately, we show that once we account for firms' dynamic incentives, their responses tend

[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.

to *reinforce* the direct effect of the policies.

We demonstrate that considering firms' dynamic incentives is crucial in assessing the policies' impact on consumption. Accordingly, our findings highlight the fact that policies that encourage product switching by reducing brand loyalty may lower smoking rates even if they do not directly make cigarettes less appealing.[2] Two forces can lead to higher consumption. First, reducing loyalty leads to more product availability, because it is easier for new products to enter the market. Second, the demand becomes substantially more elastic. Although such conditions would generally lead to lower prices and more consumption, as market participants argue, firms' dynamic incentives counter these effects. This offsetting force arises because firms have less incentive to lower prices to attract consumers when they cannot retain them in the future. When brand loyalty is high, firms can efficiently lock in buyers and secure profits over time, and thus turn customers into a valuable asset. Reduced loyalty makes it harder for companies to retain buyers, which reduces their long-term value to the firm and discourages investments in attracting consumers. Our estimates indicate that when brand loyalty significantly decreases from estimated levels, firms' dynamic considerations *reverse* the negative effect of expanded product availability and increased price elasticity on consumption. In that case, firms' responses reinforce the direct effect of the policies and result in lower consumption.

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 respond to the policy by lowering prices aggressively to recapture lost smokers. However, firms recognize that because addiction has decreased, they cannot lock customers into their products. Therefore, the policy discourages firms from investing in turning individuals into smokers. This change in strategy 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 and exit decisions with consumer inertia in an infinite-period model, allowing for a complex interplay between prices and industry dynamics. Second, our equilibrium notion renders our model suitable for empirical analysis. We propose a tractable equilibrium definition that builds on Fershtman and Pakes [2012] and Ifrach and Weintraub [2017]. It 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, allowing us to solve the model for several levels of addiction and brand loyalty levels, which goes 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. First, we document persistent consumption choices. On average, less than 12% of smokers quit in a year,

[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.

and more than 80% of smokers repeat the same product choice. Persistent choices reflect both inherent preferences and state-dependent utility influenced by previous behavior, which we refer to as consumer inertia [Heckman, 1981]. Differentiating between inertia and persistent preferences is relevant to firm behavior. Under consumer inertia, past purchases shape future demand, which guides firms' pricing strategies; persistent preferences, in contrast, limit firms' influence on future choices.

The Uruguayan experience provides significant variation in prices and choice sets, which considerably affects smoking rates and helps to identify consumer inertia (addiction and loyalty) separately from persistent preferences. We leverage two primary sources of variation to separately identify inertia and persistent preferences. First, there are notable tax oscillations. These fluctuations arise from (1) governmental priority shifts regarding tobacco control and (2) setting specific taxes at nominal values. Tax-driven price swings aid in studying quitting behavior across tax rates to learn about addiction, following the intuition of Pakes et al. [2021]. Second, a regulation forbade firms from offering multiple products under the same brand name, and the policy forced approximately 40% of products out of the market. For example, Philip Morris discontinued Marlboro sub-varieties, which represented over 25% of total sales. Hence, the choices of 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 reintroduction, which aids in the study of 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 the average price to repeat their product choice. In this regard, the mean own-price elasticity is around -1.0, which is low compared with other industries but consistent with the scarce literature that treats 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.

We estimate fixed and marginal costs using the method of simulated moments (MSM).[3] Although our equilibrium notion renders MSM computationally feasible, we must overcome a few hurdles. First, we discuss how to address potential equilibrium multiplicity using the absorbing steady state of the game without product assortment. We then observe that prices depend on fixed costs through the next period's portfolio probabilities. Thus, we cannot split the problem into two steps by recovering marginal cost from static first-order price conditions and then solving the entry/exit dynamic game to estimate fixed costs, 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, which implies that taxes represent more than 90 % of firms' total marginal costs. Following Besanko et al. [2010], we define marginal virtual costs as follows: From marginal costs, we subtract the value that acquiring a new customer adds to a company's profits over time. In simple terms, marginal virtual costs represent the cost to serve an additional customer net of how much the customer will contribute to profits in the future. In our setting, cus-

[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.

tomers' long-term value substantially decreases the virtual cost of cigarettes. Interestingly, while products share similar marginal costs (due to the high tax incidence), virtual costs vary widely.

Next, we suggest that observed firms' pricing strategies are influenced by long-term considerations and consistent with the estimated 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 either consumers' low disutility from prices or high inertia. If firms believed consumers' mild response to prices was not due to consumer inertia or were myopic, 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. 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. 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 occasionally implied setting prices at cost for months—are similar and not caused by cost changes or consumer preferences.[4]

Moving to 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 causes consumers to be more price-sensitive and less likely to repeat their choices without lowering their overall cigarette valuation.[5] This direct effect triggers two equilibrium responses that would lead to higher consumption. First, demand becomes more elastic: 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 lowers barriers to 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 they could before loyalty declined. Thus, they lack incentives to lower prices to lock customers in. We estimate that 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 demonstrates that reducing firms' motivation to attract consumers can decrease overall cigarette consumption, even as product availability increases and consumers become more price-sensitive and do not value cigarettes less. We then examine a policy aimed at substantially lowering cigarette valuation: reducing the degree of addictiveness. Moreover, we assume that such counterfactual preferences can be implemented through nicotine caps, as proposed by the FDA. The direct effect on consumers is sub-

[4]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.

[5]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.

stantial because smoking in the past would not make smoking today any more enjoyable for consumers. Therefore, if firms continue to use the same strategies as in the pre-policy period, eliminating addiction leads to an approximately 30% reduction in smoking rates. Firms' responses reinforce this effect. As policies lower addictiveness, they reduce the long-term value a smoker has for the firm because lower addiction levels increase the probability that consumers will switch to the outside option (quitting). Firms are thus less aggressive in rebuilding their lost customer base, which further lowers consumption. Concretely, firms' strategy adjustment reduces smoking rates 25% more than we would have observed in a counterfactual long-run steady state in which firms did not adjust their strategies.

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" such as tobacco, alcohol, and sugar by making them less affordable. However, evidence suggests that this approach has negative distributional consequences, as recently illustrated 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 that our results are relevant for other sin goods markets in which consumer inertia is significant, such as gambling. Ultimately, 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, ours is one of the few studies accounting for firm responses and industry dynamics. See [Levy et al., 2019] for an in-depth discussion about tobacco control from an economic and marketing perspective. A few exceptions are Ciliberto and Kuminoff [2010], evaluating 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 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], suggesting 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].[6] 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]. 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, Luco, 2019, 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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[6] Philip Morris was sued for predatory pricing due to its aggressive pricing strategy, following the policy that eliminated multiple products.

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