

Impact of Choice Set on Tobacco Consumption

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Abstract

This paper estimates the effect of a change in the consumer choice set on cigarette purchases. We exploit unforeseen plant shutdowns resulting from the 2011 earthquake in Japan that led to the discontinuation of selected tobacco products. Using national representative scanner data from 2010 to 2014, we find that removing one or more products from the tobacco choice set led to a significant long-term reduction in cigarette purchases. The total amount of tar and nicotine in cigarette purchases has decreased by about 25 and 18 percentage points per month, respectively. About 70% of affected smokers did not search for alternative tobacco products and remained purchasing from their restricted choice set. The empirical results support some predictions of the behavioral economic model of self-control in Gul and Pesendofer (2001).

Keywords: Choice-set dependent preference, Self-control, Tobacco consumption

JEL classification: I10, I18, D01

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1. Introduction

Smoking is widely known to be addictive and harmful, killing millions every year. Many smokers experience self-control problems and find it difficult to resist the temptation of cigarettes. Behavioral economic theory suggests that sophisticated smokers who are aware of their self-control problems would seek commitment devices to resist temptation and help reduce consumption. A notable strand of the theory proposed by Gul and Pesendorfer (2001, 2005, 2007) argues that these devices do not rule out the source of temptation. Smokers would bear the high cost of resisting temptation, which often exceeds the benefits. Instead, smokers may remove tempting goods (such as high-nicotine cigarettes) from their choice sets before the actual product choice is made. This strategy can eliminate the cost of self-control, improving consumer welfare, and achieving favorable behavior change by not consuming tempting goods. The Gul-Pesendorfer (GP) model provides a theoretical basis for the emerging discussion about the implementation of prohibitive policies, such as bans and supply restrictions, to alter consumer behavior.

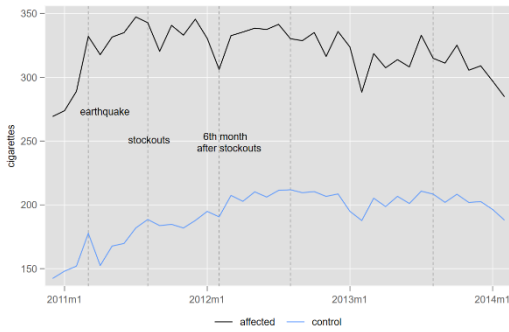
To date, empirical tests for the GP model have relied primarily on laboratory and field experiments (Houser et al., 2018; Toussaert 2018, 2019; Lec and Tarroux, 2019). Experimenters offer subjects a limited number of options and examine their responses to the removal of tempting choices within a brief period. Yet one-shot experiments do not reveal individual decisions in the long term. While, in theory, subjects who demand self-control would always exclude tempting options and maintain a restricted choice set, subjects in a naturally occurring environment may respond inconsistently in the short and long term. Regarding smoking, for instance, some smokers, even if they have committed to excluding tempting goods from their choice sets, can relapse later or search for substitutes with similar attributes, such as tar, nicotine, and flavor, to compensate for the loss of their choice sets. In this study, we investigate the long-term adjustment process of consumer choice sets and consumption after eliminating choices from a choice set.

2. Identification Strategy

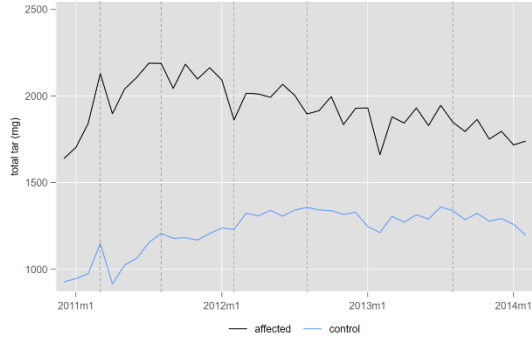
In this paper, we provide causal estimates of long-term behavioral changes from restricted choice sets. Drawing such a causal inference is challenging. First, a situation in which individuals prefer a restricted choice set while confronting a broader choice set is rare (Toussaert, 2018). Second, individual choice set is usually formed over time and is highly endogenous because it is associated with a complex system of individual, social, and environmental factors.

Our identification strategy is to exploit a product discontinuation caused by an unforeseen natural disaster – the 2011 Great East Japan Earthquake. On March 11, 2011, an M9 class earthquake hit four major factories of Japan Tobacco Inc. (JT), the third-largest tobacco manufacturer in the

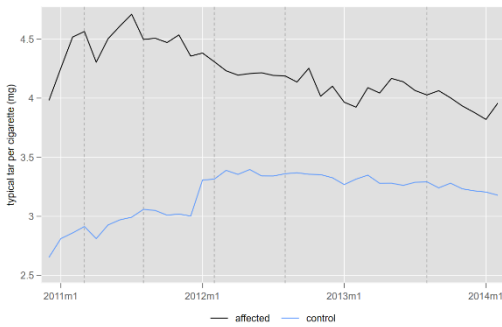
world. While JT's factories in other areas of the country were intact, JT was not capable of maintaining the full capacity of production. Unable to continue the supply of all products, JT decided to permanently terminate certain products produced in the earthquake-stricken area. This decision soon affected the availability of the discontinued products across the country. Smokers who regularly consumed these products had to change their purchasing patterns (see Figure 1).



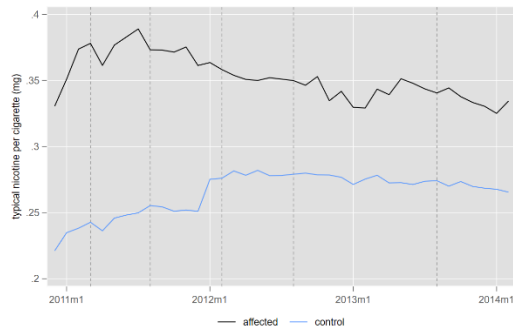
(a) Total number of cigarettes



(b) Total amount of tar in purchased cigarettes



(c) Typical tar content in a cigarette



(d) Typical nicotine content in a cigarette

Figure 1: Average purchases over time

We apply a difference-in-differences approach, in which we compare tobacco purchases of affected consumers before and after the stockouts of discontinued products. Purchasers were affected if they bought at least one pack of the discontinued product before the earthquake. A concern with the identification strategy is that, in the absence of product discontinuation, the difference in purchases between affected and comparison consumers is not constant over time. We pair consumers with their observable characteristics using propensity score matching method. The matched sample reveals that affected and comparison consumers have similar trends of purchases before the stockouts of discontinued products.

3. Data

We use nationally representative consumer scanner data called SCI (Nationwide Consumer Panel Survey) in Japan from April 2010 to December 2014. We focus on 16,533 cigarette

purchasers who purchased at least one pack of cigarettes during the survey period. We aggregate all transactions of each cigarette purchaser in a month and obtain 542,582 observations of total monthly purchases. The purchase volume is measured by the number of cigarettes and total tar (nicotine) in purchased products. The number of cigarettes masks the heterogeneity of tar and nicotine content, which poses different risks to health. In assessing tobacco use, the amount of tar and nicotine rather than the number of cigarettes smoked has real importance. Tar is responsible for the increased health risks of smoking, whereas nicotine causes addiction.

In the sample, 664 purchasers (4%) were affected. These purchasers tended to be older, male, married, and employed. Notably, the affected purchasers with higher education are 7% higher than their nonaffected counterparts. In terms of household income, affected purchasers are more likely to be from middle to high- income families (5.5 million and over). Regarding the purchase volume, affected consumers purchased fewer cigarettes or cigarettes with less tar (nicotine) than nonaffected consumers.

4. Results

We present three main findings. First, over the years following the stockouts of discontinued products, about 70% of the affected smokers did not seek alternatives to compensate for the loss of their choice sets. Instead, they switched to cigarettes with less tar or nicotine content from their restricted choice sets. Second, as a result of product switching, the total tar and nicotine amounts in cigarettes purchased each month have decreased by 216 mg (35%) and 17 mg (18%), respectively. In contrast, the number of cigarettes purchased per month has only slightly reduced by about a pack of cigarettes. Third, the purchases did not decrease immediately after the stockouts but were adjusted gradually over time. The statistically significant reductions occur after the 12th month of stockouts.

We also speculate on several factors that influence the changes in cigarette purchases. First, the total tar in cigarettes has significantly reduced even if the discontinued product was a secondary option in the choice set. Second, the stockouts of discontinued products uniformly affected consumers across the country. Consumers in earthquake-stricken areas experienced the same behavioral changes in cigarette purchases as those in other areas. Third, unemployment or income reductions caused by the earthquake are not the reason for behavioral changes in cigarette purchasers. The educational gradient in smoking explains the decline in purchases. The reduction in purchases is pronounced among well-educated and high-income consumers.

Our findings, taken together, support the predictions of the GP model and extend the discussion by examining long-term adjustments in the choice set and consumption. To our knowledge, only

a handful of papers has demonstrated the role of “availability strategy” in controlling consumption. For instance, Bernheim et al. (2016) investigated the effect of allowable sales hours on liquor consumption. Their availability strategy is more about manipulating temporal availability rather than outright bans in our study. We are the first to use nonexperimental data to examine the causal effects of removing options from a choice set on consumer behavior. Moreover, exploring changes in the choice set over time distinguishes our study from the previous literature.

From a policy perspective, our work contributes to the debate on tobacco control policies. Raising taxes is widely regarded as an effective way to reduce tobacco consumption. However, it also faces criticism for ignoring the heterogeneity of tar and nicotine content in products that pose different health risks. A series of studies have documented the side effects of tax increases. Adda and Cornaglia (2006) showed that, while smokers reduce the number of cigarettes smoked, they turn to products with high tar and nicotine content or inhale deeply to extract the required level of addiction. Related studies, such as those by Evans and Farrelly (1998), Farrelly et al. (2004), and Cotti and Tefft (2016), have confirmed the existence of such compensatory behavior. Our analyses provide a contrasting result to these studies. We find that removing one or more options from the choice set has driven consumers to switch to low-tar (nicotine) cigarettes, reducing the total purchase of tar and nicotine, whereas the number of cigarettes purchased has only slightly decreased. Although low-tar cigarettes are not a safe option, such switching may imply that consumers take the product discontinuation as an opportunity to exercise self-control. They maintain the habit of smoking but at a lower intensity.

5. Conclusion

This paper tests the GP model (Gul and Pesendorfer, 2001, 2004, 2007), which predicts that removing tempting options from a choice set can constrain addictive behavior. Using a natural experiment, we provide evidence for the effect of changing choice sets on tobacco consumption. We find that product discontinuation has a significant effect on the size and composition of the choice set and, therefore, on cigarette purchases. Consumers choose items from the existing choice set and maintain a restricted choice set. A restricted choice set driven through product discontinuation induces consumers to reduce tobacco purchases, particularly in terms of total tar and nicotine purchased. Discontinued products on the market contain higher levels of tar and nicotine, making them more tempting for some consumers. The removal of temptation offers smokers a sustainable commitment and hence promotes sustainable behavior change to reduce smoking.

Our findings are timely and relevant to the recent debates on tobacco control policy. While taxation has long been considered the most effective method to control smoking prevalence, product bans,

as an application of manipulation of consumer choice sets, can also be a tobacco control tool. Our study provides some insight for predicting consumer responses to such a policy in the long run.

Reference

Adda, J. and Cornaglia, F. (2006) Taxes, Cigarette Consumption, and Smoking Intensity. *The American Economic Review*, 96, 1013–1028.

Bernheim, B. D., Meer, J. and Novarro, N. K. (2016) Do consumers exploit commitment opportunities? evidence from natural experiments involving liquor consumption. *American Economic Journal: Economic Policy*, 8, 41–69.

Cotti, C., Nesson, E. and Tefft, N. (2016) The Effects of Tobacco Control Policies on Tobacco Products, Tar, and Nicotine Purchases among Adults: Evidence from Household Panel Data. *American Economic Journal: Economic Policy*, 8, 103–123.

Evans, W. N. and Farrelly, M. C. (1998) The compensating behavior of smokers: Taxes, tar, and nicotine. *The RAND Journal of Economics*, 29, 578–595.

Farrelly, M. C., Nimsch, C. T., Hyland, A. and Cummings, M. (2004) The effects of higher cigarette prices on tar and nicotine consumption in a cohort of adult smokers. *Health Economics*, 13, 49–58.

Gul, F. and Pesendorfer, W. (2001) Temptation and self-control. *Econometrica*, 69, 1403–1435.

— (2004) Self-control and the theory of consumption. *Econometrica*, 72, 119–158.

— (2007) Harmful addiction. *The Review of Economic Studies*, 74, 147–172.

Houser, D., Schunk, D., Winter, J. and Xiao, E. (2018) Temptation and commitment in the laboratory. *Games and Economic Behavior*, 107, 329–344.

Le Lec, F. and Tarroux, B. (2019) On attitudes to choice: Some experimental evidence on choice aversion. *Journal of the European Economic Association*.

Toussaert, S. (2018) Eliciting temptation and self-control through menu choices: A lab experiment. *Econometrica*, 86, 859–889.

– (2019) Revealing temptation through menu choice: field evidence. Unpublished.