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CONSUMER TOBACCO PRODUCT CHOICES IN CHINA:
THE IMPACT OF A BAN ON FLAVORED E-CIGARETTES

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ABSTRACT

A growing body of economic research explores the impacts of U.S. e-cigarette regulations on consumer tobacco choices, but less is known about e-cigarette regulation in China, the world's largest tobacco market. We study China's ban of flavored e-cigarettes. The ban of all flavors in e-cigarettes other than tobacco was part of a comprehensive package of regulatory policies adopted in 2022. We collected stated preference data through two discrete choice experiments conducted in 2021 and 2023, with about 600 subjects each. All subjects were adult current smokers. In the experiments, subjects made hypothetical choices between cigarettes, e-cigarettes, and quitting. Product prices and the attributes of e-cigarettes were experimentally varied, allowing us to identify the impact of flavor availability on stated preferences. We use the data to estimate conditional logit models and to predict the impact of the flavor ban and other policies. The empirical results suggest that a ban of flavored e-cigarettes decreases stated preferences for e-cigarettes but also has the unintended consequence to increase stated preferences for cigarettes. Despite the predicted decrease in e-cigarette choices, the predicted choice share of flavored e-cigarettes when they are illegal but loosely enforced is 53% of the predicted share when legal. This large illegal share is consistent with anecdotal evidence and with the evidence from our 2023 background survey that flavored e-cigarettes remain popular after the ban although fewer vapers reported getting their e-cigarettes from specialty or general retailers.

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1. Introduction

A long line of health economics research explores the impact of tobacco regulations on consumer choices (DeCicca, Kenkel, and Lovenheim 2022). More recently, this line of research has been extended to study new products such as e-cigarettes that do not involve the combustion of tobacco. In addition to studying the impact of familiar tobacco control policies such as excise taxes, studies of the new products also explore new regulations of product attributes such as flavors in e-cigarettes. Much of the research has focused on the U.S. Less is known about the impact of e-cigarette regulation in the low- and middle-income countries that account for 80% of global tobacco users (WHO, 2025). China is the world's largest tobacco producer and consumer, with more than 288 million smokers (WHO, 2025).

We study China's ban of flavored e-cigarettes. The ban of all flavors in e-cigarettes other than tobacco was part of a comprehensive package of regulatory policies adopted in 2022. Other policies included the imposition of high excise taxes (47%), the application of cigarette health warnings to e-cigarette packaging, promotion of anti-vaping public health campaigns, and licensing requirements for manufacturers, wholesalers, and retailers, among other mandates (STMA, 2022; MOF, 2022; SA, 2022). China's e-cigarette policies are intended to discourage vaping among teens. Because adult smokers use flavored e-cigarettes as a way to cut down or quit smoking, the flavor ban might also have the unintended consequences of discouraging smoking cessation and increasing adult smoking.

We analyze stated preference data collected in discrete choice experiments (DCEs) where adult smokers made hypothetical choices between cigarettes, e-cigarettes, or quitting. Experimental variation identifies the causal effects of product attributes – the availability of flavors, prices, and health warnings – on stated preferences. Prior studies use the method of differences-in-differences and quasi-experimental variation in state policies to identify the causal effects of flavor bans and taxes in observational data on retail sales and self-reported e-cigarette use in the U.S. (Cotti et al, 2022; Cotti et al., 2025; Saffer et al., 2025). Because China's flavor ban was nationwide, the differences-in-differences method cannot be used. Even a simpler before-and-after study of China's flavor ban faces challenges. Because multiple e-cigarette regulatory policies were enacted in 2022, it would be difficult or impossible to disentangle the separate impacts. In addition, analysis of observational data on retail sales would be misleading if the ban led to illegal markets. In this context, analysis of data from DCEs provides valuable

information about a policy that is inherently difficult to study. DCEs are a well-established method with strong internal validity and, when applied to familiar product choices as is the case here, good external validity (McFadden, 2017; Penn and Hu, 2018; Kenkel et al. 2026).

2. Background

Scientific evidence indicates that while e-cigarettes are not without health risks, they are substantially less harmful than combustible cigarettes (NASEM, 2018; McNeill et al., 2022) and can serve as an effective smoking cessation tool (Lindson et al., 2024; Auer et al., 2024; Kasza et al., 2024). Approximately 27% of China’s adult population (aged 15+) are current smokers (Xiao et al., 2022). Although vaping prevalence in China remains low—below 1% in the general population and 3% among smokers in 2018 (compared with approximately 3% and 10%, respectively, in the United States, where the adult smoking rate was below 14%, Villarroel et al., 2020)—both overall vaping prevalence and daily vaping among vapers nearly doubled between 2015 and 2018 (Zhao et al. 2020; Xiao et al., 2022). A national survey conducted in 2018 found that the most commonly reported reason for vaping in China is smoking cessation (Xiao et al., 2022): 46% of all Chinese vapers and 43% of young vapers aged 15–24 report using e cigarettes to quit smoking, approaching the level observed in Great Britain (52.8%, Cornish et al., 2018).

Like in many other countries, China’s regulatory interventions targeting e-cigarettes did not emerge until e-cigarette use became increasingly visible among young people, particularly school aged students. The youth protection movement prompted a series of policy actions. These began with a ban on the sale of e-cigarettes to minors in 2018, followed in 2019 by both an online sales ban and a ban on e-cigarette advertising. The most consequential development occurred in 2020, when an amendment to a national law safeguarding minors officially recognized e-cigarettes as a type of tobacco product. This legal reclassification paved the way for further policy actions and, in 2021, formally placed the e-cigarette industry under the supervision of the State Tobacco Monopoly Administration (STMA)—the same authority that oversees China’s state-owned tobacco monopoly. Subsequently, the STMA developed and implemented a strong and comprehensive e-cigarette regulatory framework in 2022 (Jiang & Zheng, 2024).

One defining feature of China’s new e-cigarette policy is the flavor ban, which prohibits the sale of e-cigarettes with flavors other than tobacco flavor (STMA, 2022). The flavor ban is also specified in the newly established National E-cigarette Product Standards (SA, 2022), which further prohibit products that allow additives to be added, nicotine free e-cigarettes (classified as

tobacco products), and synthetic nicotine. To ensure product quality control and limit the circulation of illegal products, the policy requires retailers, wholesalers, and manufacturers engaged in e-cigarette operations to obtain licenses from local STMA offices and to process all transactions through a national e-cigarette transaction management platform. In addition, the policy specifies quantity limits for e-cigarettes that may be mailed domestically or carried into China from abroad (a maximum of 10 devices per person).

The new regulations mandate e-cigarette packages carry the same health warning labels as cigarette packages, with the word “smoking” replaced by “smoking e-cigarettes,” displayed in identical formats and locations. The primary warning, which is always displayed on the front, reads: “Smoking e-cigarettes is harmful to your health. Do not smoke e-cigarettes in non-smoking places.”

One month after the STMA regulations took effect, the Ministry of Finance imposed ad valorem taxes on e-cigarettes, levied at 36% at the production and import stage and 11% at the wholesale stage (MOF, 2022). The regulatory framework also includes additional provisions, such as granting the STMA authority over domestic e-cigarette sales and production quotas and imposing initial and random product quality inspections on manufacturers.

Despite the breadth of the new regulatory framework, enforcement appears limited. Chinese news coverage has documented the continued availability of illegal flavored e-cigarettes on popular social media platforms and their presence in the market, often disguised as other consumer goods (Wang et al., 2025). Several factors may contribute to this relatively weak enforcement. First, the policy has apparently mainly achieved its goal of limiting youth access to e-cigarettes, a dramatic shift from the pre-policy environment in which e-cigarettes were widely accessible, particularly in popular retail areas. Second, the traditional tobacco industry faces limited competitive pressure because vaping prevalence in China has remained low and the new regulations have severely curtailed the domestic e-cigarette industry. The STMA has inherent incentives to protect the interests of the China Tobacco Manufacturing Corporation (CTMC), its affiliated tobacco enterprise. This dual regulator–producer structure has long been recognized as a major impediment to effective tobacco control in China, despite China’s ratification of the WHO Framework Convention on Tobacco Control in 2005.

3. Data and the Discrete Choice Experiments (DCEs)

The data come from two DCEs conducted online with subjects from China: one in 2021, less than a year before the implementation of the new e-cigarette policy, and the other in 2023, approximately six months after the policy took effect. The DCEs were originally developed in English, translated into Chinese, and fielded online by the survey firm SSRS. The samples included 620 current smokers in 2021 and 606 in 2023. After excluding subjects reporting extreme cigarette prices (lowest and highest 2.5%), the final samples included 590 subjects in 2021 and 583 subjects in 2023.¹

The 2021 DCE was part of a multi-country series that used a common design to assess potential impacts of four widely discussed regulatory approaches to e-cigarettes: taxation, the availability of flavors, nicotine limits, and health warning labels. (All four domains were later incorporated into China's new e-cigarette policy). Subjects were asked to imagine shopping at the place where they usually purchase cigarettes. In each choice task, they chose one of three alternatives: a pack of cigarettes, an e-cigarette equivalent to a pack of cigarettes, or attempting to quit (phrased as "I will quit smoking cigarettes and not use e-cigarettes"). Figure 1A shows an example choice set of the 2021 DCE.

Table 1A lists the product attributes and levels in the 2021 DCE. Both cigarette and e-cigarette prices had three levels: low (half the mid-level), mid, and high (double the mid-level). The mid-level cigarette price was the subject's self-reported price paid for their last purchase of a pack of cigarettes (from a background survey), while the mid-level price for an e-cigarette was set to the average market price at the time (10 Yuan).

The e-cigarette flavor options in the 2021 DCE included both the pre-policy set ("tobacco, menthol, fruit/sweet/candy available") and the post-policy restriction ("tobacco only"). The nicotine content limit introduced in the new policy (≤ 20 mg) matches the mid-level nicotine attribute in the DCE. Health warning labels were selected warnings used or recommended internationally in 2021: a reduced-risk message from the UK, a nicotine-addiction warning from the US, and a toxin-exposure warning from Australia. For cigarettes, only the price

¹ As explained below, self-reported cigarette prices are used as the basis for the cigarette prices shown in the experiment. Self-reported prices with extreme values can lead to unreliable parameter estimates in the conditional logit model.

attribute varied; flavor, nicotine content, and warnings were fixed at status-quo levels across all scenarios.

The 2023 China DCE was designed specifically to assess the impacts of the newly implemented e-cigarette regulations but retained most features of the 2021 design. Subjects again chose among cigarettes, e-cigarettes, and quitting (see Figure 1B). However, the 2023 subjects made choices between a total of five options, because both cigarette and e-cigarette options now included flavored and non-flavored versions. For flavored products, the design also introduced a new legality-status attribute with three levels—legal, illegal with loose enforcement, and illegal with strict enforcement. The illegal categories for flavored e-cigarettes reflect their status under the new policy. The illegal status of flavored cigarettes in the experiment was mainly exploratory; although menthol cigarettes have been banned in the European Union and in some states and localities in the U.S., the Chinese government has not indicated any intention to restrict flavored cigarettes.

Price levels in the 2023 DCE followed the same structure as in 2021 (low, mid, high), but the mid-level e-cigarette price was updated to reflect the newer market average (15 Yuan). E-cigarette warning labels were identical to those in the 2021 DCE except that the toxin-exposure warning was replaced with the policy-required warning, which is based on China's longstanding cigarette warning that appears on cigarette packaging and in smoke-free public areas. Warning labels did not differ between flavored and non-flavored e-cigarette options. Placeholder text was used when attributes did not vary (see Table 1B).

In both DCEs, the experimental randomization was designed and implemented by SSRS, a professional survey firm, and followed established good-practice guidelines such as minimizing respondent burden and maximizing statistical efficiency (Johnson et al., 2013). The 2021 DCE had 324 possible scenarios and the 2023 DCE had 2,916 possible scenarios (e.g., for the 2021 DCE: 3 cigarette price levels $\times$ 3 e-cigarette price levels $\times$ 3 flavor levels $\times$ 3 nicotine levels $\times$ 4 warning labels). Because the full factorials would be too burdensome for subjects, a block factorial design was used. 120 scenarios were selected for the 2021 DCE and 142 for the 2023 DCE. Selected scenarios for each DCE were grouped into 12 blocks, each containing 12 scenarios (with some scenarios appearing in multiple blocks). Blocks were randomly assigned to participants. The experimental variation identifies the main effects of the attributes, but because we do not use a full factorial our design does not identify all possible interaction effects.

Each DCE was embedded within a comprehensive survey that collected demographic information and details on participants' smoking and vaping behaviors (e.g., number of days smoking or vaping in the past 30 days and cigarette purchase habits), risk perceptions of smoking and vaping, and other tobacco-use related factors. The 2021 and 2023 surveys were largely identical, with minor updates. Most items were adapted from well-established national and international tobacco surveys, such as the Tobacco Use Supplement to the U.S. Current Population Survey. The full survey instruments are available upon request.

4. Conditional Logit Model

We analyze the DCE data using the random utility model (RUM) framework, which is widely used in econometric analysis of discrete choice data. Under the RUM, individuals are assumed to choose the option that provides the highest utility among the available alternatives. Utility from choosing each alternative consists of a representative (systematic) component and an unobserved random component.

In the following equation we specify the utility for individual i from choosing alternative j at choice task t in either the 2021 or 2023 DCE as a linear function of alternative-specific constants (ASC_j), alternative attributes (X_{jt}), and individual characteristics (Z_i). The term ϵ_{ijt} is the unobserved random utility.

$$U_{ijt} = ASC_j + X_{jt}' \beta + Z_i' \gamma + \epsilon_{ijt}$$

The ASCs capture baseline preference for each product (cigarettes or e-cigarettes) relative to quitting, which serves as the reference category in all models. X includes a product price variable (linearized, in Yuan) and indicator variables for other product attribute levels. The specification also allows the baseline preferences of each product type to vary with the individual characteristics Z_i . Assuming the error term ϵ_{ijt} is independently and identically distributed (i.i.d.) with a type 1 extreme value distribution, the resulting choice probabilities follow the logit form. We estimate the conditional logit model using Stata's "cmlogit" command.

In the 2021 DCE, X includes indicators for 2 flavor availability levels (reference category: all flavors available) and 3 warning labels (reference category: "no warning"). In the 2023 DCE, X includes indicators for 2 legality status levels (separately for flavored cigarettes and flavored e-cigarettes, reference category: "legal") and 3 e-cigarette warning labels (separately for flavored and non-flavored, reference category: "no warning").

In the RUM, the coefficient on product price represents the marginal utility of income (the change in utility from a 1-Yuan increase in the price of product j). Other coefficients in β capture the marginal utility associated with a specific attribute level relative to their reference category (e.g., the marginal utility of choosing a flavored e-cigarette in 2023 when it is illegal but sold under the counter, compared with when it is legal).

The vector Z includes indicator variables for individuals' age group, gender, educational level, employment status, household income, place of residence, and household composition. Demographic variables are included as controls to address potential imbalances between the 2021 and 2023 samples that could bias the ASCs (though not the coefficients on the experimentally varied attributes) and thereby affect the comparability of the policy simulation results across the two years.

Due to comparability concern, the nicotine content attribute is excluded because it does not appear in the 2023 design. Given the random and orthogonal experimental variation in attributes, dropping the nicotine attribute does not create omitted variable bias.

5. Results

5.1. Sample Descriptive Statistics

Table 2A summarizes subjects' demographic characteristics. Descriptive statistics are reported separately for the 2021 and 2023 samples. Overall, subjects' demographics were broadly similar across the two surveys, with some exceptions. In both samples, the subjects were relatively young, with over 70% under age 45 and about two-thirds reported having children. Around 90% were male. A large majority (78+%) had relatively high educational attainment (some college or higher), were employed full-time, reported annual household incomes of 130,000 Yuan or above, and resided in medium-sized cities (population ≥ 1 million) or larger. However, compared to the 2021 sample, a notably lower fraction of the 2023 subjects were in the lowest income category (7% versus 22%) and a notable higher fraction of the 2023 subjects were in the highest income category (50% versus 25%). About 23–37% reported living with at least one other smoker in their household.

Tables 2B and 2C summarize subjects' current smoking and vaping behaviors reported in the background survey. All subjects in the samples are current smokers and most (84-88%) report daily smoking. On days smoked, the average number of cigarettes smoked per day is about 10 in the 2021 sample and about 12 in the 2023 sample. Over 60 percent of both samples report

current vaping some days or daily. Among current vapers, the frequency of e-cigarette use in the past 30 days was 20 days in 2021 and down to 15 days in 2023.

Interestingly, although the sale of flavored e-cigarettes was banned in 2022, around 90% of vapers in both the 2021 and 2023 samples reported using flavored e-cigarettes. However, the reported sources of e-cigarettes are different between the samples. In the 2021 sample, the shares of vapers reported getting their e-cigarettes from specialty tobacconists and vape shops or from general retailers such as supermarkets are both around 70 percent (subjects could indicate multiple sources). In the 2023 sample, the fraction of subjects reporting these sources fell to below 41 percent. The fraction reporting getting their e-cigarettes from family/friends or social media increased from 4% in 2021 to 45% in 2023.

5.2. Conditional Logit Models of Consumer Tobacco Product Choices

Tables 3A and 3B present the conditional logit models estimated with the data from the 2021 and 2023 DCEs. The estimated equations are in a utility metric, and in both the 2021 and 2023 models the estimated effects of the product attributes mainly have the expected signs in that metric. In both models, higher product prices reduce respondent utility. Because the price coefficient reflects the marginal utility of income (per 1 Yuan), coefficients for other attributes can be expressed in monetary terms (willingness to pay) by dividing them by the price coefficient. Our discussion of the Table 3 results uses the implied willingness to pay estimates to make the magnitudes more readily interpretable.

In the 2021 model, compared with having no flavor restrictions, a scenario where only tobacco-flavored e-cigarettes are available reduces respondent utility by an amount equivalent to roughly 14 yuan—about half the average price of a pack of cigarettes (27 yuan). In the 2023 model, when tobacco-flavored e-cigarettes are illegal but available under the counter, the predicted loss in utility is much larger, with the implied willingness to pay exceeding 220 yuan. More stringent enforcement (i.e., “illegal street market”) generates a slightly larger reduction in utility worth about 241 yuan.

The nicotine-addiction warning label produces the largest disutility of all warnings in both years. The effect of the reduced-risk warning label is never statistically significant and sometimes has an unexpectedly negative effect. Interestingly, in the 2023 model the coefficients on the e-cigarette warning labels (both flavored and non-flavored) are almost all negative, indicating disutility relative to the omitted category—the policy-required warning, which is the

well-known cigarette warning label widely used in China. Although most of these negative coefficients are not statistically significant, the pattern suggests that respondents may perceive the unfamiliar e-cigarette-specific warnings as more concerning than the familiar cigarette warning now required on e-cigarettes, probably because they have not yet fully associated the standard cigarette warning with e-cigarettes. We note the caveat that the coefficients on the warning attributes are estimated imprecisely.

5.3. Policy Simulations

Using each of the estimated conditional logit models, we predict the probabilities of choosing cigarettes, e-cigarettes, and quitting under both the pre-policy (2021) and post-policy (2023) market conditions. The differences between the predicted probabilities across the two scenarios represent the estimated policy effects. These estimates capture the combined impacts of the e-cigarette tax, flavor ban, and new warning requirements. We also used the models to predict the effects of each policy implemented alone. Predictions are generated at the individual level using Stata's margins command and weighted to represent the national sample.

Appendix Table 1 lists the product attribute levels used in the simulations, chosen to reflect the actual 2021 and 2023 market environments. For simulations based on the 2023 DCE model, the legality status for flavored e-cigarettes is set to “illegal but available under the counter,” reflecting the loosely enforced flavor ban anecdotally observed in the post-policy period. Simulating the effect of the 2022 e-cigarette warning label requirement presented some difficulties. The 2021 DCE did not include the warning that was required by the 2022 law. Instead, for the post-policy simulation using the 2021 model, the warning label is set to the toxin-exposure label, which like the required-warning mentions health effects. For the post-policy simulation using the 2023 model, the warning label is set to the warning label required by the 2022 legislation. However, because the conditional logit model estimates unexpectedly showed that this warning is preferred to no warning (although imprecisely estimated), in the policy simulations the counter-intuitive effect of this warning label is to increase e-cigarette use. To explore the impact of this unexpected result, we also estimated the effects when the e-cigarette warning label attribute was assumed not to change.

Table 4A and 4B present simulated choices under pre-policy (2021) and post-policy (2023) conditions based on the 2021 and 2023 logit models. In the 2021 model simulations, the package of policy changes is predicted to decrease the fraction of choices for e-cigarettes by six

percentage points, from 47% to 41%. Almost all of the shift is to increase cigarette choices by 5 percentage points; the predicted impact on the fraction of quit attempts is small. In the 2023 model simulations, the package of policy changes is predicted to decrease the fraction of choices of flavored e-cigarettes by 5 percentage points, mainly shifting into an increase in the fractions of choices of unflavored e-cigarettes. The predicted fractions of choices for cigarettes are unchanged with and without the package of policies. However, these net effects reflect the anomalous prediction that the required e-cigarette warning label alone increased choices for both flavored and unflavored e-cigarettes. In the simulations that assume the warning label did not change, the combination of the other two policies is to decrease the fraction of flavored e-cigarette choices and to increase the fractions of unflavored e-cigarette choices and cigarette choices.

Considering each policy separately, in the 2021 policy simulations the e-cigarette flavor ban by itself is predicted to decrease e-cigarette choices by 3 percentage points. In the 2023 policy simulations the e-cigarette flavor ban is predicted to decrease flavored e-cigarette choices by 4.4 percentage points. Despite this decrease, the predicted choice share of flavored e-cigarettes when they are illegal but loosely enforced is 53% ($= 0.048/0.091$) of the predicted share when legal. This large illegal share is consistent with anecdotal evidence and with the evidence from our 2023 background survey that flavored e-cigarettes remain popular after the ban although fewer vapers reported getting their e-cigarettes from specialty or general retailers. In the 2023 simulations, the cigarette flavor ban is also predicted to increase unflavored e-cigarette choices so the predicted net impact on e-cigarette choices is smaller.

In both the 2021 and 2023 policy simulations, the e-cigarette flavor ban is predicted to have the unintended consequence of increasing cigarette choices. Difference-in-difference studies of U.S. e-cigarette flavor bans also find some evidence that the bans increase cigarette use (Cotti et al. 2025, Saffer et al. 2025). Obviously, the contexts of smoking in China and the U.S. are quite different. However, in both countries most vapers are former or current smokers, so it is perhaps not surprising that when their preferred flavored e-cigarettes are banned some vapers shift back into smoking.

Turning to the other policies, in both the 2021 and 2023 policy simulations the predicted impact of the 47% tax by itself is small, suggesting that the demand for e-cigarettes is price inelastic. Increases in e-cigarette prices might have not changed consumer stated preferences

much because even after the price increase, e-cigarettes are less expensive than cigarettes. In the 2021 policy simulations, the predicted effects of the warning label requirement by itself is to decrease e-cigarette choices by 3 percentage points and to increase cigarette choices by 3 percentage points. As discussed above, in the 2023 policy simulations the warning label requirement is counter-intuitively predicted to increase e-cigarette use.

We are unable to benchmark our estimates because we are unaware of any research that uses observational data and a credible quasi-experimental design to estimate the impact of China's ban on flavored e-cigarettes, the price-elasticity of demand for e-cigarettes in China, or the impacts of the required-warning. The background surveys we conducted as part of our 2021 and 2023 DCEs provide observational data on smoking and vaping behaviors pre-policy and post-policy. We pooled the 2021 and 2023 background survey data and conducted a before-and-after analysis of the impact of the package of policies.² The estimated effects are in the same directions as, but much larger than, the predictions from the DCE models. The number of vaping days in the past 30 days is estimated to decrease by 59%, the number of cigarettes consumed in the past 30 days is estimated to increase by 19%, and the effects on past-year quit attempts and on quit intentions are minimal. However, because the before-and-after study lacks an untreated control group and the 2021 and 2023 samples differ in demographic characteristics, we cannot interpret the observational results as causal.

6. Discussion

Our analysis of data collected from adult smokers in China suggests that a ban of flavored e-cigarettes decreased stated preferences for e-cigarettes but also has the unintended consequence to increase stated preferences for cigarettes. Globally, policy makers in different countries have taken widely different approaches to the tradeoffs between making e-cigarettes available to help adult smokers quit smoking versus preventing non-smokers, especially youth, from initiating use of an addictive product. Because our samples did not include non-smoking youth, our study does not provide evidence about both sides of the tradeoffs. However, evidence that the ban on

² We estimated ordinary least squares models of the number of vaping days and cigarettes smoked in the past 30 days and linear probability models of the probability of a past-year quit attempt and the probability of stating an intention to quit in the next six months. The estimated treatment effect of the package of policies is the coefficient on an indicator that the observation is from the 2023 sample. The models controlled for demographics. Results are available upon request.

flavored e-cigarettes might increase adult smoking is an important consideration for China's tobacco and nicotine regulatory policy.

Our DCE models provide predictions of the effects of the package of policies enacted in China in 2022: the e-cigarette flavor ban, new warning label requirement, and a large tax increase. However, the package of policies, especially when combined with the contemporaneous anti-vaping media campaign, might also have led to changes in consumer risk perceptions. A limitation of our study is that we cannot identify the trends in risk perceptions or their causal effects on behavior. However, data from our background surveys in 2021 and 2023 describe substantial misinformation across multiple dimensions related to consumer perceptions about the risk of e-cigarettes (Table 5).³³ E-cigarettes contain nicotine, and 78% - 83% of our samples agree with the incorrect statement that nicotine is the component of cigarette smoke that causes most smoking-related cancers. Close to half of our samples agree that vaping is just as harmful or more harmful than smoking. On average our samples also perceived that the life expectancy of vapers is only a year or less longer than the life expectancy of smokers. Many Chinese smokers who could benefit by using e-cigarettes to cut down or quit smoking might be discouraged by their misperceptions of the health gains. In contrast, another misperception might help explain the popularity of flavored e-cigarettes among vapers; 40% to 44% of our samples incorrectly believe that flavored e-cigarettes are less harmful than unflavored e-cigarettes. Public health authorities in China and across the globe face the challenging task of providing consumers with the risk information they need to make informed choices between smoking and vaping, and if they vape, between flavored and unflavored e-cigarettes.

³³ This set of questions was asked after the DCE tasks, to avoid biasing DCE responses.

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Table 1A. Product Attributes and Attribute Levels in the 2021 DCE

Attribute	Cigarettes (pack)		An e-cigarette (cigarette-pack equivalent)	
Price	1	0.5*P	1	5 Yuan
	2	P	2	10 Yuan
	3	2*P	3	20 Yuan
Nicotine Content	You will inhale between 22-38 mg of nicotine per pack of typical cigarettes if you smoke regulars, or between 12-20 mg of nicotine per pack if you smoke so-called mild or light cigarettes.		1	Various nicotine levels available, up to 5mg
			2	Various nicotine levels available, up to 20mg
			3	Various nicotine levels available, up to 50mg
Flavor	Your current cigarette flavor		1	Available flavors are tobacco, menthol, fruit/sweet/candy
			2	Available flavors are tobacco and menthol
			3	The flavor available is tobacco only
Warning	Smoking is harmful to your health; please don't smoke in smoke-free places		1	No warning
			2	E-Cigarettes aren't completely risk-free, but they carry a small fraction of the risk of cigarettes
			3	This product contains nicotine; nicotine is an addictive chemical
			4	E-cigarettes may expose users to chemicals and toxins at levels that have the potential to cause health effects

Note: “P” is the price respondents reported paying for their last pack of cigarettes.

Table 1B. Product Attributes and Attribute Levels in the 2023 DCE

Attribute	Non-Flavored cigarettes	Flavored cigarettes	A tobacco flavored e-cigarette	A flavored e-cigarette
Price	0.5*P	0.5*P	7.5 Yuan	7.5 Yuan
	P ^a	P ^a	15 Yuan	15 Yuan
	2*P	2*P	30 Yuan	30 Yuan
Legality	Legal	Legal	Legal	Legal
		Legality 2 ^b		Legality 2 ^b
		Legality 3 ^c		Legality 3 ^c
Warning	Warning 4 ^e	Warning 4 ^e	No warning	No warning
			2021 DCE Warning 2 ^d	2021 DCE Warning 2 ^d
			2021 DCE Warning 3 ^d	2021 DCE Warning 3 ^d
			Warning 4 ^e	Warning 4 ^e

Notes:

- “P” is the price respondents reported paying for their last purchased pack of cigarettes.
- “Legality 2” refers to the statement: “Prohibited. Available under-the-counter and online from retailers who continue to sell nicotine e-cigarettes.”
- “Legality 3” refers to the statement: “Prohibited. Strictly enforced. Only available from illegal dealers, e.g. street sellers.”
- “2021 DCE Warning 2” and “2021 DCE Warning 3” represent the second (smaller-risk) and third (nicotine-addiction) e-cigarette warning labels used in the 2021 DCE, respectively (see Table 1A).
- “Warning 4” refers to the message: “Smoking is harmful to your health; please don't smoke in smoke-free places”.

Table 2A. Demographic characteristics

	<u>Mean</u>	
	2021	2023
Age (years)	39.4	40.5
Age 19-30	0.27	0.24
Age 31-45	0.44	0.49
Age 46+	0.29	0.27
Male	0.94	0.87
High school or lower	0.13	0.086
Some college or college	0.33	0.41
University or higher	0.55	0.51
Full-time employed	0.88	0.89
Household income <130,000 Yuan(\$20,500)	0.22	0.070
Household income 130,000-250,000 Yuan(\$20,500-39,500)	0.54	0.43
Household income 250,000+ Yuan (\$39,500+)	0.25	0.50
Place of residence: County city or smaller, <1m	0.13	0.22
Place of residence: Medium or large city, 1-10m	0.35	0.27
Place of residence: Metropolis area, 10m+	0.52	0.51
Presence of children in the household	0.64	0.64
Living with any regularly smoker	0.23	0.37
Four or more people live in household	0.34	0.20
Observations	590	583

Note: Data source is the XXX University online DCE background surveys (China, 2021 and 2023); sampling weights were not applied.

Table 2B. Characteristics of Cigarette Use and Quit Attempts

	<u>Mean</u>	
	2021	2023
Smoking cigarettes every day	0.84	0.88
Days smoking cigarettes in the past 30 days	28.7	28.7
Cigarettes smoked per day in past 30 days	9.90	12.3
Smokes flavored cigarettes	0.49	0.62
Usually purchases cigarettes by Pack	0.72	0.73
Usually purchases cigarettes by Carton	0.27	0.26
Cigarette price paid for the last pack (20 cigarettes)	27.6	30.4
Age starting smoking cigarettes regularly	22.3	23.8
Heaviness of Smoking Index (high:3-6)	0.34	0.39
Tried quitting smoking in past 12 months	0.55	0.64
Tried quitting smoking without using e-cigarettes in the past 12 months	0.26	0.42
Consider quitting smoking in next 6 months	0.58	0.61
Consider quitting smoking without using e-cigarettes in the next 6 months	0.25	0.41
Observations	590	583

Note: Data source is the XXX University DCE background surveys (China, 2021 and 2023); sampling weights were not applied

Table 2C. Characteristics of E-cigarette Use

	<u>Mean</u>	
	2021	2023
Ever used E-cigarettes	0.66	0.63
Vaping every day or some days now	0.63	0.60
Days vaped in the past 30 days (among current vapers)	20.4	14.6
Currently use flavored (non-tobacco) E-cigs (among current vapers)	0.89	0.90
Currently vape fruit flavor (among current vapers)	0.46	0.49
Currently vape mint flavor (among current vapers)	0.50	0.41
Currently vape menthol flavor (among current vapers)	0.34	0.27
Currently vape tobacco flavor (among current vapers)	0.36	0.36
Currently vape candy flavor (among current vapers)	0.21	0.19
Currently vape clove flavor (among current vapers)	.	0.17
Currently vape liquor flavor (among current vapers)	.	0.086
Source of e-cigarettes: friend/relative or social media	0.04	0.45
Source of e-cigarettes: Tobacconist or vape shop	0.70	0.34
Source of e-cigarettes: Internet	0.27	0.14
Source of e-cigarettes: retailers (supermarket, etc.)	0.69	0.41
Observations	590	583

Note: Data source is the XXX University online DCE background surveys (China, 2021 and 2023); sampling weights were not applied.

Table 3A. Conditional logit model of consumer tobacco product choices in the 2021 DCE

	Coefficient (standard error))
Price (Yuan)	-0.0068*** (0.00152)
Available flavors are tobacco and menthol	-0.0026 (0.0499)
Available flavor is tobacco only	-0.096 (0.0501)
E-cigarettes carry a small fraction of the risk	-0.025 (0.0631)
This product contains nicotine, nicotine is an addictive chemical	-0.20** (0.0676)
E-cigarettes may expose users to chemicals and toxins...	-0.11 (0.0632)
Cigarettes	
<i>(Demographic fixed effects)</i>	
Constant (ASC)	0.36 (0.927)
E-cigarettes	
<i>(Demographic fixed effects)</i>	
Constant (ASC)	0.44 (0.937)
Observations	21,060

Data source: XXX University online Discrete Choice Experiment, China, November 2021. Fixed effects control for age group, gender, educational attainment, employment status, household income, place of residence, and household composition. Standard errors clustered at the individual level are in parentheses. * p<0.05, ** p<0.01, *** p<0.001

Table 3B. Conditional logit model of consumer tobacco product choices in the 2023 DCE

	Coefficient (standard error)
Price (Yuan)	-0.0034** (0.00116)
Illegal retail market for flavored cigarettes	-0.43*** (0.0698)
Illegal street market for flavored cigarettes	-0.40*** (0.0715)
Illegal retail market for flavored e-cigarettes	-0.75*** (0.135)
Illegal street market for flavored e-cigarettes	-0.82*** (0.143)
Non-flavored e-cigarettes: (No warning label)	-0.078 (0.0709)
Non-flavored e-cigarettes: Smaller-risk warning	0.012 (0.0722)
Non-flavored e-cigarettes: Nicotine-addiction warning	-0.16* (0.0730)
Flavored e-cigarettes: (No warning label)	-0.085 (0.146)
Flavored e-cigarettes: Smaller-risk warning	-0.097 (0.153)
Flavored e-cigarettes: Nicotine-addiction warning	-0.037 (0.130)
Non-flavored cigarettes	
<i>(Demographic fixed effects)</i>	
Constant (ASC)	3.74* (1.518)
Flavored cigarettes	
<i>(Demographic fixed effects)</i>	
Constant (ASC)	3.01 (1.572)
Non-flavored E-cigarettes	
<i>(Demographic fixed effects)</i>	
Constant (ASC)	2.87 (1.538)
Flavored E-cigarettes	

(Demographic fixed effects)

Constant (ASC)	1.88 (1.549)
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Observations	33,360
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Data source: XXX University online Discrete Choice Experiment, China, 2023. Fixed effects control for age group, gender, educational attainment, employment status, household income, place of residence, and household composition. Standard errors clustered at the individual level are in parentheses. * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Table 4A: Predictions After the 2021 Weighted Conditional Logit Models**Predicted Outcomes with the Package of 2022 Policies**

	Pre-policy	Post-policy with no e-cig warning change	Post-policy with full requirements
1. Cigarette	0.49	0.51	0.54
2. E-cigarette	0.47	0.44	0.41
3. Quit	0.045	0.048	0.050
Observations	21,060	21,060	21,060

Predicted Outcomes of Each 2022 Policy Separately

	Post-policy with only e-cig taxes	Post-policy with only e-cig flavor ban	Post-policy with only required e-cig warning
1. Cigarette	0.49	0.51	0.52
2. E-cigarette	0.46	0.44	0.44
3. Quit	0.046	0.046	0.047
Observations	21,060	21,060	21,060

Table 4B: Predictions After the 2023 Weighted Conditional Logit Models**Predicted Outcomes with the Package of 2022 Policies**

	Pre-policy	Post-policy with No e-cig warning change	Post-policy with full requirements
1. non-flavored Cigarette	0.41	0.43	0.41
2. Flavored Cigarette	0.25	0.27	0.25
3. non-flavored e-cigs	0.23	0.25	0.28
4. Flavored E-cigs	0.092	0.048	0.042
5. Quit	0.014	0.015	0.014
Observations	33,360	33,360	33,360

Predicted Outcomes of Each 2022 Policy Separately

	Post-policy with only e-cig taxes	Post-policy with only e-cig flavor ban	Post-policy with only required e-cig warning
1. non-flavored Cigarette	0.41	0.43	0.39
2. Flavored Cigarette	0.25	0.26	0.24
3. non-flavored e-cigs	0.23	0.25	0.27
4. Flavored E-cigs	0.091	0.048	0.083
5. Quit	0.014	0.015	0.014
Observations	33,360	33,360	33,360

Table 5. Risk Perceptions

	<u>Mean</u>	
	2021	2023
Vaping vs smoking: Much less harmful	0.10	0.043
Vaping vs smoking: Less harmful	0.35	0.46
Vaping vs smoking: Just as harmful	0.42	0.32
Vaping vs smoking: More harmful	0.058	0.13
Vaping vs smoking: Much more harmful	0.012	0.012
Vaping vs smoking: I don't know	0.059	0.036
Flavored vs non-flavored E-cigs: Much less harmful	0.086	0.053
Flavored vs non-flavored E-cigs: Less harmful	0.31	0.39
Flavored vs non-flavored E-cigs: Just as harmful	0.51	0.39
Flavored vs non-flavored E-cigs: More harmful	0.039	0.10
Flavored vs non-flavored E-cigs: Much more harmful	0.0068	0.029
Flavored vs non-flavored E-cigs: I don't know	0.046	0.033
Perceived life expectancy for smokers	68.5	70.0
Perceived life expectancy for vapers	69.6	69.5
Agree -nicotine in cigarettes causes most of the cancer	0.83	0.78
Observations	590	583

Note: Data source is the XXX University online DCE background surveys (China, 2021 and 2023); sampling weights were not applied.

Appendix Table 1: Product attribute values used in simulations

DCE	product attributes	Attribute values/levels matching e-cigarette policy condition in	
		2021	2023
2021 DCE			
	Cigarette price	Individual price (last pack in 2021)	Average price of last pack in 2023 survey
	EC price	10 yuan (average price in 2021)	Add 47% Tax (14.7 yuan)
	EC flavors available	All flavors	Only tobacco flavor
	EC warning labels	None	Toxin-exposure warning
2023 DCE			
	Cigarette (both types) price	Average price of last pack in 2021 survey	Individual price (last pack in 2023)
	Flavored cigarette legality	Legal	Legal
	EC (both types) price	10 yuan (average price in 2021)	Add 47% Tax (14.7 yuan)
	Flavored EC legality	Legal	Illegal retail market
	EC warning (both types)	None	Required warning (cigarette-warning like)

