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Cigarette packaging, warnings, prices, and contraband: A discrete choice experiment among smokers in Ontario, Canada

G. Emmanuel Guindon^{a,b,c,*}, Emmanouil Mentzakis^d, Neil J. Buckley^e

^a Centre for Health Economics and Policy Analysis, McMaster University, Hamilton, ON, Canada

^b Department of Health Research Methods, Evidence, and Impact, McMaster University, Hamilton, ON, Canada

^c Department of Economics, McMaster University, Hamilton, ON, Canada

^d Department of Economics, City, University of London, London, United Kingdom

^e Department of Economics, York University, Toronto, ON, Canada

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ABSTRACT

In Canada, despite substantial decline, tobacco use remains the leading risk factor responsible for mortality and morbidity. There is overwhelming evidence that higher tobacco taxes reduce tobacco use, even if high taxes create an incentive to avoid or evade tobacco taxes. Recently, in addition to taxes, plain and standardized packaging and printing a warning on each cigarette have been lauded to reduce tobacco use. In November 2019, Canada became the country with the most comprehensive cigarette packaging regulations; and in June 2022, Canada proposed to print health warnings on individual cigarettes, the first jurisdiction to ever do so. The regulations came into force on August 1, 2023, and are being implemented through a stepwise approach. Our objective was to examine the effects of plain and standardized packaging, warning on cigarettes, price, and the availability of illicit cigarettes on intention to purchase and risk perceptions. We conducted a discrete choice experiment, and examined heterogeneity in preferences using latent class models among smokers in Ontario, Canada. We found that using latent class analyses was essential in quantifying preferences for attributes of cigarettes and cigarette packs. First, nearly half of smokers stated a preference for cheaper illicit cigarettes in a branded pack without any health warnings, regardless of the licit cigarette alternatives. For about 20% of respondents, plain packaging and especially warning on cigarette sticks decreased the probability of stating a purchasing preference for these alternatives. Third, about a third of respondents chose competing alternatives with mostly one attribute in mind, price. Lastly, none of the products and attributes seem to have significantly influenced risk perception. Our findings attest to the importance of prices and taxes, to the potential of warnings on cigarette sticks to control tobacco use, and indicate that efforts to restrict the availability of illicit cigarettes may yield substantial benefits.

1. Introduction

Tobacco use is one of the leading causes of preventable death and illness globally. In 2019, tobacco use and exposure to secondhand smoke accounted for nearly nine million deaths equivalent to 15% of all deaths (GBD 2019 Risk Factors Collaborators, 2020). Additionally, there are well-documented associations between socioeconomic status (SES) and smoking (Hiscock et al., 2012). In Canada, despite substantial decline, tobacco use remains the leading risk factor responsible for mortality and morbidity (Alam et al., 2019). Moreover, socioeconomic differences in tobacco use have increased, leading to increased inequity in the

distribution of tobacco-related disease (Corsi et al., 2014).

An important recent policy intervention for cigarettes has been the introduction of plain and standardized packaging. In November 2019, Canada became the country with the most comprehensive cigarette packaging regulations. The regulations included provisions such as prohibiting brand colours, graphics and logos on packages, requiring a drab brown colour to appear as the base colour for all brands, requiring cigarette packages to be in a standardized slide and shell format, and requiring the largest health warnings on cigarette packages in the world in terms of surface area (Canadian Cancer Society, 2019; Government of Canada, 2018).¹ In May 2018, the Canadian Minister of Health

* Correspondence to: Centre for Health Economics and Policy Analysis, McMaster University, 1280 Main Street West, Hamilton, L8S 4K1, ON, Canada.

E-mail address: emmanuel.guindon@mcmaster.ca (G.E. Guindon).

¹ The standardized/plain-packaging came into effect November 9, 2019; retailers had until February 7, 2020 to comply.

announced plans to require a health warning on the cigarette itself. Despite the prominence of warnings on cigarette packs, smokers can avoid them using physical (covering or concealing the pack) or psychological (ignoring warnings and focusing on branding) means (Maynard et al., 2014; Moodie, 2018). Emerging research has shown that health warnings on cigarette sticks may be an effective means of conveying the risk of tobacco use (Drovandi et al., 2018, 2019a, b; Hassan and Shiu, 2015; Hoek et al., 2016). In June 2022, the Government of Canada proposed to print health warnings on individual cigarettes, the first jurisdiction to ever do so (Government of Canada, 2022). The regulations came into force on August 1, 2023, and are being implemented through a stepwise approach.

There is substantial international and Canadian evidence that tax and price strategies that raise tobacco prices reduce tobacco use (International Agency for Research on Cancer, 2011; US National Cancer Institute, World Health Organization, 2016). Further, reviews of smoking and SES concluded that increasing the price of tobacco products was the intervention with the greatest potential to reduce health inequities from tobacco use (Brown et al., 2014a, b; Hill et al., 2014). High taxes, however, create an incentive to avoid or evade tobacco taxes (National Research Council, Institute of Medicine, 2015). In the province of Ontario, the latest estimates suggested that about 15% of smokers' most recent cigarette purchases had been from a First Nations reserve (the predominant source of undertaxed and untaxed cigarettes) (Driezen et al., 2020; Guindon et al., 2017). Lower priced illicit cigarettes may be sold in packaging which do not display legally mandated warning or with branding which contravenes plain packaging regulations. Comprehensive marketing restrictions such as the prohibition of all advertising, promotion, and sponsorship, including point-of-sale, and plain/standardized packaging has led the tobacco industry to increasingly focus its attention on the use of price as a marketing tool (Henriksen, 2012).

Given the illegal nature of illicit cigarettes and that no jurisdiction required health warnings on individual cigarette sticks, it was not feasible to use standard empirical approaches such as quasi-experimental designs to examine their effects. We conducted a stated preference discrete choice experiment to examine the effects of plain/standardized packaging, health warning on individual cigarette sticks, price, and the availability of contraband cigarettes on intention to purchase and risk perceptions among smokers residing in Canada's most populous province, Ontario.

2. Methods

2.1. Study sample

The participants were recruited from the Smokers' Panel, an ongoing online survey of adult smokers and recent quitters managed by the University of Toronto's Ontario Tobacco Research Unit. Only panel members from Ontario who reported smoking cigarettes daily or occasionally were eligible to participate. A financial incentive was provided to encourage participation. After completion of the survey, respondents were entered into a draw with a 1 in 50 chances to win Can\$250 (about €173/USD183 when the survey was administered). The online survey was conducted in May and June 2020.

2.2. Questionnaire development

Our questionnaire was informed by a scoping review of studies that used stated preference experimental approaches to examine plain/standardized packaging, health warning on cigarette sticks, price, or contraband cigarettes. A draft questionnaire was piloted among 34 students and staff of McMaster University.

2.3. Outcomes

We examined two outcomes, intention to purchase and risk perception: 1) If these were the only options you had to choose from, which would you be most likely to buy: A, B, C, or none? 2) Which of these do you think would pose the least risk to your health: A, B, C, or other?

For the first question, respondents were instructed as follows: "choosing 'none' implies that you would choose not to smoke. For example, if you smoke a pack of 25 cigarettes a day, selecting 'none' means that you would prefer not to smoke for a day rather than buying any of the three packs shown. Similarly, if you smoke a pack of 25 cigarettes per week, choosing 'none' implies that you would choose not to smoke any cigarettes for a week."

2.4. Products and attributes

In a first experiment, we examined a pack of 25 du Maurier cigarettes, the most popular brand in Canada (unlike the United States, in Canada the most popular pack size is 25, not 20 cigarettes) and three attributes: 1) packaging, plain packaging vs packaging with some branding; 2) health warning on cigarette sticks, with vs without; and, 3) price, Can\$12.00, Can\$13.20, Can\$14.50, Can\$15.95, and Can\$17.50. In a second experiment, we expanded the set of packs and introduced a pack (25 sticks) of illicit cigarettes, Canadian Goose. Unlike licit cigarettes, the packaging of Canadian Goose cigarettes did not display any mandated health warnings. We only varied price because illicit cigarettes can be substantially cheaper than licit cigarettes. We used prices of Can\$3.00 and Can\$6.00 for Canadian Goose cigarettes.² All levels are binary-coded. Alternative specific constants are part of the specification and enter as two parameters (i.e., one for the contraband pack and one for the opt-out option).

2.5. Experimental design

To study the effects of attributes on outcomes with and without an illicit cigarette option, we developed two separate experiments with a similar structure. The first presented three licit alternatives (all du Maurier) and an opt-out (none/other). The second, presented two licit cigarette alternatives (both du Maurier), an illicit alternative (Canadian Goose), and an opt-out. For each of the two experiments, a separate experimental design was generated. In both cases, we opted for D-fractional factorial designs which allowed for all main effects and two-way interactions. The effects of packaging and warnings on cigarette sticks were modelled as binary variables while price was modelled as a continuous variable. The first design resulted in six choice sets of three licit cigarette alternatives with an opt-out. The second design resulted in 12 choice sets of two licit and one illicit cigarette alternatives with an opt-out. To minimize response burden, the 12 choice sets were split into two blocks, each with six choice sets. Participants were randomly assigned to one of the two blocks of design two or design one. In developing the design, close attention was given to choice sets with dominated options (i.e., where all the levels of one alternative are unambiguously better than the levels of a second alternative) and imposed restrictions prohibiting dominated alternatives from appearing in our experimental design (Johnson et al., 2013). For licit (du Maurier) options, we imposed the following restriction: 1) attributes/levels cannot differ in price only; 2) plain packaging, with warnings on cigarette sticks, cannot be the most expensive licit option; 3) packaging with branding, without warnings on cigarette sticks cannot be the cheapest licit option; and 4) all attributes/levels cannot be identical. We imposed no restriction on the illicit option (Canadian Goose). Design 2 can be viewed as a labelled design with four alternatives. The first two licit

² The pack shown in the online survey could be purchased in the fall of 2019 for Can\$ 3.00.

cigarettes alternatives feature common attributes (i.e., common pack and price attributes) and experimental restrictions, the third alternative is the illicit cigarette alternative parameterized with one constant (i.e., alternative specific constant) and a dedicated price attribute (i.e., separate from the licit alternative price attribute). Given that there are no clear dominated options for the illicit alternative, no restrictions were imposed. The presence of two separate independent price attributes allowed estimation of two separate price effects (i.e., one for licit and one for illicit cigarettes). Finally, the opt-out is a fourth alternative that is parameterized only as a constant (i.e., alternative specific constant). Both designs were generated using Ngene 1.2 (ChoiceMetrics, 2018). Fig. 1 presents choice set examples for the two experimental designs. The survey instruments are available online.³

2.6. Statistical analysis

Analyses of experimental choices follow from the random utility framework using the conditional logit, whereby utility consists of an additive deterministic linear-in-parameters component and a stochastic extreme value type I distributed error term (McFadden and Zarembka, 1974). For design 1, a fractional factorial design was used through the modified Federov algorithm with a D-error of 0.34, while an identical design without any imposed restrictions had a D-error of 0.25, suggesting a 30% drop in efficiency. A similar methodology was used for design 2 with a D-error of 0.22. An identical design without any imposed restrictions had a D-error of 0.20, suggesting a 10% drop in efficiency.

Unobserved heterogeneity in preferences was accommodated through a latent class model which sorted individuals probabilistically into a fixed number of latent classes of distinct preferences and preference parameters were estimated for each class (Greene and Hensher, 2003). Class assignment was a function of a constant and individual characteristics, if model fit was improved (according to the Bayesian Information Criterion, BIC). For intention to purchase, class assignment was parameterized using the following characteristics: sex, education, household income, addiction (reporting smoking within five minutes, and six to 30 minutes, of waking-up), and reporting usually smoking an illicit brand of cigarettes. For risk perception, parameterization with individual characteristics did not improve goodness-of-fit. Consequently, the latent class specification was estimated without any individual characteristics. The optimal number of latent classes was determined exogenously and was a trade-off between goodness-of-fit, explanatory power, the number of additional parameters, and ease of interpretation (Czajkowski et al., 2019). Testing alternative specifications involving four models (i.e., design 1 and 2, with two outcomes each), interactions reduced model fit (according to BIC) in three out of four specifications, with marginal improvement for the intention to purchase decision (design 1, without illicit cigarettes option). For ease of interpretation, we present main effects models across all four estimations. Further, we found that the latent class models for our design that did not include an illicit option (design 1) did not converge; we present no results based on estimations that did not converge. In design 2 which included an illicit brand option, we found that a three and a two latent class model fit the data better (according to BIC) for the intention to purchase and risk perception decisions, respectively. According to the BIC criterion, the latent class model specification that converged greatly improved fit.

Models were estimated for each of the two outcomes and two experimental designs. Estimated coefficients are part-worth utilities and denote the effect of the respective attribute level had on respondents selecting an alternative possessing that feature. However, the lack of

natural units for part-worth utilities hinders direct interpretation and hence, following estimations, we calculated predicted probabilities for six alternatives (i.e., the four du Maurier and one Canadian Goose packs and an opt-out) for a given price of Can\$15 for du Maurier and Can\$5 for Canadian Goose. These probabilities capture the average probability with which each alternative would be selected if all were available to an individual. To obtain more intuitive insight into price effects, we calculated the change in the predicted probabilities of choosing 'none' (i.e., not smoking for a day for a pack-a-day smoker, not smoking for a week for a pack a week smoker) for a 10% price increase for both licit and illicit brands. All analyses were conducted using Stata 15.1.

3. Results

Table A1 (see appendix) presents the characteristics of the sample. Respondents who were randomized to design 1 or 2 had fairly similar characteristics. About 35% of respondents were male, mean age was about 50 years, household annual income was fairly equally distributed between categories, about 44% had some post-secondary education, less than bachelor's level while about 25% had at least a bachelor's degree, most were white, and few were aboriginal persons (6%), or had been a landed immigrant (12%). Most respondents were daily smokers (85%), about 27, 15, and 13% usually smoked premium, discount and value cigarette brands while about 11% usually smoked native cigarette brands such as Canadian Goose, Putter's and Sago. Most respondents (77%) smoked within 60 minutes of waking up, only 35 and 28% thought that smoking cigarettes once in a while had moderate or great risk of harm, most had tried to stop smoking in the last year (62%) and about 19% had used an electronic cigarette in the past 30 days.

3.1. Intention to purchase

Tables 1 and 2 present predicted probabilities (untransformed regression results and willingness to pay [WTP] estimates are presented in Tables A2 and A3 in the appendix). Results from the conditional logit regressions, when preference heterogeneity was ignored, are very similar for both designs (Table 1, top panel). The results indicate that the average smoker in our sample had substantially higher predicted probabilities of selecting the licit brand with plain packaging (design 1: Pr 0.32 and Pr 0.41 vs Pr 0.06 and Pr 0.18; design 2: Pr 0.21 and Pr 0.24 vs Pr 0.11 and Pr 0.13), and slightly lower predicted probabilities of choosing an option with a warning on each cigarette stick. Of note, the average respondent had a 0.28 predicted probability of choosing a pack of Canadian Goose cigarettes, an illicit brand.

Examining the price effects, a 10% increase in the price of du Maurier cigarettes was associated with a 1.2 and 0.4 percentage point increase in the predicted probability of choosing 'none', in design 1 and 2 respectively. A change in the price of Canadian Goose cigarettes (an illicit brand) was not associated with any significant or meaningful changes in the probability of choosing 'none'.

Table 2 (top panel) and Fig. 2 (left panel) present the results of the latent class analyses. Class 1 (share = 0.21) consisted of smokers who were extremely averse to purchasing illicit cigarettes (Pr 0.01) or cigarettes with a warning on each stick, regardless of plain packaging (Pr 0.04 and Pr 0.05 for pack with plain packaging/branding and with warning on cigarette sticks, respectively). Class 2 (share = 0.44) consisted of respondents with a strong preference for cheaper illicit cigarettes. Class 3 (share = 0.36) consisted of smokers who indicated a preference for the least appealing option, plain packaging with a warning on each cigarette stick (Pr 0.50), and not packaging with some branding without any warning on cigarette sticks (Pr 0.05) or contraband cigarettes (Pr 0.01).

Focusing on class 3 (the only class with a non-negligible number of respondents who selected the option 'none'), a 10% increase in the price of du Maurier cigarettes was associated with a 4.9 percentage points increase in the predicted probability of choosing 'none', an increase of

³ Experiment 1: <https://surveys.mcmaster.ca/limesurvey/index.php/966896?lang=en>; Experiment 2, block 1: <https://surveys.mcmaster.ca/limesurvey/index.php/338287?lang=en>; and, Experiment 2, block 2: <https://surveys.mcmaster.ca/limesurvey/index.php/562666?lang=en>



Fig. 1. Choice sets examples for the two experimental designs.

Table 1
Conditional logit models – results, predicted probabilities.

Product, product attributes	Design 1 – licit only		Design 2 – licit/ illicit	
	Pr	95%CI	Pr	95%CI
<i>– Intention to purchase</i>				
Plain packaging, with warnings on cig. sticks	0.32	(0.27,0.37)	0.21	(0.18, 0.23)
Plain packaging, w/o warnings on cig. sticks	0.41	(0.37,0.45)	0.24	(0.21, 0.27)
Packaging with branding, with warnings on cig. sticks	0.06	(0.04,0.08)	0.11	(0.10, 0.13)
Packaging with branding, w/o warnings on cig. sticks	0.18	(0.14,0.21)	0.13	(0.11, 0.16)
Contraband cig., with branding, w/o any warnings			0.28	(0.23, 0.33)
None	0.03	(0.01,0.06)	0.03	(0.02, 0.05)
<i>– Risk perceptions (least risk to health)</i>				
Plain packaging, with warnings on cig. sticks	0.08	(0.05,0.1)	0.12	(0.10, 0.14)
Plain packaging, w/o warnings on cig. sticks	0.22	(0.18,0.26)	0.15	(0.13, 0.17)
Packaging with branding, with warnings on cig. sticks	0.06	(0.04,0.08)	0.11	(0.09, 0.13)
Packaging with branding, w/o warnings on cig. sticks	0.15	(0.11,0.18)	0.12	(0.10, 0.14)
Contraband cig., with branding, w/o any warnings			0.14	(0.11, 0.17)
Other	0.50	(0.43,0.56)	0.36	(0.32, 0.41)

more than 50%. As previously, a change in the price illicit cigarettes was not associated with any significant or meaningful changes in the probability of choosing ‘none’.

Parameterizing class assignment, less addicted smokers with higher

levels of education tended to fall into class 1. Members of class 2 were more likely to be male, less educated, more addicted to nicotine, and users of illicit cigarettes, while class 3 members were more likely to be female, and less addicted to nicotine.

3.2. Risk perception

Results from the conditional logit regressions, when heterogeneity was ignored, indicate a preference for the response category ‘other’ (Table 1, bottom panel). The predicted probabilities for the response category ‘other’ are substantially higher (Pr 0.50 and Pr 0.36) other response categories. Results for design 2 suggest little differences between the five cigarette options; all predicted probabilities fall in a narrow range, 0.11–0.15.

Exploring heterogeneity (Table 2, bottom panel; Fig. 2, right panel), class 1 (share = 0.50) consisted of smokers who almost invariably selected ‘other’ (Pr 0.85). Nearly all respondents that provided a reason for choosing ‘other’ indicated that all options were equally risky as packaging and price have nothing to do with risk to health. Class 2 (share = 0.50) consisted of smokers who rarely chose ‘other’ (Pr 0.03). Overall, in class 2, plain packaging and warnings on cigarette sticks did not seem to affect risk perception. Similarly, no meaningful or statistically significant price effects were observed in either of the designs or model specifications. Finally, adding individual characteristics in the class membership equation of the latent class models did not improve model fit (class assignment is based on a constant).

4. Discussion

Using latent class analyses was essential in quantifying preferences for attributes of cigarettes and cigarette packs. When examining the intention to purchase cigarettes, we found three distinct classes of

Table 2
Latent class models, design 2 – results, predicted probabilities.

Product, product attributes	Class 1, share = 0.21		Class 2, share = 0.44		Class 3, share = 0.36		Class 1, share = 0.50		Class 2, share = 0.50		
	Pr	95%CI	Pr	95%CI	Pr	95%CI	Pr	95%CI	Pr	95%CI	
<i>– Intention to purchase</i>						<i>– Risk perceptions (least risk to health)</i>					
Plain packaging, with warnings on cig. sticks	0.04	(0.01, 0.06)	0	(0.00, 0.01)	0.5	(0.42, 0.59)	0.04	(0.02, 0.05)	0.18	(0.15, 0.21)	
Plain packaging, w/o warnings on cig. sticks	0.43	(0.32, 0.54)	0	(0.00, 0.01)	0.19	(0.14, 0.25)	0.03	(0.01, 0.04)	0.24	(0.20, 0.28)	
Packaging with branding, with warnings on cig. sticks	0.05	(0.03, 0.07)	0	(0.00, 0.01)	0.13	(0.09, 0.17)	0.02	(0.01, 0.03)	0.16	(0.13, 0.19)	
Packaging with branding, w/o warnings on cig. sticks	0.47	(0.36, 0.59)	0	(0.00, 0.01)	0.05	(0.03, 0.08)	0.01	(0.00, 0.02)	0.2	(0.16, 0.23)	
Contraband cig., with branding, w/o any warnings	0.01	(0.00, 0.02)	0.98	(0.96, 1.00)	0.03	(0.00, 0.10)	0.06	(0.00, 0.13)	0.19	(0.12, 0.26)	
None/Other	0	(0.00, 0.00)	0	(0.00, 0.01)	0.09	(0.07, 0.12)	0.85	(0.78, 0.93)	0.03	(0.02, 0.04)	

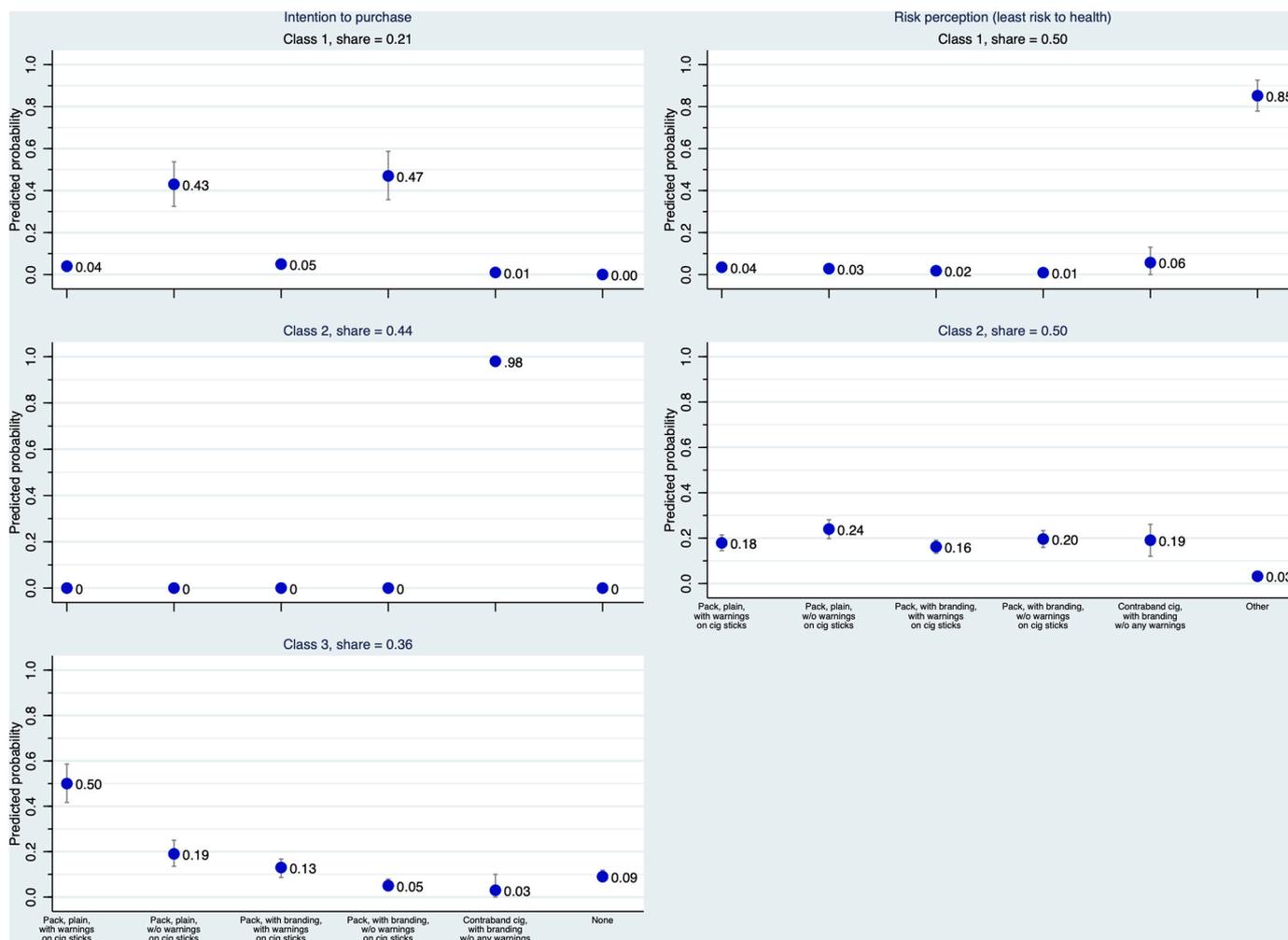


Fig. 2. Latent class models, design 2 – results, predicted probabilities.

smokers. First, nearly half of smokers stated a preference for cheaper illicit cigarettes in a branded pack without any health warnings, regardless of the licit cigarette alternatives. These preferences may have been driven by price, branding, the absence of health warnings, or a dislike for the only licit brand alternative, du Maurier.

Second, for about 20% of respondents, plain packaging and warning on cigarette sticks decreased the probability of stating a purchasing preference for these alternatives. In this class, the effect of printing a warning on cigarette sticks was particularly salient, much more so than moving from packaging with some branding to plain packaging. Given the prominent warnings with graphic pictures present before the introduction of plain packaging in Canada, this result is not surprising.

Third, for about a third of respondents, plain packaging and warning on cigarette sticks seemed to have the opposite of the intended effect of

such regulations. It is possible that plain/standardized packs were perceived to have a cleaner design than packs available before the policy change which had fairly limited branding, that respondents were averse to the branding design of du Maurier cigarettes, or that removing all branding reduced brand appeal between price categories (premium, discount, and value brands) which smokers of non-premium cigarettes may have valued. The novelty of printing a warning on each cigarette stick may also have increased preferences for such an alternative. Additionally, smokers may have chosen plain/standardized packs because the packs were familiar to them, as they had been on the shelves for the past four to eight months. Although the aforementioned explanations may be plausible, we feel the stated preferences of smokers in this class are not necessarily counterintuitive and can be explained entirely by price. To avoid dominated options, the least desirable licit

option (plain/standardized pack with a warning on each cigarette sticks) was always the cheapest licit option. Given that the manufactured tobacco in a du Maurier cigarette is the same regardless of packaging and health warnings, we feel members of this class likely chose competing alternatives with mostly one attribute in mind, price.

We did not find that any of the attributes significantly enhanced the perceived risk of cigarettes use among current smokers. Given that most of our sample consists of older daily smokers, and that almost two-thirds of respondents had stopped smoking for at least 24 hours because they were trying to reduce or quit in the past 12 months, this finding is not necessarily surprising. Moreover, warnings with graphic pictures were first implemented in Canada in 2001 (Cunningham, 2022). Consequently, most smokers in our sample were likely well aware of the risk to health associated with cigarette use.

4.1. Limitations

First, in the introduction section of our experiment, we indicated that illicit cigarettes in Ontario typically do not adhere to any health regulations such as graphic health warning labels or ingredient disclosure, and that ingredient composition may differ as illicit cigarettes are not tested by Health Canada. This information may have ‘primed’ respondents to select a licit option. Second, given that only about 10% of respondents reported du Maurier as their usual brand, a dislike for du Maurier may have inflated the selection of the illicit brand. However, more than 85% of the sample responded “no” to the question “Do you think you would have responded differently to the preceding six questions if, instead of having shown you packages of du Maurier, we would have shown you packages of a different cigarette brand such as Canadian Classics or Pall Mall as shown below?,” it is unlikely that the results were driven by the choice of du Maurier as the licit brand. Lastly, some of our findings may not be generalizable to other markets and populations. First, the Canadian context of cigarette tax evasion and avoidance differs from other markets. The involvement of members of some Indigenous communities, particularly in Ontario, makes its tobacco market distinctive (World Bank, 2019). Second, Canada’s long history with prominent health warnings with pictures makes the move to plain packaging somewhat subtle. Third, our sample included only current cigarette smokers which limits generalizability to nonsmokers, particularly young susceptible nonsmokers. Fourth, the design for the warning on individual cigarettes recently implemented in Canada is different; the warning is on the filter only.

5. Conclusion

Our findings attest to the importance of prices and taxes to control tobacco use. Purchasing preferences were likely driven by price for as much as 80% of our sample of Ontario current smokers; about 44% of respondents invariably chose the illicit option which was substantially cheaper (Can\$3 and Can\$6 vs Can\$12 to Can\$17.50), while a further 36%, most often than not, selected the cheapest pack among licit cigarette alternatives. Warning on cigarette sticks proved particularly salient for about 21% of the sample. Plain packaging, however, did not seem to alter purchasing preferences substantially. Our findings also indicate that efforts to restrict the availability of illicit cigarettes may yield substantial benefits. Lastly, none of the products and attributes (licit and illicit cigarettes, plain packaging, health warnings on cigarette sticks, and price) seem to have significantly influenced risk perception.

Ethics approval

This study was approved by the Hamilton Integrated Research Ethics Board (HIREB); HIREB Project #: 2652.

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CRediT authorship contribution statement

G. Emmanuel Guindon: Conceptualization, Methodology, Validation, Investigation, Writing – original draft, Visualization, Supervision, Project administration, Funding acquisition. **Emmanouil Mentzakis:** Conceptualization, Methodology, Software, Validation, Formal analysis, Investigation, Data curation, Writing – review & editing. **Neil J. Buckley:** Conceptualization, Methodology, Software, Validation, Investigation, Writing – review & editing.

Data availability

Data will be made available on request.

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Appendix A. Supporting information

Supplementary data associated with this article can be found in the online version at [doi:10.1016/j.ehb.2023.101340](https://doi.org/10.1016/j.ehb.2023.101340).

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