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ABSTRACT

Of the 45.7 million current smokers in the U.S. age 12 and over, more than 18.5 million usually smoke menthol cigarettes. The Food and Drug Administration recently proposed a tobacco product standard that would prohibit menthol as a characterizing flavor in cigarettes. The FDA concludes that the prohibition of menthol in cigarettes is appropriate for public health, meeting the criterion established by the 2009 Tobacco Control Act. In this paper we explore whether there are internality-based market failures that provide an applied welfare economics rationale to prohibit menthol. Our empirical approach provides descriptive evidence from the 2018-2019 Tobacco Use Supplement to the Current Population Survey on how menthol use is associated with smokers' market demand along multiple intensive and extensive margins. We also use direct measures of smoking-related misinformation and internalities, and stated preference data, from a 2021 Cornell Online Survey. We acknowledge that the associations we document in observational data might reflect bias due to self-selection into menthol use. We discuss several lines of evidence about whether self-selection into menthol use might be mainly quasi-random. We leave it to reader whether there is convincing evidence that differential levels of internality-based market failures are a sufficient justification for the proposed prohibition of menthol cigarettes.

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1. Introduction

Of the 45.7 million current smokers in the U.S. age 12 and over, more than 18.5 million usually smoke menthol cigarettes.[1] Menthol cigarettes are tobacco cigarettes to which natural menthol from mint or synthetic menthol has been added as a flavoring; menthol and non-menthol cigarettes have similar nicotine- and tar-content.[2] In the U.S., 40 percent of all smokers and 85 percent of Black smokers usually smoke menthol cigarettes. Since 2009, menthol has been the only flavor legally allowed in cigarettes sold in the U.S.

The Food and Drug Administration (FDA) recently proposed a tobacco product standard that would prohibit menthol as a characterizing flavor in cigarettes (FDA 2022b). The FDA cites evidence that because menthol reduces the irritation and harshness of smoking, menthol promotes youth smoking initiation and makes it more difficult for adult smokers to quit. Although menthol is not harmful per se, the FDA concludes that the prohibition of menthol in cigarettes is appropriate for the protection of public health, meeting the criterion established by the 2009 Tobacco Control Act for FDA regulation of tobacco products.

Executive Orders 12866 and 13563 require that Federal agencies complete a regulatory impact analysis of any economically significant regulation. The FDA has determined that the tobacco product standard prohibiting menthol is an economically significant regulation and has

[1] From its analysis of the 2019 National Survey on Drug Use and Health (NSDUH), the Food and Drug Administration estimates that there are 18.589 million menthol smokers and 27.113 million non-menthol smokers, which totals 45.7 million current smokers (FDA 2022a, Table 1). From data from the 2018-2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS), which we use below, the National Cancer Institute estimates that there are 28.367 million current smokers in the U.S. age 18 and over (https://cancercontrol.cancer.gov/brp/tcrb/tus-cps/results/2018-2019/table-1). The NSDUH estimates include 0.534 million smokers aged 12-17, an age group which is not included in the TUS-CPS data. The sources of the remaining discrepancy are not obvious. DeCicca, Lovenheim, and Kenkel (2022) provides additional comparisons of U.S. smoking rates across several national data sets.

[2] Nicotine is the addictive component of tobacco smoke, while tar consists of the byproducts of combustion and includes carcinogenic and toxic chemicals. Both menthol and non-menthol cigarettes are available in a range of nicotine- and tar-levels.

completed a preliminary regulatory impact analysis (PRIA) (FDA 2022c). In addition to applying the public health criterion, the FDA's PRIA conducts an applied welfare economics analysis that examines the market failures addressed by the prohibition of menthol, the benefits and costs of the regulation, and regulatory alternatives. The PRIA argues that "Nicotine addiction can lead to cigarette smoking that does not accurately reflect individual preferences" and reviews behavioral economics research on internality-related market failures and neuroscience research on the development of the brain during adolescence, when many smokers start (FDA 2022b, pp. 19-22). From its discussion of market failures associated with smoking and the role of menthol, the PRIA concludes that the prohibition of menthol would reduce the initiation and experimentation of smoking and "would provide those who seek to quit smoking an improved chance of aligning their smoking behavior with their preferences and reduce negative internalities…." (FDA 2022c, p. 26). Another important rationale for the prohibition of menthol is to reduce smoking-related health disparities across population groups including Blacks with higher rates of menthol use.

In this paper, we provide evidence on whether menthol smokers are different from non-menthol smokers in ways that provide an applied welfare economics rationale to prohibit menthol. We address the first step in federal regulatory impact analysis and explore the "market failure or other social purpose" that justifies the need for regulation targeted at menthol cigarettes (Office of Management and Budget 2003). To do so, we build on and contribute to recent research on how to incorporate internalities into tobacco regulatory analysis.

In section 2 we provide more background on tobacco regulatory analysis. As discussed there, one approach to incorporate internalities is to measure regulation-induced consumer surplus changes using a rational benchmark demand schedule rather than the market demand schedule

which reflects consumer mistakes (Ashley, Nardinelli, and Lavaty 2015, Cutler et al. 2015, Jin et al. 2015, Levy, Norton and Smith 2017, Weimer 2017). In this paper, we provide descriptive evidence on whether menthol and non-menthol market demand schedules are systematically different. To the extent we find that the menthol and non-menthol market demand schedules are similar, our results will suggest whether the products generate similar internalities and therefore should be regulated similarly.[3] We are not able to fully explore the difficult question of how the menthol and non-menthol market demand schedules differ from the rational benchmark demand schedule for smoking. Our results thus do not allow us to conduct the benefit-cost analysis needed to address whether the optimal regulation is to allow or to prohibit both menthol and non-menthol cigarettes. However, we note that the Tobacco Control Act explicitly does not allow the FDA to prohibit all cigarettes.

In section 3 we describe our data and empirical approach. Most of our analyses use nationally representative data on adult smoking behaviors from the 2018-2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS). Our empirical approach provides descriptive evidence on how menthol use is associated with smokers' market demand along multiple intensive and extensive margins. If there are internality-based market failures that justify regulating menthol cigarettes differently, we expect our analysis of the TUS-CPS data to find that menthol use is associated the following outcomes: more daily smoking, more cigarettes smoked per day, more cigarettes addiction, younger age at initiation, and less quitting. We conduct additional analyses of data from the 2021 Online Cornell Survey (OCS) which provides

[3] The analysis of the optimal regulation of e-cigarettes versus cigarettes by Allcott and Rafkin (2022) can also be applied to the question of the optimal regulation of menthol versus non-menthol cigarettes. Their Proposition 1 implies that when the distortions created by externalities and internalities are homogenous "the optimal taxes for each will be exactly equal to the average marginal distortion and substitution plays no role" (p. 10). However, even when menthol and non-menthol cigarettes generate similar distortions, policies that target menthol might be justified by other social purposes such as generating tax revenues or reducing racial disparities.

direct measures of smoking-related internalities and data on smokers' stated preferences in a discrete choice experiment. If there are internality-based market failures that justify regulation menthol cigarettes differently, we expect our analysis of the OCS data to find that menthol use is associated with more misinformation and internalities, and that menthol and non-menthol smokers have different stated preferences for tobacco product attributes such as health warnings.

As discussed in more detail in section 3, the descriptive associations from our empirical models contribute to the policy debate about the proposed prohibition of menthol cigarettes in several ways. First, the estimated associations provide direct evidence on whether menthol use might be a useful marker to use to target policy. Second, we use the framework of the Rubin causal model to discuss how our results, with cautious interpretation, shed light on the plausibility and magnitude of the causal treatment effect of menthol on smoking and internality outcomes.

Section 4 presents empirical evidence on the observed determinants of self-selection into smoking and menthol use and discusses possible unobservable heterogeneity that might lead to self-selection bias in our empirical approach. Section 5 presents empirical evidence on how menthol use is associated with smokers' market demand along multiple intensive and extensive margins. Sections 6 and 7 provide descriptive evidence on how menthol use is associated with smoking-related internalities and stated preferences for tobacco product attributes. Section 8 concludes with a discussion of possible policy implications and directions for future work.

2. Background on Tobacco Regulatory Analysis

Tobacco regulatory analysis addresses two distinct questions: whether the regulation is appropriate for public health; and whether the regulation improves societal welfare, as measured by benefit-cost analysis. The prohibition of menthol is expected to improve public health by

reducing smoking initiation and cessation, thus reducing the number of smokers. The FDA's preliminary regulatory impact analysis (PRIA) builds estimates of the impact of menthol prohibition on smoking initiation and cessation rates into a population health model. The model predicts that over a 40-year time horizon, the prohibition of menthol will prevent almost 650,000 premature deaths of smokers due to smoking-related illnesses, 61,000 premature deaths of non-smokers due to secondhand smoke, and almost 600 infant deaths (FDA 2022c, pp. 100 – 109). In its benefit-cost analysis, the PRIA multiplies the estimated avoided premature deaths by the value of a statistical life to quantify the dollar value of the gross lifesaving benefits of the proposal.[4]

In contrast to the PRIA's approach, a line of economics research uses the standard approach in benefit-cost analysis to measure regulation-induced consumer surplus changes with respect to the smoking demand schedule (Weimer 2017, Chapter 7). To incorporate internalities, these studies measure consumer surplus with respect to a rational benchmark demand schedule rather than the market demand schedule. When smokers make mistakes in their smoking decisions, the observed market demand schedule lies above the rational benchmark demand schedule; the vertical distance between the schedules measures the dollar value of the marginal internality and misinformation. As Levy, Norton, and Smith (2017) emphasize, in this approach it is not necessary to follow the PRIA's approach and begin with an estimate of the number of smokers' lives saved by the regulation. However, the PRIA's approach is consistent with the demand schedule approach as long as the analysis offsets part of the gross lifesaving benefits by the consumer surplus loss, using the rational benchmark demand schedule (Ashley, Nardinelli, and

[4] The FDA PRIA provides estimated ranges of quantified benefits and costs over the 40-year time horizon and calculates the discounted present value at both a 3 percent and a 7 percent discount rate.

Lavaty 2015). The PRIA includes a qualitative discussion but does not quantify the consumer surplus losses to menthol smokers from the prohibition of menthol.[5]

Benefit-cost analysis of tobacco regulations faces the empirical challenge of quantifying the internality-related market failures and constructing the rational benchmark demand schedule. Boardman, Greenberg, Vining, and Weimer (2022) caution that analysts need to present "strong empirical evidence," including evidence from market behavior wherever possible, that consumers are making mistakes that lead to internalities. Structural econometric studies of smoking demand provide mixed evidence about internalities. One line of research estimates the Becker and Murphy (1988) rational addiction model which assumes no internalities. Three early empirical implementations find support for rational addiction to cigarettes (Chaloupka 1991, Becker, Grossman, and Murphy 1994, Baltagi and Griffin 2001). In a prominent extension of the rational addiction model, Gruber and Kőszegi (2001) embeds time-inconsistency into a model with addiction. In the Gruber-Kőszegi model, the addictive nature of cigarettes combined with limited self-control produce an internality: future utility is lowered by current consumption. Because of the strong modeling assumptions, Gruber and Kőszegi are unable to empirically distinguish the addiction model with time-inconsistency from Becker and Murphy's rational addiction model. A recent study develops an empirical test to distinguish between time-

[5] If smokers are fully informed and rational there are no internalities; the observed market demand schedule reflects smokers' decisions that the value of smoking exceeds the value of the risk to their own health. In this case, the prohibition of menthol benefits society by reducing externalities, i.e. the external lives lost due to secondhand smoke. The PRIA estimates that the prohibition of menthol will save about 1,605 deaths each year from secondhand smoke. Using the PRIA's central estimate that the value of a statistical life is $11.8 million, the lifesaving benefits from reduced secondhand smoke are worth $18.9 billion annually (FDA 2022c, p. 108). The PRIA estimates the size of the current menthol cigarette market at 78 billion sticks or 3.9 billion packs of 20 sticks each (FDA 2022c, p. 63). Under these assumptions, the break-even consumer surplus loss from the prohibition of menthol is $4.86 per pack (= $18.9 billion/ 3.9 billion packs); if the consumer surplus loss is less than $4.86 per pack, the lifesaving benefits from reduced secondhand smoke exceed smokers' lost consumer surplus. The PRIA argues that the quantified gross life-saving benefits of the proposal are so large that "any reasonable consideration" of consumer surplus loss would not change the conclusion that the proposal's benefits justify the costs (FDA 2022c, p. 168).

consistent versus time-inconsistent consumers and finds support for the rational addiction model; it cannot reject the hypothesis that Russian smokers are time-consistent (Picocoli and Tiezi 2021). Kaestner and Callison (2018) provides additional tests of the hypothesis that smokers behave in a forward-looking manner, but their results do not rule out the possibility of internalities.

Our empirical examination of the market failure rationale for the prohibition of menthol builds on another approach to incorporate internalities into tobacco regulatory analysis. Cutler et al. (2015) and Jin et al. (2015) develop proxies for the benchmark rational demand schedule for smoking by identifying sub-groups of consumers whose choices are more likely to be well-informed and rational. Both studies examine the smoking choices made by highly educated consumers whose decisions about smoking initiation occurred after the health risks of smoking were widely publicized. In an alternative analysis, Cutler et al. (2015) also examine the smoking choices of non-addicted smokers. The differences between the observed market demand schedule and these proxies for the rational benchmark demand schedule measure smoking-related internalities. In the same spirit, our empirical analysis below explores the differences between the market demand schedules for menthol and non-menthol cigarettes.

The goal of our comparisons is to shed light on whether the market demand schedules for menthol and non-menthol cigarettes appear to reflect different degrees of internalities that might justify different regulatory approaches. We do not compare either market demand schedule to a benchmark rational demand schedule, so our analysis does not shed light on the optimal regulation of smoking more generally. We do not conduct a benefit-cost analysis of the proposed prohibition of menthol; instead we examine the economic case based on internality-related market failures for regulating menthol cigarettes differently than non-menthol cigarettes.

3. Data and Empirical Approach

Our first source of data is the 2018-2019 Tobacco Use Supplement to the Current Population Survey (TUS-CPS). The TUS is sponsored by the National Cancer Institute and administered as part of the U.S. Census Bureau's CPS. We use data from adult self-respondents. An Appendix available upon request provides more details about the samples uses in our analyses and provides descriptive statistics.

Our second source of data is the Online Cornell Survey (OCS), which was conducted for us in November 2021 by the survey firm SSRS. Survey respondents were obtained using the SSRS Probability Panel. SSRS Opinion Panel members are recruited randomly based on nationally representative Address Based Sample design. The analysis sample from the OCS consists of 1,129 current smokers aged 18 and above. [6] The OCS included a background survey about smoking behaviors, a discrete choice experiment, and follow-up survey questions about smoking-related information, internalities, and other topics.

Our empirical analysis of the associations between menthol use and smoking and internality outcomes uses three specifications: the first specification only includes an indicator that individual i uses menthol (M_i) and a constant term; the second specification adds a set of socio-demographic variables (X_i) and state fixed effects (δ_x); and the third specification adds the interaction term M_i x $Black_i$. The socio-demographic variables in the vector X_i measure

[6]The full sample from the OCS consists of 1200 current smokers. For the analysis reported in Table 6 below we drop 71 observations with extreme values (less than zero or greater than 31 years) in the variable measuring the life expectancy loss due to smoking. For the analysis reported in Table 7 we drop an additional 105 observations with extreme values in the reported price paid for cigarettes. The ABS includes Hawaii and Alaska. ABS respondents are randomly sampled by MSG through the U.S. Postal Service's Computerized Delivery Sequence, a regularly updated listing of all known addresses in the U.S. For the SSRS Opinion Panel, known business addresses are excluded from the sample frame. Additionally, the SSRS Opinion Panel recruits hard-to- reach demographic groups via the SSRS Omnibus survey platform. The SSRS Omnibus completes more than 50,000 surveys annually with 80 percent cell allocation.

race/ethnicity, sex, age, marital status, schooling, labor force status, income, and city size. The state fixed effects control for cross-sectional differences in cigarette taxes as well as other differences across states.[7] In the third specification, the smoking or internality outcome O_{is} of individual i in state s is given by:

$$O_{is} = \beta_0 + \beta_1 M_i + \beta_2 \text{Black} + \beta_3 M_i \text{ x Black} + \alpha X_i + \delta_s + \varepsilon_{is} \quad (1)$$

In addition to adding control variables, our second and third specifications allow us to explore the much higher prevalence of menthol smoking among Blacks. The role of racial disparities in menthol cigarette smoking and health-related outcomes as part of the motivation for the proposed prohibition of menthol (FDA 2022b, 2022c). Below, when we discuss results from equation (1) we mainly focus on the differences in the smoking or internality outcomes between the omitted baseline group (non-menthol, white smokers) and two other groups. First, we discuss the differences in outcomes between the baseline group and non-Black menthol smokers, which is given by β_1. Second, we discuss the differences in outcomes between the baseline group and Black menthol smokers, which is given by $\beta_1 + \beta_2 + \beta_3$.

The descriptive associations from our empirical models contribute to the policy debate about the proposed prohibition of menthol cigarettes in several ways. First, the estimated associations from our first specification provide direct evidence on whether menthol use might be a useful marker to target tobacco regulations.[8] If menthol use is a stable marker for undesirable smoking outcomes such as heavier smoking and addiction, it might make sense to target tobacco regulations towards menthol use. However, both the public health case and the economic case for

[7] The sample period of the 2018-2019 TUS-CPS is too short to provide enough within-state variation in cigarette taxes or other policies to identify their effects.
[8] We thank an anonymous referee for the suggestion that menthol use might be a useful marker or tag.

menthol prohibition based on internality-related market failures are stronger to the extent menthol use plays a causal role.[9]

Our empirical results further contribute to the current policy debate because, with cautious interpretation, they shed light on the plausibility and magnitude of the causal treatment effects of menthol on smoking and internality outcomes. Smokers are not randomly assigned to use menthol or non-menthol cigarettes, so neither our results nor the descriptive epidemiologic research reviewed by the FDA Tobacco Product Safety Advisory Committee (TPSAC 2011) and the FDA (2022d) necessarily correspond to the causal treatment effects of menthol use. Using the terminology of the Rubin causal model, for someone who smokes menthol, the causal treatment effect of smoking menthol involves comparing their observed smoking or internality outcome to their potential outcome in the counterfactual world where they smoked non-menthols.[10] For someone who smokes non-menthols, the causal effect involves a comparison to their potential outcome if they smoked menthols. It is of course impossible to observe both potential outcomes for any one person: someone either smokes menthols or non-menthols.[11]

The methodological challenge is to try to learn something about the causal treatment effect of menthol by comparing the average outcome in a sample of menthol smokers to the average outcome in a sample of non-menthol smokers. The fact that smokers self-select into menthol use

[9] For example, menthol use might not be a stable marker for undesirable outcomes over time, especially after the prohibition of menthol.

[10] Our discussion closely follows the general discussion of self-selection bias in observational data by Angrist and Pischke (2009, pages 13 – 15).

[11] While any given cigarette is either menthol or non-menthol, in principle over the course of a day, week, or longer period smokers could switch back-and-forth between menthols and non-menthols. In practice, when the 2018-2019 TUS-CPS asked current smokers whether their usual cigarette brand is menthol or non-menthol, less than four percent responded that they do not have a usual type. There appears to be only limited switching between menthols and non-menthols over longer time periods. The 2018-2019 TUS-CPS asked current menthol smokers how long they had smoked menthols. 53 percent of current menthol smokers responded that they had smoked menthol "all or nearly all the years" they had smoked, 15 percent responded "most of the years" they had smoked, and 9 percent responded "half of the years" they had smoked.

means that observed differences in smoking outcomes or internality outcomes between menthol users and non-users reflect both the causal treatment effect of menthol and self-selection. Put differently, the causal treatment effect of menthol use is the observed difference in outcomes associated with menthol use minus the unobserved selection bias. Depending on the direction of the selection bias, the observed difference in outcomes might over- or under-state the causal treatment effect of menthol use on undesirable smoking outcomes.

Our goal is to provide empirical evidence that sheds light on the economic case for menthol prohibition based on internality-related market failures. If we take the FDA (2022c) PRIA's case as the starting point or null hypothesis, an important threat to inference arises if our estimates of observed differences reflect favorable self-selection on unobservables, where menthol users would have had better outcomes such as less addiction under the counter-factual where they did not use menthol cigarettes.[12] For example, suppose the observed difference is that an outcome like addiction is less likely with menthol use. If there is a treatment effect where menthol use causes more addiction, it must have been offset by a favorable selection bias term that is larger than the treatment effect but in the opposite direction. The question then becomes whether that magnitude and sign of the selection bias term is plausible.

In section 4, we present evidence on the observable determinants of selection into smoking and menthol use (which we can control for when comparing outcomes between menthol and non-menthol smokers) and discuss possible unobservable determinants. We focus on the likelihood and magnitude of unobservable favorable selection into menthol that might mask the

[12] Although we view the FDA (2022c) PRIA case as our starting point, the PRIA's narrative review of prior studies does not provide a set of point estimates that we could use to specify null and alternative hypotheses for testing. Another approach could use the PRIA's evidence on the sign of the effects as a null hypothesis and conduct and report one-sided hypothesis tests based on that null. Instead, we present the more familiar and conservative two-sided tests of the null hypothesis that the estimated coefficients are zero.

causal treatment effects of menthol use. After presenting our empirical results in sections 5, 6, and 7, in the concluding discussion we summarize the possible implications of our estimates about the causal treatment effects of menthol use. In light of the inherent uncertainty about the nature of self-selection on unobservables, we use cautious language throughout.

4. Selection into Smoking and Menthol Use

To explore the observable determinants of self-selection into smoking and menthol use, we estimate linear probability models of smoking participation, and, conditional on smoking participation, menthol smoking (Table 1). In our analysis sample from the 2018-2019 TUS-CPS data, the smoking participation rate is 12 percent. Conditional on smoking participation, 29 percent smoke menthol cigarettes. The model of smoking participation presented in column (1) of Table 1 shows well-known socio-demographic gradients. Smoking participation among Blacks is almost 4 percentage points lower than among whites. Compared to people with less than a high school education, among college graduates smoking participation is 12.4 percentage points lower; compared to people in households with annual income of less than $25,000, among people in households with annual income of above $75,000 smoking participation is 5.7 percentage points lower. The schooling and income gradients are similar when we restrict the sample to Blacks (column 2).

Columns (3) and (4) of Table 1 present results from models of the probability of menthol smoking, conditional on smoking participation. In the full sample of current smokers, the most striking (and well-known) pattern is that compared to white smokers, Black smokers are 51.6 percentage points more likely to smoke menthol cigarettes (column 3). Interestingly, in the full sample of current smokers, smoking menthol does not show strong gradients with schooling or household income. When the sample is restricted to Black current smokers, smoking menthol

does not show a strong gradient with schooling but there is some evidence of a negative gradient with income.

The evidence from Table 1 about the observable determinants of selection into smoking provide insights into what unobservable heterogeneity might also be driving self-selection into smoking.[13] The strong negative gradients between schooling and smoking and income and smoking imply that there might also be unfavorable self-selection into smoking on unobservables. As discussed above, Cutler et al. (2015) and Jin et al. (2015) suggest that smoking-related internalities such as present bias might be negatively correlated with schooling. There might also be similar additional unobserved heterogeneity in other internalities and other factors related to riskier behaviors that drive self-selection into smoking. The results from an empirical study that treats smoking and health outcomes over the life cycle as jointly endogenous are also consistent with unfavorable self-selection into smoking (Darden, Gilleskie, and Strumpf 2018). The study finds that if smoking is treated as random there is a 9.3-year difference in the life expectancy of smokers and non-smokers; the bias-corrected difference falls to 4.3 years. The substantial bias-correction implies substantial unfavorable self-selection into smoking.[14]

The Table 1 results about the observable determinants of self-selection into menthol use suggest that different unobservable determinants might be at work. The lack of a gradient between schooling and selection into menthol use might imply quasi-random selection into menthol use, i.e. neither unfavorable nor favorable self-selection. By quasi-random, we mean that while people might be non-randomly assigned to menthol use, the unobservable assignment mechanism does not lead to bias when inferring the causal effects on menthol use on the

[13] Altonji, Elder, and Taber (2005) and Oster (2019) provide more detailed analysis of the argument that self-selection on observables can provide insight into self-selection on unobservables.
[14] Their model corrects for bias from both observable and unobservable determinants of selection into smoking.

outcomes of interest in this study. The strongest observable determinant of selection into menthol use is Black race. Below, we will discuss in detail the possible roles menthol cigarette product advertising targeted at Blacks might play in driving self-selection into menthol.

Smokers' self-reports about the reasons they prefer menthol or non-menthol cigarettes provide additional evidence about whether self-selection into menthol use is quasi-random. Although not included in the 2018-2019 TUS-CPS, the earlier 2011-2012 TUS-CPS directly asked smokers about the reasons they usually smoked menthol or non-menthol cigarettes. Smokers were given a list of four possible reasons and asked to indicate yes or no for each, i.e. they can cite multiple reasons. Panel A of Table 2 presents the results for the full sample of menthol and non-menthol smokers; Panel B presents the result for Black menthol and non-menthol smokers. "Better flavor" was the most common reason, cited by 85 percent of the full sample of menthol smokers as a reason they usually smoke menthol and by 68 percent of non-menthol smokers as a reason they usually smoke non-menthol. The next most frequently indicated reasons were that their usual cigarette type is less harsh on the throat or chest, cited by about 30 to 40 percent of smokers. The least commonly cited reason was that their usual type of cigarette is "less harmful," cited by 16 percent of menthol smokers as a reason they usually smoke menthol and by 14 percent of non-menthol smokers as a reason they usually smoke non-menthol.

The similarity of the reasons cited by both menthol and non-menthol smokers might suggest quasi-random self-selection into menthol use. If there were favorable selection because menthol cigarettes have more appeal to less present-biased and/or to more health-minded smokers, a higher fraction of menthol smokers would be expected to report "less harmful" as a reason for their use. The importance of "better flavor" and "less harsh" suggests that self-selection into

menthol might instead be based on unobservable differences in preferences, akin to a preference for chocolate versus vanilla ice cream. It is not clear why the preference for menthol cigarettes varies by race/ethnicity. However, research finds other distinct consumer preferences by race over other differentiated products including radio format and fast food (Siegelman and Waldfogel 2001, Waldfogel 2008).

Part of the explanation for different stated reasons for menthol use might be differential exposure by race to advertisements for menthol cigarettes. Consistent with Becker and Murphy's (1993) model of advertisements and the advertised good as complements, smokers might tend to respond that they prefer the flavor of the type of cigarettes they see advertised more often. The FDA Tobacco Products Scientific Advisory Committee reviews evidence that from the 1960s onward, the tobacco industry targeted menthol marketing towards Blacks (TPSAC 2011, pp. 72-77). The importance of Black as an observable determinant of menthol use suggests that additional unobservable heterogeneity in exposure to menthol marketing could partly drive self-selection into menthol use. Whether such unobservable heterogeneity results in favorable, unfavorable, or quasi-random selection into menthol depends on the nature of the advertising. Using data from 1998 – 2016, Kenkel, Mathios, and Wang (2018) find little evidence that menthol advertising in magazines expands the size of the menthol cigarette market and suggest instead that manufacturers advertise to increase their brands' share of an essentially fixed-size market. To the extent that unobservable heterogeneity due to marketing exposure encourages Black smokers to choose specific menthol brands, selection into menthol use might be quasi-random.

Favorable selection into menthol use based on unobservable heterogeneity in advertising exposure is more likely to the extent that menthol marketing expands the size of the menthol

market. Favorable selection is even more likely to the extent marketing promotes menthol as less harmful. In fact, advertisements in the 1930s for the first menthol brands made explicit health claims compared to non-menthol cigarettes. However, in 1942 the Federal Trade Commission halted explicit health claims for menthol cigarettes, ironically on the grounds that it was misleading to claim that menthol cigarettes were healthier because it was not established that any cigarettes were harmful. Since 1965, cigarette advertisements have been required to include health warnings; since 1971 cigarette advertisements on television and radio have been banned; and since 1998, there have been additional restrictions on advertising aimed at youth. Nevertheless, magazine and point-of-sale advertisements that associate cigarettes with healthy and attractive people might make implicit health claims. To the extent menthol advertisements are more successful in making implicit health claims than non-menthol advertisements, differential exposure to advertising might lead to unobservable heterogeneity in internalities and similar factors. However, the patterns in Panel B of Table 2 are not consistent with this speculation. Black non-menthol smokers are slightly more likely to report "less harmful" as a reason for their usual brand than are Black menthol smokers (22 percent compared to 20 percent).

To sum up, the results in this section document self-selection into smoking and menthol use based on observables; based on these results we speculate on the nature of self-selection into menthol use on unobservables. We see no strong reason to suspect there is favorable and strong self-selection into menthol which could mask treatment effects where menthol use causes undesirable smoking and internality outcomes. Smokers' stated reasons for their choices of menthol versus non-menthol and the history of cigarette industry advertising are consistent with quasi-random self-selection into menthol use. Of course, smokers' ex post responses about

reasons for their choices cannot be used to model selection and may reflect biases such as confirmation bias. Nevertheless, the responses provide corroborative evidence about the nature of the unobservable heterogeneity that drives self-selection into menthol use.

5. Menthol Use and Smoking and Internality Outcomes

Menthol Use and Smoking Behaviors

We now turn to describing how smoking behaviors are associated with menthol use (Table 3). In the column (1) models that simply compare menthol smokers to non-menthol smokers, menthol smokers are less likely to smoke daily, smoke fewer cigarettes per day, and are less likely to have started smoking before age 18. The associations are statistically significantly different from zero but are not very large in magnitude. When the socio-demographic control variables are added in the column (2) models, the associations between menthol use and the smoking behaviors are smaller in magnitude. Black is more strongly associated with smoking behaviors than menthol use. In the column (3) models with interaction terms, there are not large differences between the baseline group of white non-menthol smokers and non-Black menthol smokers; the only statistically significant difference is that non-Black menthol smokers smoke about one-half fewer cigarettes per day. There are larger and statistically significant differences between the baseline group and Black menthol smokers. Black menthols smokers are 10.1 percentage points less likely to be daily smokers, smoke 4.8 fewer cigarettes per day, and are 12.9 percentage points less likely to have started smoking before age 18. All of these differences are substantial compared to the sample means of the smoking outcome variables.

Table 3 also includes results from models of nicotine addiction, based on the heaviness of smoking index (HSI). The HSI is a simplified version of the Fagerstrom Test of Nicotine Dependence (Borland et al. 2010). The HSI is based on the two items in the Fagerstrom Test that

have been found to be most predictive of quitting: cigarettes per day and time to first cigarette of the day. The HSI takes values from 0 to 6 and is scored as follows: 0 if 1-10 cigarettes per day, 1 if 11-20 cigarettes per day, 2 if 21-30 cigarettes per day, and 3 if 31 or more cigarettes per day; and 0 if 61 or more minutes time to first cigarette, 1 if 31 to 60 minutes time to first cigarette, 2 if 6-30 minutes time to first cigarette, and 3 if 5 minutes or less time to first cigarette. One measure of nicotine addiction is whether the HSI is 3 or above. In our 2018-2019 TUS sample, by this measure 45.1 percent of all daily smokers are addicted. At the extreme values of the HSI index, 12.6 percent of daily smokers score 0 (low or no addiction) and 1.4 percent score 6 (strong addiction).

In the column (1) model of Table 3 Panel D, menthol is associated with a 7.1 percentage point lower probability of being addicted to nicotine. In the column (2) model, Black is more strongly associated than menthol use with a lower probability of addiction. In the column (3) model, there is a small and statistically insignificant difference between the baseline group of white non-menthol smokers and non-Black menthol smokers. Compared to the baseline group, Black menthol smokers are 20 percentage points less likely to be addicted, which is large compared to the sample proportion of 45.1 percent addicted.

The evidence in Table 3 suggests that Black menthol smokers tend to smoke less, are less likely to have started smoking before age 18, and are less likely to be addicted. The associations with Black are stronger than the associations with menthol. Although the findings from previous research are mixed, our findings are in part consistent with the conclusions of previous reviews of descriptive epidemiologic evidence. The FDA Tobacco Products Scientific Advisory Committee concluded that “the preponderance of evidence shows that menthol smokers do not report an earlier age of initiation of cigarette use” (TPSAC 2011, p. 113). The TPSAC report also

concluded that there was insufficient evidence to conclude that menthol increases addiction among adults but concluded that a relationship between menthol and addiction in youth smokers was more likely than not (TPSAC 2011, p. 217). Similarly, the FDA's more recent literature review concluded that the "evidence is not sufficient to support a conclusion of an association of menthol in cigarettes with dependence [addiction] among adults due to inconsistent findings." (FDA 2022d, p. 5)

Menthol Use and Quitting Behavior

Our next set of empirical exercises explores differences in quitting behaviors among menthol and non-menthol smokers (Table 4). We focus first on past-year and lifetime quitting (Panels A and B). To estimate the models of past-year quitting, we use the sample of all past-year daily smokers, i.e., current daily smokers and former daily smokers who quit in the past year. In the Table 4 Panel A column (1) model, the probability of past-year quitting is about the same for menthol and non-menthol smokers; the results are similar in the column (2) model that includes additional control variables, and in the column (3) model that includes the menthol x Black interaction term. However, when we use the sample of ever smokers in Panel B, in the column (1) model the probability of lifetime quitting is 7.1 percentage points lower among menthol ever smokers.[15] When additional control variables are included in the column (2) model, Black is more strongly associated than menthol use with a lower probability of lifetime quitting. In the column (3) model, compared to the baseline group of white non-menthol ever-smokers, lifetime quitting is 2.4 percentage points lower among non-Black menthol ever-smokers and 7.8 percentage points lower among Black menthol ever-smokers. The prevalence of lifetime quitting

[15] The measures needed to conduct this analysis of menthol use and lifetime quitting are only available for the respondents to the May 2019 TUS-CPS.

is 63.8 percent, compared to the past-year quit rate of 8.9 percent. It is possible that in our data we are unable to detect small differences in past-year quitting among menthol users and Blacks that, over time, cumulate into detectably lower rates of lifetime quitting.

The next panels C, D, and E of Table 4 explore other dimensions of quitting behavior: the probability of a quit attempt in the past year, the number of quit attempts in the past year, and intentions to quit in the next six months. [16] In the column (1) models that simply compare menthol and non-menthol smokers, menthol smokers are more likely to have attempted to quit smoking in the past year (Panel C) and reported more quit attempts in the past year (Panel D). In the column (2) models that includes additional controls, the associations between quit attempts and menthol use become smaller, while the probability of an attempt and the number of quit attempts are more strongly associated with Black. The column (3) models show an interaction effect where the probability of an attempt and the number of quit attempts are highest among Black menthol smokers. Turning to another dimension of quitting behaviors, in Panel E the column (1) and (2) models do not show strong associations between menthol use and intentions to quit in the next six months. The column (3) model results imply that compared to white non-menthol smokers, Black menthol smokers are 7.8 percentage points more likely to report that they intend to try to quit smoking in the next six months.[17] The higher probability reflects a positive interaction between menthol use and Black race; non-Black menthol smokers are slightly and statistically insignificantly less likely to intend to quit.

[16] We use the sample of past-year smokers to estimate the model of past-year quit attempts. The TUS-CPS question to current smokers about past-year quit attempts is not given to former smokers. Our definition of quit attempts assumes that all former smokers who reported quitting within the past year also attempted to quit within the past year. We use the sample of current daily smokers to estimate the models of the number of quit attempts in the past year and intentions to quit in the past six months. These questions were not given to former smokers.

[17] The comparison is given by $\beta_1 + \beta_2 + \beta_3 = -0.0144 - 0.0366 + 0.129 = 0.078$.

The last panel F of Table 4 reports models of the probability of successful past-year quitting conditional on having made at least one quit attempt. In the column (1) model, conditional on attempting at least once, menthol smokers are slightly less likely to successfully quit. The column (2) model shows the conditional probability of quitting given at least one attempt is lower for Black smokers. The column (3) model provides evidence of an interaction effect where the conditional probability of quitting given at least one attempt is lower for Blacks who also smoke menthol. Although the coefficients on menthol, Black, and menthol x Black are estimated imprecisely, adding up the coefficients shows that compared to the baseline group Black menthol smokers are 6.0 percentage points less likely to successfully quit and the sum of the coefficients is statistically significant. Recalling that we find small associations between these variables and the unconditional probability of successful quitting in the past year, the negative associations with the conditional probability of quitting are mainly driven by the higher rate of quit attempts among menthol smokers and Black smokers.

To sum up, although the results are mixed, we find evidence that menthol use is associated with lower rates of lifetime quitting and weaker evidence that menthol use among Blacks is associated with a lower rate of successful past-year quitting conditional on having made at least one attempt. As in the Table 3 models of other smoking behaviors, there are also differences in quitting behaviors between Black and white smokers. Our findings on the associations between menthol use and quitting smoking are broadly consistent with the TPSAC comprehensive review and the FDA's more recent literature review. The TPSAC review concluded that the evidence is sufficient to conclude that a relationship is more likely than not that menthol cigarettes reduced successful quitting among Blacks, but that the relationship was as likely as not for other racial/ethnic groups (TPSAC 2011, p. 217). Similarly, the FDA's more recent literature review

reaches the stronger conclusion that menthol "is associated" with less quitting among Black smokers but only reaches the qualified conclusion that menthol smoking "is likely associated" with less quitting in the general population (FDA 2022d, p. 5).[18]

However, our findings and previous findings of an association between menthol use and lower lifetime quitting/ successful quitting conditional on an attempt pose something of a puzzle. The TPSAC (2011, Figure 1, p. 15) describes a conceptual framework that shows how a causal factor like the biochemical properties of menthol act through pathways (mechanisms) to produce smoking outcomes. The cooling properties of menthol suggest a possible pathway where menthol smokers inhale cigarettes more deeply, become more addicted, and therefore have more difficulty quitting. However, the FDA's recent literature review concludes that the evidence is not sufficient to support a conclusion that menthol is associated with altered puff topography such as inhaling more deeply, nor is the evidence sufficient to show that menthol is associated with differences in addiction (FDA 2022d); as reported above, we also find no evidence that menthol use is associated with more addiction. Another possible causal factor in the TPSAC (2011) conceptual framework is tobacco industry marketing, which might operate through different pathways than the biochemical properties. For example, for a given level of addiction, exposure to menthol product advertising might act as a cue that triggers cravings and thus makes quitting more difficult. However, an econometric study of the effects of magazine advertisements does not find any evidence that menthol advertising affects cigarette demand on multiple margins including quitting (Kenkel, Mathios, and Wang 2018). Although our findings indicate an association between menthol use and lower lifetime quitting, it remains puzzling that we and

[18] The FDA's conclusions about the overall quality and strength of evidence are grouped into five possible statements: is associated, is likely associated, is likely not associated, is not associated, or is not sufficient to support a conclusion of an association (FDA 2022, p. 16).

other researchers find a lack of associations with plausible causal pathways from reduced menthol use to quitting.

Menthol Use and Cigarette Purchasing Behaviors

We now turn to exploring differences between menthol and non-menthol smokers in four cigarette purchasing behaviors: whether they purchase cigarettes by the pack or carton, the price paid per pack, whether they purchase in a state other than their state of residence, and whether they have made single-cigarette purchases (Table 5). Although these cigarette purchasing behaviors are not measures of cigarette demand, they are expected to reflect demand- and supply-side conditions in cigarette markets. On the demand-side, heavier and more addicted smokers are likely to engage in more bulk purchases, price search, and tax avoidance (DeCicca, Kenkel, and Liu 2013a); heavier and more addicted smokers are probably less likely to make single-cigarette purchases because such purchases are inconvenient and more costly per cigarette. However, to the extent the purchasing behaviors reflect supply-side differences, they might provide alternative explanations for the associations we discuss above between menthol use and smoking and quitting behaviors (Tables 3 and 4). After discussing the empirical associations between menthol use and purchasing behaviors, we discuss possible supply-side interpretations of the patterns.

Panel A of Table 5 presents linear probability models of whether their last cigarette purchase was by the pack versus a carton (of ten packs). In the column (1) model, menthol smokers are 8.7 percentage points more likely to purchase cigarettes by the pack. When socio-demographic control variables are included in the column (2) model, Black is more strongly associated than menthol use with a higher probability of purchasing cigarettes by the pack. In the column (3) model, non-Black menthol smokers are slightly more likely to purchase cigarettes by the pack

than the baseline group of white non-menthol smokers. The column (3) model shows a direct effect of Black and an interaction effect where Black menthol smokers are the group most likely to purchase cigarettes by the pack. Compared to the baseline group of white non-menthol smokers, Black menthol smokers are 21.9 percentage points more likely to purchase by the pack. The difference is substantial compared to the sample mean of 67 percent pack-purchases.

Panel B of Table 5 presents models of the price paid per pack, conditional on having purchased by the pack. Similar to the patterns in purchasing by the pack, menthol smokers and Blacks pay higher prices per pack and there is evidence of a menthol x Black interaction effect. However, compared to the sample mean price paid of $6.61 per pack, the price differences are small.

The next panel of Table 5 presents models of the probability of making a cigarette purchase in a state other than the respondent's state of residence, which often reflects the incentives to avoid high home-state cigarette taxes (DeCicca, Kenkel, and Liu 2013b). Menthol smokers and Black smokers are less likely to make out-of-state purchases; the differences are fairly small in absolute terms but are about 25 percent of the sample mean of 8.8 percent border-crossing.

Panel D of Table 5 presents models of the probability of having purchased a single cigarette or "loosie." Sales of single cigarettes are illegal and often occur on the street, with a higher price per cigarette than in pack or carton purchases. In the column (1) model, menthol smokers are more likely to have made a single-cigarette purchase. In the column (2) model, menthol is not associated with single-cigarette purchases, but Black smokers are 7.6 percentage points more likely to have made such a purchase, which is substantial compared to the sample mean of 4.1 percent. The column (3) results are similar. These patterns are consistent with the evidence of

illegal street markets in some areas of large cities such as the South Bronx neighborhood of New York City (Shelley et al. 2007).

To sum up, Black menthol smokers are less likely to purchase cigarettes by the pack and, conditional on pack-purchases, pay higher prices per pack. Black menthol smokers are less likely to make out-of-state purchases but more likely to purchase high-price single cigarettes. Correct interpretation of the patterns requires consideration of both demand- and supply-side factors. To the extent these patterns reflect demand-side behaviors including price search and tax avoidance, the patterns tend to corroborate the patterns documented above that Black menthol smokers are less to be daily smokers, smoke fewer cigarettes per day, and are less likely to be addicted.

However, to the extent there are supply-side factors that increase menthol cigarette prices, there might be reverse causality where the higher prices help explain why Black menthol smokers smoke less heavily. Although our models include state fixed effects and indicators of city-size, the higher prices might reflect supply-side heterogeneity in cost-shifters or market power in markets with higher shares of Black menthol smokers. Prior research on the price-elasticity of cigarette demand sheds light on the likely magnitude of the reverse causality explanation. From the Table 3 column (3) model, Black menthol smokers smoke 4.8 fewer cigarettes per day, which is 34 percent lower than the sample mean quantity. We estimate that Black menthol smokers on average pay $0.77 more per pack, which is 12 percent higher than the sample mean price.[19] Prior research provides a strong consensus that cigarette demand is price-inelastic, but not perfectly inelastic. Consensus estimates of the price-elasticity of demand imply

[19] From Table 5, Black menthol smokers pay higher prices for three reasons: they are less likely to buy cigarettes by the carton (which are sole at a volume discount); conditional on pack purchases, they pay higher prices per pack; and they are less likely to make out-of-state purchases to avoid higher taxes. To get the combined effects of these differences, after putting the per-carton price on a per-pack basis, we pooled together pack- and carton buyers and re-estimated the Table 5 column (3) model of price paid.

that reverse causality from higher prices to reduced demand probably explains only a small fraction of the Black menthol smokers' lower demand.[20]

Menthol Use and Consumer Information and Internalities

We next use data from the Online Cornell Survey's questions about smoking-related consumer information and internalities (Table 6). As described in more detail below, the OCS data provides five measures of mistaken information or internalities. To help summarize the results and ease interpretation, we create a simple index as the sum of five indicators of mistaken information and internalities that might provide a rationale for regulating menthol cigarettes more strictly than non-menthol cigarettes. Panel A of Table 6 reports the results of models that use the index as the dependent variable. The coefficients on menthol, Black, and the menthol x Black interaction term are not statistically significantly different from zero. The magnitudes of the coefficients are small and correspond to less than one-fifth of a mistake or internality, out of a possible total of five. However, the results of an exploratory factor analysis suggest that the simple index might be inappropriate. The factor analysis does not identify a useful way to reduce the five variables to a smaller number of common latent factors. Moreover, the analysis finds that each of the variables that make up the index has a high level of uniqueness, measured as the percentage of variance in that variable that is not explained by the common latent factors.[21] In this situation, it is useful to estimate separate models of the five measures of mistaken

[20] DeCicca, Kenkel, and Lovenheim (2022) suggest that the price-elasticity of the demand for cigarettes per day is in the range from -0.2 to -0.35. Under the assumptions that supply-side factors explain all of the higher prices paid by Black menthol smokers and that the price-elasticity of demand is -0.35, reverse causality from higher prices predicts that Black menthol smokers smoke 0.6 fewer cigarettes per day, which is 12.5 percent of the reduction in demand associated with menthol use among Black smokers (4.8 cigarettes). A reviewer of this paper suggested that Black menthol smokers' demand might be more elastic. If the price-elasticity of demand is -0.6, reverse causality predicts that Black menthol smokers smoke 1.0 fewer cigarettes per day, which is 21.5 percent of the reduction in demand associated with menthol use among Black smokers.

[21] Detailed results from the factor analysis are available upon request.

information and externalities. For example, there might be relationships between menthol use and the five variables separately that are obscured by summing them together.

Panel B of Table 6 explores differences in the first measure – consumer perceptions about the life expectancy loss due to smoking. If compared to non-menthol smokers, menthol smokers perceived a lower life expectancy loss, it might provide a rationale for regulating menthol more strictly. On average, OCS respondents perceived that the life expectancy loss due to smoking is 11.7 years, slightly more than the public health consensus of 10 years (Jha et al. 2013). In the column (1) model, menthol use is associated with perceiving an additional 1.5 years of life expectancy loss, but in the column (2) model Black is more strongly associated with perceived life expectancy loss than menthol use. From the column (3) model, compared to white non-menthol smokers, Black menthol smokers perceive about 1.9 more years of life expectancy loss and the sum of the coefficients is statistically significant.[22]

The models presented in Panel C of Table 6 explore differences in a common misperception, that nicotine is the substance that causes most of the cancer caused by smoking. Although nicotine is addictive, by itself it does not cause cancer. The misperception that nicotine causes cancer might discourage smokers from using e-cigarettes or FDA-approved nicotine replacement therapies as ways to cut down or quit smoking. In the column (1) model, menthol smokers are 4.4 percentage points more likely to believe that nicotine causes cancer. In the column (2) model, menthol use is not associated with this misperception, but Black smokers are 13.7 percentage points more likely to believe that nicotine causes cancer. In the results in the column (3) model,

[22] As noted earlier, Darden, Gilleskie, and Strumpf (2018) use data from a long panel to jointly model smoking and health and allow for correlated unobservable heterogeneity. Their estimates imply that smoking causes 4.3 years of life expectancy loss, which implies that the public health consensus and the OCS respondents both over-estimate the loss due to smoking; the results in Table 6 suggest that Black menthol and non-menthol smokers over-estimate the life loss due to smoking more than average in the OCS sample. Although over-estimation is also a form of misinformation, it does not provide a rationale to regulate menthol cigarettes more strictly.

compared to white non-menthol smokers, Black menthol smokers are 12.4 percentage points more likely to believe that nicotine causes cancer and the sum of the coefficients is statistically significant. The Panel D results show somewhat mixed associations between Black smokers or menthol smokers and perceptions that e-cigarettes – which contain nicotine but not the harmful components of tobacco smoke generated by combustion – are as harmful or more harmful than smoking.

The models presented in Panels E and F of Table 6 explore differences in smoking-related internalities. The dependent variable for one set of models (Panel E) measures strong agreement with the statement "I smoke more than I should." We follow Allcott, Lockwood, and Taubinsky (2019, p. 1586) who use agreement with an analogous statement about consumption of sugar-sweetened beverages as a measure of internalities. By this measure, 54 percent of the sample of smokers impose internalities on themselves. In the column (1) and (2) models, this measure of internalities does not vary by menthol use. In the column (3) model, the coefficients on Black and the menthol x Black interaction are large and have opposite signs. Compared to the omitted category of white non-menthol smokers, Black menthol smokers are 3.6 percentage points more likely to experience the internality but the sum of the coefficients is not statistically significantly different from zero. Black non-menthol smokers are 17.3 percentage points less likely to experience this internality compared to white non-menthol smokers. We note that Black non-menthol smokers are a small minority of Black smokers.

The dependent variable for the models presented in Panel F of Table 6 measure whether the respondent continued to smoke longer than they planned when they started smoking. The measure takes a value of one if the smoker's current age is older than the age at which they planned to quit smoking. The measure also takes a value of one for smokers who were not

thinking about quitting smoking when they started. By this measure, 85 percent of smokers have smoked longer than they planned, or failed to plan. Again, in the column (1) and (2) models, there is no evidence that this measure of internalities varies with menthol use. The results in the column (2) and (3) models provide some evidence that Black smokers, especially those who do not smoke menthol, are less likely to experience this internality; however, the coefficients are estimated imprecisely and are not statistically significant at conventional confidence levels.

6. Menthol and Non-Menthol Smokers' Stated Preferences for Tobacco Products

In this section we report evidence on menthol and non-menthol smokers' stated preferences in a discrete choice experiment (DCE) included in the 2021 Online Cornell Survey (Table 7). The 2021 OCS was not designed to study menthol use or the regulation or prohibition of menthol cigarettes. Instead, the 2021 OCS combined an online experiment about another proposed tobacco regulation – graphic cigarette warning labels – with a DCE about choices between smoking, vaping, and quitting. By analyzing the separate sub-samples in Table 7, we explore if the determinants of the choices in the DCE differ systematically between menthol and non-menthol smokers. In the DCE, the prices of cigarettes and e-cigarettes, and the attributes of the e-cigarettes including the availability of flavors, the available nicotine levels, and the e-cigarette health warning, were experimentally varied. In addition, when making their choices half of the sample saw one of the current text cigarette health warnings, while the other half of the sample saw one on the new graphic cigarette warnings. Subjects responded to 12 choice sets; for each choice set they indicated their immediate choice today and their choice six months from now. Kenkel et al. (2023a) provide more discussion of the graphic warning labels DCE.

Table 7 presents estimates of linear probability models of subjects' stated tobacco product choices. The models are estimated separately for the sub-samples of 448 menthol smokers and

576 non-menthol smokers.[23] In general, menthol and non-menthol smokers respond similarly to tobacco product prices and attributes. For example, increasing the price of cigarettes by $1 decreases the probability of the immediate choice of cigarettes today by 1.8 percentage points among menthol smokers and by 2.2 percentage points among non-menthol smokers. Compared to subjects who saw the text cigarette warning, menthol smokers who saw the graphic pictorial warning were 5.1 percentage points less likely to choose cigarettes while non-menthol smokers were 5.9 percentage points less likely to choose cigarettes. Higher cigarette prices and the graphic warning shifted both menthol and non-menthol smokers into e-cigarettes and into quitting. A substantial difference in stated preferences is that the availability of flavors in e-cigarettes increased the probability that menthol smokers chose e-cigarettes but did not affect non-menthol smokers' choices.

The broad similarity of the determinants of menthol smokers' and non-menthol smokers' tobacco product choices, except for the role of flavors, sheds light on whether self-selection into menthol use is quasi-random. For example, if there were favorable self-selection where menthol smokers were less subject to internalities or more health-minded, it might be expected that menthol smokers' choices would be more responsive to the graphic warnings on cigarettes and the different health warnings on e-cigarettes. The results in Table 7 also show that policies including taxes and warning labels should be similarly effective in reducing menthol and non-menthol smoking.

[23] Some subjects were dropped from the estimation sample because the reported price they paid for their last pack of cigarettes was outside any reasonable range and for other reasons; see Kenkel et al. (2023a). Each subject provided 12 responses the choice scenarios, leading to the numbers of observations reported in Table 6. Standard errors are clustered at the individual-level.

7. Discussion

Because we conducted a large number of analyses of the associations between menthol use and smoking and internality outcomes, to help summarize the main results from Tables 3 – 6 are collected in Table 8. Above, we discuss the magnitudes and details of these results. Here, we focus on whether the broad patterns are consistent or not consistent with internality-based market failures that justify regulating menthol cigarettes more strictly. In Table 8, statistically significant results that are consistent with internalities are shaded in dark gray, statistically significant results that are in the opposite direction than would be consistent with internalities are shaded in light gray, and statistically insignificant results are unshaded.

The results summarized in Table 8 make two contributions to the current policy debate about the FDA's proposed prohibition of menthol cigarettes. First, column (2) does not provide consistent evidence that menthol is a useful marker to target stricter regulation. In many cases, the associations are in the opposite direction than would be consistent with menthol serving as a marker for internalities; menthol use is associated with less daily smoking, fewer cigarettes smoked per day, later smoking initiation, and less addiction.

Second, Table 8 sheds light on the argument that internality-based market failures justify regulating menthol cigarettes more strictly than non-menthol cigarettes. To explore whether internalities play a larger role in the market demand schedule for menthol cigarettes, we examine menthol and non-menthol market demand schedules along multiple intensive and extensive margins. In these models we control for socio-demographics and allow the effect of menthol to be different between Blacks and non-Blacks. Column (3) of Table 8 collects the estimates that compare outcomes for non-Black menthol smokers to the baseline group of white non-menthol smokers; column (4) collects the estimates that compare outcomes for Black menthol smokers

compared to the baseline group. The column (3) results show mainly small and statistically insignificant results, while the column (4) results are often in the opposite direction than would be consistent with internalities.[24]

We acknowledge that the associations we document in observational data on cigarette demand might reflect bias due to self-selection into menthol use. In principle, it is possible that menthol use has important adverse causal treatment effects that are masked by strong favorable self-selection into menthol use. However, the observed determinants of selection into menthol use, smokers' stated reasons for menthol use, comparisons of direct measures of internalities, and the similarity in the determinants of stated preferences for tobacco product choices by menthol and non-menthol smokers, are at least consistent with mainly quasi-random self-selection into menthol use. We stress that by quasi-random, we mean that although people might be non-randomly assigned to menthol use, the unobservable assignment mechanism does not lead to bias when inferring the causal treatment effects of menthol use, i.e. there is no self-selection bias. We cannot rule out all possible unobserved sources of self-selection bias. Ultimately, discussions about unobservable self-selection are inherently speculative. Neither the evidence cited in the FDA's PRIA nor the evidence in this paper are from a research design that relies on random or quasi-random assignment. We thus leave it to the reader whether there is convincing evidence that differential levels of internality-based market failures provide a sufficient justification for the FDA's proposed prohibition of menthol cigarettes, a policy which would affect over 18.5 million menthol smokers.

[24] Out of the 20 entries in Column (4) of Table 8, three are statistically significant results that are consistent with internalities: lifetime quitting, successful quit conditional on an attempt, and misinformation about nicotine. Below, we discuss alternative policies that could address these disparities.

FDA may have public health justifications for banning menthol cigarettes that are not rooted in market failures and applied welfare economics. The 2009 Tobacco Control Act (TCA) that established FDA authority over tobacco products describes the use of tobacco by young people as an issue "of particular concern to public health officials." Internalities like present bias might play a larger role in youth smoking than in the data on adult smoking that we study. However, the TCA's particular concern about youth smoking might also reflect paternalism, which Jones and Bayer (2007) argue is central to public health ethics. Whether rooted in internalities or paternalism, concerns about youth smoking might be better addressed by policies targeted at youth. From the 2019 National Survey on Drug Use and Health (NSDUH), it is estimated that there were about 18 million adult menthol smokers about versus 500,000 youth menthol smokers aged 12-17 (FDA 2022a, Table 1). Many tobacco control policies already target youth smoking, including the 2020 federal law known as T21 that increased the national legal purchase age for tobacco products to 21. Extrapolating from their difference-in-difference study of the impact of state T21 laws, Hansen et al. (2023) suggest that the federal T21 law might account for almost half of the 4 percentage point drop in smoking between 2019 and 2021 among young adults aged 18-20, with additional spillover effects to reduce smoking by younger teens.[25]

The prohibition of menthol cigarettes also might have unintended consequences and fail to achieve the public health objective of reducing youth smoking. The FDA conducts compliance checks including underage buyer "sting" inspections to enforce the federal purchase age, although the evidence of the program's earlier effectiveness (when the federal purchase age was

[25] In the 2021 National Youth Tobacco Survey (NYTS) 150,000 or 0.6 percent of middle and high school students were past 30-day users of menthol cigarettes (Gentzke, Wang, Cornelius et al. 2022). The difference between the 2019 NSDUH estimate of 500,000 youth menthol smokers and the 2021 NYTS estimate of 150,000 youth menthol smokers could reflect a combination of differences in the sampling frame and design of the two surveys, the impact of COVID-19 and social distancing policies on teen smoking behavior, and the causal impact of the federal T21 law.

18) is mixed (Abouk and Adams 2017, Feng and Pesko 2019). If menthol cigarettes continue to be allowed to be sold legally, increased FDA enforcement of T21 might be an effective way to further reduce youth smoking. However, if the prohibition of menthol cigarettes creates a substantial illegal market, youth might have more access to menthol cigarettes in an unregulated illegal market than in a well-regulated legal market.

Another part of the public health rationale for the proposed prohibition of menthol is to reduce health disparities and improve the health of vulnerable populations including Blacks (FDA 2022c). Good policy analysis considers alternative policy approaches to achieve the same ends. Some tobacco control policies are likely to reduce smoking across the board; for example, the results of the discrete choice experiment reported above suggest that the new graphic cigarette warnings (currently in litigation) will increase quitting among both menthol and non-menthol smokers by 3 to 4 percentage points immediately and by 5 to 7 percentage points in six months.

An alternative way to reduce smoking-related health disparities is to adopt policies that help vulnerable populations, instead of targeting their choice of cigarette flavor. For example, policies could target improving access to medical care, including pharmaceutical treatments for smoking cessation, among Black smokers and other vulnerable populations. An important market development is the introduction of non-combustible tobacco products like e-cigarettes that deliver nicotine without the toxicants created by tobacco combustion. The FDA recognizes the lower health risks of non-combustible tobacco products and has authorized the sale of a form of smokeless tobacco, a heated tobacco product, nicotine-containing discs and chews, and tobacco-flavored e-cigarettes as appropriate for public health due to the potential health benefits to adult smokers who switch (see for example, FDA 2021). Public policies to encourage smokers,

especially Black smokers, to switch to e-cigarettes and other tobacco harm reduction products are another route to improve health and reduce health disparities. For example, public information campaigns to correct the common misperception that nicotine causes cancer could help encourage more smokers to quit by using products like e-cigarettes as well as pharmaceutical nicotine replacement products. Such an information campaign would directly address one of the few results in column (4) of Table 8 that are consistent with an internality-based market failure – Black menthol smokers are more likely to be misinformed that nicotine causes cancer. Furthermore, it might address the other two results consistent with disparities among Black menthol smokers – lower rates of lifetime quitting and of successful quitting conditional on a past-year quit attempt.

Beyond the questions of whether there are market failures or public health rationales for regulating menthol cigarettes differently than non-menthol cigarettes, future research could explore whether much stronger regulation – perhaps a prohibition – of all cigarettes, not just menthols, would be socially optimal in an applied welfare economics framework. In that framework, because the TCA does not allow the FDA to prohibit all cigarettes, the proposed prohibition of menthol cigarettes could be evaluated as a feasible second-best policy. To predict the impact of the prohibition of menthol cigarettes would require estimates of the fractions of current menthol smokers who quit smoking and the fractions who would substitute into non-menthol cigarettes, e-cigarettes, and illegal menthol cigarettes. The FDA's PRIA relies heavily on an expert elicitation study for these parameters (Levy et al. 2021). To complete the benefit-cost analysis would require estimates of the uninternalized distortions in the menthol cigarette market, i.e. the externalities plus the internalities less current cigarette taxes. DeCicca, Kenkel, and Lovenheim (2022) review empirical estimates of smoking-related externalities and

internalities. The reviewed evidence suggests that cigarette taxes are currently more-than-high enough to correct for smoking-related externalities. Empirical evidence on the size of smoking-related internalities is more limited. An additional challenge is to develop estimates of the social costs of illegal markets for menthol cigarettes.

Future research could take a quasi-experimental approach to the welfare analysis of a national menthol prohibition by exploiting the experiments created by the recent bans of menthol cigarettes in some localities and in the states of Massachusetts and California. However, estimates from those experiments might lack external validity for extrapolation to predict the impact of a national prohibition. Menthol smokers can make cross-border purchases in response to local and state bans, but opportunities to evade a national prohibition would be different and might be more limited.[26] A related empirical challenge is that to the extent menthol smokers make cross-border purchases or purchase cigarettes from illegal markets, many menthol smokers "treated" by the locality- and state-level quasi-experiments could be non-compliers. This might reduce statistical power and suggests the empirical strategy of using the quasi-experiments as an instrumental variable to estimate the local average treatment effect on the population of compliers. In addition to predicting the impacts on smoking and quitting, the exogenous variation in menthol use could be leveraged to estimate the impacts of menthol use on internalities. Jin et al. (2015) provide an example that uses the quasi-experiment created by national policy variation over time to include smoking internalities in retrospective and prospective cost-benefit analyses of U.S. anti-smoking policies.

[26] Under a national menthol prohibition, menthol smokers could make cross-border purchases from Mexico but not Canada where menthol cigarettes are already prohibited. However, instead of cross-border cigarette purchases, sometimes called casual smuggling, a national menthol prohibition might lead to more organized smuggling and illegal markets.

Another direction for research on cigarette prohibitions is to collect stated preference data from discrete choice experiments. Kenkel et al. (2023b) report preliminary results from a 2022 DCE which was designed to provide estimates of the parameters needed for welfare analysis of the proposed menthol prohibition. The estimated mixed logit model predicts that in response to a prohibition more current menthol smokers would quit, with some substitution into e-cigarettes but very little substitution into non-menthol cigarettes. However, the model also predicts a large potential demand for menthol cigarettes purchased from illegal markets, if such markets arise. More research is needed on the economics of illegal cigarette markets.

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Tables

Table 1: Selection into Smoking and Menthol Use

	Current Smoker		Menthol Smoker	
	Full sample	Black	Full sample	Black
Non hispanic black	-0.0371***		0.516***	
	(0.00302)		(0.0112)	
Non hispanic asian	-0.0525***		0.127***	
	(0.00430)		(0.0240)	
Non hispanic other	0.0369***		0.0549**	
	(0.00754)		(0.0219)	
Hispanic	-0.0963***		0.0836***	
	(0.00295)		(0.0131)	
Male	0.0338***	0.0540***	-0.105***	-0.0598***
	(0.00174)	(0.00601)	(0.00673)	(0.0208)
Age 30-39	0.0712***	0.0688***	-0.00725	0.101**
	(0.00329)	(0.0106)	(0.0125)	(0.0393)
Age 40-49	0.0655***	0.0708***	-0.0829***	0.0693*
	(0.00348)	(0.0110)	(0.0133)	(0.0405)
Age 50-59	0.0738***	0.101***	-0.0920***	0.0737*
	(0.00344)	(0.0109)	(0.0129)	(0.0387)
Age 60+	0.00916**	0.0712***	-0.0785***	0.0277
	(0.00359)	(0.0117)	(0.0142)	(0.0412)
Not married (divorced, etc.)	0.0662***	0.0364***	0.00808	0.000627
	(0.00220)	(0.00787)	(0.00814)	(0.0304)
Never married	0.0500***	0.0616***	0.0150	0.0459
	(0.00250)	(0.00782)	(0.00924)	(0.0289)
Completed high school	-0.0285***	-0.0563***	0.0142	0.0280
	(0.00345)	(0.00993)	(0.0104)	(0.0275)
Some college	-0.0570***	-0.0864***	0.0336***	0.0203
	(0.00368)	(0.0108)	(0.0115)	(0.0328)
College graduate or higher	-0.124***	-0.126***	0.00463	0.00858
	(0.00346)	(0.0105)	(0.0115)	(0.0350)
Unemployed	0.0720***	0.0921***	0.0162	0.0855**
	(0.00570)	(0.0146)	(0.0168)	(0.0411)
Retired	-0.0404***	-0.0426***	-0.0248**	-0.0367
	(0.00282)	(0.0102)	(0.0120)	(0.0376)
Not in the labor market	0.0530***	0.0535***	-0.0143	0.0226
	(0.00270)	(0.00837)	(0.00895)	(0.0270)
Household income $25,000-$49,999	-0.0138***	-0.0269***	0.00259	-0.0188
	(0.00251)	(0.00752)	(0.00858)	(0.0256)
Household income $50,000-$74,999	0.00509**	-0.0107	0.00276	-0.0573*
	(0.00229)	(0.00842)	(0.00908)	(0.0348)
Household income $75,000+	-0.0566***	-0.0613***	0.000701	-0.0219
	(0.00236)	(0.00814)	(0.00899)	(0.0346)
Metropolitan area (CBSA) size:250,000-500,000	-0.00389	-0.00334	0.0308**	0.00233
	(0.00342)	(0.0124)	(0.0125)	(0.0423)
Metropolitan area (CBSA) size:500,000+	-0.0232***	-0.00508	0.0358***	-0.0135
	(0.00190)	(0.00714)	(0.00716)	(0.0239)
Constant	0.176***	0.119***	0.306***	0.704***
	(0.00484)	(0.0151)	(0.0165)	(0.0500)
Observations	136,649	13,124	16,352	1,749
Dep Var Mean	0.121	0.136	0.294	0.754

Source: Authors' calculations from the 2018-2019 Tobacco Use Supplement to the Current Population Survey.
*Statistical significance at the 5% level.
**Statistical significance at the 1% level.
***Statistical significance at the 0.1% level.

Table 2: Reasons Smokers Smoked Menthol or Non-Menthol Cigarettes

	Menthol Smoker	Non-Menthol Smoker	Total
Panel A: All Smoker			
Less harmful	16%	14%	15%
Better flavor	85%	68%	72%
Less harsh on your THROAT	42%	35%	37%
Less harsh on your CHEST	32%	30%	31%
Panel B: Black Smoker			
Less harmful	20%	22%	21%
Better flavor	82%	59%	76%
Less harsh on your THROAT	41%	37%	40%
Less harsh on your CHEST	37%	34%	36%

Source: Authors' calculations from the 2010-2011 Tobacco Use Supplement to the Current Population Survey. Smokers can cite multiple reasons.

Tabel 3: Menthol Use and Smoking Behaviors

	(1)	(2)	(3)
Panel A: Daily Smoker			
Menthol Smoker	-0.0229**	0.0071	0.0038
	(0.0070)	(0.0075)	(0.0080)
Non Hispanic Black		-0.1140***	-0.1350***
		(0.0119)	(0.0202)
Menthol x Black			0.0302
Observations	16,352	16,352	16,352
Dep Var Mean	0.782	0.782	0.782
Panel B: Cigarettes Smoked per Day			
Menthol Smoker	-1.880***	-0.468**	-0.463**
	(0.156)	(0.162)	(0.171)
Black		-4.354***	-4.321***
		(0.263)	(0.463)
Menthol x Black			-0.0474
			(0.539)
Observations	12,626	12,626	12,626
Mean of dependent variable	14.35	14.35	14.35
Panel C: Started Smoking Before Age 18			
Menthol Smoker	-0.0373***	-0.0072	-0.0051
	(0.00867)	(0.00929)	(0.00983)
Black		-0.118***	-0.104***
		(0.0146)	(0.0252)
Menthol x Black			-0.0197
			(0.0295)
Observations	15,923	15,923	15923
Dep Var Mean	0.532	0.532	0.532
Panel D: Addiction, based on the Heaviness of Smoking Index			
Menthol Smoker	-0.0712***	-0.0120	-0.0103
	(0.0100)	(0.0107)	(0.0112)
Black		-0.184***	-0.170***
		(0.0176)	(0.0321)
Menthol x Black			-0.0194
			(0.0369)
Observations	11,970	11,970	11,970
Dep Var Mean	0.451	0.451	0.451
Control	No	Yes	Yes
State FE	No	Yes	Yes

Note: Authors' calculations from the 2018-2019 Tobacco Use Supplement to the Current Population survey. Different panels show different outcome variables and the three columns display different specifications. Column (1) is the baseline without any control variables. The models reported in columns (2) and (3) include additional control variables: Asian, Hispanic, and other race/ethnicity, sex, age, marital status, schooling, labor force status, income, city size, and state fixed effects. Column (3) further considers the interaction between Black and menthol. As described in the text, the sample for each panel is different. Appendix 2 provides a more detailed explanation of the sample construction process.

*Statistical significance at the 5% level.

**Statistical significance at the 1% level.

***Statistical significance at the 0.1% level.

Tabel 4: Menthol Use and Quitting Behaviors

	(1)	(2)	(3)
Panel A: Past-year Quitting			
Menthol Smoker	0.0045	0.0053	0.0069
	(0.00533)	(0.00580)	(0.00610)
Black		-0.0150	-0.0033
		(0.00948)	(0.0166)
Menthol x Black			-0.0166
			(0.0193)
Observations	13,802	13,802	13,802
Dep Var Mean	0.0885	0.0885	0.0885
Panel B: Lifetime Quitting			
Menthol Smoker	-0.0708***	-0.0255**	-0.0243*
	(0.00926)	(0.00912)	(0.00958)
Black		-0.0485**	-0.0401
		(0.0157)	(0.0251)
Menthol x Black			-0.0133
			(0.0308)
Observations	13,914	13,914	13,914
Dep Var Mean	0.638	0.638	0.638
Panel C: Past-year Quit Attempt			
Menthol Smoker	0.0405***	0.0190	0.0144
	(0.00922)	(0.0100)	(0.0105)
Black		0.0496**	0.0167
		(0.0164)	(0.0286)
Menthol x Black			0.0468
			(0.0333)
Observations	13,802	13,802	13,802
Dep Var Mean	0.408	0.408	0.408
Panel D: Number of Past-year Quit Attempts			
Menthol Smoker	0.136***	0.0704*	0.0496
	(0.0259)	(0.0283)	(0.0297)
Black		0.185***	0.0384
		(0.0458)	(0.0801)
Menthol x Black			0.209*
			(0.0934)
Observations	12,536	12,536	12,536
Dep Var Mean	0.828	0.828	0.828
Panel E: Intention to Quit in Next 6 Months			
Menthol Smoker	0.0146	-0.0017	-0.0144
	(0.00975)	(0.0106)	(0.0112)
Black		0.0541**	-0.0366
		(0.0172)	(0.0302)
Menthol x Black			0.129***
			(0.0352)
Observations	12,287	12,287	12,287
Dep Var Mean	0.398	0.398	0.398
Panel F: Successful Quit Conditional on Quit Attempt			
Menthol Smoker	-0.0102	0.0008	0.0056
	(0.0119)	(0.0130)	(0.0137)
Black		-0.0523*	-0.0150
		(0.0210)	(0.0386)
Menthol x Black			-0.0510
			(0.0442)
Observations	5,633	5,633	5,633
Dep Var Mean	0.217	0.217	0.217
Control	No	Yes	Yes
State Fixed Effect	No	Yes	Yes

Note: Different panels show different outcome variables and the three columns display different specifications. Column (1) is the baseline without any control variables. The models reported in columns (2) and (3) include additional control variables: Asian, Hispanic, and other race/ethnicity, sex, age, marital status, schooling, labor force status, income, city size, and state fixed effects. Column (3) further considers the interaction between Black and menthol. As described in the text, the sample for each panel is different. Appendix 2 provides a more detailed explanation of the sample construction process. Source: Authors' calculations from the 2018-2019 Tobacco Use Supplement to the Current Population survey

*Statistical significance at the 5% level.

**Statistical significance at the 1% level.

***Statistical significance at the 0.1% level.

Table 5: Menthol Use and Cigarette Purchasing Behaviors

	(1)	(2)	(3)
Panel A: Purchase by the Pack			
Menthol Smoker	0.0871***	0.0245**	0.0142
	(0.00811)	(0.00855)	(0.00906)
Black		0.176***	0.112***
		(0.0134)	(0.0228)
Menthol x Black			0.0927***
			(0.0269)
Observations	16,039	16,039	16,039
Dep Var Mean		0.670	0.670
Panel B: Price Paid per Pack			
Menthol Smoker	0.158***	0.0655*	0.0380
	(0.0415)	(0.0326)	(0.0347)
Black		0.365***	0.199*
		(0.0487)	(0.0868)
Menthol x Black			0.229*
			(0.0992)
Observations	10,264	10,264	10,264
Dep Var Mean	6.614	6.614	6.614
Panel C: Purchase in State Other than State of Residence			
Menthol Smoker	-0.0119*	0.00335	0.0048
	(0.00508)	(0.00531)	(0.00562)
Black		-0.0224**	-0.0130
		(0.00830)	(0.0143)
Menthol x Black			-0.0135
			(0.0168)
Observations	14,905	14,905	14,905
Dep Var Mean	0.0883	0.0883	0.0883
Panel D: Single-Cigarette Purchase			
Menthol Smoker	0.0318***	0.0059	0.0038
	(0.00342)	(0.00367)	(0.00390)
Black		0.0755***	0.0630***
		(0.00575)	(0.00980)
Menthol x Black			0.0181
			(0.0115)
Observations	16,154	16,154	16,154
Dep Var Mean	0.0411	0.0411	0.0411
Control	No	Yes	Yes
State Fixed Effect	No	Yes	Yes

Note: Different panels show different outcome variables and the three columns display different specifications. Column (1) is the baseline without any control variables. The models reported in columns (2) and (3) include additional control variables: Asian, Hispanic, and other race/ethnicity, sex, age, marital status, schooling, labor force status, income, city size, and state fixed effects. Column (3) further considers the interaction between Black and menthol. As described in the text, the sample for each panel is different. Appendix 2 provides a more detailed explanation of the sample construction process. Source: Authors' calculations from the 2018-2019 Tobacco Use Supplement to the Current Population survey.

*Statistical significance at the 5% level.

**Statistical significance at the 1% level.

***Statistical significance at the 0.1% level.

Table 6: Menthol Use and Consumer Information and Internalities

	(1)	(2)	(3)
Panel A: Index of Mistaken Information and Internalities			
Menthol Smoker	-0.0664	-0.0541	-0.0652
	(0.0630)	(0.0669)	(0.0691)
Black		0.0562	-0.0968
		(0.113)	(0.259)
Menthol x Black			0.186
Observations	1,129	1,129	1,129
Dep Var Mean	2.66	2.66	2.66
Panel B: Perceived Life Years Lost Due to Smoking			
Menthol Smoker	1.457***	0.469	0.457
	(0.431)	(0.451)	(0.465)
Black		1.376	1.205
		(0.763)	(1.741)
Menthol x Black			0.207
Observations	1,129	1,129	1,129
Dep Var Mean	11.73	11.73	11.73
Panel C: Agree That Nicotine Causes Cancer			
Menthol Smoker	0.0440	-0.0158	-0.0175
	(0.0294)	(0.0313)	(0.0323)
Black		0.137**	0.113
		(0.0529)	(0.121)
Menthol x Black			0.0285
			(0.132)
Observations	1,129	1,129	1,129
Dep Var Mean	0.40	0.40	0.40
Panel D: Perceive E-cigarette Use as More Harmful than Smoking			
Menthol Smoker	0.00530	-0.0178	-0.0130
	(0.0299)	(0.0327)	(0.0337)
Black		-0.0152	0.0508
		(0.0554)	(0.126)
Menthol x Black			-0.0801
			(0.138)
Observations	1,129	1,129	1,129
Dep Var Mean	0.56	0.56	0.56
Panel E: Strongly Agree That I Smoke More than I Should			
Menthol Smoker	-0.00776	0.00366	-0.00944
	(0.0300)	(0.0330)	(0.0340)
Black		0.00737	-0.173
		(0.0559)	(0.127)
Menthol x Black			0.219
			(0.139)
Observations	1,129	1,129	1,129
Dep Var Mean	0.54	0.54	0.54
Panel F: Smoked Longer than I Thought I Would			
Menthol Smoker	-0.0295	0.0104	0.0105
	(0.022)	(0.022)	(0.023)
Black		-0.036	-0.035
		(0.037)	(0.0847)
Menthol x Black			-0.00172
			(0.0923)
Observations	1,129	1,129	1,129
Dep Var Mean	0.85	0.85	0.85
Control	No	Yes	Yes
State Fixed Effect	No	Yes	Yes

Note: Different panels show different outcome variables and the three columns display different specifications. Column (1) is the baseline without any control variables. The models reported in columns (2) and (3) include additional control variables: Asian, Hispanic, and other race/ethnicity, sex, age, marital status, schooling, labor force status, income, city size, and state fixed effects. Column (3) further considers the interaction between Black and menthol. As described in the text, the sample for each panel is different. Appendix 2 provides a more detailed explanation of the sample construction process. Source: Online Cornell Survey 11/2021.

*Statistical significance at the 5% level.

**Statistical significance at the 1% level.

***Statistical significance at the 0.1% level.

Table 7: Menthol and Non-Menthol Smokers' Stated Preferences for Tobacco Products Immediate Choice Today

	Immediate Choice Today						Choice of six months from now					
	Menthol			Non-Menthol			Menthol			Non-Menthol		
	Cigarette	E-Cigarette	Quit	Cigarette	E-Cigarette	Quit	Cigarette	E-Cigarette	Quit	Cigarette	E-Cigarette	Quit
Cigarette Warning												
Pictorial Warning	-0.051*	0.012	0.038	-0.059**	0.030	0.029	-0.074**	0.001	0.073**	-0.081***	0.026	0.054*
	(0.031)	(0.029)	(0.026)	(0.026)	(0.023)	(0.023)	(0.031)	(0.029)	(0.034)	(0.027)	(0.025)	(0.030)
Price												
Cigarette Price	-0.018***	0.009***	0.008***	-0.022***	0.012***	0.010***	-0.017***	0.007***	0.011***	-0.016***	0.008***	0.008***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
E-cigarette Price	0.016***	-0.020***	0.003	0.018***	-0.016***	-0.003	0.011***	-0.016***	0.005**	0.013***	-0.014***	0.000
	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.003)	(0.003)	(0.002)	(0.002)	(0.002)	(0.002)
E-Cigarette Available Flavor												
Tobacco, Menthol, Fruit/Sweet/Candy	-0.054***	0.055***	-0.001	-0.004	0.010	-0.006	-0.059***	0.072***	-0.014	-0.007	0.015*	-0.008
	(0.012)	(0.012)	(0.009)	(0.011)	(0.010)	(0.008)	(0.012)	(0.012)	(0.010)	(0.010)	(0.009)	(0.008)
Tobacco and Menthol	-0.052***	0.045***	0.007	-0.013	-0.012	0.025***	-0.050***	0.056***	-0.006	-0.005	-0.004	0.008
	(0.014)	(0.013)	(0.011)	(0.011)	(0.008)	(0.009)	(0.012)	(0.012)	(0.011)	(0.010)	(0.008)	(0.009)
E-cigarette Available Nicotine Level												
Up to 20mg	0.004	-0.017	0.012	-0.012	0.018**	-0.006	-0.000	-0.006	0.007	-0.008	0.005	0.002
	(0.011)	(0.011)	(0.008)	(0.009)	(0.008)	(0.007)	(0.010)	(0.010)	(0.009)	(0.008)	(0.007)	(0.007)
Up to 50mg	0.020**	-0.022**	0.002	0.006	-0.000	-0.006	0.001	-0.011	0.011	-0.000	0.007	-0.007
	(0.010)	(0.010)	(0.009)	(0.010)	(0.009)	(0.008)	(0.010)	(0.010)	(0.010)	(0.009)	(0.008)	(0.008)
E-Cigarette Warning												
Are Not Completely Risk Free	0.003	-0.012	0.009	0.008	0.005	-0.014	-0.005	0.002	0.003	0.008	0.004	-0.012
	(0.013)	(0.013)	(0.012)	(0.011)	(0.009)	(0.010)	(0.013)	(0.013)	(0.013)	(0.011)	(0.010)	(0.011)
Contain Nicotine, Which Is Addictive	0.027*	-0.017	-0.010	0.034***	-0.016	-0.018*	0.015	-0.001	-0.014	0.016	-0.007	-0.008
	(0.015)	(0.014)	(0.012)	(0.013)	(0.011)	(0.010)	(0.015)	(0.015)	(0.014)	(0.013)	(0.011)	(0.012)
May Expose Users to Chemicals and Toxins	0.012	-0.014	0.002	0.017	-0.021**	0.004	0.007	-0.007	0.000	0.010	-0.023**	0.013
	(0.014)	(0.013)	(0.012)	(0.012)	(0.010)	(0.010)	(0.014)	(0.014)	(0.014)	(0.011)	(0.010)	(0.010)
Constant	0.819***	0.160*	0.021	0.495***	0.326***	0.180*	0.970***	0.317***	-0.286**	0.579***	0.177*	0.243*
	(0.112)	(0.094)	(0.098)	(0.109)	(0.093)	(0.106)	(0.116)	(0.102)	(0.123)	(0.111)	(0.102)	(0.131)
Observations	5,376	5,376	5,376	6,912	6,912	6,912	5,376	5,376	5,376	6,912	6,912	6,912
Dep Var Mean	0.558	0.268	0.175	0.616	0.203	0.182	0.423	0.245	0.332	0.442	0.200	0.358

Note: Additional control variables include smoking status (being every day smoker), age of smoking initiation, heavy smokers (heavy smoker index ≤ 3), vaping status (ever used e-cigarette), quitting effort (tried to quit during last 12 months), quit intention (intend to quit in the next 6 months), gender (being male), age, household size, education (reference category is grade school/some high school), household income above 50k, full-time employed, white. The reference category of e-cigarette available flavor "tobacco only", the reference category of e-cigarette available nicotine level is "up to 5mg", the reference category of e-cigarette warning is "no warning." Standard errors clustered at respondent level. Source: 2021 Online Cornell survey.

*Statistical significance at the 10% level.

**Statistical significance at the 5% level.

***Statistical significance at the 1% level.

Table 8: Summary of Estimated Associations between Menthol Use and Smoking/Internality Outcomes

	(1)	(2)	(3)	(4)
	Sample Mean of outcome variable	Menthol as Marker	Difference between non-Black menthol smokers and baseline group	Difference between Black menthol smokers and baseline group
		β_1 from specification (1)	β_1 from specification (3)	$\beta_1 + \beta_2 + \beta_3$ from specification (3)
Table 3: Menthol Use and Smoking Behavior				
Daily Smoker	0.782	-0.029**	0.003	-0.101***
Cigarettes per day	14.35	-1.88***	-0.463**	-4.831***
Started smoking before age 18	0.532	-0.037***	-0.0051	-0.129***
Addiction, based on the Heaviness of Smoking Index	0.451	-0.071***	-0.010	-0.200***
Tabel 4: Menthol Use and Quitting Behaviors				
Past-year quitting	0.088	0.004	0.006	-0.013
Lifetime quitting	0.638	-0.070***	-0.024*	-0.078***
Past-year quit attempt	0.408	0.040***	0.014	0.078***
Number pf past-year quit attempts	0.828	0.136***	0.0496***	0.297***
Intent to quit in next 6 months	0.398	0.014	-0.014***	0.078***
Successful quite attempt	0.217	-0.010	0.005	-0.060**
Table 5: Menthol Use and Cigarette Purchasing Behaviors				
Purchase by pack	0.067	0.0871**	0.014	0.219***
Price paid per pack	6.615	0.158***	0.038	0.237***
Purchase out of state	0.088	-0.012*	0.004	-0.022**
Single cigarette purchase	0.014	0.031***	0.003	0.085***
Table 6: Menthol Use and Consumer Information and Internalities				
Index of Mistaken Information and Internalities	2.66	-0.066	-0.065	0.023
Perceived life years lost to smoking	11.73	1.457**	0.457	1.8688**
Agree that nicotine causes cancer	0.4	0.044	-0.017	0.1242**
Perceive E-cigs more Harmful	0.56	-0.007	-0.009	-0.042
Strongly Agree I smoke more than I should	0.54	-0.008	-0.009	0.036
Smoked longer than intended	0.85	-0.0295	0.0105	-0.0256

Note: Statistically significant results that are consistent with internality-based market failures are shaded in dark gray. Statistically significant results that are not consistent with internality-based market failures are shaded in light gray. The table contains selected results from tables 3 – 6. Those tables provide the standard errors of the estimated coefficients, additional details about the model specifications that produced the reported results, and results from additional specifications not reported. Column (2) refers to the β_1 coefficient on Menthol Smoker from specification (1). Specification (1) does not include any control variables. The estimates β_1 from specification (1) show the associations of menthol use with the row's outcome variable, compared to the baseline of white non-menthol smokers. Column (3) refers to the β_1 coefficient on Menthol Smoker from specification (3). Specification (3) includes the additional control variables listed in the notes to tables 3 - 6. The estimates of β_1 from specification (3) show the associations of menthol use with the row's outcome variable for non-Black menthol smokers, compared to the baseline of white non-menthol smokers, after controlling for the other variables. Column (4) refers to the sum of the β_1 coefficient on Menthol Smoker, β_2 coefficient on Black, and β_3 coefficient on Menthol×Black from specification (3). The estimates of $\beta_1 + \beta_2 + \beta_3$ from specification (3) show the associations of menthol use and the row's outcome variable for Black menthol smokers, compared to the baseline of white non-menthol smokers. The significance levels in column (4) refer to the test that the sum of the coefficients is different from zero. Standard errors clustered at the respondent level.

*Statistical significance at the 5% level.

**Statistical significance at the 1% level.

***Statistical significance at the 0.1% level.