9-20-2020

Smoke or Vapor: Regulation of Tobacco and Vaping

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Prieger, James, "Smoke or Vapor: Regulation of Tobacco and Vaping" (2020). Pepperdine University, *School of Public Policy Working Papers*. Paper 78.

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September 14, 2020

Chapter forthcoming in *Regulation and Economic Opportunity: Blueprints for Reform*, The Center for Growth and Opportunity

Smoke or Vapor?

Regulation of Tobacco and Vaping

E-cigarettes and vaping raise new questions about the risks to health from their use and how they should be regulated and taxed compared to tobacco. This chapter reviews current and upcoming regulation of e-cigarettes and tobacco and discusses the main issues involved with each. Steps toward better regulation based on harm reduction are proposed.

Smoke or Vapor?

Regulation of Tobacco and Vaping

James E. Prieger

Executive summary

E-cigarettes and vaping raise new questions about the risks to health from their use and how they should be regulated and taxed compared to tobacco. The latter has a long history of taxation and a more recent history of regulation in the United States. E-cigarettes, on the other hand, have only recently begun to be regulated, but by treating them as “tobacco products” the federal regulator includes them by default in the regulatory apparatus design for tobacco control and is sending the tacit message that they are just as harmful as smoking. That is not likely to be the case.

Rationales for regulating tobacco center around correcting for adverse consequence to others of smokers’ decisions, correcting for faulty reasoning of smokers, and paternalism. Taxes and regulations on tobacco can have the unintended consequences of increasing inequality, since their burden falls mainly on lower-income individuals, and stimulating illicit trade in tobacco.

Discussion of regulation targeting e-cigarettes begins with answering many fundamental questions about vaping: is vaping safer than smoking? (almost surely so); can e-cigarettes aid cessation of smoking? (most likely); are children getting addicted to e-cigarettes (perhaps, but probably not in the numbers often assumed); does vaping lead to smoking? (unknown; the evidence is much weaker than often presented); will the new federal prohibition on selling e-cigarettes to those under 21 years of age reduce youth vaping? (unknown, since sales to youth were already disallowed in most places); are there health harms from secondhand vapor? (possibly, but they are almost surely much less than any from secondhand smoke); and whether restrictions on tobacco advertising apply (or should apply) to e-cigarettes (most do not, and applying them may hinder adult cessation). Unintended consequences of

regulating e-cigarettes include the potential for exacerbating the problem of illicit trade, which already exists, and discouraging harm reduction for smokers who would otherwise switch to vaping.

The state of knowledge about the health harms of e-cigarettes and other relevant factors are far too uncertain to arrive at a solid idea of what optimal regulation would look like or what the optimal tax rate would be, as conventionally defined by economists. However, several steps can be taken in the right direction. For tobacco, the possibility that tax rates are too high must be considered. Regarding e-cigarettes: 1) the concept of risk-proportionate regulation should be the guiding principle; 2) the tendencies to understate the likely health benefits of switching from cigarettes to e-cigarettes should be curbed; 3) the uncertainty regarding the health effects of e-cigarettes should not be used to discourage smokers to switch; 4) targeting regulation narrowly at youth is better than broadly applied rules; 5) heavily taxing e-cigarettes is not likely to be in the best interests of public health; 6) careful consideration of whether banning the use of e-cigarettes in public spaces is appropriate is warranted; and 7) regulatory uncertainty at the federal level should be resolved quickly. Finally, in regards to both tobacco and e-cigarettes, serious attention must be paid to the interplay among illicit markets, taxation, regulation, smoking, and vaping. In particular, since e-cigarettes offer smokers an alternative to buying illicit tobacco products, e-cigarettes can attenuate the link between tobacco taxation and illicit trade and thus can provide a valuable “safety valve.”

1 Introduction

Given the well-known health harms from smoking, tobacco is regulated and taxed nearly everywhere around the world. With the introduction of electronic nicotine delivery systems (ENDS), commonly known as e-cigarettes, new questions have arisen about the risks to health from their use and whether they should be regulated as strictly as tobacco. In some quarters, the promise that e-cigarettes and vaping could potentially delivery an attractive, smoking-like sensory experience while

avoiding the health harms from combusting and inhaling tobacco has been greeted with enthusiasm, since the new products could help some smokers transition to a less risky product. In other quarters, and in much of the American public health community, e-cigarettes were greeted with skepticism and hostility, since they could potentially renormalize smoking, set back the great gains in tobacco control of the past several decades, and hook a new young generation on nicotine and smoking. This chapter covers the regulatory history of tobacco and e-cigarettes, upcoming regulatory actions and challenges, a discussion of the key issues involved with regulation of these activities, and suggestions toward better regulation.

Before continuing, a brief discussion of vaping technology and terminology will be helpful. All e-cigarettes work by means of a battery operated heater that vaporizes an e-liquid, which is then inhaled by the user. Sometimes grouped with e-cigarettes are heat-not-burn (HNB) products that heat ground tobacco without combustion. There are many types of e-cigarettes and vaping systems, from cartridge-based “closed” systems in which the consumer buys a disposable, unmodifiable e-liquid cartridge, to tank-based “open” systems in which the vaper buys vials of e-liquid for refill and can customize what is vaped. All of these will be referred to as “e-cigarettes” and their consumption will be called “vaping” unless a distinction among products is required. The exception is that when discussing the scientific literature on the health effects of e-cigarettes, HNB products are typically not included in the studies. Finally, use of e-cigarettes is not smoking; nothing is combusted and there is no smoke.

2 Regulation of tobacco and e-cigarettes in the United States

2.1 Tobacco and Smoking

From 1900 to 1964, per capita consumption of cigarettes grew rapidly from a low figure, until in the latter year the average was more than half a pack a day per adult.¹ The watershed moment in the history of smoking in this country was the publication of the Surgeon General’s report in 1964, which

stated that “cigarette smoking is a health hazard of sufficient importance in the United States to warrant appropriate remedial action.”² After that year, consumption began its long decline, falling to 0.13 packs sold a day per adult in 2018.³ Of course, the average smoker consumes more than that. In 2018, adult smokers reported smoking a bit more than half a pack a day, while retail sales of cigarettes averaged a bit less than one pack per day per adult smoker.⁴ That same year, there were about 34 million adult cigarette smokers and 49 million adult users of any tobacco product, including e-cigarettes.⁵ These figures imply that the prevalence of cigarette smoking has fallen to 13.7% among adults, while the prevalence of any form of tobacco consumption is 19.7%. Adult cigarette smoking prevalence has declined about two-thirds from its peak in the 1960s.

The sale and use of tobacco has been regulated in various ways for decades in the United States, although much of the regulatory action has come relatively recently compared to the long history of smoking. The first federal action regarding the tobacco industry and the health effects of its products was the required addition of the notice that smoking “may be hazardous to your health” on packs. The health warning, which came into effect in 1966, was the first of its kind in the world.⁶ Despite the landmark Surgeon General’s report in 1964, until the 1980s tobacco was specifically exempted from legislation (e.g., the Toxic Substances Control Act) and regulation (e.g., by the Consumer Product Safety Commission) that otherwise would have curtailed the industry or the freedom to smoke.⁷ In 1985, a set of four rotating health warnings with stronger wording were required on cigarette packaging.⁸ The FDA sought to add graphical health warnings in 2011, but legal action by the tobacco industry has delayed the requirement for almost a decade.⁹

The first federally mandated restrictions on where one could smoke came in the late 1980s with bans on smoking on certain domestic airline flights.¹⁰ The so-called Synar Amendment of 1992 required all states to adopt and enforce restrictions on the sales and distribution of tobacco to minors; federal enforcement of the restrictions (through the withholding of certain federal payments to the States)

went into effect in 1996.¹¹ While as recently as the 1980s some states had no restrictions on sales to minors, however defined, by 1995 all states and the District of Columbia prohibited the sale and distribution of tobacco products to those under 18 years of age.¹²

In 1998, the three major tobacco manufacturers signed the Master Settlement Agreement (MSA) with 46 states. In exchange for immunity from legal claims by these states for costs incurred for smoking-related illnesses and death, the three major tobacco manufacturers agreed to pay the states an estimated \$206 billion, finance a \$1.5 billion anti-smoking campaign, and cease various forms of advertising, product placement, event sponsorship, and any form of marketed aimed at youth. While the settling states say that “the central purpose of the MSA is to reduce smoking, especially in American youth,”¹³ it appears that the states spend little of the money collected from the MSA and tobacco taxes on tobacco prevention and cessation programs—well less than three percent in 2018.¹⁴

The entering wedge for direct federal regulation of tobacco as a consumer product came with the Family Smoking Prevention and Tobacco Control Act (TCA) of 2009, which granted the Food and Drug Administration (FDA) the authority to regulate tobacco products. The FDA’s first action under the TCA was to issue a rule in 2010 prohibiting the sale of cigarettes and smokeless tobacco to any person under age 18 (which was already illegal in all states).¹⁵ Since that time there has been a steady flow of proposed and final rules and “guidance” from the FDA regarding tobacco regulation. Figure 1 shows the growth of federal regulation regarding tobacco over time, as measured by the cumulative number of pages of rules in the Federal Register. By 2015, there were over 200 pages of binding regulations, and by the beginning of 2020 there were 224 pages of rules, over 150 pages of guidance regarding those rules, and well over 400 accumulated pages of proposed rules. The pages of proposed rules nearly doubled in 2019 with recent actions by the FDA (about which more will be said in section 2.3 below).

Figure 1: The growth of federal regulation regarding tobacco and e-cigarettes from the FDA

In the first of two recent federal regulatory actions, the age limit for retail sales of tobacco products after December 2019 was raised from 18 to 21 years of age.¹⁶ Before that time, well fewer than half the states had an age restriction that high. In its most recent action, the FDA issued rules requiring graphical warnings on cigarette packages. These new color graphics depicting the negative health consequences of smoking will occupy the entire top half of the area of the front and rear faces of cigarette packages.¹⁷ Some research indicates that such large graphical warnings are more likely to be noticed by smokers or more likely to lead them to consider cessation or smoking less.¹⁸

In addition to tobacco regulations, the federal government has levied excise taxes on cigarettes continuously since the time of the Civil War.¹⁹ The tax remained at 8 cents a pack from 1951 to 1983, when it was doubled. In the early 1990s the tax was raised to 24 cents, and in the early 2000 the tax was raised to 39 cents. In 2009 the largest increase ever resulted in a per-pack tax of \$1.01, where it remains today.

State taxes on tobacco vary widely, although most states have increased their cigarette taxes in the last two decades. From 1970 to 2018, the average state excise tax (not weighted for population or consumption) increased from 9.6 cents per pack to \$1.74, for an annualized growth rate of 7.5% (inflation during this period averaged 3.9% per year) (see Figure 2). State taxes grew exceptionally quickly after 2000, with a growth rate of the average tax of 7.5% per year (compared to inflation of 2.0% per year). Adding the federal tax on top of the state taxes shows that the combined rates rose by an average of 5.7% per year since 1970 and 6.9% per year since 2000. These large increases in the taxes over time resulted in almost 40% of the retail sales prices of cigarettes going to excise taxes in 2018, or, to put it another way, an effective 65% tax rate on a pack.

Figure 2 also shows the population weighted averages of the taxes; these reflect the excise taxes facing the average person in the nation. For the most part these are similar to the simple averages, with the exception of a divergence in 2017 due to California enacting a large tax increase. Overall, these levels of taxation make cigarettes one of the most highly taxed products in the nation. By comparison, state alcohol taxes averaged only three to five cents per drink in 2015.²⁰

Figure 2: The growth of state and federal excise taxation on cigarettes

2.2 E-Cigarettes

The market for e-cigarette products in the United States began to take off around 2006. In 2008, the e-cigarette market had only \$28 million in revenue from an estimated 190,000 vapers, but by 2017 it was a \$4.6 billion market earned from an estimated 8.4 million vapers.²¹ Those figures represent a revenue growth rate of over 50% per year. Given the recency of e-cigarettes as a significant product it is unsurprising that the regulatory history regarding vaping is short. In 2016, the FDA “deemed” e-cigarettes (or, more properly speaking, electronic nicotine delivery systems, ENDS) to be tobacco products. While the FDA has the legal authority to deem new or existing products to be tobacco products, and thus subject to their regulatory authority, it is worth noting that ENDS do not contain tobacco. While nicotine is the addictive substance found in tobacco, it is the other constituents in tobacco that, when combusted and inhaled, cause the main health problems associated with smoking. In particular, to quote a report from the National Academies of Sciences, “there is no evidence to

indicate that nicotine is a carcinogen.”²² Thinking of e-cigarettes as a tobacco product thus greatly confuses the issue, a point to which we will return below.

After deeming e-cigarettes to be a tobacco product, the FDA aimed its entire set of tobacco-related regulations at vaping products as well. Manufacturers of existing products had to register with the FDA and submit lists of products, their ingredients, and evidence on their health effects.²³ Products are now required to place on the packaging a warning that they contain nicotine and that nicotine is an addictive chemical. Products introduced between 2007 and August 2016 could continue to be sold while their applications for regulatory approval were considered by the FDA.²⁴ New e-cigarette products are not allowed to be introduced after August 2016 without premarket approval. Since the FDA has not ruled on any e-cigarette application yet, in part because continuing legal action made uncertain the deadline for their submission, anti-vaping advocates can still truthfully claim that there are no FDA-approved e-cigarettes on the market.²⁵ In January 2020, the FDA also effectively prohibited sales of any flavored cartridge-based e-cigarettes (other than tobacco-, mint-, and menthol-flavored).²⁶ However, flavored e-liquids for open-system tank vaping (typically available at vape shops) remain allowed.²⁷

With e-cigarettes added to the regulatory purview of the FDA, age restrictions on sales to youth under age 18 and the prohibition of sales from vending machines came into force in 2016.²⁸ Most states had already banned sales to youth before the federal action (see Figure 3), and over time many states raised their age restrictions on sales to 19 or 21 years. Near the end of 2019, as mentioned above, the federal age limit was raised to 21 for all tobacco products, thus including e-cigarettes.

Source: Tobacco Control Legal Consortium and other sources.

Figure 3: The growth of state regulation regarding e-cigarette sales to youth

States have also been free to impose other regulation upon the sales and usage of e-cigarettes. The increasing number of other regulations among the states is depicted in Figure 4. Some states require retailers to obtain special licenses to sell e-cigarettes, typically with the goal of limiting youth access to vaping products; some place the same restrictions on using the devices in public that smokers face (thus applying “smoke-free” rules to a smoke-free product). Finally, a minority of states levies excise taxes on e-cigarettes (in contrast to ubiquitous state tax cigarettes).

Source: Tobacco Control Legal Consortium and other sources.

Figure 4: The growth of other state regulations regarding e-cigarette sales and usage

2.3 Upcoming Potential Regulatory Changes

The FDA is currently undertaking several rulemaking processes on tobacco regulation. One regulatory proceeding is considering whether menthol flavoring in cigarettes (other flavors are already illegal) will be banned.²⁹ Perhaps the most ambitious regulatory action contemplated by the FDA is to lower nicotine in cigarettes to minimally- or non-addictive levels.³⁰ While the FDA does not have the authority to ban cigarettes outright, such action would effectively kill the legal market for the product as it exists today. Public comments on the latter two proceedings were due in the summer of 2018 but the FDA has not issued final rules (or announced that they were abandoning the effort) for either as of the start of 2020.

As discussed in section 2.1, apart from a single heat-not-burn product, the FDA has not issued rulings on any of the submissions for regulatory product approval for e-cigarette products. Thus, the industry faces a large degree of uncertainty going forward regarding the amount of effort required for

successful submissions. The fact that the one approved product, IQOS by Philip Morris International (PMI), purportedly required billions of dollars for regulatory compliance on the part of the manufacturer and experienced two years of regulatory delay until approval does not bode well for any maker of e-cigarettes apart from the largest tobacco manufacturers.³¹

Although not new regulation per se, the main upcoming regulatory action by the FDA—eagerly awaited by industry and the public health community—is a definitive ruling on any of the regulatory approvals sought for e-cigarette products, discussed above. It remains to be seen whether any such products will be allowed to claim that they are safer than cigarettes or whether they aid in cessation of smoking. It is also unclear whether any cartridge-based ENDS products flavored with other than mint or menthol will be approved; despite the current sales ban the FDA has not ruled out such products from gaining regulatory approval. As mentioned above, the only ruling to date has been on a heat-not-burn product, which differs in many ways from traditional vaping products.

3 Issues involved with taxing and regulating tobacco and e-cigarettes

3.1 Tobacco

In this section, the various rationales offered for regulating tobacco and some of the unintended consequences of doing so are discussed.

3.1.1 What are the rationales for taxing and regulating?

The three main rationales for excise taxes and regulations on tobacco fall into two categories. The main *economic* rationale has traditionally been to tax tobacco to align the private and social costs of smoking. The main *actual* rationale appears to be paternalism. In recent years a hybrid rationale has emerged in which theories from behavioral economics are used to justify paternalistic taxation and regulation. These are all discussed here.

3.1.1.1 *The economic rationale: externalities*

The traditional economic rationale for tobacco taxation is to correct consumers' faulty incentives (i.e., taxation to correct for externalities à la Pigou). In other words, the main economic rationale for tobacco taxation depends on the presence of negative externalities.

An externality in this context is an effect of consumption that creates adverse consequences for persons other than the decision-maker. So-called Pigovian taxes are set to correct for the externalities, so that the consumer considers the costs and benefits of his actions from the social rather than merely the personal perspective. The two externalities discussed for consumption of tobacco are the burdens imposed on taxpayers (fiscal externalities) and the burdens imposed on non-smokers (health externalities).³² When smokers degrade their likely future health by their consumption of tobacco, they create future expected costs for publicly funded health programs such as Medicare. However, whether it is proper to treat such "fiscal externalities" identically to other externalities in the social calculus is debated.³³ Externalities require attention and possibly correction because they create inefficiencies, not because they transfer benefits from one party to another in the economy. The inefficiencies associated with fiscal externalities, however, are due to the inefficiencies inherent in subsidized healthcare, not smoking per se. That is, the inefficiency (if any) arises because of the policy (Medicare), not the individual's action (smoking).

The remaining difficulties with an argument based on fiscal externalities, for those wishing to justify large tax rates on cigarettes, are twofold. First, the cost of a pack is borne today (by the buyer) but any future external costs for society to fund healthcare are far in the future. The present expected discounted value of those future health costs is small, and thus so would be the corrective taxes. (Note, however, that if healthcare cost increases continue to outpace general inflation, this first rebuttal loses some force.) Second, since smokers on average die younger than nonsmokers, they *reduce* the drain on the public purse for social security payments and have fewer years of eligibility for (costly) Medicare.³⁴

Thus it is unsurprising that studies taking these considerations into account while computing the optimal tax generally find that current excise tax levels are too high compared to the net externalities.³⁵ even using an astronomically high figure for the health cost to society of smoking a single pack (\$35), the optimal tax to correct for negative externalities would be only 40 cents per pack (compared to the actual excise tax averaging around \$2.80 in 2018).³⁶ The weight of the literature instead finds similarly small externalities, but some notable exceptions actually find social savings from smoking (although these tend to be countries with higher public expenditure on health than the United States).³⁷

The other negative externality created by smoking is the burden imposed on non-smokers, primarily through second-hand smoke. Such burdens include the annoyance from being exposed to others' smoke and any adverse health effects. Given that "everyone knows" how harmful second-hand smoke is, many people would be surprised to learn how weak the scientific evidence used to justify the indoor smoke-free laws of the 1990s actually was.³⁸ A landmark study in 1993 from the Environmental Protection Agency purported to show the adverse health effects of second-hand smoke and was influential in the passage of many local and state smoke-free ordinances. However, the report was savaged by a federal court.³⁹ The study, which stated that it reviewed the best available scientific evidence at the time, was thrown out by the court in part because it "did not demonstrate a statistically significant association between [second-hand tobacco smoke] and lung cancer," which was its main claim. The point of rehearsing the story behind the first smoke-free ordinances is not to suggest that second-hand smoke does not have adverse health effects; that link is better established today. Rather, it is to note that, as is likely the case with the debate about e-cigarettes today (as will be covered in section), the call to regulate smoking was sustained by political and social factors beyond those supported directly by the scientific knowledge at the time.⁴⁰

Today, it is estimated that there are about 41,000 deaths per year in the United States attributable to second-hand smoke.⁴¹ That figure represents about 1.5% of all deaths.⁴² The negative

effects of maternal and passive smoking on infant and child health are considered some of the most important negative externalities.⁴³ Various studies have associated smoking during pregnancy with reduced fetal growth, low birth weight, and, later in life, obesity, cardiovascular disease, and respiratory ailments. However, it remains the case that some of the links are often weaker than people assume. For example, one meta-analysis covering 76 studies on environmental tobacco smoke exposure found that there was no statistically significant association between environmental tobacco smoke in the home and premature births, low birthweight, spontaneous abortions, or lower APGAR scores at birth.⁴⁴ On the other hand, the same meta-analysis found positive association of secondhand smoke with congenital malformations.⁴⁵ Furthermore, many studies find that anti-smoking regulations are associated with better infant and child health.⁴⁶

Before leaving the subject of negative externalities, it is important to note that a tax is a blunt instrument to reduce environmental tobacco smoke exposure. While the price elasticity of market demand for cigarettes is estimated to be around 0.4, implying that a 10% increase in the price reduces total consumption in the market by only 4%, other more direct interventions can have much larger impacts. For example, if the concern is regarding the health of unborn children in a smoking household, then one behavioral intervention—involving advising about health risks, introducing strategies within the home to eliminate exposure to smoke, and other aspects—reduced the odds of second-hand smoke exposure by one-half.⁴⁷ From the viewpoint of political economy, it must be recognized that policymakers may prefer tobacco taxes to cessation or second-hand smoke behavioral intervention programs because the former raises revenue for the state while the latter require public expenditure.

3.1.1.2 The behavioral rationale: “internalities”

Since taxes on tobacco may already be too high from the usual point of view of taxing to correct for externalities, tobacco control advocates have turned to the recent justifications based on behavioral economics that have cropped up in recent years. The non-technical version of this argument proceeds

along these lines: Youth are not rationally forward-thinking consumers, and most smokers begin in their youth. The former assertion, coupled with the latter empirical observation, and supplemented with survey evidence showing that most smokers say that they wished that they had not started smoking,⁴⁸ argue for setting aside the usual economic rationales and deciding to “just tax it”, in this view. Arguments against this rationale include the observation that (as discussed above) taxes are blunt instruments to prevent smoking, especially since many youth do not pay for their cigarettes and in particular their *first* cigarettes.⁴⁹ The greatest weight of a tax would fall on adults, not youth. Furthermore, sales of tobacco to youth are already illegal; if that “infinite tax” does not prevent initiation of smoking by youth, then why would a finite tax (especially since both can be evaded, as discussed in section 3.1.2.2 below)? The evidence is mixed regarding the impact of cigarette prices on youth smoking. At least some studies find that higher prices lower the propensity of youth to smoke,⁵⁰ although other research indicates that the actual driver affecting youth’s smoking behavior is anti-smoking sentiment or regulations in the state rather than prices per se.⁵¹

Extending the behavioral economic rationale for tobacco taxes to adults requires a theory involving so-called “internalities,” irrational behavior due to limited self-control or foresight. Such theories, when applied to tobacco consumption, assume that there is a “behavioral wedge” between the price of the good and the value to the consumer of the last unit consumed.⁵² Whereas a rational consumer (roughly speaking) spends money on a commodity to the point where it is just worth it, in terms of satisfaction gained for the price paid, the behavioral wedge implies that the individual “overconsumes” the good, even as evaluated by the person’s own preferences. This may happen, for example, if youth underestimate the likelihood that they will get addicted and become life-long smokers (with all the resulting pecuniary and health costs) when first trying smoking. The result is that, theoretically, increasing a price by increasing an excise tax actually increases the person’s welfare. Thus a tax helps “nudge” a consumer toward an outcome that is better for that person, in the estimation of

that person. One study adopting this approach arrived at an “optimal” tax to correct for internalities would be up to \$15 per pack (!), which is far higher than any tax in the nation. Thus the behavioral approach is convenient for parties advocating for higher tobacco taxes.

3.1.1.3 *The paternalistic rationale*

As is clear from the discussion of the behavioral rationale, many policy analysts and policy makers approach the subject of tobacco regulation with a heavy dose of paternalism, viewing smokers as faulty decision-makers who need to be saved from their poor choices. Some authors are quite explicit about this; for example, one behavioral economic study performed for a lung cancer group states that “...we will focus on failures of individual self-control which lead to excessive smoking relative to desired levels. In such a case, tobacco taxation can provide a corrective force to combat failures of self-control.”⁵³ In this approach, the power of the state to tax provides a corrective force to nudge (or shove) irrational, tricked, or self-deluded smokers toward cessation.

Paternalism is a comfortable position for many policy makers to adopt, since given smoking’s negative correlation with income and education relatively few of them smoke today. As Kip Viscusi has pointed out, since they chose not to smoke it is therefore easy for them to assume that smokers are mistaken, irrational, or in need of policy nudges toward cessation.⁵⁴ Of course, just because a behavior is hard to quit, it does not necessarily follow that the choice to begin was irrational (as most coffee drinkers would attest).⁵⁵ Furthermore, assumed faulty choices based on mistaken perceptions of the health effects of smoking appear to be unlikely, since if anything the American public *overestimates* the risks of smoking today.⁵⁶ (The evidence on whether youth in particular hold correct perceptions of the risks from smoking is mixed, however.)⁵⁷

Evidence for intertemporal irrationality and time inconsistency in decision-making (by which economists mean that your future self will regret decisions made by your present self) comes mainly from lab experiments. These are typically performed on college students at elite universities, hardly a

representative demographic. There is also a small empirical literature which claims to find time inconsistency in real-world economic decisions (other than smoking).⁵⁸ Such apparent irrationality, of course, follows from individuals in the data not making the choices that the economic theorists think that they should after estimating impressively technical yet still restrictive models of choice; it remains to be seen how robust these findings will be to more realistic models of economic behavior based on less restrictive assumptions.

While the arguments for paternalistic action by the state thus assume that smokers “need help helping themselves,” arguments for less paternalism can be based on normative and positive grounds.⁵⁹ Normative ideas include those that the proper role of government is to protect the liberty of the citizens regarding, *inter alia*, economic decisions, and that (absent compelling reasons to the contrary) individuals should be free to make choices without governmental interference. Conversely, even granting the premise of limited cognition and the desire to optimize the behavior of individuals who cannot do so themselves, bounded rationality can raise the costs of government decision-making relative to private decision-making.⁶⁰ Positive arguments against paternalistic tobacco taxes are based on the unintended consequences that they can cause. For example, evidence from the 1990s indicated that higher prices caused smokers to switch to cigarettes that were higher in tar and nicotine, and therefore more harmful and addictive.⁶¹ Other unintended consequences are covered in the next section.⁶²

3.1.2 Unintended consequences from taxes and regulations

An effective approach to policy must focus less on what policymakers hope will happen and more on what is likely to happen. This takes us into the realm of unintended consequences.

3.1.2.1 Tax equity

A standard desideratum for taxation is equity, based on the ability-to-pay principle. This principle leads to the system of progressive income taxation in the United States, for example. However,

excise taxes on cigarettes are regressive: poorer individuals spend a greater share of their income on consumption, and therefore an excise tax takes a greater share portion of a poor person's income than it does of a wealthy person. Furthermore, cigarette smoking is more prevalent among lower-income groups in the United States. These facts compound to make tobacco taxes doubly regressive.⁶³ While tobacco taxes may constitute only a small part of the total financial burden facing most smokers, in some cases the tax burden could be onerous. Consider, as an extreme example, a full-time minimum wage worker in Chicago, where combined federal, state, county, and local tobacco taxes during the second half of 2019 were \$8.17 per pack.⁶⁴ During that period, the taxes alone on a pack-a-day smoking habit would have taken up 12% of the individual's gross wages.⁶⁵

If higher taxes encouraged many low-income individuals to quit smoking, then one could argue that the regressive impact of tobacco taxes would be blunted or removed entirely. The evidence for the predicate is weak, however. While there is evidence that higher prices lead to there being fewer smokers, even among the low-income population, evidence for a link between prices and cessation is less clear (in part because cessation is harder to study than smoking prevalence). One study found that there is no correlation between cigarette prices in the state and successful cessation among smokers below the poverty line, either in bivariate analysis or after controlling for other factors.⁶⁶ Low-income individuals who still smoke tend to be hard-core smokers whose behavior is difficult to change; taxing them simply raises their financial burdens if they do not quit.⁶⁷ The indirect evidence for higher taxes leading to cessation is stronger: several studies show that tax increases lead to a lower smoking prevalence among older smokers.⁶⁸ Given that few people begin smoking once out of their 20s, a lower prevalence among older smokers is indicative of cessation.⁶⁹ Regardless, another study found that even when accounting for the different sensitivity among income groups of smoking to prices, cigarette tax increases remain regressive.⁷⁰

Proponents of higher tobacco taxes often respond to the regressivity argument by arguing that revenue from the taxes should be directed toward cessation programs intended to help low-income smokers quit or to relieve their financial burdens.⁷¹ The former may be an admirable intention, but as mentioned above less than three percent of current tobacco tax and MSA payments are spent on cessation.⁷² The latter is an odd argument, since no scheme taxing a subset of the poor could result in net financial gains for those taxed. A final open question regarding the equity of taxes is whether the health benefits of reduced smoking accrue disproportionately to lower income individuals and families. If so, the direct regressivity of the taxes would be attenuated (or even reversed) by the offsetting health benefits.

3.1.2.2 Illicit trade

As stated in a leading economics textbook on public finance, “markets do not take taxes lying down.”⁷³ Furthermore, “the avoidance of taxes is the only pursuit that still carries any reward” (attributed to John Maynard Keynes). A large body of research indicates that increasing tobacco taxes can have the unintended consequence of stimulating illicit trade in tobacco products (ITTP).⁷⁴ In this country, most ITTP takes the form of legitimately manufactured cigarettes that are transported between states to be sold illicitly, avoiding state and local excise taxes at the point of retail sale. ITTP can also involve counterfeit cigarettes, untaxed sales from Native American reservations, illicit whites (cigarettes legal in the country of manufacture but intended for illegal sales in other markets), and gray market re-imported goods.⁷⁵ ITTP is big business. The National Academy of Sciences found in 2017 that illicit sales compose between 8.5 percent and 21 percent of the total market for cigarettes in the United States. This range represents between 1.24 to 2.91 billion packs of cigarettes annually and between \$2.95 billion and \$6.92 billion in lost gross state and local tax revenues.”⁷⁶ Worldwide, the avoided taxes from ITTP are estimated to be in the tens of billions of dollars per year, putting ITTP in the same financial class as the global traffic in illicit drugs.⁷⁷

The economic explanation for ITTP is simple: licit and illicit cigarettes are substitutes, and when the tax-inclusive price of the licit good rises, some users will switch to the illicit substitute. The degree to which tax increases and tax differentials among states and localities cause substitution toward ITTP depends on many factors, including the rule of law, enforcement at customs borders and at points of sale, the ease of access to illicit sources, the price differential between licit and illicit cigarettes, and the moral sentiments of the smoker.⁷⁸

While the basic fact that an increase in taxes leads to more ITTP, holding other factors constant, is generally accepted by most economists, there is much disagreement over the policy implications. If tax rates across states were unified, then presumably raising a unified rate would not stimulate as much ITTP as raising an already high local tax (such as in Chicago or New York City) given the large role that interstate tax arbitrage currently plays.⁷⁹ Some in the public health community downplay any suggestion that taxes are linked to ITTP, dismissing the argument through guilt by association, since the tobacco industry makes this claim.⁸⁰ Others argue that either the effects are small or that other measures can be taken to combat illicit trade.⁸¹ Careful empirical investigation has shown, however, that raising taxes can lead to sizeable increases in ITTP.⁸² Notwithstanding, the evidence is clear that in most cases ITTP may erode but does not reverse revenue gains from increased taxes. Similarly, taxes do decrease consumption, even though ITTP may attenuate the amount by which it does so.⁸³

Before leaving the subject of ITTP, it is important to note that it creates additional harms to health. Counterfeit cigarettes have been shown to contain pesticides, human and animal waste, heavy metals, and other harmful substances.⁸⁴ Furthermore, law enforcement directed at ITTP can create other harms, including those from incarceration and violence, given the well-known link between enforcement against illicit drug markets and violence.⁸⁵

3.2 E-cigarettes

The main issues surrounding vaping concern its safety, its relationship to smoking and whether it is a promising avenue for harm reduction, and unintended consequences from regulation and taxation. Harm reduction refers to policies and approaches aimed at reducing the harms from an addictive substance, but not the use of the substance per se.⁸⁶ The viewpoint of harm reduction is widely accepted in the public health community for alcohol and illicit drugs, but it is controversial in the tobacco control community, mainly because of guilt by association with Big Tobacco, which “has been seen by some to lead the harm reduction push (through the development of new nicotine delivery devices).”⁸⁷ Thus in traditional tobacco control the importance of abstinence is taken as the goal rather than finding safer ways to consume nicotine. The rejection of harm reduction as a guiding philosophy is sometimes justified with reference to the precautionary principle, which posits that lack of scientific certainty should not delay action to regulate or ban new products such as e-cigarettes.⁸⁸ Notwithstanding, the discussion to follow examines the issue through the lens of harm reduction and whether e-cigarettes could be part of such an approach.

3.2.1 Is vaping safer than smoking?

What many consider to be the most important question is the easiest to answer. Because they do not involve combustion, and because the combustion of the organic material in a cigarette creates nearly all the health hazards, it would be surprising indeed if e-cigarettes were found to be as risky for health as smoking. This simple expectation has been greatly muddled in the public mind by certain public health advocates who hold a priori goals of abstinence for both smoking and vaping. Thus a review of the state of current knowledge on this topic is useful.

To begin with, from the standpoint of harm reduction, the question is not whether e-cigarettes pose *no* health risks at all (except perhaps for the question of initiation by youth, a question to which we will return below). In the context of the public health disaster caused by smoking, the proper first

question must be whether e-cigarettes are *safer* than cigarettes, and to what degree. Before delving into the literature, it is useful to know that after considering the state of the evidence, the official health ministry of England declared that vaping is at least 95% less harmful to health than smoking.⁸⁹ The purpose of Public Health England's statement in 2015 was not to present a precise risk multiple but instead to effectively encourage smokers who have been unable to quit by other methods to switch to vaping instead of smoking.⁹⁰

E-liquids and vapor contain substances known to be harmful to human health when inhaled, including irritants, carcinogens, and particulates (Cheng, 2014). Then again, much of modern life exposes individuals to harmful substances. Thus the question is what the short- and long-term health effects from such exposure are and how they compare with those from smoking. One difficulty in discussing the health effects of "vaping" is the great multiplicity of products; there is no "standard" vapor, concentration of chemicals in e-liquids, or intensity of inhalation. Notwithstanding, one study found that along the spectrum of products tested, the preponderance of products produced vapor with cancer potencies of less than 1% of tobacco smoke.⁹¹ Having fewer harmful substances in the vapor leads to fewer in the body. Another study concluded that switching completely from cigarettes to e-cigarettes "substantially reduced levels of measured carcinogens and toxins" in the body.⁹² Overall, the National Academy of Sciences (NAS) report on e-cigarettes found that "there is conclusive evidence that completely substituting e-cigarettes for combustible tobacco cigarettes reduces users' exposure to numerous toxicants and carcinogens present in combustible tobacco cigarettes."⁹³

Perhaps the strongest case against vaping on grounds of deleterious health effects would be based on respiratory disease, since exposure to particulates and flavorings in e-cigarette vapor could potentially impair the function of the lungs. Several studies find that vaping can cause acute respiratory symptoms such as coughing and wheezing, particularly among adolescents. Some of these studies do not control for concurrent or past smoking; controlling for these confounding factors can remove some

of the positive associations between vaping and respiratory symptoms.⁹⁴ Even here, however, the recent National Academy of Sciences report concluded that “there is no available evidence whether or not e-cigarettes cause respiratory diseases in humans.”⁹⁵ Conversely, the same report found “limited evidence” for improvement in symptoms from asthma and chronic obstructive pulmonary disease (COPD) when smokers who suffered from those ailments switched completely to vaping. Summarizing evidence concerning a variety of potential ill health effects, the NAS report found that there is “substantial evidence that completely switching from regular use of combustible tobacco cigarettes to e-cigarettes results in reduced short-term adverse health outcomes in several organ systems”, including the respiratory system.

To conclude, while there is great uncertainty about the long-term effects of vaping, the answer to whether using e-cigarettes is better for health than smoking is almost surely “yes”. When viewed along the continuum of health risk for nicotine delivery methods, e-cigarettes appear to be much closer to nicotine replacement therapies than to smoking. However, the strongest conclusions for the supremacy of e-cigarettes over cigarettes regarding health effects are reached for users who switch completely away from smoking. There is no available evidence whether long-term e-cigarette use among dual users (i.e., those who continue to smoke) changes morbidity or mortality compared to smokers who do not vape.⁹⁶

3.2.2 Do e-cigarettes aid in cessation?

Is vaping a useful aid to help smokers quit smoking, or does it just prolong the habit by allowing smokers another way to consume nicotine when they are temporarily unable to smoke? It appears likely that e-cigarettes would be a more appealing cessation aid than nicotine replacement therapies (NRTs) such as patches, gum, or lozenges, given the sensory and behavioral similarity of vaping to smoking. The scientific literature on e-cigarettes and cessation is still in its early stages; given the novelty of vaping no long-term studies on e-cigarettes and cessation have been performed. However, the initial literature is

mainly encouraging. A review of existing studies conducted in 2015 found that, overall, use of e-cigarettes was positively associated with both cessation of smoking and reduction in the intensity of smoking (for those who did not quit).⁹⁷ A more recent review of studies on cessation came to a similar conclusion, but only after excluding numerous published studies that did not meet standard levels of quality for scientific research in medicine or public health.⁹⁸ The latter meta-analysis found that rates of smoking cessation with e-cigarettes were generally similar to rates of cessation with NRT, while the former found e-cigarettes to be twice as effective as NRT.⁹⁹ Some research conducted after these reviews also supports the role that e-cigarettes can play in cessation.¹⁰⁰

3.2.3 Are kids getting addicted to e-cigarettes?

There have been many dire, headline-grabbing reports issued in recent years referring to the “vaping epidemic” among youth. For example, many variations on the headline that “teen vaping surges to more than one in four students” appeared in 2019.¹⁰¹ However, the publicized prevalence of 27% pertains to using an e-cigarette once or more during the past 30 days among high-school students. There is clearly a lot of casual use among high-schoolers, since their prevalence of *substantial* use of e-cigarettes (defined as use on 20 or more days out of the past 30) is less than 10%.¹⁰²

Furthermore, substantial use of e-cigarettes is mostly confined to youth who already smoke. Among students who had never tried any actual tobacco product in 2018, the prevalence of substantial use of e-cigarettes was found to be only 1.0% in another study.¹⁰³ For such never-smokers, only 3.8% reported craving and only 3.1% reported wanting to use an e-cigarette within 30 minutes of waking. Combined with evidence that most dual-using high-schoolers began with smoking, not vaping (see the next section), the article concludes that the data “do not support claims of a new epidemic of nicotine addiction stemming from use of e-cigarettes.”¹⁰⁴ Nevertheless, however measured the prevalence of vaping continues to rise among youth, and as such it will require continued monitoring.

Finally, it is worth noting that not all youth vaping represents net health harms to the individual and society, given that in a counterfactual “no e-cigarettes” world some young vapers would be smokers instead (or, in the case of dual use, potentially heavier smokers). The relationship between vaping and smoking is discussed next.

3.2.4 Does vaping lead to smoking among youth?

The findings discussed in the previous section that most e-cigarette use is by smokers leads to the question of which came first. Does vaping lead to smoking (the “gateway hypothesis”), or do underage smokers just find vaping a convenient (and likely cheaper)¹⁰⁵ way to consume nicotine while at school or elsewhere? First, it should be noted that many of the claims that e-cigarette use “causes” smoking are based on nothing more than the observation in population studies that many youth are dual users. However, it is likely that part of the association between vaping and smoking among youth is due to smoking leading to vaping. Another large part of the association is likely due to underlying (confounding) factors (such as a desire for risk-taking or exposure to smoking family members or peers) that make a youth more likely to vape *and* smoke.¹⁰⁶

Given that randomized controlled trials involving exposure to vaping performed on youth are unethical, evidence can only come from observational studies of the population. Such studies, however, are inescapably beset by potential confounding factors. Population studies can control for certain observable demographic and behavioral confounders. Studies doing so that follow youth over time who do not initially smoke find that there is, in the estimation of the NAS report, “substantial evidence” that e-cigarette use increases the risk of trying cigarettes among youth and young adults. However, it is impossible to control for all of the many genetic, behavioral, psychological, and environmental factors that surely must influence the propensities to smoke and vape, and none of the studies use econometric techniques designed to give some assurance that causal effects were identified. Some researchers, therefore, conclude that the association between vaping and smoking is more likely to be spurious than

to be evidence of the gateway hypothesis.¹⁰⁷ As better data and more sophisticated statistical techniques are brought to bear on this question, it may be hoped that greater confidence can be placed on one conclusion or the other.

If the conclusion in the NAS report is statistically meaningful, one would expect that as vaping among youth has risen, so would have youth smoking rates. This is not the case, however. Simply put, youth smoking initiation has been falling while the prevalence of vaping has been rising. A recent trend analysis of the relationship between vaping and youth smoking found that “while trying electronic cigarettes may causally increase smoking among some youth, the aggregate effect at the population level appears to be negligible.”¹⁰⁸ Furthermore, the criterion of temporal precedence for causality states that if vaping causes smoking, then vaping must come before smoking. However, for the great majority of high school smokers, cigarettes were tried before any use of e-cigarettes.¹⁰⁹ In 2014, only 2% of current high-school age e-cigarette users who had smoked at least 25 cigarettes in their lifetimes said that they began with e-cigarettes. In 2015, that proportion had risen but was still only between 8% and 15%.¹¹⁰

Another way to pose the question is whether restrictions on youth access to e-cigarettes will decrease smoking. The scant evidence on this subject appears to point to the opposite conclusion. Imposing minimum age laws for sales of e-cigarettes increased youth smoking participation by about one percentage point, which suggests that some youth who otherwise would have purchased e-cigarettes either began smoking or failed to quit.¹¹¹ Evidence in a similar vein comes from another study of underage rural girls: laws restricting sales of e-cigarettes to youth increased the prevalence of smoking by during pregnancy by 0.6 percentage points, with evidence indicating the cause to be reduced cessation of smoking.¹¹² Given that the goal of minimum age laws is not just to discourage vaping but ultimately to improve health, these iatrogenic effects partially dilute the benefits of such laws.

3.2.5 Will the new federal minimum age law reduce youth vaping?

Young people between 18 and 21 years of age could legally purchase e-cigarettes in the majority of states at the beginning of 2019 (see), whereas none of them could a year later. How much the new age restrictions will reduce vaping among youth is as yet unknown. Based on previous experience with tobacco minimum age laws, we should expect that without enforcement the new law will have little to no effect on underage use.¹¹³ With enforcement, it is natural to expect that youth vaping would decline at least to some extent, if experience with earlier tobacco laws and youth smoking can be a guide.¹¹⁴

However, several factors suggest that the minimum age laws will not eliminate use by underage vapers. First, most youth do not buy their own e-cigarettes at retail stores, since in most places those under 18 have already been disallowed from legal purchase since 2016; acquiring e-cigarettes from social sources (e.g., friends and family) is much more common.¹¹⁵ However, the hope of those raising the legal purchasing age is that younger teens will have fewer members of their social sourcing networks who are over 21. Second, many youth who vape have already demonstrated willingness to break the law. Over two-fifths of youth who use e-cigarettes report vaping THC, which is illegal for youth even in states that legalized cannabis.¹¹⁶ Finally, even in relatively high enforcement states such as California, 7% of stores were willing to sell e-cigarettes illegally to underage vapers.¹¹⁷ This latter finding is in accord with research showing that the majority (75%) of underage smokers who attempt to purchase tobacco in the US are not refused because of age.¹¹⁸

3.2.6 Does vaping create externalities?

As discussed in section 3.1.1.1 above, a classic argument for taxing tobacco rests on health harms created by second-hand smoke. What about second-hand exposure to vapor from e-cigarettes, or even third-hand exposure to chemical residue that settles from vapor onto surfaces? If second and third-hand exposure created large health harms, then taxes on e-cigarettes and restrictions on where they can be used may be justified. Given that the health harms of vaping are not yet known with

precision, it is unsurprising that the secondary and tertiary health impact are also largely unknown, at least in the sense that no “optimal tax” can be calculated yet to align private and social incentives. One systematic review of the scientific literature led to no stronger a statement than that second- and third-hand exposure to vapor from e-cigarettes has “the *potential* to lead to adverse health effects” (emphasis added).¹¹⁹ The influential NAS report concluded that using an e-cigarette indoors “may involuntarily expose non-users to nicotine and particulates” but also that the effects of such exposure remains unknown.¹²⁰ More certain than any health risk from exposure to others’ vapor is that it is likely to be less harmful than second-hand smoke. The two studies just cited state that the “risk from being passively exposed to ... vapor is likely to be less than the risk from passive exposure to conventional cigarette smoke” and that there is “moderate evidence that secondhand exposure to nicotine and particulates is lower from e-cigarettes compared with combustible tobacco cigarettes.”¹²¹

3.2.7 Do restrictions on advertising tobacco apply to e-cigarettes? Should they?

Many of the restrictions on advertising tobacco do not apply to e-cigarettes, since the most important restrictions—most notably, the ban on advertising cigarettes on television and radio—are not FDA regulations. When the FDA deemed e-cigarettes to be tobacco products (see section 2.2), any regulations promulgated by that agency thenceforth applied to e-cigarettes. Thus, since 2018, by federal law all advertisements for e-cigarettes must display the warning that “This product contains nicotine derived from tobacco. Nicotine is an addictive chemical.” The notice must occupy at least 20 percent of the area of the advertisement.¹²² However, there is no federal law against advertising e-cigarettes on television, radio, websites, billboards, public transportation, and other outdoor venues, whereas these are prohibited in most of the U.S. for cigarettes.¹²³ Some states, however, ban advertising of e-cigarettes on billboards.

Whether advertising of e-cigarettes helps or hinders public health depends on how youth and adults respond to advertising, the health effects of vaping, and whether smokers use e-cigarettes to aid

cessation. One recent study found that viewing television (but not magazine) advertising of e-cigarettes encouraged smokers to quit, with most of the effect due to greater success per quit attempt rather than an increase in attempts. The authors estimate that 3% of the decrease in the prevalence of adult smoking is due to television advertising. This evidence, which the authors call “tentative” since it was gathered from a relatively short period (two years of data), should give policymakers pause before considering indiscriminate bans on advertising of e-cigarettes. Whether and how ads targeted or particularly attractive to youth can be prevented without banning all advertising remains an open question, both for vaping and for other goods such as alcohol.¹²⁴

3.2.8 What about the recent health scares involving vaping and lung illness?

In mid-2019, a spate of visits to emergency rooms across the country linked vaping to acute lung injuries, and the government responded promptly—by created an acronym for the phenomenon: e-cigarette/vaping-associated lung injury (EVALI). While by the end of the year the tide of cases of illness and death from EVALI appeared to be receding, the highly publicized events raised the issue of the health effects of e-cigarettes to prominence in the public’s eye. As of the time of writing, officials are still investigating the causes of EVALI, and given that products of questionable legality appear to be involved in many cases the true causes may never be nailed down. However, here is what seems to be known at the present.

As of January 20, 2020, there were 2,711 hospitalizations and 60 deaths connected with EVALI.¹²⁵ The emergency room visits rose sharply in August 2019 and peaked in September. Note that since the prevalence of e-cigarette usage that been growing smoothly and steadily since at least 2006, a suddenly appearing (and declining) epidemic such as EVALI cannot logically be caused by vaping in general. The best current guess as to the cause of EVALI centers around vitamin E acetate, a chemical added to e-cigarettes containing THC (loosely speaking, “marijuana vapes”). In government tests, 48 of 51 EVALI patients examined had vitamin E acetate in their lung fluid, compared to *none* found in a

comparison group of 99 healthy people.¹²⁶ Of the roughly 2,000 EVALI patients for whom data were available, 82% reported using THC-containing products; given that such products are illegal in some places under state law and illegal everywhere under federal law, this percentage is undoubtedly lower than the actual proportion of THC vapers. Of those using such THC-containing products, 84% reported acquiring products from informal sources: friends, dealers, off the street, or online sellers; all other than physical commercial sources such as dispensaries and vape shops. Furthermore, the most commonly used brand in a sample of 86 EVALI patients was a generic THC cartridge made by multiple unregulated makers and sold on the black market.¹²⁷

While some public health officials seized upon the epidemic as evidence that vaping in general is deleterious to health, the official recommendations from the Center for Disease Control and Prevention (CDC) (at the time of writing) are to avoid vaping THC, avoid the additive vitamin E acetate, be aware of “the wide range of health effects” associated with THC use, and to seek help for abuse of cannabis by a healthcare professional. In particular, the CDC specifically warns against returning to smoking instead of vaping for those who quit smoking or are trying to quit.

3.2.9 If we heavily regulate, tax, or ban e-cigarettes, what might be the unintended consequences?

Some of the potential unintended consequences of over-regulating e-cigarettes are similar to those discussed for the case of tobacco (see section 3.1.2 above), while others differ. The tax equity issue due to the regressivity of excise taxation remains, although not doubly so, since it is not the case that lower income individuals are more likely to vape.¹²⁸ The more important consideration are the health consequences of discouraging use of a nicotine product at the lower end of the continuum of risk and the potential for black-market substitution.

3.2.9.1 Harm reduction and the continuum of risk

The harm reduction (as opposed to the abstinence) approach to tobacco control views tobacco and nicotine-containing products as lying along a continuum of risk.¹²⁹ Combustible products, most

notably cigarettes, pose the greatest hazards, while nicotine replacement therapies pose the least. Some public health authorities embracing the harm reduction approach, perhaps most notably Public Health England, place e-cigarettes close to the low-risk end of the continuum. The key question for harm reduction is what will happen if e-cigarettes are banned, heavily taxed, or saddled with overly burdensome regulation? If more people continue to smoke instead of switching to vaping or quitting, then the evidence reviewed above indicates that it is highly likely that public health would suffer. Per-unit or ad valorem taxation of e-cigarettes may also encourage substitution toward products with higher concentrations of nicotine, which may increase health harms for youth.¹³⁰ On the other hand, if vaping renormalizes smoking and increases initiation among youth, public health could suffer in the future. Discussion of these consequences continues in the next section.

3.2.9.2 Illicit trade

Given the relative novelty of vaping, illicit trade in e-cigarette products (ITEP) is much less studied than ITTP.¹³¹ Apparently a thriving black market in counterfeit e-cigarettes already exists, although the prevalence is unknown and claims by manufacturers may be overstated. A worrisome feature of counterfeit e-liquids is the uncertainty of what they contain; one study found that many of them contain nicotine even when labeled as zero-nicotine products.¹³² Black-market THC vaping products have been found to contain pesticides, heavy metals, and lead, and counterfeit nicotine e-liquids have been traced to illicit, unsanitary facilities in China.¹³³ Packaging and supplies to assemble counterfeit vaping products are readily available online.¹³⁴ The barriers to entry the market for counterfeit products therefore seem to be low. As in any other market, as taxes or sales restrictions on licit product rise, substitution by some users to illicit sources should be expected, although the sensitivity of ITEP to taxation has not been explored yet.

There is another important aspect linking regulation of e-cigarettes to illicit trade, however. When e-cigarettes are readily available to smokers at reasonable prices, they offer smokers an attractive

alternative to buying illicit tobacco products to reduce the costs of consuming nicotine. E-cigarettes could thus attenuate the link between higher cigarette taxes and stricter regulations on traditional tobacco products and ITTP. An econometric study found empirical support for this hypothesis.¹³⁵ Using data from Europe, econometric analysis showed that in places lacking availability of e-cigarettes, there was a sizeable, statistically significant positive relationship between tax increases for cigarettes and ITTP. However, the availability of e-cigarettes attenuated the size of that link: “the more available e-cigarettes become, the less the ITTP market share rises in response to tax-driven price increases for conventional cigarettes.”¹³⁶ In places where e-cigarette markets are large enough, cigarette prices no longer have any significant effect on illicit trade.

4 Steps Toward Better Regulation

If more were understood about the actual health effects of vaping and exactly what the relationships were among the prices of tobacco, e-cigarettes, vaping, and youth initiation of smoking, and furthermore it were agreed upon whether vapers and smokers need to be “saved from themselves” due to irrational choices, then in principal one could compute optimal prices for tobacco and e-cigarettes and levy taxes to achieve them. Complicating the analysis are the additional factors discussed above regarding the relationships among the price of tobacco, the price and attractiveness of vaping, and illicit trade. Furthermore, policymakers would also have to decide whether and how to weigh the equity considerations raised by tobacco taxation. Given the great uncertainty in the precise degree to which vaping is safer than smoker, no such tax rates can be computed at present. However, although a “first best” regulatory policy toward tobacco and vapor cannot be determined, there are sensible steps that can be taken that are likely to be in the right direction.

For tobacco, difficult and honest discussion needs to take place about the role of high rates of excise taxation. Given the evidence discussed above that current tax rates are higher than those

required to correct for externalities and that the burden falls heavily on low-income individuals, the remaining rationales for taxation rest on paternalism, whether dressed in the clothing of behavioral economics or not.¹³⁷ How much of the desire of states and localities to tax tobacco stems from the ease of raising revenue from a socially disfavored minority?

Regarding e-cigarettes, the following seven recommendations can guide policymakers toward better regulation. First, the overriding principle to shape thinking about regulating tobacco and e-cigarettes should be risk-proportionate regulation.¹³⁸ Products that are not as harmful to health should be regulated less stringently, taxed at lower levels, or even encouraged if they aid in cessation of tobacco use. By deeming e-cigarettes to be “tobacco products,” the FDA created a setting that prompted all the anti-tobacco crusading zeal to be indiscriminately directed at vaping as well. But since vaping is almost surely less harmful to health than smoking, the regulatory touch should also be lighter.

Second, the tendencies among the public health community in the United States to understate the likely health benefits of switching from cigarettes to e-cigarettes should be curbed. Sometimes this happens through confusing the absolute risk from vaping (which is often characterized in more certain or inflated terms than the current state of the science warrants) with the relative risk of vaping versus smoking (since e-cigarettes may have some health harms, “therefore” it is no better than smoking). The approach of anti-vaping advocates among the public health community to jump from the uncertainty in the scientific literature to statements implying that e-cigarettes could be comparably risky or even more dangerous than cigarettes, while technically true since long-term health effects are unknown, is highly misleading.¹³⁹ Such statements have helped convince many members of the public to hold potentially dangerous attitudes about the relative health harms of smoking and vaping. Surveys indicate that today the majority of Americans believe e-cigarettes are just as harmful as cigarettes, and about 10 percent think that vaping is more dangerous than smoking.¹⁴⁰ Fewer than 3% of adults think that e-cigarettes are much less harmful than cigarettes.¹⁴¹ These negative perceptions of e-cigarettes have grown rapidly in

recent years. This is concerning, given that the perceived risk of smoking relative to vaping is known to affect the decision to use e-cigarettes.¹⁴²

Third, and related to the previous point, the uncertainty regarding the health effects of e-cigarettes should not be used to discourage smokers to switch. The personal negative health impacts from smoking are large and well-studied. Switching completely away from such a harmful activity to an activity that is very likely to be less harmful—even if the degree of relative risk is uncertain—is likely to improve the health prospects of the switcher (refer to section 3.2.1 above). The potential costs to public health of discouraging smokers to switch to e-cigarettes are high. One study found that compared to the status quo, replacement of cigarette by e-cigarette use over a 10-year period would result in 1.6 to 6.6 million fewer premature deaths and 20.8 to 86.7 million fewer years of life lost.¹⁴³

Fourth, given the potential benefits to adult smokers from switching to e-cigarettes and the potential harms to youth from taking up vaping or, in consequence, smoking, targeting regulation narrowly at youth may be better than blunt, broadly applied rules. Thus the current age limits on purchases of e-cigarettes are mainly uncontroversial, as are the FDA's enforcement against e-liquids designed to resemble child-friendly food products or future restrictions on advertising aimed at youth. Of course, youth-oriented restrictions may prevent some young people who already smoke from switching to a less harmful product, since most smokers began their habit before age 18 (and recall that the age restriction for e-cigarette sales is now 21). Tobacco control expenditure on campaigns and information to alert youth to the potential dangers of vaping, in principle, are also relatively uncontroversial, since nicotine may have adverse health effects on adolescents that it does not for adults.¹⁴⁴ However, as with any abstinence campaign, it is likely that some youth will reject such messages, particularly if they sense that the claims are overblown or manipulative. Given the absence of solid knowledge about adverse health effects, some youth-oriented anti-vaping messages instead rely on false syllogisms along the lines of "Big Tobacco wants you to vape, and tobacco kills, therefore vaping

will kill you.” Others attempt to parlay the recent epidemic of EVAPI into messages not to use licit products such as Juul and other commercially available, non-THC e-cigarettes, which (given the current but evolving knowledge reviewed in section 3.2.7) does not appear to be a supportable conclusion.¹⁴⁵ It is an open question why the same public health community that rejects fear-based anti-drug messages as ineffective or, worse, causing a boomerang effect¹⁴⁶ embraces them for the anti-vaping crusade.

Fifth, given the benefits of targeting regulation toward youth, heavily taxing e-cigarettes is not likely to be in the best interests of public health. As discussed previously, a tax (or any general regulation affecting all ages of users) is a very blunt instrument. While some youth may be deterred from using e-cigarettes by higher prices, given the apparently large current appetite for black-market vapes that the EVAPI epidemic revealed, coupled with the evidence from tobacco taxes and ITTP, it seems highly likely that high taxes on e-cigarettes will drive more youth demand toward less reputable and potentially much more dangerous sources. In any event, sales to those under 21 years of age are already banned, which is equivalent to an infinitely high tax that applies only to youth. Furthermore, burdening adult smokers with high taxes will discourage some of them from switching to vaping, to the likely detriment of their health. Indeed, if e-cigarettes are viewed as a form of nicotine-replacement therapy, there might even be a case for subsidizing them for smokers attempting cessation (as NRTs are subsidized through private health insurance and various public programs) rather than taxing them. Thus, proposed legislation such as the “E-Cigarette Tax Parity Act,” which seeks to tax nicotine equally regardless of the mode of delivery, not only almost certainly violate the principle of risk-proportionate regulation but also may be harmful to public health.¹⁴⁷

Sixth, careful consideration of whether banning the use of e-cigarettes in public spaces is appropriate is warranted. As reviewed above, it is far more certain that switching from smoking to vaping is beneficial for the health of the user than it is that e-cigarettes create substantial health harms from secondary exposure. But the ability to use e-cigarettes to consume nicotine, even if only in

designated areas, while at work or in public spaces could be a powerful incentive for a smoker to switch. On the flip side, the ability to consume nicotine more easily may also prevent or delay some smokers from cessation (the “dual use” case). More study will be required in this regard, but it is not at all clear that excessive caution is better than cautious optimism regarding the social costs and benefits of vaping bans in public and work spaces. Banning vaping where smoking is banned also sends the message that the two activities are equally harmful, which relates back to the second and third points discussed above.

Seventh, efforts toward resolving the regulatory uncertainty at the federal level should receive high importance. The FDA currently states that “no ENDS products have been authorized by the FDA — meaning that all ENDS products currently on the market are considered illegally marketed and are subject to enforcement, at any time, in the FDA’s discretion.”¹⁴⁸ Yet the agency has so far allowed sales of commercial nicotine e-cigarette products, as long as there is no sales or marketing to youth. The current regulatory environment is thus one in which the industry, and the specific manufacturers and retailers in the industry, are subject to a higher degree of regulatory dependence and uncertainty than most other industries. The negative effects of regulatory uncertainty and regulatory delay on investment and product innovation are well studied in other industries.¹⁴⁹ If e-cigarettes aid cessation or otherwise reduce harms from smoking, then innovation in that product space should be encouraged rather than discouraged.

Finally, in regards to both tobacco and e-cigarettes, serious attention must be paid to the interplay between taxation, regulation, and illicit markets. If e-cigarettes are inexpensive, attractive to users, easy to obtain, and able to be used in places where smoking is forbidden, then there will be a lower likelihood that current smokers will turn to the black market when faced with higher taxes or increased restrictions.¹⁵⁰ Because the argument that higher taxes stimulate ITTP is convenient for tobacco manufacturers lobbying for lower tax rates, the public health community has a long history of

discounting the possibility out of hand. This is in contrast to the well-established links found by economists studying cigarette taxation and smuggling (see section 3.1.2.2). The already-present black market in tobacco, e-cigarettes, and e-liquids should not be viewed as a theoretical possibility of limited practical import. Instead, illicit trade in all these product markets—and the likelihood that stricter regulation and higher taxation will exacerbate them—must be part of the policy calculus from the beginning. This will involve planning for enforcement against illicit markets, which must include action stronger than the preferred tool of warning letters sent to noncompliant retailers and manufacturers currently used by the FDA.¹⁵¹ The policymaking must also recognize that harsher, more effective enforcement can create its own harms—a notion familiar to the harm reduction community regarding illicit drugs but curiously absent among anti-tobacco advocates.¹⁵²

¹ Institute of Medicine, *Ending the Tobacco Problem: A Blueprint for the Nation* (Washington, DC: The National Academies Press, 2007), <https://doi.org/10.17226/11795>.

² U.S. Department of Health, Education, and Welfare, *Smoking and Health: Report of the Advisory Committee to the Surgeon General of the Public Health Service* (Washington, DC: U.S. Government Printing Office, 1964).

³ Euromonitor International, *Tobacco in the United States*, Country Report, January 2019, Passport.

⁴ The smoking intensity figure of 11.5 cigarettes per day (with a 95% confidence interval for the mean of [11.2, 11.8]) is calculated by the author from the 2018 Tobacco Use Supplement to the Current Population Survey. The retail sales figures are from Euromonitor (2019), (cited above). The discrepancy between self-reported smoking behavior and sales per adult smoker is due to the well-known fact that survey respondents tend to underreport smoking and because many underage smokers consume some of the sales.

⁵ MeLisa R. Creamer et al., “Tobacco Product Use And Cessation Indicators among Adults — United States, 2018,” *Morbidity and Mortality Weekly Report* 68, no. 45 (2019): 1013–1019, <http://dx.doi.org/10.15585/mmwr.mm6845a2>.

⁶ Heikki Hiilamo, Eric Crosbie, and Stanton A. Glantz, “The Evolution of Health Warning Labels on Cigarette Packs: The Role of Precedents, and Tobacco Industry Strategies to Block Diffusion,” *Tobacco Control* 23, no. 1 (2014): e2, <http://dx.doi.org/10.1136/tobaccocontrol-2012-050541>.

⁷ Institute of Medicine, *Ending the Tobacco Problem: A Blueprint for the Nation* (Washington, DC: The National Academies Press, 2007), <https://doi.org/10.17226/11795>. (cited above)

⁸ Heikki Hiilamo, Eric Crosbie, and Stanton A. Glantz, “The Evolution of Health Warning Labels on Cigarette Packs: The Role of Precedents, and Tobacco Industry Strategies to Block Diffusion,” *Tobacco Control* 23, no. 1 (2014): e2, <http://dx.doi.org/10.1136/tobaccocontrol-2012-050541>. (cited above)

⁹ See 84 Federal Register 42754, and the discussion below in section 2.3.

¹⁰ Public Law 100-202 (1987) banned smoking on domestic airline flights scheduled for two hours or less, while Public Law 101-164 (1989) did the same for flights scheduled for six hours or less.

¹¹ States were required to have (and enforce through random inspections) laws “prohibiting any manufacturer, retailer or distributor of tobacco products from selling or distributing such products to any individual under the age of 18.” In the event of noncompliance, a state would lose eligibility for a Substance Abuse Prevention and Treatment (SAPT) Block Grant. See 61 Federal Register 1492.

¹² See Dorie E. Apollonio and Stanton A. Glantz, “Minimum Ages of Legal Access for Tobacco in the United States From 1863 to 2015,” *American Journal of Public Health* 106, no. 7 (2016): 1200–1207, <https://doi.org/10.2105/AJPH.2016.303172>; and D.M. Shelton et al., “State Laws on Tobacco Control--United States, 1995” *Morbidity and Mortality Weekly Report Surveillance Summaries* 44, no. 6 (1995): 1–28.

¹³ The statement is from the National Association of Attorneys General Center for Tobacco and Public Health, the organization set up by the AGs of the settling states to handle matters pertaining to the MSA. See “National Center for Tobacco and Public Health,” *National Association of Attorneys General*, https://www.naag.org/naag/about_naag/naag-center-for-tobacco-and-public-health.php.

¹⁴ Campaign for Tobacco-Free Kids, *A State-by-State Look at the 1998 Tobacco Settlement 21 Years Later*, 2020, <https://www.tobaccofreekids.org/what-we-do/us/statereport>.

¹⁵ See 75 Federal Register 13225. The rule was a revised version of a 1996 FDA rule that was ultimately voided by the Supreme Court, which ruled in 2000 that the FDA lacked the authority to regulate tobacco as a drug (FDA v. Brown & Williamson Tobacco Corp. (98-1152) 529 U.S. 120 (2000), 153 F.3d 155, affirmed.).

¹⁶ The new regulation (which took effect immediately upon President Trump signing the bill on December 20, 2019) amends the Federal Food, Drug, and Cosmetics Act at 21 U.S.C. 387f(d) to include the higher minimum age of retail sale for any tobacco product, which also includes e-cigarettes (due to the FDA deeming action described in the next section).

¹⁷ For the final rule, see 85 FR 15638.

¹⁸ See David Hammond et al., “Text and Graphic Warnings on Cigarette Packages: Findings from the International Tobacco Control Four Country Study,” *American Journal of Preventive Medicine* 32, no. 3 (2007): 202–209, <https://doi.org/10.1016/j.amepre.2006.11.011>; and Seth M. Noar et al., “Pictorial Cigarette Pack Warnings: A Meta-Analysis of Experimental Studies,” *Tobacco Control* 25, no. 3 (2016): 341–354, doi:10.1136/tobaccocontrol-2014-051978. However, apparently no study has shown that graphical warnings lead to improvement in actual cessation (versus stated intentions to quit).

¹⁹ Orzechowski and Walker, *The Tax Burden on Tobacco* (Arlington: Orzechowski & Walker, 2014), taxadmin.org/assets/docs/Tobacco/papers/tax_burden_2014.pdf.

²⁰ See Timothy S. Naimi et al., “Erosion of State Alcohol Excise Taxes in the United States,” *Journal of Studies on Alcohol and Drugs* 79, no. 1 (2018): 43–48, <https://doi.org/10.15288/jsad.2018.79.43>.

²¹ Euromonitor (2019), (cited above).

²² National Academies of Science, Engineering, and Medicine, *Public Health Consequences of E-Cigarettes*, (Washington, DC: The National Academies Press, 2018), <https://doi.org/10.17226/24952>.

²³ See the review of regulatory status of e-cigarettes provided by the Ned Sharpless, the acting commissioner of the FDA, Ned Sharpless, “How FDA is Regulating E-Cigarettes,” *Food and Drug Administration*, September 10, 2019, <https://www.fda.gov/news-events/fda-voices-perspectives-fda-leadership-and-experts/how-fda-regulating-e-cigarettes>.

²⁴ After a court decision, the deadline for filing the applications with the FDA was initially set at May 12, 2020, but this was later extended by 120 days due to impacts from COVID-19 in April. The court ordered that products with timely applications could remain on the market for one year pending FDA review.

²⁵ The one partial exception is PMI’s heat-not-burn (HNB) product IQOS, which heats tobacco (unlike conventional ENDS products, which vaporize an e-liquid) without combustion so that the vapor can be inhaled. HNB products are often considered a different category than e-cigarettes by users, researchers, and manufacturers.

²⁶ See Food and Drug Administration, *Enforcement Priorities for Electronic Nicotine Delivery Systems (ENDS) and Other Deemed Products on the Market Without Premarket Authorization: Guidance for Industry*, January 2020, <https://www.fda.gov/media/133880/download>.

²⁷ Or, more properly speaking, they are technically still illegal (as with all ENDS apart from IQOS) but are not a candidate for FDA enforcement at the present time.

²⁸ However, as discussed in note 11 above, rather than an outright restriction the federal age limit is instead enforced through financial consequences for states that do not so restrict sales. As Figure 3 shows, nearly all states followed the prompting from the FDA. Michigan, however, did not restrict sales of e-cigarettes to minors until April 2019 (see Malachi Barrett, “Michigan Senate Approves Ban on E-Cigarette Sales to Minors,” *MLive*, April 23, 2019,

<https://www.mlive.com/public-interest/2019/04/michigan-senate-approves-ban-on-e-cigarette-sales-to-minors.html>).

²⁹ For the advance notice of proposed rulemaking (ANPRM), see 83 FR 12294. The due date for comments from interested parties was extended to July; see 83 FR 26618.

³⁰ For the advance notice of proposed rulemaking (ANPRM), see 83 FR 11818.

³¹ For the rough cost estimate, see Jennifer Maloney, “FDA Clears Philip Morris International Heat-Not-Burn IQOS Device for Sale in U.S.” *Wall Street Journal*, April 30, 2019, <https://www.wsj.com/articles/fda-approves-philip-morris-international-heat-not-burn-iqos-device-for-sale-in-u-s-11556649003>.

³² The discussion here follows Kenneth Warner et al., “Criteria for Determining an Optimal Cigarette Tax: The Economist's Perspective,” *Tobacco Control* 4, no. 4 (1995):380-386, <https://www.jstor.org/stable/20747487>.

³³ The argument presented here is from Browning, Edgar K. “The Myth of Fiscal Externalities.” *Public Finance Review* 27, no. 1 (January 1999): 3–18.

³⁴ See Jane G. Gravel and Dennis Zimmerman, *Cigarette taxes to fund health care reform: an economic analysis* (Washington, DC: Library of Congress, 1994); and Willard G. Manning et al., “The Taxes of Sin: Do Smokers and Drinkers Pay Their Way?” *JAMA* 261, no. 11 (1989): 1604–1609, doi:10.1001/jama.1989.03420110080028.

³⁵ It is also important to note that studies (such as those cited in note 34) were reaching such conclusions well before the recent rounds of increases in tobacco taxes (refer back to Figure 2).

³⁶ For the average tax rate, see Figure 2; for the study, see Jonathan Gruber and Botond Köszegi, *A Modern Economic View of Tobacco Taxation*, (Paris, France: International Union Against Tuberculosis and Lung Disease, 2008). This estimate of the net negative externality does not include any harmful effects of second-hand smoke

³⁷ Sijbren Cnossen, “Tobacco Taxation in the European Union,” *FinanzArchiv/Public Finance Analysis* 62, no. 2 (2006): 305-322, <https://www.jstor.org/stable/40913115>.

³⁸ See William K. Viscusi, “The New Cigarette Paternalism,” *Regulation* 25, no. 4 (2002): 58-64; and Gary L. Huber, Robert E. Brockie, and Vijay K. Majhajan, “Smoke and Mirrors: The EPA’s Flawed Study of Environmental Tobacco Smoke and Lung Cancer,” *Regulation* 16, no. 3 (1993): 44-54.

³⁹ In *Flue-Cured Tobacco Co-op. v. U.S.E.P.A.* (4 F. Supp. 2d 435 (M.D.N.C. 1998)), a U.S. District Court found that the “EPA’s study selection is disturbing” and that the agency had cherry-picked the data, excluding almost half the available evidence (the half that did not support its preferred conclusion). While this court decision was later overturned for the reason that the EPA’s study was not a reviewable action under the Administrative Procedures Act, the findings regarding the scientific weakness of the report were left un rebutted (*Flue-Cured Tobacco Cooperative Stabilization Co., et al. v. Environmental Protection Agency, et al.*, 313 F.3d 852, United States Court of Appeals for the Fourth Circuit (2002)).

⁴⁰ For a fascinating sociological perspective on why the anti-smoking crusade began to succeed when it did after “centuries of failure,” see Collins, R. (“Tobacco Ritual and Anti-Ritual: Substance Ingestion as a History of Social Boundaries.” In *Interaction Ritual Chains*, pp. 297-344, Princeton University Press, 2004), who points out the importance of non-scientific factors such as the “enjoying the moral prestige of a popular progressive movement.”

⁴¹ See U.S. Department of Health and Human Services, *The Health Consequences of Smoking—50 Years of Progress: A Report of the Surgeon General* (Atlanta: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention, National Center for Chronic Disease Prevention and Health Promotion, Office on Smoking and Health, 2014). Note that such estimates are typically reported without confidence intervals, but given the uncertainty in the relative risks underlying the calculations the confidence intervals would be wide.

⁴² See Melanie Heron, “Deaths: Leading Causes for 2014,” *National Vital Statistics Reports* 65, no. 5 (2016): 1-95.

⁴³ See Banderali, G., Martelli, A., Landi, M. et al. Short and long term health effects of parental tobacco smoking during pregnancy and lactation: a descriptive review, *Journal of Translational Medicine* 13, 327 (2015) and Kerry Anne McGeary, Dhaval Dave, Brandy Lipton, and Timothy Roeper (2020), “Impact of Comprehensive Smoking Bans on the Health of Infants and Children,” *American Journal of Health Economics* 6(1):1-38.

⁴⁴ See Giselle Salmasi, Rosheen Grady, Jennifer Jones, and Sarah D. McDonald, “Environmental Tobacco Smoke Exposure and Perinatal Outcomes: A Systematic Review and Meta-Analyses,” *Acta Obstetrica et Gynecologica Scandinavica* 89, no. 4 (2010): 423-441, doi:10.3109/00016340903505748. Note that the results regarding low birthweight are equivocal: while there is no statistically significant association between environmental tobacco

exposure and low birthweight, defined as being less than 2.5 kg, there is a statistically significant association with lower birthweight per se. Regardless, comparison of results in other studies shows that the negative impact on birthweight of drinking one additional cup of coffee a day is more certain than the impact of a father smoking preterm (where certainty is ascertained by statistical significance and the width of confidence intervals) (for the impact of father smoking, see Ting-Jung Ko et al., “Parental Smoking During Pregnancy and Its Association with Low Birth Weight, Small for Gestational Age, and Preterm Birth Offspring: A Birth Cohort Study,” *Pediatrics and Neonatology* 55, no.1 (2014): 20-27, <https://doi.org/10.1016/j.pedneo.2013.05.005>; for the impact of drinking coffee, see Jongeun Rhee et al., “Maternal Caffeine Consumption During Pregnancy and Risk of Low Birth Weight: A Dose-Response Meta-Analysis of Observational Studies,” *PLOS ONE* 10, no. 7 (2015): 1-18, DOI:10.1371/journal.pone.0132334.

⁴⁵ The difficulty with measuring how detrimental maternal and passive smoking may be to neonatal and child health is exacerbated by the high likelihood that unobserved factors are correlated with these causes and the health outcomes. Most of the public health studies in the meta-analysis cited use cross-sectional data and cannot control for such confounding factors. A better-designed study demonstrates that the impact of maternal smoking on infant health and the infant healthcare cost savings associated with ceasing smoking during pregnancy are typically overestimated by an order of magnitude (Almond, Douglas, Kenneth Y. Chay, David S. Lee, (2005), “The Costs of Low Birth Weight” *The Quarterly Journal of Economics* 120(3):1031–1083).

⁴⁶ As discussed in the previous note, most such studies suffer potential bias from confounding factors. One recent study using methodology to reduce the impact of omitted variable bias (and, interestingly, one cited by a referee as bolstering the link between smoking and the health of infants and children) showed that after controlled for unobserved confounding factors at the county level, there was no association (at the standard 5% significance level) between comprehensive smoking bans and birthweight or the prevalence of low birthweight (see the bottom of panel b of Table 3) or the prevalence of hay fever, any respiratory allergies, asthma, ear infections, or being in “excellent or very good” general health (McGeary, et al. (2020), cited above). Out of nine child health outcomes studied, the only two displaying significant association with a ban were emergency room visits and being in “fair or poor” general health.

⁴⁷ Ayman El-Mohandes et al., “An Intervention to Reduce Environmental Tobacco Smoke Exposure Improves Pregnancy Outcomes,” *Pediatrics* 125, no. 4 (2010): 721–728, doi:10.1542/peds.2009-1809.

⁴⁸ For example, roughly 90% of U.S. smokers agreed with the statement “If you had to do it over again, you would not have started smoking” (Geoffrey T. Fong et al., “The Near-Universal Experience of Regret Among Smokers in Four Countries: Findings from the International Tobacco Control Policy Evaluation Survey,” *Nicotine & Tobacco Research* 6, no. 3 (2004): 341–351, DOI: 10.1080/14622200412331320743).

⁴⁹ Over 60% of child smokers in one study said that they were given their first cigarettes. See Janet G. Baugh et al., “Development Trends of First Cigarette Smoking Experience of Children: The Bogalusa Heart Study,” *American Journal of Public Health* 72, no. 10 (1982): 1161-1164.

⁵⁰ Hana Ross and Frank Chaloupka, “The Effect of Cigarette Prices on Youth Smoking,” *Health Economics* 12, no. 3 (2003): 217-230, <https://doi.org/10.1002/hec.709>; Dean R. Lillard, Eamon Molloy, and Andrew Sfekas, “Smoking initiation and the iron law of demand,” *Journal of Health Economics* 32, no. 1 (2013): 114-127.

⁵¹ Philip DeCicca, et al., “Youth Smoking, Cigarette Prices, and Anti-Smoking Sentiment,” *Health Economics* 17, no. 6 (2007): 733-749; Jeffrey Wasserman et al., “The Effects of Excise Taxes and Regulations on Cigarette Smoking,” *Journal of Health Economics* 10, no. 1 (1991):43-64, [https://doi.org/10.1016/0167-6296\(91\)90016-G](https://doi.org/10.1016/0167-6296(91)90016-G).

⁵² That is, the money-metric marginal utility from consumption. See Emmanuel Farhi and Xavier Gabaix, “Optimal Taxation with Behavioral Agents,” *American Economic Review* 110, no. 1 (2020): 298–336, DOI: 10.1257/aer.20151079.

⁵³ Jonathan Gruber and Botond Köszegi, *A Modern Economic View of Tobacco Taxation*, (Paris, France: International Union Against Tuberculosis and Lung Disease, 2008). (cited above)

⁵⁴ William K. Viscusi, “The New Cigarette Paternalism,” *Regulation* 25, no. 4 (2002): 58-64. (cited above)

⁵⁵ For assumptions under which a rational individual would choose to become addicted, see Gary S. Becker and Kevin M. Murphy, “A Theory of Rational Addiction” *Journal of Political Economy* 96, no. 4 (1988): 675-700, <https://www.jstor.org/stable/1830469>.

⁵⁶ Viscusi (2002) (cited above), shows that at a time when medical science indicated the risk of lung cancer for an average smoker at 6-13%, the public thought it was 47%. Similar overestimation of risk is also present for premature mortality and life-years lost.

⁵⁷ The evidence in Romer and Jamieson (Daniel Romer and Patrick Jamieson, "Do Adolescents Appreciate the Risks of Smoking? Evidence from a National Survey" *Journal of Adolescent Health* 29, no. 1, (2001): 12-21, [https://doi.org/10.1016/S1054-139X\(01\)00209-9](https://doi.org/10.1016/S1054-139X(01)00209-9)) shows that among 14-22 year olds, 70% of smokers and 79% of nonsmokers overestimated the risks of lung cancer. The same researchers found that only 34% of smokers and 41% of nonsmokers overestimated the total mortality risk of smoking, which they take to be around 50%. However, at the time of this study the public was being told by the Surgeon General's report on smoking and the National Cancer Institute that the mortality risk was 0.18 to 0.36 (see William K. Viscusi, "The New Cigarette Paternalism," *Regulation* 25, no. 4 (2002): 58-64) (cited above); it appears unlikely that any average smoker or nonsmoker would be looking at the technical academic or clinical literature indicating higher risk. Thus, compared to what they were being told by the most prominent sources of information, the large majority of both smokers and nonsmokers were overestimating the risks. One would expect that as the higher estimates of mortality risk diffused into the public-facing messaging in the tobacco control community that people's perceptions of risk would likewise rise in response, of the degree of overestimation were to remain similar. However, apparently no more recent studies on risk perception have been performed.

⁵⁸ For example, one strand of literature finds time inconsistency in labor market and welfare program participation decisions (see Hanming Fang and Dan Silverman, "Time-Inconsistency and Welfare Program Participation: Evidence from the NLSY," *International Economic Review* 50, no. 4 (2009): 1043-1077).

⁵⁹ See Russell S. Sobel and Joshua C. Hall, "In Loco Parentis: A Paternalism Ranking of the States," in *For Your Own Good: Taxes, Paternalism, and Fiscal Discrimination in the Twenty-First Century*, ed. Adam J. Hoffer and Todd Nesbit (Arlington: Mercatus Center at George Mason University, 2018).

⁶⁰ The argument follows from the observations that consumers have better incentives to correct their behavior than do government decision-makers and that consumers have stronger incentives to make good choices when choosing what to buy than how to vote. See Edward L. Glaeser, "Paternalism and Psychology," *Regulation* 29, no. 2 (2006).

⁶¹ See M.C. Farrelly C.T. Nimsch, A. Hyland and M. Cummings, "The Effects of Higher Cigarette Prices on Tar and Nicotine Consumption in a Cohort of Adult Smokers," *Health Economics* 13, no. 1 (2004): 49-58, DOI: 10.1002/hec.820. Despite the oft-heard slogan that "there is no such thing as a safer cigarette," the epidemiological evidence indicates that low-tar cigarettes reduce the risk of lung cancer and total mortality for smokers (G.C. Kabat, "Fifty Years' Experience of Reduced-Tar Cigarettes: What Do We Know About Their Health Effects?" *Inhalation Toxicology*, 15(2003):1059-1102).

⁶² For more complete critiques of paternalism and taxation, see Adam Hoffer and Todd Nesbit, ed., *For Your Own Good: Taxes, Paternalism, and Fiscal Discrimination in the Twenty-First Century* (Arlington: Mercatus Center at George Mason University, 2018); Adam J. Hoffer, William F. Shughart II, and Michael D. Thomas, "Sin Taxes and Sindustry: Revenue, Paternalism, and Political Interest," *The Independent Review* 19, no. 1 (2014).

⁶³ See Matthew C. Farrelly et al., "Response by Adults to Increases in Cigarette Prices by Sociodemographic Characteristics," *Southern Economic Journal* 68, no. 1 (2001):156-165, doi.org/10.2307/1061518; Don Fullerton and Diane L. Rogers, *Who Bears the Lifetime Tax Burden?* (Washington, DC: Brookings Institution Press, 1993); Andrew B. Lyon and Robert M. Schwab, "Consumption Taxes in a Life-Cycle Framework: Are Sin Taxes Regressive?" *The Review of Economics and Statistics* 77, no. 3 (1995): 389-406, <https://www.jstor.org/stable/2109902>; and Dahlia K. Remler, "Poor Smokers, Poor Quitters, and Cigarette Tax Regressivity," *American Journal of Public Health* 94, no. 2 (2004): 225-229.

⁶⁴ See "Increases and Changes to Consumer Taxes in Chicago for 2020," The Civic Federation, January 10, 2020, <https://www.civicfed.org/civic-federation/blog/increases-and-changes-consumer-taxes-chicago-2020>. The minimum wage in Chicago at the time was \$12/hour.

⁶⁵ See also Matthew C. Farrelly, James M. Nonnemaker, and Kimberly A. Watson, "The Consequences of High Cigarette Excise Taxes for Low-Income Smokers," *PLOS ONE* 7, no. 9 (2012): e43838, which concludes after an empirical examination that high cigarette taxes "can impose a significant financial burden on low-income

smokers,”; and James E. Prieger et al., “The Impact of E-Cigarette Regulation on the Illicit Trade in Tobacco Products in the European Union,” 2019, <https://ssrn.com/abstract=3435177> (hereafter the “BOTEC study”), which discusses at length the issue of “specific impoverishment” caused by tobacco taxes.

⁶⁶ See, e.g., Maya Vijayaraghavan et al., “The Effectiveness of Cigarette Price and Smoke-Free Homes on Low-Income Smokers in the United States,” *American Journal of Public Health* 103, no. 12 (2013): 2276-2283, <https://doi.org/10.2105/AJPH.2013.301300>. Furthermore, while some evidence shows that higher prices are associated with lower smoking prevalence among low-income individuals, that would not by itself imply that taxes cause cessation, since it could just as well mean that fewer such individuals ever started smoking.

⁶⁷ See Michael L. Marlow and Sherzod Abdukadirov, “Taxation as Nudge: The Failure of Anti-Obesity Paternalism” in *For Your Own Good: Taxes, Paternalism, and Fiscal Discrimination in the Twenty-First Century*, ed. Adam J. Hoffer and Todd Nesbit (Arlington: Mercatus Center at George Mason University, 2018).

⁶⁸ Philip DeCicca and Logan McLeod, “Cigarette taxes and older adult smoking: Evidence from recent large tax increases,” *Journal of Health Economics* 27, no. 4 (2008): 918-929;

⁶⁹ Even here, the evidence is mixed, because when the estimated smoking responses to tax increases are used to simulate trends in the prevalence of smoking in the U.S., the models greatly underpredict actual smoking rates (Philip DeCicca, et al., “The Economics of Smoking Prevention,” in *Oxford Research Encyclopedia of Economics and Finance* (2018)). That is, if tax increases discouraged adult smoking so much, then there would not be so many actual smokers still. Thus, DeCicca and Kenkel conclude that “the true [price] elasticity lies between zero and -0.1, which is considerably smaller than the corresponding consensus estimate.”

⁷⁰ Gregory J. Colman and Dahlia K. Remler, “Vertical Equity Consequences of Very High Cigarette Tax Increases: If the Poor Are the Ones Smoking, How Could Cigarette Tax Increases Be Progressive?” *Journal of Policy Analysis and Management* 27, no. 2 (2008): 376–400. This study also discusses how under extreme behavioral models (as discussed in section above), cigarette taxes can be progressive, but nevertheless concludes that “taxes and other hindrances on smoking benefit higher-income more than lower-income smokers who are planning to quit” [p.396].

⁷¹ See, e.g., Maya Vijayaraghavan et al., “The Effectiveness of Cigarette Price and Smoke-Free Homes on Low-Income Smokers in the United States,” *American Journal of Public Health* 103, no. 12 (2013): 2276-2283, <https://doi.org/10.2105/AJPH.2013.301300>. (cited above)

⁷² See Campaign for Tobacco-Free Kids, *A State-by-State Look at the 1998 Tobacco Settlement 21 Years Later*, 2020, <https://www.tobaccofreekids.org/what-we-do/us/statereport>. (cited above) While this fact may appear to be at odds with the common recent practice of earmarking tax increases for cessation programs or other public health initiatives, the fungibility of state tax revenue implies that earmarking a dollar does not imply that an *additional* dollar will be spent on the targeted cause; see George R. Crowley and Adam J. Hoffer, “Earmarking Tax Revenues: Leviathan’s Secret Weapon?” in *For Your Own Good: Taxes, Paternalism, and Fiscal Discrimination in the Twenty-First Century*, ed. Adam J. Hoffer and Todd Nesbit (Arlington: Mercatus Center at George Mason University, 2018).

⁷³ See Jonathan Gruber, *Public Finance and Public Policy* (New York: Worth Publishers, 2005), 547.

⁷⁴ See Roger Bate, Cody Kallen, and Aparna Mathur, “The Perverse Effect of Sin Taxes: The Rise of Illicit White Cigarettes,” *Applied Economics* 52, no. 8 (2020): 789-805, DOI: 10.1080/00036846.2019.1646403; James E. Prieger and Jonathan Kulick “Cigarette Taxes and Illicit Trade in Europe” *Economic Inquiry* 56, no. 3 (2018): 1706-1723; James E. Prieger and Jonathan Kulick, “Tax Evasion and Illicit Cigarettes in California: Part IV— Smokers’ Behavioral and Market Responses to a Tax Increase,” January 24, 2019, <https://ssrn.com/abstract=3322095>; Philip DeCicca, Donald Kenkel, and Feng Liu, “Excise Tax Avoidance: The Case of State Cigarette Taxes,” *Journal of Health Economics* 32, no. 6 (2013): 1130–1141; Michael LaFaive, “Prohibition by Price: Cigarette Taxes and Unintended Consequences,” in *For Your Own Good: Taxes, Paternalism, and Fiscal Discrimination in the Twenty-First Century*, ed. Adam J. Hoffer and Todd Nesbit (Arlington: Mercatus Center at George Mason University, 2018); and the numerous empirical studies cited in these studies.

⁷⁵ See James E. Prieger, Jonathan Kulick, and Mark A.R. Kleiman, “Unintended Consequences of Cigarette Prohibition, Regulation, and Taxation,” *International Journal of Law, Crime and Justice* 46, (2016): 69-85, <https://doi.org/10.1016/j.ijlcrj.2016.03.002>.

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- ⁷⁶ National Research Council and Institute of Medicine, *Understanding the U.S. Illicit Tobacco Market: Characteristics, Policy Context, and Lessons from International Experiences*, ed. Peter Reuter and Malay Majmundar (Washington, DC: The National Academies Press, 2015), 4.
- ⁷⁷ See discussion of this comparison in the BOTE Study (2019).
- ⁷⁸ For empirical evidence on the final point, see James E. Prieger and Jonathan Kulick, "Tax Evasion and Illicit Cigarettes in California: Part IV— Smokers' Behavioral and Market Responses to a Tax Increase," January 24, 2019, <https://ssrn.com/abstract=3322095>. (cited above)
- ⁷⁹ Rajiv Goel and James W. Saunoris, "Cigarette Smuggling: Using the Shadow Economy or Creating Its Own?" *Journal of Economics and Finance* 43 (2019): 582–593.
- ⁸⁰ See Julia Smith, Sheryl Thompson, and Kelley Lee, "Death and Taxes: The Framing of the Causes and Policy Responses to the Illicit Tobacco Trade in Canadian Newspapers," *Cogent Social Sciences* 3, no. 1 (2017), <https://doi.org/10.1080/23311886.2017.1325054>.
- ⁸¹ See Luk Joossens and Martin Raw, "From Cigarette Smuggling to Illicit Tobacco Trade," *Tobacco Control* 21, no. 2 (2012): 230–234, www.jstor.org/stable/41516027.
- ⁸² See in particular James E. Prieger and Jonathan Kulick "Cigarette Taxes and Illicit Trade in Europe" *Economic Inquiry* 56, no. 3 (2018): 1706–1723. (cited above)
- ⁸³ A group of economists with diverse perspectives on tobacco taxation and ITTP state that "little disagreement exists that an increase in the tax rate would generate significant increases in revenue, or that it would decrease consumption"; see Kenneth Warner et al., "Criteria for Determining an Optimal Cigarette Tax: The Economist's Perspective," *Tobacco Control* 4, no. 4 (1995): 380–386, <https://www.jstor.org/stable/20747487>, (cited above).
- ⁸⁴ See Lee Moran, "Fake Cigarettes Containing Human Feces, Rat Droppings Flood British Market: Report," *New York Daily News*, November 11, 2014, <http://www.nydailynews.com/news/world/fake-cigarettes-humanfeces-hit-uk-market-report-article-1.2006457>; W. Edryd Stephens, Angus Calder, and Jason Newton, "Source and Health Implications of High Toxic Metal Concentrations in Illicit Tobacco Products," *Environmental Science & Technology* 39, no. 2 (2005): 479–488; and Oliver Bennett, "How Counterfeit Cigarettes Containing Pesticides and Arsenic Make it to Our Streets," *Independent*, August 7, 2018, https://www.independent.co.uk/news/long_reads/smuggling-cigarettes-tobacco-counterfeit-illicit-trade-black-market-crime-a8479021.html.
- ⁸⁵ See James E. Prieger, Jonathan Kulick, and Mark A.R. Kleiman, "Unintended Consequences of Cigarette Prohibition, Regulation, and Taxation," *International Journal of Law, Crime and Justice* 46, (2016): 69–85, <https://doi.org/10.1016/j.ijlcrj.2016.03.002>, (cited above); James Prieger and Jonathan Kulick, "Violence in Illicit Markets: Unintended Consequences and the Search for Paradoxical Effects of Enforcement," *B.E. Journal of Economic Analysis and Policy* 15, no. 3 (2015): 1263–1295; and James Prieger and Jonathan Kulick, "Unintended Consequences of Enforcement in Illicit Markets," *Economics Letters* 125, no. 2 (2014): 295–297.
- ⁸⁶ See Alison Ritter and Jacqui Cameron, "A Review of the Efficacy and Effectiveness of Harm Reduction Strategies for Alcohol, Tobacco and Illicit Drugs," *Drug and Alcohol Review* 25, no. 6 (2006): 611–624.
- ⁸⁷ Alison Ritter and Jacqui Cameron, "A Review of the Efficacy and Effectiveness of Harm Reduction Strategies for Alcohol, Tobacco and Illicit Drugs," *Drug and Alcohol Review* 25, no. 6 (2006): 613, (cited above).
- ⁸⁸ See the discussion of harm reduction vs. the precautionary principle in Lawrence W. Green, Jonathan E. Fielding, and Ross C. Brownson, "The Debate About Electronic Cigarettes: Harm Minimization or the Precautionary Principle" *Annual Review of Public Health* 39 (2018):189–191.
- ⁸⁹ See A. McNeill et al., "E-Cigarettes: An Evidence Update," *Public Health England* (London, 2015), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/733022/E-cigarettes_an_evidence_update_A_report_commissioned_by_Public_Health_England_FINAL.pdf.
- ⁹⁰ "Based on current knowledge, stating that vaping is at least 95% less harmful than smoking remains a good way to communicate the large difference in relative risk unambiguously so that more smokers are encouraged to make the switch from smoking to vaping" (A. McNeill et al., "E-Cigarettes: An Evidence Update," *Public Health England* (London, 2015), https://assets.publishing.service.gov.uk/government/uploads/system/uploads/attachment_data/file/733022/E-cigarettes_an_evidence_update_A_report_commissioned_by_Public_Health_England_FINAL.pdf). (cited above)
- Given the clarity of the statement, the obvious implication that switching should be encouraged, and the

resistance of some in the American public health community to that message, it is unsurprising that Public Health England has been attacked for its statement (see, for example, Thomas Eissenberg et al., “Invalidity of an Oft-Cited Estimate of the Relative Harms of Electronic Cigarettes,” *American Journal of Public Health* 110, no. 2 (2020): 161-162). A good discussion of the issues involved and a rebuttal may be found in Clive Bates, “Vaping is Still at Least 95% Lower Risk than Smoking – Debunking a Feeble and Empty Critique,” *The Counterfactual* (blog), January 17, 2020, <https://www.clivebates.com/vaping-is-sill-at-least-95-lower-risk-than-smoking-debunking-a-feeble-and-empty-critique>.

⁹¹ William E. Stephens, “Comparing the Cancer Potencies of Emissions from Vapourised Nicotine Products Including E-Cigarettes with Those of Tobacco Smoke,” *Tobacco Control* 27, no. 1 (2018): 10-17, DOI: 10.1136/tobaccocontrol-2017-053808.

⁹² See Lion Shahab et al., “Nicotine, Carcinogen, and Toxin Exposure in Long-Term E-Cigarette and Nicotine Replacement Therapy Users: A Cross-Sectional Study,” *Annals of Internal Medicine* 166, no. 6 (2017): 390-400, DOI: 10.7326/M16-1107.

⁹³ See National Academies of Science, Engineering, and Medicine, *Public Health Consequences of E-Cigarettes*, (Washington, DC: The National Academies Press, 2018), <https://doi.org/10.17226/24952>, (cited above).

⁹⁴ For example, one study found that the odds of wheezing in adolescents are affected by e-cigarette use only when past cigarette use is not controlled for; see Rob McConnell et al., “Electronic Cigarette Use and Respiratory Symptoms in Adolescents,” *American Journal of Respiratory and Critical Care Medicine* 195, no. 8 (2017): 1043-1049, <https://doi.org/10.1164/rccm.201604-0804OC>. Conversely, the association between vaping and the odds of having symptoms of bronchitis was reduced in magnitude but not removed.

⁹⁵ See National Academies of Science, Engineering, and Medicine, *Public Health Consequences of E-Cigarettes*, (Washington, DC: The National Academies Press, 2018), <https://doi.org/10.17226/24952>, (cited above).

⁹⁶ See National Academies of Science, Engineering, and Medicine, *Public Health Consequences of E-Cigarettes*, (Washington, DC: The National Academies Press, 2018), <https://doi.org/10.17226/24952>, (cited above).

⁹⁷ See Muhammad Aziz Rahman et al., “E-Cigarettes and Smoking Cessation: Evidence from a Systematic Review and Meta-Analysis,” *PLOS ONE* 10, no. 3 (2015), DOI: 10.1371/journal.pone.0122544.

⁹⁸ See Andrea C Villanti et al., “How Do We Determine the Impact of E-Cigarettes on Cigarette Smoking Cessation or Reduction? Review and Recommendations for Answering the Research Question with Scientific Rigor,” *Addiction* 113, no. 3 (2018): 391-404, DOI: 10.1111/add.14020. The observation that this review found that *most* studies on vaping and cessation (all but four out of 91) failed to constitute reliable scientific evidence is important, because public health researchers who oppose vaping sometimes claim that “the weight of the evidence” shows that e-cigarette use does not aid cessation.

⁹⁹ The cessation rate, defined as the 12-month quit rate, was found to be about 10% with NRTs and 20% with e-cigarettes; see Muhammad Aziz Rahman et al., “E-Cigarettes and Smoking Cessation: Evidence from a Systematic Review and Meta-Analysis,” *PLOS ONE* 10, no. 3 (2015), DOI: 10.1371/journal.pone.0122544, (cited above).

¹⁰⁰ Some recent studies finding that e-cigarettes may aid cessation use quasi-experimental designs (Dhaval Dave, et al., 2019, Does e-cigarette advertising encourage adult smokers to quit? *Journal of Health Economics* 68 (2019):102227; Henry Saffer, et al., “E-Cigarettes and Adult Smoking: Evidence from Minnesota,” NBER Working Paper No. 26589) while other studies employ randomized controlled trials (Peter Hajek, “A Randomized Trial of E-Cigarettes versus Nicotine-Replacement Therapy,” *New England Journal of Medicine* 380: 629-37, which finds that e-cigarettes were more effective for smoking cessation than nicotine-replacement therapy).

¹⁰¹ See, for example, Angelica LaVito, “CDC Says Teen Vaping Surges to More than 1 in 4 High School Students,” *CNBC*, September 12, 2019, <https://www.cnn.com/2019/09/12/cdc-says-teen-vaping-surges-to-more-than-1-in-4-high-school-students.html>.

¹⁰² Karen A. Cullen et al., “E-Cigarette Use Among Youth in the United States, 2019,” *JAMA* 322, no. 21 (2019): 2095-2103, DOI :10.1001/jama.2019.18387. This figure is derived by multiplying the any-use prevalence of 27.5% by the proportion of current users using 20 days or more out of the last 30 (34.2%).

¹⁰³ Robert West, Jamie Brown, and Martin Jarvis, “Epidemic of Youth Nicotine Addiction? What Does the National Youth Tobacco Survey Reveal About High School E-Cigarette Use in the USA?” *Qeios*, 2019, preprint version available at <https://doi.org/10.32388/745076.3>.

¹⁰⁴ Robert West, Jamie Brown, and Martin Jarvis, “Epidemic of Youth Nicotine Addiction? What Does the National Youth Tobacco Survey Reveal About High School E-Cigarette Use in the USA?” *Qeios*, 2019, preprint version available at <https://doi.org/10.32388/745076.3>, (cited above).

¹⁰⁵ Given that cigarette taxes are generally higher than taxes on e-cigarettes (if there are any), among other reasons, vaping is generally seen to be cheaper than smoking. Depending on the cigarettes and vaping device/method compared, the cost differences can be very large. See, e.g., Wolff-Mann, E. “Vaping Is 95% Healthier and 40% Cheaper Than Smoking,” *money.com* (Aug 20, 2015; <https://money.com/vaping-healthier-cigarettes-expensive>) and <https://ecigaretterevuewed.com/smoking-vs-vaping-cost-comparison>.

¹⁰⁶ This is known as the “common liability hypothesis”; see Lynn T. Kozlowski and Kenneth E. Warner, “Adolescents and E-Cigarettes: Objects of Concern May Appear Larger than They Are,” *Drug and Alcohol Dependence* 174, (2017): 209–214, <https://doi.org/10.1016/j.drugalcdep.2017.01.001>.

¹⁰⁷ See Jean-Francois Etter, “Gateway Effects and Electronic Cigarettes,” *Addiction* 113, no. 10 (2018): 1776–1783, doi:10.1111/add.13924.

¹⁰⁸ See D.T. Levy et al., “Examining the Relationship of Vaping to Smoking Initiation Among US Youth and Young Adults: A Reality Check,” *Tobacco Control* 28, no. 6 (2019): 629–635, DOI:10.1136/tobaccocontrol-2018-054446.

¹⁰⁹ Robert West, Jamie Brown, and Martin Jarvis, “Epidemic of Youth Nicotine Addiction? What Does the National Youth Tobacco Survey Reveal About High School E-Cigarette Use in the USA?” *Qeios*, 2019, preprint version available at <https://doi.org/10.32388/745076.3>, (cited above).

¹¹⁰ Robert West, Jamie Brown, and Martin Jarvis, “Epidemic of Youth Nicotine Addiction? What Does the National Youth Tobacco Survey Reveal About High School E-Cigarette Use in the USA?” *Qeios*, 2019, preprint version available at <https://doi.org/10.32388/745076.3>, (cited above). The relevant survey question was not asked in more recent waves of the relevant survey.

¹¹¹ Similarly sized effects were found by two studies (Dhaval Dave, Bo Feng, and Michael F. Pesko, “The effects of e-cigarette minimum legal sale age laws on youth substance use” *Health Economics* 28, no. 3 (2019): 419–436; A.S. Friedman, “How Does Electronic Cigarette Access Affect Adolescent Smoking?” *Journal of Health Economics* 44 (2015):300–308.

¹¹² Michael F. Pesko, Janet M. Currie, “E-cigarette minimum legal sale age laws and traditional cigarette use among rural pregnant teenagers,” *Journal of Health Economics*, 66, 2019, Pages 71–90.

¹¹³ Rigotti, N. A. (1999). Youth access to tobacco. *Nicotine & Tobacco Research*, 1(Suppl_2), S93–S97.

¹¹⁴ There is remarkably little evidence on this topic from the U.S. context. Rigotti (1999) reports on two controlled studies from the U.S.; in one enforcement of minimum age laws to purchase tobacco had no effect on youth smoking but in the other enforcement was associated with lowering the growth rate of youth smoking. The 2015 National Academies study on the issue found no studies at all on the topic in the U.S. but cited evidence from Europe that minimum age laws reduce youth smoking prevalence (Bonnie RJ, Stratton K, Kwan LY, editors. *Public Health Implications of Raising the Minimum Age of Legal Access to Tobacco Products*. Washington (DC): National Academies Press; 2015).

¹¹⁵ Only 10.5% of 15- to 17-year-old vapers bought their own e-cigarettes; it is much more common to ask someone to buy on their behalf (17.3%) or to get them from someone else (57%) (Susanne Tanski, Jennifer Emond, Cassandra Stanton, Thomas Kirchner, Kelvin Choi, Ling Yang, Chase Ryant, Joelle Robinson, Andrew Hyland, “Youth Access to Tobacco Products in the United States: Findings From Wave 1 (2013–2014) of the Population Assessment of Tobacco and Health Study,” *Nicotine & Tobacco Research*, Volume 21, Issue 12, December 2019, Pages 1695–1699). See similar evidence from Hannah M. Baker, Sarah D. Kowitt, Clare Meernik, Courtney Heck, Jim Martin, Adam O. Goldstein, Leah Ranney “Youth source of acquisition for E-Cigarettes,” *Preventive Medicine Reports*, Volume 16, 2019, article 101011; and Jessica K. Pepper, Ellen M. Coats, James M. Nonnemaker, Brett R. Loomis, “How Do Adolescents Get Their E-Cigarettes and Other Electronic Vaping Devices?” *American Journal of Health Promotion*, Vol 33, Issue 3, 2019.

¹¹⁶ Amy Fairchild, Cheryl Heaton, James Curran, David Abrams, Ronald Bayer, 2019, “Evidence, alarm, and the debate over e-cigarettes” *Science* Vol. 366, Issue 6471: 1318–1320.

¹¹⁷ Henriksen, Lisa, Schleicher, Nina C., Johnson, Trent O., Lee, Joseph G. L. “Assurances of Voluntary Compliance: A Regulatory Mechanism to Reduce Youth Access to E-Cigarettes and Limit Retail Tobacco Marketing” *American Journal of Public Health*, 2020, Vol. 110, Issue 2, pp. 209-215.

¹¹⁸ Tanski et al., 2019, cited above.

¹¹⁹ See Isabel M.R. Hess, Kishen Lachireddy, and Adam Capon, “A Systematic Review of the Health Risks from Passive Exposure to Electronic Cigarette Vapour,” *Public Health Research & Practice* 26, no. 2 (2016), <http://dx.doi.org/10.17061/phrp2621617>.

¹²⁰ See National Academies of Science, Engineering, and Medicine, *Public Health Consequences of E-Cigarettes*, (Washington, DC: The National Academies Press, 2018), <https://doi.org/10.17226/24952>, (cited above).

¹²¹ See Hess et al. (2016) for the former quotation and NAS (2018) for the latter. Note also that the careful (and carefully worded) conclusion of these scientific assessments stand in contrast to the World Health Organization (which comes down strongly against vaping), which answered the question of “Are secondhand ENDS emissions dangerous?” with an unequivocal “Yes. The aerosols in ENDS typically contain toxic substances, including glycol which is used to make antifreeze. ENDS pose risks to users and non-users.” See Department of Communications, “Q&A Detail: E-Cigarettes,” *World Health Organization*, January 29, 2020, <https://www.who.int/news-room/q-a-detail/e-cigarettes-how-risky-are-they> (visited January 23, 2020; the “Yes” in the answer was later removed). See also Clive Bates, “World Health Organisation Fails at Science and Fails at Propaganda—The Sad Case of WHO’s Anti-Vaping Q&A,” *The Counterfactual*, January 30, 2020, <https://www.clivebates.com/world-health-organisation-fails-at-science-and-fails-at-propaganda-the-sad-case-of-whos-anti-vaping-qa>, for discussion of the merits of WHO’s statement.

¹²² See 21 CFR 1143.3.

¹²³ The television and radio ad ban for cigarettes is nationwide (under a federal law, not an agency regulation) but the other venues mentioned are prohibited under the Tobacco Master Settlement Agreement, which applies in 46 states (A. Glass, “Congress Bans Airing Cigarette Ads, April 1, 1970,” *Politico*, www.politico.com/story/2018/04/01/congress-bans-airing-cigarette-ads-april-1-1970-489882).

¹²⁴ See, e.g., Michele Simon “Reducing Youth Exposure to Alcohol Ads: Targeting Public Transit” *Journal of Urban Health* 2008; 85(4): 506–516.

¹²⁵ The information here and the statistics to follow are from the Center for Disease Control and Prevention (CDC)’s information page at https://www.cdc.gov/tobacco/basic_information/e-cigarettes/severe-lung-disease.html (as visited January 30, 2020). The CDC is a part of the United States Department of Health and Human Services.

¹²⁶ If the test group with EVAPI were typical of the general population of vapers with regard to the presence of vitamin E acetate (VEA) in their lungs, as would be the case if VEA (and hence THC) had nothing to do with the illnesses, then the probability of observing *no* VEA in the control group is a vanishingly small number: 1.5×10^{-122} , a zero followed by a decimal point and another 121 zeroes.

¹²⁷ The brand is Dank Vapes; see Jennifer Maloney and Daniela Hernandez, “Vaping’s Black Market Complicates Efforts to Combat Crises,” *Wall Street Journal*, October 6, 2019, <https://www.wsj.com/articles/vapings-black-market-complicates-efforts-to-combat-crises-11570354204>.

¹²⁸ A review of studies found that “no clear patterns emerged” in the relation between socioeconomic status and e-cigarette usage, and that if anything income appears to be positively associated with use. See Greg Hartwell et al., “E-Cigarettes and Equity: A Systematic Review of Differences in Awareness and Use Between Sociodemographic Groups,” *Tobacco Control* 26, no. e2 (2017): e85-e91, DOI: 10.1136/tobaccocontrol-2016-053222.

¹²⁹ See, for example, David B. Abrams DB. , “Promise and Peril of E-Cigarettes: Can Disruptive Technology Make Cigarettes Obsolete?” *JAMA* 311, no. 2 (2014;311(2)): 135–136. , DOI: 10.1001/jama.2013.285347.

¹³⁰ As of early 2020, every state tax on e-cigarettes is ad valorem, a specific tax per milliliter of e-liquid or per cartridge, or a combination of the two; in particular, no state taxes the concentration of nicotine (National Conference of State Legislatures (2020), “E-Cigarette & Vaping Product Taxes”, <https://www.ncsl.org/research/fiscal-policy/electronic-cigarette-taxation.aspx>). On the potential for nicotine to harm the development of the adolescent brain, see note 144 below.

¹³¹ See the BOTEC Study (2019), (cited above), for one of the few discussions of ITEP.

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- ¹³² See Esther E. Omaiye et al., “Counterfeit Electronic Cigarette Products with Mislabeled Nicotine Concentrations,” *Tobacco Regulatory Science* 3, no. 3 (2017): 347-357, <https://doi.org/10.18001/TRS.3.3.10>.
- ¹³³ See Jennifer Maloney and Daniela Hernandez, “Vaping’s Black Market Complicates Efforts to Combat Crises,” *Wall Street Journal*, October 6, 2019, <https://www.wsj.com/articles/vapings-black-market-complicates-efforts-to-combat-crises-11570354204>, (cited above).
- ¹³⁴ See Daniela Hernandez, “Sales of Illicit Vaping Products Find Home Online,” *The Wall Street Journal*, September 20, 2019, <https://www.wsj.com/articles/sales-of-illicit-vaping-products-find-home-online-11568971802>.
- ¹³⁵ See the BOTE Study (2019), (cited above). The study has not yet undergone peer review, however.
- ¹³⁶ See the BOTE Study (2019), (cited above).
- ¹³⁷ See Sijbren Cnossen, “Tobacco Taxation in the European Union,” *FinanzArchiv/Public Finance Analysis* 62, no. 2 (2006): 305-322, <https://www.jstor.org/stable/40913115>, cited above, who states that “government measures to reduce smoking through higher taxes would seem to be a form of paternalism about which economics has little to say.”
- ¹³⁸ See Frank J. Chaloupka, David Sweanor, and Kenneth E. Warner, “Differential Taxes for Differential Risks — Toward Reduced Harm from Nicotine-Yielding Products,” *New England Journal of Medicine* 373, no. 7 (2015): 594–597, DOI: 10.1056/NEJMp1505710; see also the BOTE Study (2019) for discussion of proportionate regulation regarding e-cigarettes.
- ¹³⁹ See, for example, the statement that “we don’t know whether e-cigarette use is as lethal as combustible cigarette use, less lethal than combustible cigarette use, or more lethal than combustible cigarette use” by one public health researcher (Virginia Commonwealth University, “An Often-Made Claim that E-Cigarettes are ‘95% Safer’ is Not Valid,” *EurekAlert*, January 8, 2020, https://www.eurekalert.org/pub_releases/2020-01/vcu-aoc010820.php).
- ¹⁴⁰ Jidong Huang et al., “Changing Perceptions of Harm of E-Cigarette vs Cigarette Use Among Adults in 2 US National Surveys From 2012 to 2017,” *JAMA* 2, no. 3 (2019), doi:10.1001/jamanetworkopen.2019.1047.
- ¹⁴¹ See the data from the National Cancer Institute at <https://hints.cancer.gov/view-questions-topics/question-details.aspx?nq=1&qid=1282>.
- ¹⁴² See, for example, Olivia A. Wackowski and Cristine D Delnevo, “Young Adults’ Risk Perceptions of Various Tobacco Products Relative to Cigarettes: Results from the National Young Adult Health Survey,” *Health Education & Behavior* 43, no. 3 (2016): 328-336, DOI: 10.1177/1090198115599988.
- ¹⁴³ David T. Levy et al., “Potential Deaths Averted in USA by Replacing Cigarettes with E-Cigarettes,” *Tobacco Control* 27, no. 1 (2018): 18-25, DOI: 10.1136/tobaccocontrol-2017-053759.
- ¹⁴⁴ The scientific evidence “is suggestive” that exposure to nicotine during adolescence may have “lasting adverse consequences for brain development,” resulting in adversely affected cognitive function and development (National Center for Chronic Disease Prevention and Health Promotion, 2014, cited above, p.126).
- ¹⁴⁵ For example, see the CDC sponsored article for schoolchildren, part of its “The Real Cost” e-cigarette prevention campaign: “The Health Impacts of E-Cigarettes: Discover the Truth About How These Devices Can Harm You,” Scholastic, 2019, http://www.scholastic.com/youthvapingrisks/healthrisksofcigarettes_studentarticle_A.pdf. The article uses the EVAPI cases to lead into the anti-e-cigarette message, clearly wanting the reader to link those health harms with uses of any e-cigarette.
- ¹⁴⁶ “We continue to be concerned that many of [the Office of National Drug Control Policy]’s advertisements are exaggerated fear appeals, which most experts in public health communications have concluded almost never work (Job 1988)”; William Dejong and Lawrence Wallack, “The Drug Czar’s Anti-Drug Media Campaign: Continuing Concerns,” *Journal of Health Communication* 5, no. 1 (2000): 77-82; See also R.F. Soames Job, “Effective and Ineffective Use of Fear in Health Promotion Campaigns,” *American Journal of Public Health* 78, no. 2 (1988): 163-167.
- ¹⁴⁷ E-Cigarette Tax Parity Act, S. 2463, 116th Cong (2019).
- ¹⁴⁸ See “FDA Finalizes Enforcement Policy on Unauthorized Flavored Cartridge-Based E-Cigarettes that Appeal to Children, Including Fruit and Mint,” Food and Drug Administration, January 2, 2020, <https://www.fda.gov/news-events/press-announcements/fda-finalizes-enforcement-policy-unauthorized-flavored-cartridge-based-e-cigarettes-appeal-children>.

¹⁴⁹ For example, see George Bittlingmayer, “Regulatory Uncertainty and Investment: Evidence from Antitrust Enforcement,” *Cato Journal* 20, no. 3 (2001): 295- 326; James E. Prieger, “Regulation, Innovation, and the Introduction of New Telecommunications Services,” *Review of Economics and Statistics* 84, no. 4 (2002): 704-715; and Kira R. Fabrizio, “The Effect of Regulatory Uncertainty on Investment: Evidence from Renewable Energy Generation,” *Journal of Law, Economics, and Organization* 29, no. 4 (2013): 765–798, DOI: 10.1093/jleo/ews007.

¹⁵⁰ See the BOTECH Study (2019), and refer to the discussion above in section 3.2.9.1.

¹⁵¹ See section IV.E of Food and Drug Administration, *Enforcement Priorities for Electronic Nicotine Delivery Systems (ENDS) and Other Deemed Products on the Market Without Premarket Authorization: Guidance for Industry*, January 2020, <https://www.fda.gov/media/133880/download>, cited above.

¹⁵² For discussion with reference to drug markets, see Jonathan Caulkins and Peter Reuter, “Towards a Harm-Reduction Approach to Enforcement,” *Safer Communities* 8, no. 1 (2009): 9-23, <https://doi.org/10.1108/17578043200900003>; for discussion with reference to tobacco markets, see James E. Prieger, Jonathan Kulick, and Mark A.R. Kleiman, “Unintended Consequences of Cigarette Prohibition, Regulation, and Taxation,” *International Journal of Law, Crime and Justice* 46, (2016): 69-85, <https://doi.org/10.1016/j.ijlcrj.2016.03.002>, cited above.