NBER WORKING PAPER SERIES

PUBLIC-PLACE SMOKING LAWS AND EXPOSURE TO ENVIRONMENTAL TOBACCO SMOKE (ETS) IN PUBLIC PLACES

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Working Paper 15849
http://www.nber.org/papers/w15849

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
March 2010

We thank Marianne Bitler, Claire de Oliveira, Susumu Imai, Madeline Zavodny, and seminar participants at UC Irvine and the 2009 Canadian Economics Association meetings for useful comments. All errors are our own. While the research and analysis are based on data from Statistics Canada, the opinions expressed do not represent the views of Statistics Canada, nor do they necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 15849
March 2010
JEL No. I1

ABSTRACT

A recent IOM report suggests that laws restricting smoking in public places reduce acute myocardial infarction, presumably by reducing exposure to environmental tobacco smoke (ETS). We study adoption of these laws in Canada using data that include questions about respondents' ETS exposure in bars, restaurants, and other places. In fixed-effects models we find that these laws had no effects on smoking but induced extremely large and statistically significant reductions in exposure to ETS in bars and restaurants for both non-smokers and smokers. Our results indicate wide latitude for health improvements in the US if smoking were banned in public places.

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I. INTRODUCTION

With an increase in the awareness of the detrimental effects of environmental tobacco smoke (ETS), the early 1990's marked a defining moment in the campaign to eliminate ETS exposure in North America. Workplaces, schools, and hospitals were the earliest targets of privately initiated and publicly adopted bans on smoking in the US, and more recently there has been increased policy activity worldwide aimed at banning smoking in a wider variety of public places such as restaurants and bars. Several peer-reviewed public health and medical studies have linked publicly-adopted smoking bans to reductions in acute myocardial infarctions (AMI) (i.e., heart attacks), and a 2009 report by the Institute of Medicine (IOM) finds the evidence is sufficient to conclude that smoking bans—including those that apply to public places such as bars and restaurants—have causal effects at reducing AMI.[1] According to the IOM report, even brief exposure to environmental tobacco smoke (ETS) can physiologically trigger AMI, thus making it plausible that public-place smoking bans could reduce AMI through reducing exposure to ETS. If true, the conclusions of the IOM report suggest wide latitude for public health improvements for many jurisdictions in the US and elsewhere that have not yet banned smoking in public places.[2]

Notably, however, we know very little about whether, how, and to what extent public-place smoking laws actually affect exposure to ETS, and we know even less about whether these effects differ by smoking status. The IOM explicitly notes this fact as a key limitation to research in this area, writing in their report that a key gap in our understanding of the health

[1] Recent research in economics has also studied the relationship between smoking bans and AMI in the US and has reached mixed conclusions. Shetty et al. (2009), for example, find that evidence for such a relationship is sensitive to choice of cities and specification.

[2] The Americans for Non-Smokers' Rights Foundation (ANRF), for example, notes that only 20 states have laws that completely prohibit smoking in all workplaces, bars, and restaurants (the three main venues they track) without provisions for designated smoking rooms or firm size exemptions.

effects of these policies is a "lack of information on changes in secondhand-smoke exposure" (IOM 2009). Most previous studies on publicly adopted smoking bans focus on own-smoking behavior (Bitler et al. 2010, Tauras 2006), with a few notable exceptions. Carpenter (2009) examines publicly adopted laws restricting smoking in private workplaces and finds that they reduce exposure to ETS at work for some groups of workers, but he does not study exposure in public places. Adda and Cornaglia (2010) study the effects of publicly-adopted smoking laws on population exposure to ETS using saliva cotinine levels (a biological marker for nicotine metabolite), but their data do not permit them to observe *where* individuals were exposed. Several other public health studies use ambient nicotine measurements or other biological markers to study ETS exposure before and after smoking bans (usually in bars and restaurants). These studies generally find large reductions in exposure but are limited to a very small number of sites and suffer from the usual concerns about other unobserved characteristics about those sites that caused them to implement a smoking ban and that may be independently correlated with smoking-related outcomes.[3] Consistent with the IOM report, we are aware of no large-scale quasi-experimental evaluations of the effects of public-place smoking laws that use direct information on the location of ETS exposure.

We fill this gap in the literature by studying the rapid diffusion of public-place smoking laws across Canada on smoking outcomes and exposure to ETS in public places.[4] Our main

[3] See, for example, IOM 2009, Akbar-Khanzadeh et al. 2004, Ellingsen et al. 2006, Giorino et al. 2008, Mulcahy et al. 2005, Al-Delaimy et al. 2001, Menzies et al. 2006, Valente et al. 2007, Pell et al. 2008, and others. Evans et al. (1999) discuss these issues in detail.

[4] Canada provides a useful point of comparison to the existing literature for several reasons. First, coverage of public-place smoking laws increased substantially over the past decade: only 20% of the country's population was covered by a public-place smoking law in 2000 compared with 100% of Canadians currently covered by such a law. By providing a comprehensive evaluation of the effects of public-place smoking laws across the country, our results likely have increased generalizability relative to many of the single-site evaluations common in previous work. Second, the nature of the policy variation over time within Canada allows us to test for the effects of local laws as well as provincial laws. This provides us tests for whether public-place smoking laws reduce ETS exposure for individuals living in cities that did not previously adopt a local law but were "forced" to go smoke-free by the

contribution is that we leverage unique confidential data from the 2002-2008 Canadian Tobacco Use Monitoring Surveys which contain detailed questions on the precise location of exposure to ETS, such as bars, restaurants, and homes.[5] This affords us the literature's first direct tests of whether, how, and to what extent public place smoking laws affect exposure to ETS in the venues explicitly covered by the laws. We also draw on an independent source of confidential data from the Canadian Community Health Surveys (CCHS) from 2000 to 2008 which contains an alternate measure of ETS exposure in public places. We use both repeated cross-section datasets to estimate models with city and year fixed effects (i.e., a difference-in-differences framework), thus identifying the effects of the public-place smoking laws on outcomes using within-city changes over time in outcomes for individuals residing in places that adopted a law, controlling for the associated within-city changes in outcomes for individuals residing in places that did not adopt a law at that same time.

To preview, we find that public-place smoking laws in Canada had no statistically significant effects at reducing population smoking participation or intensity.[6] This suggests that public-place smoking laws are unlikely to have improved cardiovascular health by inducing existing smokers to quit. We do, however, find that public-place smoking laws significantly reduced ETS exposure in a variety of public places, especially inside bars/taverns, inside restaurants, and on outdoor patios at bars and restaurants. These estimated reductions in ETS exposure are: 1) observed for both non-smokers and smokers in the CTUMS; 2) very large in

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provincial law, thus isolating variation that is more plausibly exogenous to outcomes than the variation used in previous single-site evaluation studies. This policy landscape also mimics the United States, whereby cities generally first adopted public-place smoking laws prior to state intervention.

[5] The validity of self-reports of ETS exposure is supported by previous research which demonstrates that these outcomes are strongly correlated with other biological markers of ETS such as ambient nicotine measurements (Coghlin et al. 1989). Self-reports also have the advantage that we can make consistent comparisons of ETS exposure outcomes across space and time using very large samples of outcome data.

[6] This is consistent with two recent studies in the US. Bitler et al. (2010 forthcoming) find that state clean indoor air laws restricting smoking in bars and restaurants had no meaningful effects on smoking participation, while Adda and Cornaglia (2010) find that smoking bans in bars and restaurants did not affect smoking cessation.

magnitude (on the order of 65 percent for bars and 75 percent for restaurants); 3) extremely robust to a variety of specification checks (e.g., trends, leads, etc.); and 4) confirmed in independent analyses of the CCHS. These findings also hold when we restrict attention to more plausibly exogenous policy variation from individuals living in cities that did not voluntarily adopt a local law prior to the implementation of a province-wide law and who were thus 'forced' to go smoke-free. The ETS exposure reductions also exhibit a plausible monotonicity associated with the strength of the law in place (i.e., stronger laws induced larger reductions in ETS exposure). Finally, we also find that public-place smoking laws significantly increased the probability non-smokers report being exposed to ETS at building entrances, consistent with displacement.

Over our sample period, total exposure to ETS in public places was cut by more than half; we estimate that public-place smoking laws can account for the majority of these improvements. Measured differently, exposure to ETS in bars and restaurants was essentially eliminated over the past decade in Canada; our estimates suggest that public-place smoking laws are responsible for most of this improvement. Overall, our results are the first to show that public-place smoking laws significantly reduce ETS exposure in a range of public places for both smokers and non-smokers. Thus, our results highlight multiple plausible mechanisms through which such laws may improve cardiovascular health. Given that a large fraction of the US and other countries still do not ban smoking in public places, our results suggest the potential for significant public health improvements if smoking were universally banned in public places.

The paper proceeds as follows. We provide a literature review in Section II and present the data and methods in Section III. Section IV presents the main results on smoking and exposure to ETS in public places, and Section V offers a discussion and concludes.

II. PREVIOUS RESEARCH

Several recent studies in economics have used quasi-experimental methods to study the effects of laws restricting smoking in workplaces and public places, with most focusing on smoking behavior. Yurekli and Zhang (2000) used aggregate data on cigarette consumption in the US from 1970-1995 and found that smoke-free legislation significantly reduced cigarette consumption in models with state and year fixed effects. Taurus (2006) used data from the 1992-1999 Tobacco Use Supplements to the Current Population Survey and estimated models with state and year fixed effects. He found that a summary index of clean indoor air laws was estimated to reduce smoking intensity but not smoking participation. More recently, Bitler et al. (2010) used data from 1992-2007 and examined the effects of venue-specific state clean indoor air laws on smoking outcomes. Their quasi-experimental results returned no evidence that clean indoor air laws reduced smoking either in the full population or for workers who should have been directly affected because they worked in the venues targeted by the clean indoor air laws, with the exception that laws restricting smoking in bars were estimated to significantly reduce the share of bartenders who smoked.

Although most studies of the effects of laws restricting smoking in workplaces and public places have examined smoking participation and intensity as the outcomes of interest, two quasi-experimental studies have tested for effects on ETS exposure. Carpenter (2009) studied local smoking laws in Ontario, Canada from 1997-2004 (before implementation of the province's strong provincial law) using data from the Centre for Addiction and Mental Health (CAMH) Monitor. He estimated models with year and county fixed effects and found that local workplace smoking laws significantly reduced ETS exposure at work among blue collar workers. Carpenter (2009) did not study ETS exposure in other public or private places due to data constraints.

Adda and Cornaglia (2010) also studied the effects of workplace and bar/restaurant smoking laws on smoking behavior, time spent in various venues, and exposure to ETS using novel data on cotinine—a metabolite of nicotine—from saliva measurements in the National Health and Nutrition Examination Survey (NHANES III).[7] Their quasi-experimental models with state and year fixed effects showed: 1) no effects of the laws on smoking cessation; 2) significant effects of the laws on reducing the amount of time that smokers spent in bars and restaurants; and 3) significant increases in ETS exposure for children living with smokers. They suggest that these patterns can best be explained by displacement of ETS from public places to private places such as homes. They do not, however, directly observe where individuals were exposed to ETS.

We build on the work of Carpenter (2009) and Adda and Cornaglia (2010) in several important ways. First and most importantly, we observe direct measures of exposure to ETS in a variety of public places. Carpenter (2009) only examines ETS exposure at work, and Adda and Cornaglia (2010) infer changes in ETS exposure indirectly from relationships between public-place smoking laws and cotinine measures. Second, we provide several useful robustness tests of the effects of public-place smoking laws, for example by directly testing for endogenous policy adoption (by controlling for leads of the public-place laws) and by isolating individuals in cities that did not adopt a local smoking restriction and were therefore 'forced' to go smoke-free due to stronger provincial laws. We are also able to explicitly test for differential effects of laws based on the strength of the law adopted. Adda and Cornaglia's policy data from the Americans for Non-smokers' Rights Foundation (ANRF) only includes variation from strong 100% smoke-free laws, and Carpenter (2009) similarly restricts attention to strong 100% smoke-free laws in

[7] Adda and Cornaglia's smoking behavior data came from the 1984-2006 Behavioral Risk Factor Surveillance System. For information on time spent in various venues they pooled data from the 2003-2006 American Time Use Survey and the 1992-1994 National Human Activity Pattern Survey.

Ontario. Since many strong laws were preceded by weaker laws (which may have had incremental effects at reducing ETS exposure), our empirical specifications are more comprehensive than have been estimated in previous work. Third, our outcome data from the CTUMS and CCHS includes detailed information on the respondent's full six-digit postal code of residence. This allows us to very precisely match the policies in place to each individual observation. In contrast, Adda and Cornaglia (2010) use as their dependent variable of interest the fraction of a state's residents covered by 100% smoke-free policies but do not directly match the local or state policy in effect to each respondent. In these ways our research complements and extends the previous quasi-experimental studies of ETS exposure in Adda and Cornaglia (2010) and Carpenter (2009).

III. DATA DESCRIPTION AND EMPIRICAL APPROACH

In order to analyze the effects of public-place smoking laws on smoking and ETS outcomes in Canada, we use confidential data from the Canadian Tobacco Use Monitoring Survey (CTUMS) from 2002-2008 and the Canadian Community Health Surveys (CCHS) from 2000-2008.[8] The CTUMS and the CCHS are both large repeated cross-sectional surveys used to gather health-related information on Canadians living in private households, excluding people on Indian reserves and on Canadian Forces bases. The main difference between the two datasets is that the CTUMS focuses entirely on smoking-related outcomes while the CCHS covers a broad range of health topics. As a result, the CTUMS contains a larger number of more detailed questions about smoking behavior and ETS exposure, while the CCHS contains only a handful of ETS exposure

[8] For the CTUMS we use the annual file that combines Cycles 1 and 2 within each year. The CTUMS was also carried out in 1999, 2000, and 2001, but in these years there is no geographic information below province. Since a key contribution of our work is to test for the effects of numerous city-level laws prior to adoption of provincial laws, we focus on data from 2002-2008. For the CCHS, we use data from Cycle 1.1 (conducted in 2000/2001), Cycle 2.1 (conducted in 2003), Cycle 3.1 (conducted in 2005) and 4.1 (conducted in 2007/2008).

questions. The ETS exposure questions in the CCHS, however, cover a longer time period, and the CCHS has four times the sample size as compared to the CTUMS. Our main specifications restrict attention to respondents between the ages of 18 and 64 who have no missing data on the outcome variables or individual demographic covariates.

We construct several outcomes on own-smoking behavior using information that is available over the entire sample period in both datasets. First, we study the probability the respondent is a current smoker. All respondents are asked "At the present time, do you smoke cigarettes daily, occasionally, or not at all?" We create an outcome variable called "current smoker" that is equal to one if the individual reports smoking cigarettes daily or occasionally. Individuals who report being daily or occasional smokers are then asked about their smoking intensity. We create an outcome equal to the number of cigarettes smoked in the previous month.[9]

Our primary information on ETS exposure comes from the CTUMS, which from 2005-2008 asked about each respondent's exposure to ETS in a variety of venues. Individual self-reports have been shown to be highly correlated with other biological markers of ETS exposure, such as saliva cotinine levels (Coghlin et al. 1999). Specifically, individuals in the CTUMS are asked: "The next questions are about exposure to second-hand smoke in places other than your own home. Second-hand smoke is what smokers exhale and the smoke from a burning cigarette. In the past month, (excluding your own smoking), were you exposed to second-hand smoke: …

[9] In the CTUMS, individuals are administered the 'smoking wheel' which asks them about the number of cigarettes smoked on each of the previous seven days, beginning with the day just before the interview and working backwards. We define smoking intensity as the number of cigarettes a smoker reports smoking in the past week multiplied by four. In the CCHS (which does not administer the smoking wheel) we define this as the usual number of cigarettes smoked each day by daily smokers multiplied by thirty. For occasional smokers we compute past month consumption by multiplying the respondent's reported usual number of cigarettes smoked on the days she smoked multiplied by the number of days in the previous month she reported smoking at least one cigarette. This two-part model of smoking behavior is standard in the literature. See, for example, Cragg (1971), Manning *et al*. (1981), Duan *et al*. (1983), Mullahy (1998), and others.

inside a car or other vehicle?" Subsequent questions ask about exposure to ETS: 1) "inside someone else's home"; 2) "on an outdoor patio of a restaurant or bar"; 3) "inside a restaurant"; 4) "inside a bar or tavern"; 5) "at a bus-stop or shelter"; 6) "at an entrance to a building"; 7) "at your workplace"; 8) "at your school"; 9) "at any other public place such as a shopping mall, arena, bingo hall, concert, or sporting event"; and 10) "outdoors such as on a sidewalk or in a park". We code an indicator variable equal to one if the respondent reports she was exposed in each specific location.

Several features of the CTUMS exposure outcomes are worth noting. First, the question is concrete. It explicitly defines ETS and asks respondents to think about locations *other than their own home*. Importantly, it also directs individuals to respond about *other people's smoke*; thus, the question is informative for both smokers and non-smokers. Finally, note that these questions are unlikely to suffer from desirability bias or related false reporting since there is no penalty to the respondent from reporting ETS exposure in these venues (unlike, say, surveys of bar or restaurant owners following adoption of smoking laws covering those venues). We rely on these CTUMS outcomes as our main sources of information on ETS exposure.

The information on ETS exposure in the CCHS is more limited, so we use those data mainly to corroborate the findings in the CTUMS. For example, the CCHS only asks questions about ETS exposure to non-smokers. More importantly, these data do not ask about ETS exposure in each location/venue separately, so we instead create an outcome variable equal to one if the respondent reports being exposed to ETS in public places (defined in the CCHS as bars, restaurants, shopping malls, arenas, bingo halls, and bowling alleys) on all or most days in the previous month.[10]

[10] The wording of the ETS exposure questions in the CCHS changed slightly over the sample period. Specifically, Cycle 1.1 of the CCHS asked all current respondents who did not report being a current smoker whether they were

To assess the impact of the public-place smoking laws, we use a difference-in-differences approach that controls for unobserved time invariant area-specific heterogeneity through the inclusion of city (i.e., Canada's statistical area classification[11]) fixed effects and for area-invariant time-specific effects with the inclusion of time fixed effects. Specifically, we estimate the following:

$$(1)\ Y_{iat} = \alpha + \beta_1 X_{iat} + \beta_2 Z_{at} + \beta_3 (\text{Public-Place Smoking Law})_{at} + \text{Area}_a + \text{Year}_t + \varepsilon_{iat}$$

where Y_{iat} refers to the various smoking and ETS exposure outcomes for individual *i* in statistical area *a* in survey year *t*.[12] X_{iat} is a vector of individual demographic controls for age and its square, a male dummy, two marital status dummies (single never married and widowed/divorced/separated, with married/common-law as the reference group), and seven dummies for educational attainment (secondary school, some postsecondary school, some college, bachelors degree, graduate degree, and education missing, with less than high school as the reference group). Z_{at} is a vector of time-varying province-specific characteristics and policies that may be correlated with adoption of public-place smoking by-laws, including: the provincial unemployment rate and the real tax-inclusive provincial cigarette price. Area_a is a vector of statistical area dummies, and Year_t is a vector of survey year dummies. We also

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exposed to second-hand smoke (i.e., ETS) on most days in the previous month. Respondents who reported that they were exposed on most days then were asked a series of questions about where they were exposed, including "in a car or other private vehicle" and "in public places (bars, restaurants, shopping malls, arenas, bingo halls, bowling alleys)". Beginning with Cycle 2.1 and onward, the screener question about any exposure was eliminated, and non-smokers were explicitly asked about exposure "every day or almost every day" for the two venues (i.e., "in a car or other private vehicle" and "in public places" (with the identical venues listed in the question as in Cycle 1.1)). Our main CCHS results are unchanged if we restrict attention to data from Cycle 2.1 onward only. Also, note that all of our models include cycle-specific dummy variables.

[11] Statistical area classifications are the combination of the census metropolitan areas (population greater than 100,000 people) and census agglomerations (population between 10,000 and 100,000 people).

[12] We use linear probability models for ease of interpretation, but probit models returned very similar results. We use OLS for the smoking intensity models where the dependent variable of the natural log of the number of cigarettes smoked in the previous month.

include unrestricted month-of-interview dummies in all specifications to account for seasonality.[13]

Public-Place Smoking Law_{at} is an indicator variable which equals one if the respondent lives in an area which is covered by a law restricting or prohibiting smoking in public places and zero otherwise.[14] We construct the law variables by matching the local smoking policy in effect at the time of the CTUMS and CCHS interviews in the respondent's postal code of residence, similar to Carpenter's (2009) study of Ontario.[15] The coefficient of interest in equation (1) is β_3, which identifies the effect of public-place smoking laws as measured by the change in outcomes for individuals living in an affected area relative to the associated change in outcomes for individuals living in a non-affected area coincident with policy adoption. The key identifying assumption of the model is that that there are no shocks other than the public-place smoking laws that affected relative outcomes of individuals in adopting places versus non-adopting places. Throughout, ε_{iat} is assumed to be a well-behaved error term. All models use sampling weights

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[13] In some models we also allow for city-specific linear time trends which are created by interacting each city indicator with a variable that equals 1 in 2000, 2 in 2001, and so forth.

[14] Enforcement of these laws varies across cities and provinces, but generally the penalty for violating a public-place smoking ordinance is a modest to severe fine (e.g., $200 in Toronto, $2000 in Nova Scotia, and up to $10,000 in Saskatchewan) (CBC News 2009). In the US, smoking laws vary substantially with respect to the venues covered (e.g., private workplaces, bars, restaurants, schools, government buildings, child care centers, transit facilities, shopping malls, and others) (Bitler et al. 2010). In practice, most US-based research focuses on laws covering private workplaces, bars, and restaurants, and there is independent variation in the venue-specific restrictions. In Canada, these policies were generally adopted as a package and usually covered workplaces and a variety of public places.

[15] Information on these local smoking restrictions comes from Health Canada. For most individuals we match on Statistical Areas (SAs) or province, but if the bylaw is below the SA level of geography (e.g., the subdivision level) we code according to the lower level of geography since we observe the respondent's full six-digit postal code. We drop a very small number of individuals whose postal code spans multiple SAs irrespective of the presence of a policy. We use the current policy in effect at the time of interview for all outcomes except the questions about exposure to ETS which ask about exposure over the past month. For these outcomes, we drop the small number of individuals who were interviewed within 30 days immediately following adoption of a public-place smoking policy.

provided by the CTUMS and CCHS, and standard errors are clustered at the statistical area level (Bertrand et al. 2004).[16]

In some robustness models we replace the single Public-Place Smoking Law dummy with a series of three indicator variables representing by-laws of varying restrictiveness. Specifically, Gold Public-Place Smoking Law is an indicator equal to one if the individual lives in an SA covered by a strong 100% smoke-free law with no exemptions or allowances for Designated Smoking Areas. Silver Public-Place Smoking Law is an indicator equal to one if the individual lives in an SA covered by a smoke-free law that allows one venue-specific exemption.[17] Bronze Public-Place Smoking Law is an indicator equal to one if the individual lives in an SA covered by a smoke-free law that allows two or more venue-specific exemptions. Designated Smoking Areas are allowed under both Silver and Bronze laws. This model corresponds to:

$$(2)\ Y_{iat} = \alpha + \beta_1 X_{iat} + \beta_2 Z_{at} + \beta_3 (\text{Gold Public-Place Smoking Law})_{at} + \beta_4 (\text{Silver Public-Place Smoking Law})_{at} + \beta_5 (\text{Bronze Public-Place Smoking Law})_{at} + \text{Area}_a + \text{Year}_t + \varepsilon_{iat}$$

where all variables are as described above.

IV. RESULTS

We present visual evidence on the trends in policy adoption and outcomes related to smoking and ETS exposure in Figure 1 and 2 for the CTUMS and CCHS, respectively. In Figure 1 we see that from 2002 to 2008 the proportion of CTUMS respondents covered by a public-place

[16] Note that all provinces adopted laws over our sample period. We code the strongest relevant policy in effect for each respondent. For example, many localities adopted a silver law prior to adoption of a province-wide gold law. Individuals in these cities are first coded as being subject to a silver law and subsequently as being subject to a gold law when the provincial law takes effect. In contrast, if a city first adopted a gold law and then the province later adopted a silver law, an individual residing in that city is coded as being subject to a gold law for the entire period beginning when the local law takes effect.

[17] According to Health Canada, Gold, Silver, and Bronze laws all prohibit smoking in restaurants. We understand the exempted venues in Silver and Bronze laws to include venues such as bars, casinos, bowling alleys, billiard halls, and bingo halls.

smoking law increased dramatically from about a third of the population to 100% of CTUMS respondents in 2008 living in a place covered by a public-place smoking law. Notably, while the increase in the probability of being covered by any law was gradual over this period, there was a sharp break in the probability individuals were covered by stronger 100% smoke-free gold public-place smoking laws beginning in 2006 when many of the large provincial laws began taking effect. The fact that the "any law" trend does not increase sharply at the same time illustrates that these strong province-wide laws were in many cases replacing weaker city-specific silver or bronze-level restrictions. Coincident with this sharp upturn in gold law coverage in Figure 1, we also observe corresponding reductions in ETS exposure inside bars and restaurants (recall that we only observe the venue-specific ETS exposure outcomes from 2005-2008). We also show in Figure 1 that exposure to ETS at building entrances increased modestly between 2005 and 2007, coincident with the sharp increase in coverage of strong public-place smoking laws.

These overall patterns are largely confirmed in Figure 2 for the CCHS. Specifically, we observe the same general pattern that there was a striking increase in the proportion of Canadians covered by a public-place smoking law over this period, with only about ten percent having a law in 2000 versus 100% of Canadians being subject to a law in 2008. Moreover, the timing of the sharp increase in gold law coverage in the CCHS data in Figure 2 (just after 2005) combined with a smooth coincident increase in the probability of being covered by any law corresponds exactly to the patterns observed in Figure 1 for the CTUMS. Over this same period Figure 2 shows that there was a nontrivial reduction in smoking participation (from 30 to 24 percent) and a much larger proportional reduction in the fraction of non-smoking Canadians who reported being exposed to ETS in public places on all or most days of the previous month (from 23 to 11 percent).

We provide basic weighted descriptive statistics for adult respondents age 18-64 in Tables 1 and 2 for the CTUMS and CCHS, respectively. Table 1 shows that about 43.7% of the CTUMS sample is covered by a 100% smoke-free gold public-place smoking law, compared with almost 20 percent covered by a silver law and 8 percent covered by a bronze law. Over the full sample period over ten percent of respondents report being exposed to ETS inside a bar/tavern or inside a restaurant, though as shown in Figure 1 these proportions fell dramatically from 2005-2008, coincident with adoption of public-place smoking laws. Over a third of respondents report being exposed to ETS on the patio of a bar or restaurant, while almost 58 percent of CTUMS respondents report being exposed to ETS at the entrance to a building. Over 20 percent of the CTUMS sample reports being a current smoker. Over 30 percent of respondents have at least a university degree, and the vast majority of the sample is married. The large provinces (Ontario, Quebec, British Columbia, and Alberta) constitute over 85 percent of the population.

These same patterns are broadly confirmed in the CCHS descriptive statistics in Table 2. Over a third of respondents in the CCHS are covered by a gold public-place smoking law, with lower proportions covered by silver or bronze laws (17.8 percent and 8.1 percent, respectively). Recall that our ETS exposure measure in the CCHS is slightly different than in the CTUMS; Table 2 shows that about 17.3 percent of non-smokers in the CCHS over the full sample period reports being exposed to ETS in public places on all or most days in the previous month. We also find slightly higher smoking rates in the CCHS than in the CTUMS, though this is partly a function of the fact that smoking rates were falling throughout the period, and the CTUMS data

(2002-2008) are more recent than the CCHS data (2000-2008). Again, the patterns of demographic characteristics in the CCHS shown in Table 2 are largely similar to those reported in Table 1 for the CTUMS, confirming that the datasets are quite comparable.

Table 3 presents the basic results for smoking participation (columns 1-4) and smoking intensity (columns 5-8) for both the CTUMS and CCHS. Each column represents a separate model, and in each case we present the coefficient on the "public-place smoking law" indicator. We present results with and without the city and year fixed effects (in the odd numbered and even numbered columns, respectively). All models include the individual level demographic controls, provincial level real cigarette prices, and provincial unemployment rates.

The results in Table 3 provide no evidence that public-place smoking laws significantly reduced smoking participation or intensity. Although models without city and year fixed effects in columns 1 (CTUMS) and 3 (CCHS) indicate that individuals in areas with public-place smoking laws are significantly less likely to smoke than individuals in areas without public place smoking laws, these relationships are not robust to including unrestricted controls for statistical area and year fixed effects in columns 2 and 4. Our preferred estimate using the larger samples of the CCHS data, for example, indicates that there was virtually no relationship between adoption of public-place smoking laws and the probability an individual reports being a smoker (top panel of column 4), and the estimate is sufficiently precise that the 95% confidence interval rules out smoking reductions larger than .7 percentage points.[18] These null findings on smoking

[18] Relative to a mean smoking rate of 26.1 percent in the CCHS, this estimate rules out effect sizes of larger than about 2.7 percent for public-place smoking laws on smoking participation.

participation are consistent with recent research on similar policies in the US (Bitler et al. 2010, Adda and Cornaglia 2010).[19]

We find qualitatively similar patterns in columns 5-8 of Table 3 for smoking intensity. While models without statistical area and year fixed effects suggest large negative associations of public-place smoking laws with smoking intensity, these relationships are much smaller and statistically (and economically) insignificant when we turn to the fixed-effects estimates in columns 6 (CTUMS) and 8 (CCHS). Overall, we conclude that public-place smoking laws in Canada had no meaningful effects on population smoking prevalence.[20] These null findings on smoking prevalence suggest that any improvements in cardiovascular health associated with smoking bans are unlikely to be attributed to reductions in smoking by existing smokers.

We turn to our main ETS exposure outcomes from the CTUMS in Table 4. Each entry is the coefficient on the "public-place smoking law" indicator, and we only report results from our preferred quasi-experimental models with city and year fixed effects. We present the relevant coefficient of interest for the first six outcomes (using the order in which they are asked in the survey) in the top panel and for the last six outcomes in the bottom panel. The results in Table 4 return strong evidence that public-place smoking laws significantly reduced exposure to ETS on outdoor patios of restaurants or bars (column 3), inside restaurants (column 4), and inside bars or taverns (column 5). Each of the estimated effects is statistically significant at the one percent level, and the estimated reductions are also very large in magnitude. The estimate in column 4,

[19] These null findings on smoking also suggest that our CCHS models of ETS exposure that restrict attention to non-smokers are not seriously contaminated by composition bias (since smoking status is not correlated with adoption of public-place smoking laws). Recall that the ETS questions in the CCHS were only asked of non-smokers.

[20] In results not reported but available upon request, we did not find evidence that real tax-inclusive provincial cigarette prices had significant effects on smoking participation or intensity once we accounted for statistical area and year fixed effects. We similarly found no economically or statistically significant relationship between provincial unemployment rates and smoking prevalence. With respect to demographic characteristics, we found the usual patterns: men are more likely to smoke than women, smoking increases with age, married individuals are less likely to smoke than unmarried individuals, and highly educated individuals are less likely to smoke than individuals with less education. The full set of coefficient estimates is available upon request.

for example, indicates that adoption of a public-place smoking law reduced the probability a respondent reports being exposed to ETS inside a restaurant in the previous month by almost 40 percentage points, or by about 75 percent relative to a mean ETS exposure rate of 54 percent for individuals not covered by a public-place smoking law in 2005. Similarly, the estimate in column 5 of Table 4 indicates that a public-place smoking law reduced exposure to ETS inside a bar or tavern by 23.9 percentage points, or by about 64 percent relative to the associated 2005 exposure rate for individuals not covered by a public-place smoking law (23.9/37.6=.64). For the other venues in the top panel of Table 4 we find much smaller and statistically insignificant effects of public-place smoking laws, including inside a car or vehicle, inside someone else's home, and at a bus stop or shelter.

We examine the remaining venues in the bottom panel of Table 4, and again we only report the coefficient on the public-place smoking law in the preferred DD models with city and year fixed effects. Interestingly, in column 7 we estimate that public-place smoking laws *increased* the probability an individual reports she was exposed to someone else's smoke at the entrance to a building, and this estimate is statistically significant at the ten percent level. This may suggest that smoking is displaced from inside public places to just outside the entrance of those places; we return to this possibility below. Interestingly, we find no substantive or statistically significant relationship between exposure at one's workplace (column 8) or school (column 9) and the presence of a public-place smoking law. This is not surprising, given that the laws we study pertain to public places and not workplaces per se (though clearly bars, restaurants, and other public places are workplaces for some small share of workers)[21] and given other research that has documented that the vast majority of private workplaces went smoke-free

[21] We do not have sufficient occupation data in the CTUMS to test whether these ETS exposure effects differ by occupation.

without the push of government intervention far before the start of our sample period (Carpenter 2009, Bitler et al. 2010, and others). We do, however, find that public-place smoking laws significantly reduced ETS exposure in a summary measure of other public venues that includes shopping malls, arenas, bingo halls, concerts, or sporting events (column 10). For these venues, we estimate that the laws reduce exposure by 5.1 percentage points, or about 15 percent relative to the proportion of individuals living in places without these laws who reported such exposure in 2005 (5.1/33.8=.15). In column 11 we find that the laws had no meaningful effect on the probability an individual was exposed outdoors, such as on a sidewalk or in a park, suggesting that smokers were not displaced to these locations. Finally, in column 12 we find that the laws significantly reduced ETS exposure in other places not explicitly asked about in the CTUMS. Specifically, we estimate that a public-place smoking law reduced exposure to someone else's ETS "anywhere else" (i.e., other than in the locations explicitly asked previously) by 3 percentage points. Relative to a mean exposure rate over the sample period of 4.4 percent, this is a very large reduction.

We next turn to the critical evaluation question of whether the reductions in ETS exposure observed in the various venues in Table 4 are driven by exposure reductions experienced by non-smokers, smokers, or both. Reduced smoking in public places could convey important cardiovascular health benefits to both non-smokers and smokers, but previous research has not addressed this question. We present results using the same specification as in Table 4 (i.e., with city and year fixed effects) but separately for the samples of current smokers and non-smokers in the CTUMS. Recall that current smoking status was unaffected by adoption of public-place smoking laws, so this exercise is not likely to be contaminated by systematic composition biases.

We present results for ETS exposure inside a restaurant (columns 1 and 2 for smokers and non-smokers, respectively), inside a bar or tavern (columns 3 and 4), and at the entrance to a building (columns 5 and 6). These results reveal strong evidence that the improvements in cardiovascular health from lower ETS exposure associated with public-place smoking laws accrue to both smokers and non-smokers. For example, we estimate reductions in ETS exposure inside a restaurant in columns 1 and 2 that are very similar in magnitude (and both statistically significant at the one percent level) for smokers and non-smokers, respectively. Interestingly, we find much larger estimated reductions in reported ETS exposure inside a bar or tavern for smokers compared with the associated reductions at that same venue reported by non-smokers, though both are statistically significant. The much larger reductions for smokers may reflect effects of the laws at changing where smokers spend their time; since they are likely to be displaced to other venues and places with fewer smokers than, say, bars or restaurants (in the pre-treatment regime), this is still likely to have positive health benefits on net since recall that the laws were not associated with changes in smoking intensity. Note that non-smokers should be no *less* likely to visit bars and restaurants after smoking restrictions are adopted, suggesting that the significant reductions in ETS exposure for non-smokers are likely lower bounds on the true effect sizes and that that the reductions in ETS inside those venues are "real".[22]

Finally, in columns 5 and 6 of Table 5 we further probe the finding from Table 4 that public-place smoking laws were estimated to increase exposure to ETS at building entrances. When we separately examine smokers and non-smokers in Table 5, there is clearer evidence for displacement: while public-place smoking laws are not significantly related to the probability smokers report being exposed to ETS at building entrances in the past month (column 5), the

[22] Results for other venues are available upon request. We do not present them here to conserve space. The patterns were qualitatively identical (i.e., significant reductions for both smokers and non-smokers) for ETS exposure: on outdoor patios of bars and restaurants; at public places such as malls, arenas, etc.; and ‘anywhere else’.

laws significantly increase the probability non-smokers report being exposed to ETS at building entrances by 4.7 percentage points. We interpret this finding as suggesting that public-place smoking laws displace some smokers from inside public venues to just outside those venues. Again, we suspect that such displacement is on net beneficial to non-smokers from a public health perspective, since this type of exposure is likely to be much more brief than, say, sustained exposure inside a restaurant during a meal.[23]

In Table 6 we examine the robustness of the main findings that public-place smoking laws significantly reduced exposure to other people's ETS in public places, particularly inside restaurants (top panel) and inside bars or taverns (bottom panel). In each column we present the results from an alternative specification check. First, we reprint the basic difference-in-differences estimates (corresponding to those printed in Table 4) for each venue in column 1. In column 2 we add controls for smooth annual city-specific trends. In these models, we identify the effects of public-place smoking laws from sharp deviations off of smooth trends in outcomes coincident with adoption of the public-place smoking law. In column 3 we directly address concerns about possible policy endogeneity by controlling for a one-year lead of the public-place smoking law variable. If large shocks to outcomes systematically precede rather than follow public-place smoking laws, this could suggest that the laws were endogenously adopted or that there is some other specification error. In column 4 we take an alternative approach for dealing with policy endogeneity by restricting attention to individuals living in cities that did not adopt city-specific public-place smoking laws and who, therefore, were 'forced' to go smoke-free in public places due to stronger provincial laws later in the period. The variation in the public-place smoking law indicator is likely more exogenous to outcomes for individuals in these cities.

[23] We do not find a similarly positive and statistically significant effect of public-place smoking laws on exposure to ETS at building entrances for smokers. One possibility is that smokers are being displaced to building entrances by themselves but not with others (recall the ETS exposure question explicitly asks about other people's smoke).

Indeed, the dependent variable means reported in Table 6 for exposure inside restaurants and inside bars provide face validity to this notion: exposure in each of these venues is substantially higher in the 'forced' sample than in the full sample, which is consistent with the idea that the variation in public-place smoking laws for the 'forced' sample is more plausibly exogenous to outcomes (i.e., they went smoke-free against their will). Finally, in column 5 we report coefficient estimates from equation (2) above, in which we replace the single public-place smoking law variable with separate indicators for laws of varying strength or restrictiveness (i.e., gold, silver, and bronze-level laws). In the presence of a true causal effect of the laws at reducing ETS in these venues, we would expect a plausible monotonicity in the strength of the law adopted.

The results in Table 6 confirm that the reductions in ETS exposure estimated in the previous tables are highly robust. For example, examining the top panel for exposure to ETS inside restaurants, we find that the coefficient estimate on the public-place smoking law variable remains large, negative, and highly significant once we include city-specific trends (column 2) or control for the one-year lead of the policy variable (column 3). Notably, the coefficient on the policy lead for the restaurant exposure variable is negative and statistically significant, but it is much smaller than the associated public-place smoking law coefficient estimate.[24] We find that the main ETS exposure result for restaurants is unchanged when we examine individuals in the 'forced' sample in column 4, and we observe a plausible monotonicity in the strength of the law specification in column 5 (though the estimates for the gold and silver laws are very similar in magnitude).

[24] A small positive and significant lead effect could arise, for example, if restaurant owners anticipated the law coming into effect and decided to comply in advance of the actual implementation date. Announcement effects would also produce the observed small lead coefficient for restaurant ETS exposure, particularly if there were uncertainty by smokers about when such laws took effect.

For exposure to ETS inside bars and taverns in the bottom panel, we find that the effects of public-place smoking laws are even more robust. While the inclusion of city-specific time trends does little to the relevant coefficient estimate in the bottom panel (as for restaurant exposure), we do not find evidence of a statistically significant lead effect in the bottom panel of column 3. Moreover, even with the control for the one-year lead, we continue to estimate that public-place smoking laws significantly reduced ETS exposure inside bars and taverns. In column 4 we continue to observe a strong effect of public-place laws in the 'forced' sample, and column 5 also exhibits stronger evidence of monotonicity in the effects according to the strength of the law adopted.[25] Overall, these results confirm that the estimated reductions in ETS exposure are highly robust, especially for exposure inside bars and taverns.

In Table 7 we examine the robustness of the ETS exposure reductions in a different way. Specifically, we turn to the independently drawn CCHS data that contains an alternative measure of such exposure: the probability an individual reports being exposed to ETS in public places (not separately by venue) on all or most days of the previous month. The format of Table 7 follows Table 6: we present the baseline difference-in-differences results in column 1, and in the remaining columns we assess robustness by: adding city-specific trends (column 2), controlling for a one-year policy lead (column 3), restriction attention to the ‘forced’ sample (column 4), and controlling for the strength of the law adopted (column 5).[26] The results in Table 7 confirm that

[25] As noted above, Health Canada's coding indicates that smoking in restaurants is prohibited in Gold, Silver, and Bronze Laws; the venue-specific exemptions for Silver (one exemption) and Bronze (two or more exemptions) can include bars, casinos, bowling alleys, billiard halls, and bingo halls. This suggests we should observe a weaker Gold/Silver/Bronze gradient in the effects of public-place smoking laws on ETS exposure in restaurants as compared to bars. Indeed, this is what the patterns in Table 6 indicate. In results not reported but available upon request we found qualitatively similar results of the robustness exercises for the other venues. Exposure to ETS on outdoor patios of bars and restaurants exhibited patterns that were qualitatively identical to those for exposure to ETS in bars in the bottom panel of Table 6, for example.

[26] As with the CTUMS, it is worth noting that the ‘forced’ sample in the CCHS has a higher rate of public-place ETS exposure than the full sample (20.6 percent versus 17.3 percent), which is consistent with the idea that the variation in public-place smoking laws for the ‘forced’ sample is more plausibly exogenous to outcomes. We also

the estimated reductions in public-place ETS exposure associated with adoption of a public-place smoking law are also found in the CCHS data. Specifically, we estimate that a public-place smoking law reduces exposure to ETS in public places by about 6 to 10 percentage points. These effect sizes are very large as a proportion of the sample mean (.174), and all of the estimates in Table 7 are statistically significant at the one percent level. Thus, while the CCHS lacks detailed information on the precise location of exposure, the main finding that public-place smoking laws significantly reduced exposure to ETS in public places is confirmed.[27]

V. DISCUSSION AND CONCLUSION

We examined the effects of numerous local and provincial public-place smoking laws adopted across Canada over the past decade on a variety of smoking-related outcomes, including a direct measure of exposure to ETS in the venues explicitly targeted by the laws. Most previous work has focused mainly on smoking prevalence or workplace ETS exposure, despite that the explicit goal of public-place smoking laws was to reduce population ETS exposure in public places more broadly. Moreover, most previous work has lacked direct information on *where* individuals were exposed to ETS.

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estimated similar models on the sample of individuals living in cities that adopted a law prior to the provincial law (i.e., the 'non-forced' sample) in the CCHS. We found a smaller decline in reported ETS exposure associated with public-place smoking laws in the 'non-forced' sample compared with the associated estimate in the 'forced' sample, though the magnitude of this difference is very small. Estimation of these models is not feasible in the CTUMS because the questions about ETS exposure in those data did not begin until 2005 which leaves us with insufficient data prior to adoption of local laws in the 'non-forced' sample.

[27] In results not reported but available upon request, we performed several other robustness checks to the main findings on public-place ETS exposure. First, our main results on reductions in ETS exposure in public places are robust to using a probit model for the dichotomous nature of the outcome instead of OLS; estimated marginal effects were virtually identical. Second, our main ETS results are also robust to excluding each of the highly populated provinces individually (Ontario, Quebec, British Columbia, and Alberta). Third, our main ETS results are robust to excluding Toronto and Vancouver. Fourth, our main ETS results are robust to excluding the small proportion of individuals living in cities that straddle province boundaries (e.g., Ottawa).

Our results indicate that public-place smoking laws in Canada did not have meaningful effects on smoking participation or intensity in either the CTUMS or the CCHS. We do, however, find in the CTUMS that the laws significantly reduced exposure to ETS in a variety of public places—especially bars, restaurants, and outdoor patios of bars and restaurants. These reductions in public-place ETS exposure are observed for both smokers and non-smokers and—particularly for exposure to ETS in bars—are extremely robust to a variety of important specification checks. We also observe these same general patterns in independent analyses of CCHS data. Interestingly, we also estimate that public-place smoking laws significantly *increased* non-smokers' exposure to ETS at building entrances, suggesting that the laws displace some smokers from inside venues to just outside those places. We did not find that the laws had significant effects at affecting exposure in several other venues, however, including in cars, in other people's homes, at bus stops and shelters, and at parks.

How large are these effects? Recall that the summary measure of public-place ETS exposure among non-smokers in Canada in the CCHS fell about 12 percentage points from 2000 to 2008 in the CCHS (from 23 percent of the sample to 11 percent being exposed on all or most days in public places). Our fixed-effects estimate in Table 7 suggests that public-place smoking laws can account for 7.3 percentage points (i.e., the majority) of this improvement. Measured differently using the venue-specific exposure outcomes in the CTUMS, we estimate that public-place smoking laws can account for the vast majority of the near elimination of ETS in bars and restaurants observed from 2005-2008. Importantly, our results uncover multiple plausible mechanisms through which public-place smoking laws may be expected to improve cardiovascular health for both smokers and non-smokers, as reported in a recent IOM report on smoking bans and heart attacks. Finally, our null findings on smoking prevalence suggest that any improvements in cardiovascular health associated with adoption of smoking bans are not likely attributable to reductions in own-smoking.

Our study is subject to several limitations. First, our outcome data are self-reported exposure outcomes and are not biological markers of exposure to ETS. Given our direct knowledge about location of exposure and the increase in external validity and generalizability, this seems a reasonable trade-off, particularly since the epidemiological literature using biomarker data is now full of single-site evaluations of public-place ETS exposure that focus on select samples (e.g., bar workers). Our results demonstrate that the effects of public-place smoking laws are economically and statistically significant across the population. A second limitation is that although we can identify the venues from which smoking is being displaced (e.g., bars, restaurants, outdoor patios, other public-places), we are unable to identify all of the venues towards which smoking is being reallocated (and we think such a reallocation exists because of the null findings on smoking participation and intensity). If smoking is being displaced to other public places besides building entrances, this is unlikely to change the overall cost/benefit analysis of the public-place smoking laws. If, however, smoking is being displaced to other private places such as homes, this may complicate a full cost-benefit analysis of the effects of these policies. Our results in Table 4 at least rule out systematic displacement to one specific private place: other people's homes.

Third, we do not observe information on where respondents spend their time. Since one rational response by smokers and non-smokers alike is to change the amount of time spent in various places in response to public-place smoking restrictions, we cannot rule out that these behavioral changes are important responses to the laws. However, note that our estimated effects on public-place ETS exposure are likely *underestimates* of the true beneficial effects of the laws at reducing ETS exposure in those venues since, if anything, these laws should have *increased* the amount of time spent in those venues by non-smokers, thus mechanically increasing potential exposure to ETS. That we still find significant reductions in ETS exposure in public places is evidence that the true per-occurrence exposure to ETS in public places is likely even lower.[28]

Despite these limitations, our results offer the strongest evidence to date that public-place smoking laws are effective tools at reducing non-smokers' and smokers' exposure to ETS in a variety of public places on a broad, population-wide scale. In so doing, these findings suggest wide latitude for significant public health improvements if the United States and other countries were to universally ban smoking in public places.

[28] We can, however, provide descriptive evidence indicating that a substantial share of individuals spend time in bars and restaurants and that individuals who patronize these establishments spend a meaningful amount of time there. Specifically, we examined confidential data from cycle 19 of the Canadian General Social Survey (GSS) on Time Use. These data provide information on individual time use over a 24-hour period. Interviews for cycle 19 of the GSS were conducted between January and December 2005, which corresponds to the beginning of our CTUMS sample with questions on ETS exposure. The GSS data indicate that approximately 20 and 5 percent of the sample whose reference day was either Friday or Saturday went to a restaurant for a meal or to a bar to socialize on the reference day, respectively. An even higher proportion of young adults age 19-35 whose reference day was a Friday or a Saturday attended a bar on that day: 8 percent of this group did so. These age-specific differences in time spent in a bar correspond with the mean exposure in bars from the CTUMS sample, were we found that in 2005 34 percent of the respondents age 19 to 35 said they were exposed to ETS in a bar, while only 16 percent of respondents age 36 to 64 said they were exposed to ETS in a bar (recall these CTUMS exposure outcomes are measured over the previous month). Moreover, the GSS data indicate that among individuals patronizing these establishments, large amounts of time are spent at bars and restaurants. Among respondents who reported going to a bar and whose reference day was Friday or Saturday, the average time spent socializing was approximately 165 minutes; the associated figure for eating a meal at a restaurant was approximately 93 minutes. Overall, then, the GSS data indicate that in 2005 (before the widespread adoption of strong provincial public-place smoking laws) a substantial share of individuals attended bars and restaurants—especially on the weekends—and spent multiple hours there on each occasion. A natural follow-up analysis would be to examine how time use patterns changed with the widespread adoption of public-place smoking laws after 2005, when the province-wide regulations were implemented, as well as to examine how patterns of time use in bars and restaurants differ by smoking status. Unfortunately, the next most recent GSS Time Use survey (Cycle 24) is not available to researchers until late 2011, and none of the time use surveys provide information on respondent smoking status. As such, we describe these GSS time use patterns to show that the reductions in ETS exposure attributable to public-place smoking laws are consistent with meaningful health improvements documented in other studies.

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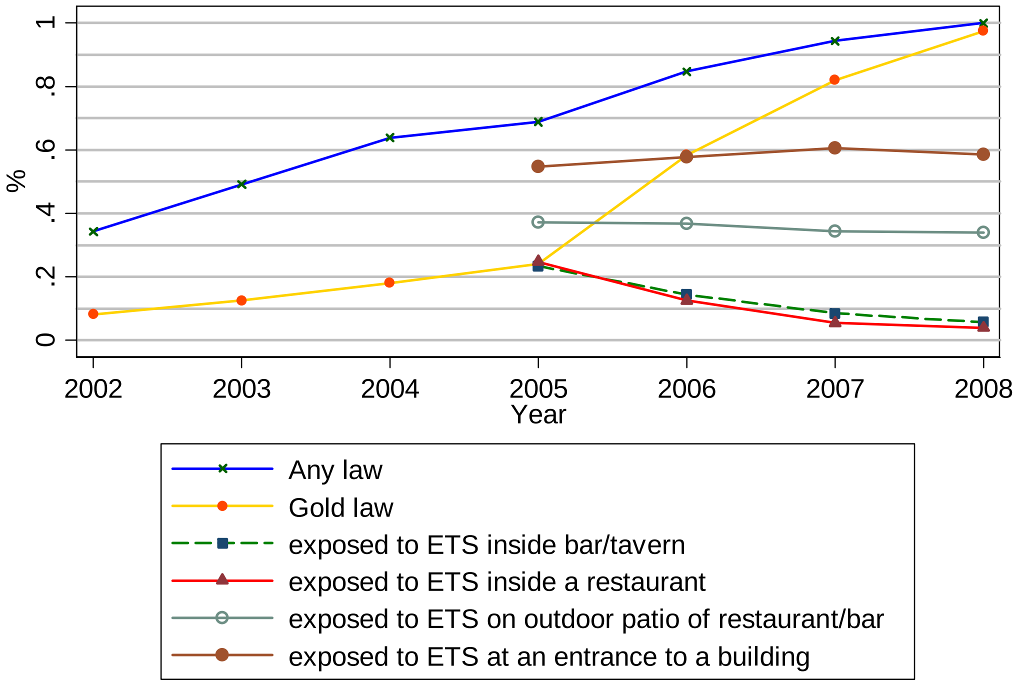
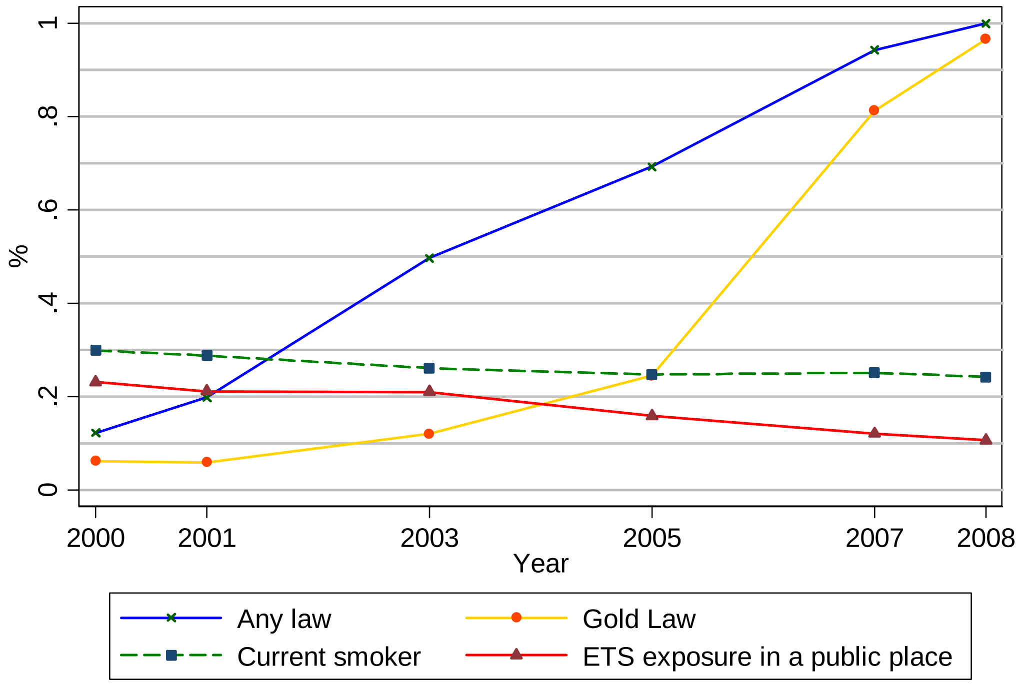
Figure 1: Trends in public-place smoking laws, ETS exposure inside bars/taverns, inside restaurants, on outdoor patios of restaurants/bars, and at building entrances, CTUMS 2002-2008



Source: CTUMS 2002-2008

Figure 2: Trends in public-place smoking laws, ETS exposure in a public place and smoking status, CCHS 2000-2008



Source: CCHS 1.1, 2.1, 3.1 and 4.1

Table 1: Descriptive Statistics, CTUMS

	Full sample
Public-place smoking law	0.712
Gold public-place smoking law	0.437
Silver public-place smoking law	0.196
Bronze public-place smoking law	0.080
Exposed to second hand smoke*	
- inside a bar/tavern	0.130
- inside a restaurant	0.116
- on the patio of a bar or restaurant	0.355
- at the entrance to a building	0.579
- inside a car or vehicle	0.261
- inside someone else's home	0.293
- at a bus stop or shelter	0.186
- at your workplace	0.271
- at your school	0.070
- at any other public place such as a shopping mall, arena, etc	0.348
- outdoors such as on a sidewalk or in a park	0.568
- anywhere else	0.045
Current smoker	0.211
Number of cigarettes smoked last month (among smokers)	380.7
Age	39.70
Male	0.497
Education	
Less than high school	0.089
High school	0.231
Some post secondary	0.154
College	0.202
University	0.301
Other	0.011
Missing	0.012
Marital status	
Single never married	0.274
Not currently married (i.e., widowed, divorced, or separated)	0.081
Missing	0.013
Observations	67,142

Notes: Weighted means, CTUMS 2002-2008, adults age 18-64.
* Weighted means, CTUMS 2005-2008, adults age 18-64.

Table 2: Descriptive Statistics, CCHS

	Full sample
Public-place smoking law	0.584
Gold public-place smoking law	0.325
Silver public-place smoking law	0.177
Bronze public-place smoking law	0.081
Exposed to ETS in public places on most or all days in previous month (among non smokers)	0.174
Current smoker	0.261
Number of cigarettes smoked last month (among smokers)	377.6
Age	39.9
Male	0.498
Education	
Less than high school	0.047
High school	0.100
Some post secondary	0.063
College	0.379
Bachelor	0.224
Graduate school	0.125
Missing	0.062
Marital status	
Single never married	0.277
Not currently married (i.e., widowed, divorced, or separated)	0.093
Province	
Newfoundland	0.009
PEI	0.003
Nova Scotia	0.023
New Brunswick	0.018
Quebec	0.236
Ontario	0.409
Manitoba	0.030
Saskatchewan	0.023
Alberta	0.102
British Columbia	0.145
Yukon	0.001
North West Territories	0.001
Observations	238,503

Notes: Weighted means, CCHS Cycles 1.1-2008, adults age 18-64.

Table 3: Public-place smoking laws had no significant effects on smoking prevalence, sample is all adults in CTUMS and CCHS, 2000-2008

	Smoking Participation				Log # cigarettes smoked last month (among smokers)			
	CTUMS (2002-2008)		CCHS (2000-2008)		CTUMS (2002-2008)		CCHS (2000-2008)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Mean of dep var	.211		.261		5.98		5.37	
Public-place smoking law	-0.037** [0.011]	-0.017 [0.009]	-0.024** [0.008]	0.002 [0.004]	-0.073** [0.021]	-0.007 [0.038]	-0.124* [0.054]	0.01 [0.017]
Observations	66,621	66,621	238,503	238,503	11,647	11,647	66,648	66,648
R-Squared	0.06	0.07	0.06	0.07	0.09	0.12	0.12	0.13
Individual and provincial controls?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
City and year fixed effects?		Yes		Yes		Yes		Yes

Notes: Sample in columns 1-2 and 5-6 includes adults age 18-64 in the CTUMS 2002-2008. Sample in columns 3-4 and 7-8 includes adults age 18-64 in the CCHS Cycles 1.1-4.1. The dependent variable in columns 1-4 is an indicator variable equal to 1 if the person reports being a current smoker. The dependent variable in columns 5-8 is the natural log of the number of cigarettes smoked last month. In the CTUMS we use information on number of cigarettes smoked over the last seven days to construct a monthly variable. Since a large number of occasional smokers in the CTUMS did not smoke in the last week, the sample in columns 5 and 6 is restricted to daily smokers. In the CCHS, the information on smoking was on the past month, and so we are able to use all current smokers. Individual demographic controls include: age and its square, a male dummy, two marital status dummies, and six education dummies (see text). All models also control for the provincial cigarette excise tax and the provincial unemployment rate. Robust standard errors in brackets are clustered on statistical areas (SAs). * significant at 5%; ** significant at 1%.

Table 4: Public-place smoking laws significantly reduced exposure to ETS in public places--especially restaurants and bars, sample is all adults in CTUMS 2005-2008

	(1)	(2)	(3)	(4)	(5)	(6)
Exposed to ETS:	Inside a car or vehicle	Inside someone else's home	On an outdoor patio of a restaurant or bar	Inside a restaurant	Inside a bar or tavern	At a bus stop or shelter
Mean of dep var:	0.261	0.293	0.355	0.116	0.130	0.186
Public-place smoking law	-0.020	-0.017	-0.113**	-0.396**	-0.239**	-0.024
	[0.012]	[0.016]	[0.016]	[0.049]	[0.015]	[0.019]
Observations	37,694	37,694	37,694	37,694	37,694	37,694
R-Squared	0.13	0.12	0.08	0.23	0.15	0.08
	(7)	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Exposed to ETS:	At an entrance to a building	At your workplace	At your school	At any other public place such as a shopping mall, arena, bingo hall, concert, or sporting event	Outdoors such as on a sidewalk or in a park	Anywhere else
Mean of dep var:	0.579	0.271	0.070	0.348	0.568	0.045
Public-place smoking law	0.026	-0.011	0.001	-0.051**	-0.010	-0.030**
	[0.013]	[0.015]	[0.005]	[0.012]	[0.014]	[0.008]
Observations	37,694	37,694	37,694	37,694	37,694	37,694
R-Squared	0.04	0.05	0.19	0.04	0.05	0.02
Individual and provincial controls?	Yes	Yes	Yes	Yes	Yes	Yes
City and year fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Sample includes adults age 18-64 in the CTUMS 2002-2008. The dependent variable in each column is an indicator equal to one if the individual reports being exposed to someone else's smoke in each of the specific areas. See notes to Table 3 for control variables. * significant at 5%; ** significant at 1%.

Table 5: Public-place smoking laws reduced exposure to ETS inside bars and restaurants for both non-smokers and smokers but increased non-smokers' ETS exposure at building entrances, sample is all adults in CTUMS 2005-2008

	(1)	(2)	(3)	(4)	(5)	(6)
Sample is:	Smokers	Non-smokers	Smokers	Non-smokers	Smokers	Non-smokers
Exposed to ETS:	Inside a restaurant	Inside a restaurant	Inside a bar or tavern	Inside a bar or tavern	At an entrance to a building	At an entrance to a building
Mean of dep var:	0.131	0.112	0.188	0.115	0.564	0.583
Public-place smoking law	-0.399**	-0.391**	-0.374**	-0.197**	-0.017	0.047**
	[0.043]	[0.053]	[0.029]	[0.016]	[0.034]	[0.017]
Observations	8,681	29,013	8,681	29,013	8,681	29,013
R-Squared	0.32	0.21	0.27	0.12	0.07	0.05
Individual and provincial controls?	Yes	Yes	Yes	Yes	Yes	Yes
City and year fixed effects?	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Sample includes adults age 18-64 in the CTUMS 2002-2008. The dependent variable in each column is an indicator equal to one if the individual reports being exposed to someone else's smoke in each of the specific areas. See notes to Table 3 for control variables. * significant at 5%; ** significant at 1%.

Table 6: The effects of public-place smoking laws on exposure to ETS are robust, sample is CTUMS 2005-2008

	(1)	(2)	(3)	(4)	(5)
Specification is:	Baseline DD	(1) + city trends	(1) + one year lead	(1), "forced" sample	(1), strength of laws
Exposed to ETS inside a restaurant					
Mean of dep var:	0.116	0.116	0.116	0.193	0.116
Year prior to adoption of law	--	--	-0.060**	--	--
			[0.022]		
Public-place smoking law	-0.396**	-0.339**	-0.438**	-0.378**	--
	[0.049]	[0.069]	[0.063]	[0.045]	
Gold law	--	--	--	--	-0.403**
					[0.048]
Silver law	--	--	--	--	-0.398**
					[0.046]
Bronze Law	--	--	--	--	-0.271**
					[0.058]
Observations	37,694	37,694	37,694	18,546	37,694
R-squared	0.23	0.24	0.23	0.31	0.23
Exposed to ETS inside a bar/tavern					
Mean of dep var:	0.130	0.130	0.130	0.174	0.130
Year prior to adoption of law	--	--	-0.055	--	--
			[0.042]		
Public-place smoking law	-0.239**	-0.213**	-0.278**	-0.225**	--
	[0.015]	[0.023]	[0.032]	[0.020]	
Gold law	--	--	--	--	-0.258**
					[0.015]
Silver law	--	--	--	--	-0.218**
					[0.024]
Bronze Law	--	--	--	--	-0.069
					[0.054]
Observations	37,694	37,694	37,694	18,546	37,694
R-Squared	0.15	0.16	0.15	0.22	0.15
Individual/provincial controls?	Yes	Yes	Yes	Yes	Yes
City and year fixed effects?	Yes	Yes	Yes	Yes	Yes

Notes: Sample includes adults age 18-64 in the CTUMS 2005-2008. The dependent variable in each column is an indicator equal to one if the individual reports being exposed to someone else's smoke in each of the specific areas. See notes to Table 3 for control variables. * significant at 5%; ** significant at 1%.

Table 7: The reductions in non-smokers' exposure to ETS in public places also obtains in the CCHS, sample is non-smokers in the CCHS Cycles 1.1-4.1 (2000-2008)

	(1)	(2)	(3)	(4)	(5)
	Baseline DD	(1) + city trends	(1) + one year lead	(1), "forced" sample	(1), strength of laws
Mean of dep var:	0.174	0.174	0.174	0.206	0.174
Year prior to adoption of law	--	--	-0.039** [0.006]	--	--
Public-place smoking law	-0.073** [0.017]	-0.058** [0.018]	-0.109** [0.018]	-0.098** [0.009]	--
Gold law	--	--	--	--	-0.096** [0.012]
Silver law	--	--	--	--	-0.077** [0.009]
Bronze Law	--	--	--	--	-0.046* [0.018]
Observations	168,279	168,279	168,279	69,968	168,279
R-Squared	0.06	0.05	0.06	0.07	0.06
Individual/provincial controls?	Yes	Yes	Yes	Yes	Yes
City and year fixed effects?	Yes	Yes	Yes	Yes	Yes

Notes: Sample includes adults age 18-64 who are non-smokers in the CCHS Cycles 1.1-4.1. The dependent variable is an indicator equal to 1 if the person reports being exposed to ETS in public places on most or all days of the previous month. Individual demographic controls include: age and its square, a male dummy, two marital status dummies, and six education dummies (see text). All models also control for the provincial cigarette excise tax and the provincial unemployment rate. Robust standard errors in brackets are clustered on statistical areas (SAs). * significant at 5%; ** significant at 1%.