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Differential impact of U.S. smoke-free air laws on restaurants and bars by employer size: a longitudinal study

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ABSTRACT

Objectives

Thirty states have smoke-free air laws that ban smoking in restaurants and bars, covering nearly two-thirds of the U.S. population. It is well-established that these laws do not generally have an adverse economic impact on restaurants and bars. However, all establishments in a geographic area are usually treated as a homogeneous group without considering the potential for differential effects by establishment characteristics. This study examines the relationship between smoke-free air laws and restaurant and bar employment within distinct categories of employer size.

Design

Observational study using longitudinal panel data

Setting

United States; North Carolina

Interventions

Smoke-free air laws

Outcome Measures

State-level accommodation and food services employment for all 50 states and DC from 1990 through 2014 (Quarterly Census of Employment and Wages); county-level restaurant and bar employment in North Carolina from 2001 though 2014 (North Carolina Department of Commerce)

Results

There is no evidence of a redistributive effect of smoke-free air laws on restaurant and bar employment by employer size.

Conclusions

Protecting employees and patrons alike from the dangers of exposure to secondhand smoke without causing economic hardship to hospitality establishments of all sizes is an important finding for policymakers considering implementation of a smoke-free air law.

STRENGTHS AND LIMITATIONS

- Heterogeneous treatment effects have not been previously considered in the context of estimating the economic impact of smoke-free air laws
- Two complementary estimators were used to ensure that the tradeoffs between bias and efficiency in using instrumental variables panel models does not bias the conclusions
- The study incorporates panel data over a long time period, both at the national level and for a single state (North Carolina), to provide a complete examination of this question
- Data availability by employer size is quite poor for more specific business types (e.g., restaurants, bars)
- Attenuation bias is a concern in the national analysis because it utilizes a higher aggregation of employment (accommodation and food services) than the target of the intervention (smoke-free air laws in restaurants and bars)

INTRODUCTION

Secondhand smoke exposure is responsible for an estimated 50,000 deaths per year in the United States among non-smoking adults and children.[1] Smoke-free air laws in the U.S. and abroad have been associated with drastic improvements in air quality, helping to improve population health by reducing rates of negative cardiac and respiratory outcomes associated with exposure to secondhand smoke, such as myocardial infarction and asthma.[1-4] Smoke-free air laws have also been associated with decreases in smoking prevalence,[2,4-6] an indication that reducing opportunities for social smoking may help encourage cessation and depress initiation by denormalizing smoking in public.[7]

Thirty states currently have smoke-free air laws that ban smoking in all restaurants and bars, covering nearly two-thirds (65.7%) of the U.S. population.[8] An additional five states have smoke-free air laws covering only restaurants, representing more than a tenth of the population (12.0%).[8] Despite the rapid expansion of smoke-free air laws during the 2000s,[9] strong public support,[10,11] and a near consensus among peer-reviewed studies that smoke-free air laws do not cause adverse economic effects,[12] legislative progress on this issue has stalled in recent years and even regressed in some cases.[13] Population coverage by comprehensive smoke-free air laws, measured by the percentage of population covered by laws that include all indoor workplaces, restaurants, and bars, rose from 2.7% in 2000 to 47.8% in 2010, but barely changed in the subsequent five years (49.7% in 2015).[14] Perhaps counterintuitively, states with pre-existing non-comprehensive laws seem less likely to subsequently pass a more comprehensive law in the future.[15] Exemptions in non-comprehensive laws have allowed establishments to reintroduce smoking. For example, the percentage of restaurants and bars that allow smoking in Georgia nearly doubled between 2006 and 2012.[16] This is concerning given the disparities that already

exist in workplace secondhand smoke exposure. Approximately one-fifth (20.4%) of employees reported being exposed to secondhand smoke in the workplace, but minorities and those with lower education or income are exposed at significantly higher rates.[11]

Opponents of these laws frequently claim that their implementation will have an adverse economic impact on the hospitality industry, particularly restaurants and bars, despite a strong evidence base to contradict these claims. Numerous studies have found similar null or positive effects of smoke-free air laws on either employment and/or sales in restaurants and/or bars in states and cities across the U.S.[2-5,12,17-26] Concerns that smoke-free air laws would drive patrons across state lines into bordering areas without such laws have so far been unsubstantiated.[27,28] Some peer-reviewed studies have found negative effects,[29,30] though in many cases, such studies have been supported by funding from the tobacco industry.[31]

Recently, new approaches have been taken to examining the long-studied empirical question of whether smoke-free laws have an adverse economic impact. Kim and Yörük (2015) used a nationally representative panel to estimate the effect of smoke-free air laws on household dining expenditures. Though dining expenditures fell among smokers in areas where a smoke-free air law was implemented, the rise in expenditures among nonsmokers and their greater weight in the population led to an overall increase, though it was not statistically significant.[32] Nagelhout *et al.* (2015) found that residents of communities that implemented smoke-free air laws between 2002 and 2007 had higher pre-existing levels of support for such laws than those living in communities that implemented laws after 2007 or not at all.[10] Nikaj, Miller, and Tauras (2016) assessed whether this self-selection of communities into adoption of smoke-free air laws played a role in the resulting economic impact. Using restaurant and bar sales data from Texas,

they found no evidence of adverse economic outcomes or significant differences in outcome trajectories between early and late adopters.[33]

Prior studies of the economic impact of smoke-free air laws have examined their effect on employment and/or sales in aggregate for a given locality (e.g., all restaurants in a city are treated as a single group). This approach explicitly ignores the possibility that the effect on restaurants or bars might vary based on employer characteristics. Regulatory burdens have been found to disproportionately disadvantage smaller businesses and encourage larger firm size.[34,35] Though smoke-free air laws may not create a cost burden, the potential for lost revenue from smoking clientele for an individual establishment can create a revenue burden. Since smaller establishments generally face a higher failure rate and may be more at risk from any sizable loss of revenue, due to borrowing constraints,[36] understanding whether prior estimates of generally null or positive effects may mask heterogeneous treatment effects by size is an important gap to address. This study seeks to address this gap using a two-pronged approach: 1) a national analysis using 25 years of hospitality employment data from all 50 states and DC, and 2) a state-level analysis using 14 years of county-level restaurant and bar employment data from North Carolina.

METHODS

Data

Employment – national

For the national analysis, annual state-level accommodation and food services employment (NAICS 72) by employer size were obtained from the Bureau of Labor Statistics Quarterly Census of Employment and Wages (QCEW) for all 50 states and the District of Columbia for 1990 through 2014. These data are derived from quarterly tax reports to state labor

departments by all employers subject to unemployment insurance, covering approximately 98% of U.S. employment.[37] Total accommodation and food services employment in each state-year was split into nine categories by employer size (<5, 5 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 249, 250 to 499, 500 to 999, and ≥1,000 employees). Any values suppressed to protect employer confidentiality were coded as missing and excluded from the analysis. These data have been used in several prior studies of the economic impact of smoke-free air laws.[19,26,29]

Employment – North Carolina

For the North Carolina analysis, quarterly employment data for restaurants (NAICS 7221 for 2001 to 2010, 7225 for 2011 to 2014) and bars (NAICS 7224) by employer size were obtained from the North Carolina Department of Commerce for all 100 counties for 2001 through 2014. The change in restaurant industry code was a result of adoption of changes to the underlying NAICS code structure by the state.[38] Total restaurant and bar employment in each county-quarter were split into nine categories by employer size (<5, 5 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 249, 250 to 499, 500 to 999, and ≥1,000 employees). Any values suppressed to protect employer confidentiality were coded as missing and excluded from the analysis.

Policy variables

For the national analysis, the smoke-free air law policy variable is coded as a continuous variable measuring the percentage of each state's population covered by any (restaurant, bar, workplace) smoke-free air law (scaled from 0 to 100). If any counties or municipalities within a state adopt a smoke-free air law during the study period (1990 to 2014), this variable measures the percentage of the population accounted for by those areas of the state over time. When a statewide smoke-free air law goes into effect, the smoke-free law variable is set equal to 100 beginning in that year. The QCEW data correspond to the first quarter of each year and were

matched to state-level smoke-free air law coverage as of the beginning of that quarter. For the North Carolina analysis, the smoke-free air law policy variable is an indicator equal to 1 beginning in the first quarter of 2010 onward and 0 otherwise. These variables were derived from a chronological database of smoke-free air laws published by the American Nonsmokers' Rights Foundation and annual state population data from the U.S. Census Bureau Population Estimates Program.[9,39]

Covariates – national

Annual state population data for 1990 through 2014 was obtained from the U.S. Census Bureau Population Estimates Program.[39] Annual state per capita pack sales for 1990 through 2014 were derived from pack sales data published in *The Tax Burden on Tobacco* and the preceding population estimates.[40] Annual federal and state cigarette excise taxes for 1990 through 2014 were also obtained from *The Tax Burden on Tobacco*. Annual state non-hospitality employment was derived from the QCEW data by subtracting accommodation and food services employment from total employment for each state-year.

Covariates – North Carolina

Annual county-level population data in North Carolina for 2001 to 2014 was obtained from the CDC WONDER Bridged-Race Resident Population Estimates.[41] Annual county-level adult smoking prevalence for 2001 to 2012 was obtained from small area BRFSS estimates published by Dwyer-Lindgren *et al.* (2014).[42] Quarterly county-level non-hospitality employment was derived from the QCEW data by subtracting accommodation and food services employment from total employment for each county-quarter.

Measurement

There are several difficulties in answering this question empirically, including 1) self-categorization of business type, 2) identification and attribution of effects, and 3) poor data availability. The first two are not unique to this study and are relevant to other studies of the economic impact of smoke-free air laws. The third is a specific challenge related to identifying effects at the level of employment within a specific category of employer size.

Business type, usually defined by NAICS industry code, is a self-categorized measure. Many full-service restaurants also have separate bar areas within their establishment and many bars also serve food. There are no pre-defined rules regarding revenue splits between food and alcohol for this categorization, though it is implicitly assumed that business self-identifying as bars are more oriented towards serving alcohol and vice versa for restaurants. Though most studies consider restaurants and bars separately, this may unnecessarily overstate the importance of changes in bar employment specifically. Employment in restaurants (5,194,814 in 2015) is far greater than that of bars (371,580) nationally and employees are relatively interchangeable across types. As spillover of employees between business types is not economically relevant to our analysis, restaurant and bar employment within each employer size category are summed for the North Carolina analysis.

Identification and attribution of effects is of particular concern for the national analysis, which uses state level employment data with a continuous measure of percentage of state population covered by either a restaurant or bar smoke-free air law. As restaurant and bar employment only accounts for approximately 43% of accommodation and food services sector employment (NAICS 72), attenuation bias is a likely problem. The North Carolina analysis addresses the problems of identification and attribution of effects in the national analysis with a

binary treatment (statewide law) and employment data specific to the direct targets of the law (restaurants and bars).

Finally, data availability by employer size is poor. The national analysis is based on a publicly available data series from the QCEW provided by the Bureau of Labor Statistics, which contains employment totals by employer size category at the state and 2-digit NAICS industry code level during the first quarter of each year. As noted in the preceding paragraph, the limited depth of these data make it difficult to analyze policies such as smoke-free air laws that impact only specific types of businesses. Since the federally reported data are a product of data aggregated from state labor departments, the labor market information website for each state was identified and searched for more detailed data by employer size. Data availability by state is described in the online appendix (Table A1) with a URL for the relevant labor market data web page, geographic level, NAICS code level, and time period. Only three states (California, North Carolina, and Washington) had data available directly better than what was contained in the QCEW, but California and Washington only had data available for years after their statewide laws had already gone into effect. The North Carolina data by employer size contain much greater geographical (county), industry (4-digit NAICS code), and temporal (quarter) detail than the QCEW (state, 2-digit NAICS code, year), providing the opportunity to conduct a state-specific analysis for North Carolina to further inform this research question.

Statistical Analysis

Dynamic panel data models are used to estimate the relationship between smoke-free air laws and employment within each category of employer size. Two variations on a standard fixed effects model with an autoregressive term are used to address bias and efficiency in estimating these policy effects: 1) an instrumental variable (IV) panel model and 2) a bias-corrected least

squares dummy variable model (LSDVc). Such models are appropriate because they can account for the autoregressive nature of employment while also accounting for correlation of errors within groups, like states or counties, over time. The former approach has been used in two recent studies of the economic impact of smoke-free air laws,[19,26] and has the added advantage of accounting for simultaneity of changes in restaurant or bar employment and general economic activity, using lagged non-hospitality employment to instrument for its value in the current time period.

Estimation with large N (number of groups), small T (number of time periods) panels using IV can be inefficient with small samples.[43] In the national analysis, there are 25 annual data points for each of 51 states and territories. As such, the IV analysis was paired with a model that attempts to reduce the bias inherent in a standard fixed effects model with an autoregressive term without the efficiency losses of IV estimation. The LSDVc estimator corrects for an approximation of the small sample bias in the standard model while retaining the improved efficiency of fixed effects estimation over IV.[44-47]

Employment in restaurants and bars exhibits a high degree of correlation between past and present values (.95–.99 across employer size categories in national data, .57–.86 in North Carolina data). To account for the dynamic nature of employment, the lagged value of the outcome (autoregressive term) is included as a covariate. To account for general economic activity that may also affect restaurants and bars, independent of the implementation of smoke-free air laws, non-hospitality employment (in units of 10,000) is also included as a covariate in each model. Population was highly correlated with non-hospitality employment (>0.9) and therefore not included as a covariate in the models. State cigarette pack sales per capita and real total cigarette excise taxes (federal plus state, in 2014 dollars) are included in the national

analysis. County smoking prevalence is included in an alternate specification for North Carolina since it is only available through 2012, which results in the dropping of the final two years of data from the model (2013-2014).

IV models were estimated using *xtivreg* with the fixed effects estimator and bootstrapped standard errors (100 replications). In these models, non-hospitality employment, at either the state-year or county-quarter level depending on the analysis, was instrumented for by its lagged value to account for unobserved confounders that may simultaneously affect restaurant or bar employment and general economic activity.[48] All first stage F-statistics were significant at the .01 level. LSDVc models were estimated using *xtlsdvc*[44] with bootstrapped standard errors (100 replications). In the national analysis, state fixed effects were included in all models to account for any unobserved differences between states. In the North Carolina analysis, county and quarter (January to March, April to June, July to September, October to December) fixed effects were included in all models to account for any unobserved differences between counties and potential seasonality in employment. Analyses were conducted using Stata 14.1.[49]

The national analysis uses the following specification as the basic framework under both estimators.

$$emp72_{sit} = emp72_{si(t-1)} + sfal_{it} + X_{it} + \mu_i + \varepsilon_{sit}$$

The outcome, $emp72_{sit}$, represents accommodation and food services employment by employer size category (s) in the given state (i) and year (t). $emp72_{si(t-1)}$ represents the lagged outcome, $sfal_{it}$ represents the percentage of state population covered by any smoke-free air law in the given state-year, X_{it} represents other controls that vary at the state-year level (e.g., non-hospitality employment, per capita cigarette pack sales, and real total cigarette excise taxes), μ_i

represents state fixed effects, and ε_{sit} is the error term. The North Carolina analysis uses the following specification as the basic framework under both estimators.

$$emp7221\_7224_{sit} = emp7221\_7224_{si(t-1)} + sfal_t + X_{it} + \mu_i + \delta_t + \varepsilon_{sit}$$

The outcome, $emp7221\_7224_{sit}$, represents restaurant and bar employment by employer size category (s) in the given county (i) and quarter-year (t). $emp7221\_7224_{si(t-1)}$ represents the lagged outcome, $sfal_t$ is a time-varying indicator for the statewide smoke-free air law, X_{it} represents other controls that vary at the quarter-year level by county (e.g., non-hospitality employment, smoking prevalence), μ_i represents county fixed effects, δ_t represents quarter fixed effects, and ε_{sit} is the error term.

RESULTS

Tables 1 and 2 contain the IV and LSDVc model results for the national analysis and Tables 3 and 4 contain the IV and LSDVc model results for North Carolina. According to the National Restaurant Association, more than 90% of restaurants in the U.S. have fewer than 50 employees.[50] These results focus on the employer size categories representing employers with fewer than 100 employees (<5, 5 to 9, 10 to 19, 20 to 49, and 50 to 99). Results for the remaining categories (100 to 249, 250 to 499, 500 to 999, and ≥1,000) in the national analysis are presented in Tables A2 (IV) and A3 (LSDVc) of the online appendix. For North Carolina, these models were not estimated due to an increasingly small number of counties with non-missing employment values (100 to 249: 24 counties [of 100], 250 to 499: 2, 500 to 999: 1, and ≥1,000: 0), which limits generalizability of the results back to the state level.

In the national analysis, percentage of state population covered by any smoke-free air law was not associated with state-level accommodation and food services employment across all categories of employer size in all but one case. In comparing the results between estimators,

there is little difference between the IV (Table 1) and the LSDVc estimates (Table 2). In the IV models (Table 1), percentage of state population covered by any smoke-free air law was only significantly associated with accommodation and food services employment for employers with 5 to 9 employees (Model 2: $b = –0.9$, $P < .05$), indicating a decrease of approximately one hospitality employee per additional 1% of state population covered by a smoke-free air law within that employer size category. In the corresponding LSDVc model (Table 2), the estimated effect was of similar magnitude but not statistically significant (Model 2: $b = –1.1$, $P > .05$) Increasing cigarette excise taxes had a positive effect on state accommodation and food services employment though it was only statistically significant in five of 10 models (Table 1, Models 2, 4, and 5; Table 2, Models 4 and 5). An alternate specification that includes year fixed effects (not shown), yielded qualitatively similar findings.

In the North Carolina analysis, the statewide smoke-free air law indicator was either insignificant or indicated a positive effect on county-level restaurant and bar employment across all categories of employer size. In comparing the results between estimators, it is clear that LSDVc models (Table 4) exhibited the expected improvements in efficiency (smaller standard errors) over the IV models (Table 3). In the IV models (Table 3), the statewide smoke-free air law was only significantly associated with restaurant and bar employment for employers with 20 to 49 employees (Model 7: $b = 844.8$, $P < .01$; Model 8: $b = 1{,}072.9$, $P < .05$), indicating an increase of approximately 800 to 1,100 restaurant and bar employees per county attributable to the law within that employer size category. In the LSDVc models (Table 4), the statewide smoke-free air law was positively associated with restaurant and bar employment in all five employer size categories and nine out of 10 models, with effect estimates ranging from an increase of nearly 40 employees per county in the <5 employees category (Model 1: $b = 37.6$, P

< .01) to more than 850 employees in the 20 to 49 employees category (Model 7: $b = 863.8$, $P < .01$). Increasing county smoking prevalence had a negative estimated effect on county restaurant and bar employment though it was only statistically significant in one model (Table 3, Model 4).

DISCUSSION

In this study, I estimate the economic impact of restaurant and bar smoke-free air laws on hospitality employment within categories of employer size. These results show no evidence that smoke-free air laws have had a redistributive effect on restaurant and bar employment by employer size. This is consistent with extensive prior research that has found no evidence that smoke-free air laws negatively impact restaurant and bar employment in the U.S when examined in the aggregate for a given city, county, or state.[12,18,19,22,26,27] In the North Carolina analysis, I find that increased smoke-free air law coverage may be associated with increases in employment within some employer size categories, which echoes recent work indicating a potential rise in overall dining expenditures associated with smoke-free air laws.[32] In the national analysis, there was a negative association within a single employer size category; however, its significance was not consistent across estimators.

The strengths of this study include the novelty of estimating differential effects by employer size and employing complementary estimators to ensure that the conclusions are not influenced by the statistical methods used. The national analysis is limited by its use of accommodation and food services employment as an outcome, which can include other types of workplaces besides restaurants and bars, such as hotels and resorts. The North Carolina analysis provided an opportunity to corroborate the findings of the national analysis and directly address its limitations. The estimated effects are much larger in the single state analysis, indicating that the national estimates were likely attenuated–as expected–due to the mismatch between the

specific venues targeted by the laws (restaurant and bars) and those captured in the employment data (accommodation and food services).

These findings provide empirical evidence that smaller restaurants and bars are not any more likely to experience adverse economic effects from smoke-free air laws than their larger counterparts–a potential concern for policymakers seeking to balance the protection of local businesses and public health. This is critical in light of recent work highlighting disparities in employees' exposure to secondhand smoke and stagnation of legislative action in spite of strong public support for these laws. Protecting employees and patrons alike from the dangers of exposure to secondhand smoke without causing economic hardship to hospitality establishments of all sizes is an important finding for policymakers considering implementation of a smoke-free air law.

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CONTRIBUTORSHIP STATEMENT

Mr. Shafer designed the study, conducted the analysis, and authored the manuscript.

COMPETING INTERESTS

All authors have completed the ICMJE uniform disclosure form (at www.icmje.org/coi_disclosure.pdf) and declare no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, and no other relationships or activities that could appear to have influenced the submitted work.

DATA SHARING STATEMENT

This study uses data assembled from several publicly available sources, including the Quarterly Census of Employment and Wages (Bureau of Labor Statistics, North Carolina Department of Commerce), Population Estimates Program (U.S. Census Bureau), U.S. Tobacco Control Laws Database (American Nonsmokers' Rights Foundation), and other publications with accompanying data. The analytic dataset and accompanying code are available from the author upon request for non-commercial research purposes.

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TABLES

Table 1. State accommodation and food services employment models, IV

	State accommodation and food services employment by employer size category, *b* (SE)				
	<5 employees	*5-9 employees*	*10-19 employees*	*20-49 employees*	*50-99 employees*
	(1)	(2)	(3)	(4)	(5)
Percentage of state population covered by any smoke-free air law	–0.1 (1.0)	–0.9* (0.5)	–0.2 (1.6)	0.5 (4.8)	–3.9 (2.8)
Prior year state accommodation and food services employment *(within employer size category)*	0.8** (0.04)	0.9** (0.01)	0.9** (0.02)	0.8** (0.1)	0.95** (0.1)
State cigarette pack sales per capita	2.0 (3.4)	–0.1 (1.7)	4.1 (4.9)	7.6 (10.9)	2.7 (5.9)
Real total cigarette excise tax *(federal plus state)*	119.2 (123.5)	135.2** (45.7)	303.8 (157.9)	1,362.3** (459.1)	558.1** (210.8)
State non-hospitality employment *(in units of 10,000)*	4.0 (3.1)	5.0** (1.0)	15.1** (2.6)	49.7* (20.9)	2.5 (13.4)
Years included	1990-2014	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	51	51	51	51	51
N (state-year observations)	757	1,157	1,224	1,224	1,171

* $P < .05$, ** $P < .01$

State non-hospitality employment instrumented for by its lagged value. State fixed effects not shown.

Table 2. State accommodation and food services employment models, LSDVc

	State accommodation and food services employment by employer size category, *b* (SE)				
	<5 employees	*5-9 employees*	*10-19 employees*	*20-49 employees*	*50-99 employees*
	(1)	(2)	(3)	(4)	(5)
Percentage of state population covered by any smoke-free air law	–0.2 (1.6)	–1.1 (0.7)	–0.5 (1.8)	–0.4 (5.2)	–5.2 (3.9)
Prior year state accommodation and food services employment *(within employer size category)*	0.9** (0.05)	0.96** (0.01)	0.99** (0.01)	0.8** (0.01)	0.9** (0.02)
State cigarette pack sales per capita	1.6 (3.9)	–0.3 (1.8)	4.0 (4.4)	12.9 (12.3)	8.2 (10.7)
Real total cigarette excise tax *(federal plus state)*	96.3 (134.0)	91.4 (47.3)	223.0 (116.5)	1,398.0** (335.0)	712.3** (253.7)
State non-hospitality employment *(in units of 10,000)*	2.1 (1.4)	0.5 (1.1)	0.6 (2.4)	53.0** (8.1)	26.8** (6.4)
Years included	1990-2014	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	51	51	51	51	51
N (state-year observations)	757	1,157	1,224	1,224	1,171

* $P < .05$, ** $P < .01$

State fixed effects not shown.

Table 3. North Carolina county restaurant and bar employment models, IV

	County restaurant and bar employment by employer size category, *b* (SE)									
	<5 employees		*5-9 employees*		*10-19 employees*		*20-49 employees*		*50-99 employees*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Statewide smoke-free air law indicator	41.3 (55.3)	32.2 (91.3)	49.0 (158.7)	3.7 (32.1)	484.3 (2,014.2)	–187.1 (754.5)	844.8** (247.7)	1,072.9* (481.3)	582.7 (629.1)	342.2 (604.0)
Prior quarter county restaurant and bar employment *(within employer size category)*	–0.2 (1.1)	–0.1 (0.1)	0.001 (0.3)	0.02 (0.1)	–0.1 (0.9)	–0.1 (0.2)	–0.002 (0.04)	0.01 (0.04)	0.01 (0.2)	–0.1 (0.2)
County smoking prevalence	–	–0.8 (11.9)	–	–36.6** (11.6)	–	–170.5 (264.1)	–	109.0 (138.5)	–	–55.4 (107.3)
County non-hospitality employment *(in units of 10,000)*	–8.2 (671.2)	39.6 (345.6)	1,382.6 (2,162.6)	–285.4 (200.4)	–3,457.4 (12,108.3)	–1,839.9 (3,585.1)	1,471.1 (1,826.2)	2,405.6 (1,947.9)	427.8 (5,176.3)	120.4 (1,505.9)
Years included	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012
N (counties)	95	94	93	93	96	95	92	91	61	56
N (county-quarter observations)	1,991	1,682	3,925	3,325	4,309	3,664	4,082	3,461	2,071	1,721

* $P < .05$, ** $P < .01$

County non-hospitality employment instrumented for by its lagged value. Quarter and county fixed effects not shown.

Table 4. North Carolina county restaurant and bar employment models, LSDVc

	County restaurant and bar employment by employer size category, *b* (SE)									
	<5 employees		*5-9 employees*		*10-19 employees*		*20-49 employees*		*50-99 employees*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Statewide smoke-free air law indicator	37.6** (4.6)	25.5 (13.6)	111.3** (3.1)	85.9** (14.9)	333.4** (9.0)	262.7** (42.5)	863.8** (24.7)	651.1** (95.5)	558.4** (21.9)	447.0** (109.1)
Prior quarter county restaurant and bar employment *(within employer size category)*	–0.1 (0.04)	–0.1 (0.1)	0.08** (0.01)	0.1 (0.1)	0.1** (0.01)	0.1* (0.04)	0.01 (0.01)	0.03 (0.04)	0.01 (0.01)	–0.04 (0.07)
County smoking prevalence	–	–3.1 (3.6)	–	–7.6 (4.3)	–	–18.6 (14.3)	–	–28.5 (28.8)	–	–11.0 (28.5)
County non-hospitality employment *(in units of 10,000)*	30.8** (4.4)	8.8 (10.1)	113.6** (2.1)	82.0** (12.7)	380.2** (8.2)	259.2** (36.3)	897.9** (17.2)	586.7** (58.1)	549.1** (10.0)	405.9** (81.7)
Years included	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012
N (counties)	95	94	93	93	96	95	92	91	61	56
N (county-quarter observations)	1,991	1,682	3,925	3,325	4,309	3,664	4,082	3,461	2,071	1,721

* $P < .05$, ** $P < .01$

Quarter and county fixed effects not shown.

Table A1. State Availability of QCEW Data by Employer Size

State	Website	Available[a]	Geographic Level	NAICS Code Level	Time Period
Alaska	http://laborstats.alaska.gov/qcew/qcew.htm	no	–	–	–
Alabama	http://www2.labor.alabama.gov/cew/default.aspx	no	–	–	–
Arkansas	http://www.discoverarkansas.net/cgi/dataanalysis/AreaSelection.asp?tableName=Industry	no	–	–	–
Arizona	https://laborstats.az.gov/quarterly-census-employment-wages	yes	state	2-digit (72)	2001-2015
California	http://www.labormarketinfo.edd.ca.gov/LMID/Size_of_Business_Data.html	yes	state	3-digit (722)	2005-2014
Colorado	https://www.colmigateway.com/admin/gsipub/htmlarea/uploads/SzCls.htm	yes	state	2-digit (72)	2001-2011
Connecticut	http://www1.ctdol.state.ct.us/lmi/202/worksites.asp	yes	county	none (all industries)	1996-2014
District of Columbia	https://www.dcnetworks.org/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Delaware	https://lmi.delawareworks.com/Content/Information/QCEW.php	no	–	–	–
Florida	http://www.floridajobs.org/labor-market-information/data-center/statistical-programs/quarterly-census-of-employment-and-wages	no	–	–	–
Georgia	https://explorer.gdol.ga.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Hawaii	https://www.hiwi.org/gsipub/index.asp?docid=422	yes	state	2-digit (72)	2001-2014
Iowa	https://www.iowaworkforcedevelopment.gov/quarterly-census-employment-and-wages	no	–	–	–
Idaho	http://lmi.idaho.gov/qcew	no	–	–	–
Illinois	http://www.ides.illinois.gov/LMI/Pages/Quarterly_Census_of_Employment_and_Wages.aspx	yes	state	none (all industries)	2015
Indiana	http://www.hoosierdata.in.gov/dpage.asp?id=61&page_path=&path_id=&menu_level=&panel_number=2&view_number=3	yes	county	none (all industries)	2006-2015
Kansas	https://klic.dol.ks.gov/gsipub/index.asp?docid=419	no	–	–	–
Kentucky	https://kylmi.ky.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Louisiana	http://www.laworks.net/Downloads/Downloads_LMI.asp#EmployWageQtr	yes	state	none (all industries)	2002-2015
Massachusetts	http://lmi2.detma.org/lmi/lmi_es_a.asp	no	–	–	–
Maryland	https://www.dllr.state.md.us/lmi/emppay/	yes	state	none (all industries)	2002-2015
Maine	http://www.maine.gov/labor/cwri/qcew.html	yes	county	2-digit (72)	2000-2015
Michigan	http://milmi.org/datasearch/firmsize	yes	state	none (all industries)	2014
Minnesota	http://mn.gov/deed/data/data-tools/qcew/	no	–	–	–
Missouri	https://www.missourieconomy.org/industry/qcew/	no	–	–	–
Mississippi	https://mdes.virtuallmi.com/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Montana	http://lmi.mt.gov/Industry/QCEWAvgWage_Employment	no	–	–	–
North Carolina	http://d4.nccommerce.com/QCEWSelection.aspx	yes	county	4-digit (7221/7225, 7224)	2001-2015
North Dakota	https://www.ndworkforceintelligence.com/gsipub/index.asp?docid=354	yes	state	2-digit (72)	1990-2015
Nebraska	https://neworks.nebraska.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
New Hampshire	http://www.nhes.nh.gov/elmi/statistics/fbs.htm	yes	county	none (all industries)	2000-2015
New Jersey	https://lwd.state.nj.us/labor/lpa/employ/qcew/qcew_index.html	yes	state	2-digit (72)	2015
New Mexico	http://www.dws.state.nm.us/Labor-Market-Information/Data-and-Statistics/Economic-Data	yes	state	none (all industries)	2000-2015
Nevada	http://nevadaworkforce.com/QCEW	yes	county	none (all industries)	2002-2015
New York	http://www.labor.ny.gov/stats/lsqcew.shtm	no	–	–	–
Ohio	http://ohiolmi.com/cep/CEP_NAICS.htm	yes	state	2-digit (72)	2004-2015
Oklahoma	https://www.ok.gov/oesc_web/Services/Find_Labor_Market_Statistics/QCEW/qcewdata2.html	no	–	–	–
Oregon	https://www.qualityinfo.org/ed-ewind/	no	–	–	–
Pennsylvania	http://www.workstats.dli.pa.gov/Products/EmploymentBySize/Pages/default.aspx	yes	state	2-digit (72)	2001-2014
Rhode Island	http://www.dlt.ri.gov/lmi/es202/size.htm	yes	state	none (all industries)	2015
South Carolina	https://jobs.scworks.org/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
South Dakota	http://dlr.sd.gov/lmic/menu_covered_workers.aspx#annsum	yes	state	1-digit (7)	2004-2014
Tennessee	https://www.jobs4tn.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Texas	http://www.tracer2.com/cgi/dataanalysis/AreaSelection.asp?tableName=Industry	no	–	–	–
Utah	http://jobs.utah.gov/wi/pubs/em/ueews/	yes	state	2-digit (72)	2006-2015
Virginia	http://bi.virginialmi.com/rdPage.aspx?rdReport=lmitools_industry&tabsIndustry=tpnlLargestEmployers#rdTabPanel-tpnlIndustryBySize	yes	county	2-digit (72)	1990-2015
Vermont	http://www.vtlmi.info/indnaics.htm#size	yes	state	2-digit (72)	2000-2015
Washington	https://fortress.wa.gov/esd/employmentdata/reports-publications/industry-reports/establishment-size	yes	state	3-digit (722)	2010-2015
Wisconsin	http://worknet.wisconsin.gov/worknet/downloads.aspx?menuselection=da&pgm=QCEW	no	–	–	–
West Virginia	http://lmi.workforcewv.org/EandWAnnual/SizeOfFirm.html	yes	state	none (all industries)	2015
Wyoming	https://doe.state.wy.us/lmi/QCEW_size/toc.htm	yes	state	none (all industries)	2000-2015

[a] Based on data publicly available through state government websites as of June 2016

Table A2. State accommodation and food services employment models, IV

	State accommodation and food services employment by employer size category, *b* (SE)			
	100-249 employees	*250-499 employees*	*500-999 employees*	*≥1,000 employees*
	(6)	(7)	(8)	(9)
Percentage of state population covered by any smoke-free air law	–0.4 (2.9)	–0.5 (4.5)	–6.2 (11.6)	–21.4 (16.1)
Prior year state accommodation and food services employment *(within employer size category)*	0.6** (0.1)	0.3** (0.1)	0.4** (0.1)	0.4** (0.1)
State cigarette pack sales per capita	–3.8 (9.2)	1.6 (16.9)	–1.3 (23.3)	–44.3 (96.3)
Real total cigarette excise tax *(federal plus state)*	–32.3 (313.5)	–470.1 (245.6)	–1,299.7* (590.6)	–1,765.7 (1,859.3)
State non-hospitality employment *(in units of 10,000)*	72.1** (15.3)	22.8** (6.3)	27.6** (9.3)	5.6 (22.0)
Years included	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	49	36	19	16
N (state-year observations)	1,070	474	216	157

* $P < .05$, ** $P < .01$

State non-hospitality employment instrumented for by its lagged value. State fixed effects not shown.

Table A3. State accommodation and food services employment models, LSDVc

	State accommodation and food services employment by employer size category, *b* (SE)			
	100-249 employees	*250-499 employees*	*500-999 employees*	*≥1,000 employees*
	(6)	(7)	(8)	(9)
Percentage of state population covered by any smoke-free air law	–0.9 (7.1)	–1.2 (4.2)	–7.1 (7.7)	–23.0 (22.5)
Prior year state accommodation and food services employment *(within employer size category)*	0.6** (0.03)	0.4** (0.03)	0.4** (0.03)	0.5** (0.1)
State cigarette pack sales per capita	3.0 (18.1)	6.8 (12.1)	11.5 (28.1)	11.3 (98.0)
Real total cigarette excise tax *(federal plus state)*	51.3 (441.8)	–434.4 (285.7)	–1,157.2* (585.1)	–1,034.5 (1,995.1)
State non-hospitality employment *(in units of 10,000)*	83.7** (7.9)	26.2** (3.0)	31.5** (3.8)	18.2 (13.1)
Years included	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	49	36	19	16
N (state-year observations)	1,070	474	216	157

* $P < .05$, ** $P < .01$
State fixed effects not shown.

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Impact of U.S. smoke-free air laws on restaurants and bars by employer size: a panel study

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ABSTRACT

Objectives

Thirty states have smoke-free air laws that ban smoking in restaurants and bars, covering nearly two-thirds of the U.S. population. It is well established that these laws generally have a null or positive economic impact on restaurants and bars. However, all establishments in a geographic area are usually treated as a homogeneous group without considering the potential for differential effects by establishment characteristics. This study uses variation in smoke-free air laws over time to estimate their impact on employment in restaurants and bars with a focus on potential differences by employer size (number of employees). A dual-pronged approach with a national and state-level analysis is used to take advantage of more granular data availability for a single state (North Carolina).

Design

Observational study using panel data

Setting

United States; North Carolina

Interventions

Smoke-free air laws

Outcome Measures

State-level accommodation and food services employment for all 50 states and DC from 1990 through 2014 (Quarterly Census of Employment and Wages); county-level restaurant and bar employment in North Carolina from 2001 though 2014 (North Carolina Department of Commerce)

Results

There is no evidence of a redistributive effect of smoke-free air laws on restaurant and bar employment by employer size.

Conclusions

The lack of a redistributive effect is an important finding for policymakers considering implementation or expansion of a smoke-free air law to protect employees and patrons from the dangers of exposure to secondhand smoke.

STRENGTHS AND LIMITATIONS

- The potential for differential economic effects of smoke-free air laws by employer size is an understudied issue
- This study uses panel data over a long time period, both at the national level (by state, 1990 through 2014) and for North Carolina (by county, 2001 through 2014), to provide a two-pronged examination of this question
- Two complementary statistical approaches were used to ensure that the choice of estimator does not bias the conclusions of the study
- Data availability by employer size is quite poor for more specific business types (e.g., restaurants, bars)
- Attenuation bias is a concern in the national analysis because it utilizes a higher aggregation of employment (accommodation and food services) than the target of the intervention (smoke-free air laws in restaurants and bars)

INTRODUCTION

Secondhand smoke exposure is responsible for an estimated 50,000 deaths per year in the United States among non-smoking adults and children.[1] Smoke-free air laws in the U.S. and abroad have been associated with drastic improvements in air quality and population health as well as decreases in smoking prevalence,[1-6] an indication that reducing opportunities for social smoking may help encourage cessation and depress initiation by denormalizing smoking in public.[7] Thirty states currently have smoke-free air laws that ban smoking in all restaurants and bars, covering nearly two-thirds (65.7%) of the U.S. population.[8] An additional five states have smoke-free air laws covering only restaurants, representing more than a tenth of the population (12.0%).[8] Despite the rapid expansion of smoke-free air laws during the 2000s,[9] strong public support,[10,11] and a near consensus among peer-reviewed studies that smoke-free air laws have generally null or positive economic effects,[12] legislative progress on this issue has stalled in recent years and even regressed in some cases.[13] Population coverage by comprehensive smoke-free air laws has barely changed since 2010 and perhaps counterintuitively, states with pre-existing non-comprehensive laws are less likely to subsequently pass a more comprehensive law in the future.[14-16] Exemptions in non-comprehensive laws have allowed establishments to reintroduce smoking,[17] which is concerning given the disparities that already exist in workplace secondhand smoke exposure.[11]

Opponents of these laws frequently claim that their implementation will have an adverse economic impact on the hospitality industry, particularly restaurants and bars, despite a strong evidence base to contradict these claims. Numerous studies have found generally null or positive effects of smoke-free air laws on either employment and/or sales—the primary indicators used to measure the economic impact of these laws[12]—in restaurants and/or bars across the U.S.[2-5,12,18-29]

A study using business sales found no evidence that smoke-free air laws impacted the value for which individual bars were sold after controlling for employer size, providing an indication that these laws do not differentially impact profitability.[30] Several studies have found negative effects but the majority were not peer-reviewed and/or supported by funding from the tobacco industry.[12,31,32]

Prior studies of the economic impact of smoke-free air laws have examined their effect on employment and/or sales in aggregate for a given locality in which all restaurants and/or bars in a city are treated as a homogeneous group. This approach explicitly ignores the possibility that the effect on restaurants or bars might vary based on employer characteristics. Regulatory burdens have been found to disproportionately disadvantage smaller businesses and encourage larger firm size.[33,34] Though smoke-free air laws may not create a cost burden, the potential for lost revenue from smoking clientele for an individual establishment can create a revenue burden. Since smaller establishments generally face a higher failure rate and may be more at risk from any sizable loss of revenue,[35] understanding whether prior estimates of generally null or positive effects may mask differential effects by employer size is an important gap to address. This study seeks to address this gap using a two-pronged approach: 1) a national analysis using 25 years of hospitality employment data from all 50 states and DC, and 2) a state-level analysis using 14 years of county-level restaurant and bar employment data from North Carolina.

METHODS

Data

Employment – national

For the national analysis, annual state-level accommodation and food services employment (NAICS 72) by employer size were obtained from the Bureau of Labor Statistics

Quarterly Census of Employment and Wages (QCEW) for all 50 states and the District of Columbia for 1990 through 2014. These data are derived from quarterly tax reports to state labor departments by all employers subject to unemployment insurance, covering approximately 98% of U.S. employment.[36] Total accommodation and food services employment in each state-year was split into nine categories by employer size (<5, 5 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 249, 250 to 499, 500 to 999, and ≥1,000 employees). Any values suppressed to protect employer confidentiality were coded as missing and excluded from the analysis. These data have been used in several prior studies of the economic impact of smoke-free air laws.[20,27,37]

Restaurant and bar-specific data by employer size was not available. The QCEW only contains employment totals by employer size category at the state and 2-digit NAICS industry code level for the first quarter of each year. Since the federal data are a product of data aggregated from state labor departments, the labor market information website for each state was identified and searched for more detailed data by employer size. Data availability by state is described in Appendix Table A1 with a URL for the relevant labor market data web page, geographic level, NAICS code level, and time period. Only three states (California, North Carolina, and Washington) had data available that was better than what was available in the QCEW; however, California and Washington only had data available for years after their statewide smoke-free air laws had already gone into effect. The North Carolina data by employer size contained much greater geographical (county), industry (4-digit NAICS code), and temporal (quarter) detail than the QCEW (state, 2-digit NAICS code, year), providing an opportunity to conduct a state-specific analysis for North Carolina to further inform this research question.

Employment – North Carolina

For the North Carolina analysis, quarterly employment data for restaurants (NAICS 7221 for 2001 to 2010, 7225 for 2011 to 2014) and bars (NAICS 7224) by employer size were obtained from the North Carolina Department of Commerce for all 100 counties for 2001 through 2014. The change in restaurant industry code was a result of adoption of changes to the underlying NAICS code structure by the state.[38] Total restaurant and bar employment in each county-quarter were split into nine categories by employer size (<5, 5 to 9, 10 to 19, 20 to 49, 50 to 99, 100 to 249, 250 to 499, 500 to 999, and ≥1,000 employees). Any values suppressed to protect employer confidentiality were coded as missing and excluded from the analysis. Restaurant and bar employment within each employer size category were summed for the North Carolina analysis as spillover of employees between business types is not relevant to our analysis and the statewide smoke-free air law covered both settings upon implementation.

Policy variables

For the national analysis, the smoke-free air law policy variable is coded as a continuous variable measuring the percentage of each state's population covered by any (restaurant, bar, workplace) smoke-free air law (scaled from 0 to 100). If any counties or municipalities within a state adopt a smoke-free air law during the study period (1990 to 2014), this variable measures the percentage of the population accounted for by those areas of the state over time. When a statewide smoke-free air law goes into effect, the smoke-free law variable is set equal to 100 beginning in that year. The QCEW data correspond to the first quarter of each year and were matched to state-level smoke-free air law coverage as of the beginning of that quarter. For the North Carolina analysis, the smoke-free air law policy variable is an indicator equal to 1 beginning in the first quarter of 2010 onward and 0 otherwise. These variables were derived from

a chronological database of smoke-free air laws published by the American Nonsmokers' Rights Foundation and annual state population data from the U.S. Census Bureau Population Estimates Program.[9,39]

Covariates – national

Annual state population data for 1990 through 2014 was obtained from the U.S. Census Bureau Population Estimates Program.[39] Annual state per capita pack sales for 1990 through 2014 were derived from pack sales data published in *The Tax Burden on Tobacco* and the preceding population estimates.[40] Annual federal and state cigarette excise taxes for 1990 through 2014 were also obtained from *The Tax Burden on Tobacco*. Annual state non-hospitality employment was derived from the QCEW data by subtracting accommodation and food services employment from total employment for each state-year.

Covariates – North Carolina

Annual county-level population data in North Carolina for 2001 to 2014 was obtained from the CDC WONDER Bridged-Race Resident Population Estimates.[41] Annual county-level adult smoking prevalence for 2001 to 2012 was obtained from small area BRFSS estimates published by Dwyer-Lindgren *et al.* (2014).[42] Quarterly county-level non-hospitality employment was derived from the QCEW data by subtracting accommodation and food services employment from total employment for each county-quarter.

Statistical Analysis

Dynamic panel data models are used to estimate the relationship between smoke-free air laws and employment within each category of employer size. Two variations on a standard fixed effects model with an autoregressive term are used to estimate these policy effects: 1) an instrumental variable (IV) panel model and 2) a bias-corrected least squares dummy variable

model (LSDVc). Such models are appropriate because they can account for the autoregressive nature of employment while also accounting for correlation of errors within groups, like states or counties, over time. The former approach (IV) has been used in two recent studies of the economic impact of smoke-free air laws and has the added advantage of accounting for simultaneity of changes in restaurant or bar employment and general economic activity. [20,27] The latter approach (LSDVc) reduces the bias inherent in an autoregressive fixed effects model without the efficiency losses of IV estimation.[43-46]

Employment in restaurants and bars exhibits a high degree of correlation between past and present values (.95–.99 across employer size categories in national data, .57–.86 in North Carolina data). To account for the dynamic nature of employment, the lagged value of the outcome (autoregressive term) is included as a covariate. To account for general economic activity that may also affect restaurants and bars, independent of the implementation of smoke-free air laws, non-hospitality employment (in units of 10,000) is also included as a covariate in each model. Population was highly correlated with non-hospitality employment (>0.9) and therefore not included as a covariate in the models. State cigarette pack sales per capita and real total cigarette excise taxes (federal plus state, in 2014 dollars) are included in the national analysis. County smoking prevalence is included in an alternate specification for North Carolina since it is only available through 2012, which results in the dropping of the final two years of data from the model (2013-2014).

The IV models were estimated using *xtivreg* with the fixed effects estimator and bootstrapped standard errors (100 replications). In these models, non-hospitality employment, for either the state-year or county-quarter level, was instrumented for by its lagged value to account for unobserved confounders that may simultaneously affect restaurant or bar employment and

general economic activity.[47] All first stage F-statistics were significant at the .01 level. The LSDVc models were estimated using *xtlsdvc* with bootstrapped standard errors (100 replications).[43] In the national analysis, state fixed effects were included in all models to account for any unobserved differences between states. In the North Carolina analysis, county and quarter (January to March, April to June, July to September, October to December) fixed effects were included in all models to account for any unobserved differences between counties and potential seasonality in employment. All analyses were conducted using Stata 14.2.[48]

RESULTS

The results presented below focus on employment in the employer size categories of fewer than 100 employees (<5, 5 to 9, 10 to 19, 20 to 49, and 50 to 99). 98.8% of restaurants and 99.8% of bars had fewer than 100 employees nationally in 2014. Results for the remaining categories (100 to 249, 250 to 499, 500 to 999, and ≥1,000) in the national analysis are presented in Appendix Tables A2 and A3. For North Carolina, these models were not estimated due to an increasingly small number of counties with non-missing employment values (100 to 249: 24 counties [of 100], 250 to 499: 2, 500 to 999: 1, and ≥1,000: 0), which limits generalizability of the results back to the state level.

Tables 1 and 2 contain the regression results for the national analysis using the instrumental variables (IV) and bias-corrected least squares dummy variable (LSDVc) models, respectively. The percentage of state population covered by any smoke-free air law was not associated with state-level accommodation and food services employment in all but one case. In the IV models (Table 1), percentage of state population covered by any smoke-free air law was only significantly associated with accommodation and food services employment for employers with 5 to 9 employees (Model 2: $b = –0.9$, $P < .05$), indicating a decrease of approximately one

hospitality employee per additional 1% of state population covered by a smoke-free air law within that employer size category. In the corresponding LSDVc model (Table 2), the estimated effect was of similar magnitude but not statistically significant (Model 2: $b = -1.1$, $P > .05$) Rising cigarette excise taxes were associated with increasing state accommodation and food services employment in five of 10 models (Table 1, Models 2, 4, and 5; Table 2, Models 4 and 5). An alternate specification that includes year fixed effects (not shown), yielded qualitatively similar findings.

Tables 3 and 4 contain the regression results for the North Carolina analysis using the instrumental variables (IV) and bias-corrected least squares dummy variable (LSDVc) models, respectively. The statewide smoke-free air law indicator was either insignificant or indicated a positive effect on county-level restaurant and bar employment across all categories of employer size. In comparing the results between estimators, it is clear that LSDVc models (Table 4) exhibited the expected improvements in efficiency (smaller standard errors) over the IV models (Table 3). In the IV models (Table 3), the statewide smoke-free air law was only significantly associated with restaurant and bar employment for employers with 20 to 49 employees (Model 7: $b = 844.8$, $P < .01$; Model 8: $b = 1{,}072.9$, $P < .05$), indicating an increase of approximately 800 to 1,100 restaurant and bar employees per county attributable to the law within that employer size category. In the LSDVc models (Table 4), the statewide smoke-free air law was positively associated with restaurant and bar employment in all five employer size categories and nine out of 10 models, with effect estimates ranging from an increase of nearly 40 employees per county in the <5 employees category (Model 1: $b = 37.6$, $P < .01$) to more than 850 employees in the 20 to 49 employees category (Model 7: $b = 863.8$, $P < .01$). Increasing county smoking prevalence

was associated with a decline in county restaurant and bar employment in one model (Table 3, Model 4).

DISCUSSION

These results suggest that smoke-free air laws have either a null or positive effect on restaurant and bar employment, consistent with extensive prior research.[12,19,20,23,27,28] In the North Carolina analysis, I find that increased smoke-free air law coverage may be associated with increases in employment within some employer size categories, which echoes recent work indicating a potential rise in overall dining expenditures associated with smoke-free air laws.[49] In the national analysis, there was a negative association within a single employer size category; however, its statistical significance was not consistent across estimators.

The strengths of this study include the novelty of estimating differential effects by employer size and employing complementary estimators to ensure that the conclusions are not overly influenced by the statistical methods used. Self-categorization of business type is a limitation, though one that is applicable to any study using employment or sales tax data. The national analysis is limited by its use of accommodation and food services employment as the outcome, which includes other types of workplaces besides restaurants and bars *(e.g., hotels, resorts*), making it difficult to analyze smoke-free air laws that may impact only specific types of businesses *(e.g., non-comprehensive smoke-free air laws)*. As restaurant and bar employment only accounts for approximately 43% of accommodation and food services sector employment, attenuation bias is a likely problem. However, the North Carolina analysis provided an opportunity to corroborate the findings of the national analysis and directly address its limitations. The estimated effects are much larger in the single state analysis, indicating that the national estimates were likely attenuated as expected.

These findings provide empirical evidence that there is no redistributive effect between smaller and larger establishments underlying generally null or positive estimates of the economic impact of smoke-free air laws–a potential concern for policymakers seeking to balance the health of local businesses and public health.[50] This is critical in light of recent work highlighting disparities in employees' exposure to secondhand smoke and stagnation of legislative action in spite of strong public support for these laws.[11,13] The lack of a redistributive effect is an important finding for policymakers considering implementation or expansion of a smoke-free air law to protect employees and patrons from the dangers of exposure to secondhand smoke.

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CONTRIBUTORSHIP STATEMENT

Mr. Shafer designed the study, conducted the analysis, and authored the manuscript.

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All authors have completed the ICMJE uniform disclosure form (at www.icmje.org/coi_disclosure.pdf) and declare no support from any organisation for the submitted work, no financial relationships with any organisations that might have an interest in the submitted work in the previous three years, and no other relationships or activities that could appear to have influenced the submitted work.

DATA SHARING STATEMENT

This study uses data assembled from several publicly available sources, including the Quarterly Census of Employment and Wages (Bureau of Labor Statistics, North Carolina Department of Commerce), Population Estimates Program (U.S. Census Bureau), U.S. Tobacco Control Laws Database (American Nonsmokers' Rights Foundation), and other publications with accompanying data. The analytic dataset and accompanying code are available from the author upon request for non-commercial research purposes.

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TABLES

Table 1. State accommodation and food services employment models, IV

	State accommodation and food services employment by employer size category, *b* (SE)				
	<5 employees	*5-9 employees*	*10-19 employees*	*20-49 employees*	*50-99 employees*
	(1)	(2)	(3)	(4)	(5)
Percentage of state population covered by any smoke-free air law	–0.1 (1.0)	–0.9* (0.5)	–0.2 (1.6)	0.5 (4.8)	–3.9 (2.8)
Prior year state accommodation and food services employment *(within employer size category)*	0.8** (0.04)	0.9** (0.01)	0.9** (0.02)	0.8** (0.1)	0.95** (0.1)
State cigarette pack sales per capita	2.0 (3.4)	–0.1 (1.7)	4.1 (4.9)	7.6 (10.9)	2.7 (5.9)
Real total cigarette excise tax *(federal plus state)*	119.2 (123.5)	135.2** (45.7)	303.8 (157.9)	1,362.3** (459.1)	558.1** (210.8)
State non-hospitality employment *(in units of 10,000)*	4.0 (3.1)	5.0** (1.0)	15.1** (2.6)	49.7* (20.9)	2.5 (13.4)
Years included	1990-2014	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	51	51	51	51	51
N (state-year observations)	757	1,157	1,224	1,224	1,171

* $P < .05$, ** $P < .01$

State non-hospitality employment instrumented for by its lagged value. State fixed effects not shown.

Table 2. State accommodation and food services employment models, LSDVc

	State accommodation and food services employment by employer size category, *b* (SE)				
	<5 employees	*5-9 employees*	*10-19 employees*	*20-49 employees*	*50-99 employees*
	(1)	(2)	(3)	(4)	(5)
Percentage of state population covered by any smoke-free air law	–0.2 (1.6)	–1.1 (0.7)	–0.5 (1.8)	–0.4 (5.2)	–5.2 (3.9)
Prior year state accommodation and food services employment *(within employer size category)*	0.9** (0.05)	0.96** (0.01)	0.99** (0.01)	0.8** (0.01)	0.9** (0.02)
State cigarette pack sales per capita	1.6 (3.9)	–0.3 (1.8)	4.0 (4.4)	12.9 (12.3)	8.2 (10.7)
Real total cigarette excise tax *(federal plus state)*	96.3 (134.0)	91.4 (47.3)	223.0 (116.5)	1,398.0** (335.0)	712.3** (253.7)
State non-hospitality employment *(in units of 10,000)*	2.1 (1.4)	0.5 (1.1)	0.6 (2.4)	53.0** (8.1)	26.8** (6.4)
Years included	1990-2014	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	51	51	51	51	51
N (state-year observations)	757	1,157	1,224	1,224	1,171

* $P < .05$, ** $P < .01$
State fixed effects not shown.

Table 3. North Carolina county restaurant and bar employment models, IV

	County restaurant and bar employment by employer size category, *b* (SE)									
	<5 employees		*5-9 employees*		*10-19 employees*		*20-49 employees*		*50-99 employees*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Statewide smoke-free air law indicator	41.3 (55.3)	32.2 (91.3)	49.0 (158.7)	3.7 (32.1)	484.3 (2,014.2)	–187.1 (754.5)	844.8** (247.7)	1,072.9* (481.3)	582.7 (629.1)	342.2 (604.0)
Prior quarter county restaurant and bar employment *(within employer size category)*	–0.2 (1.1)	–0.1 (0.1)	0.001 (0.3)	0.02 (0.1)	–0.1 (0.9)	–0.1 (0.2)	–0.002 (0.04)	0.01 (0.04)	0.01 (0.2)	–0.1 (0.2)
County smoking prevalence	–	–0.8 (11.9)	–	–36.6** (11.6)	–	–170.5 (264.1)	–	109.0 (138.5)	–	–55.4 (107.3)
County non-hospitality employment *(in units of 10,000)*	–8.2 (671.2)	39.6 (345.6)	1,382.6 (2,162.6)	–285.4 (200.4)	–3,457.4 (12,108.3)	–1,839.9 (3,585.1)	1,471.1 (1,826.2)	2,405.6 (1,947.9)	427.8 (5,176.3)	120.4 (1,505.9)
Years included	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012
N (counties)	95	94	93	93	96	95	92	91	61	56
N (county-quarter observations)	1,991	1,682	3,925	3,325	4,309	3,664	4,082	3,461	2,071	1,721

* $P < .05$, ** $P < .01$

County non-hospitality employment instrumented for by its lagged value. Quarter and county fixed effects not shown.

Table 4. North Carolina county restaurant and bar employment models, LSDVc

	County restaurant and bar employment by employer size category, *b* (SE)									
	<5 employees		*5-9 employees*		*10-19 employees*		*20-49 employees*		*50-99 employees*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Statewide smoke-free air law indicator	37.6** (4.6)	25.5 (13.6)	111.3** (3.1)	85.9** (14.9)	333.4** (9.0)	262.7** (42.5)	863.8** (24.7)	651.1** (95.5)	558.4** (21.9)	447.0** (109.1)
Prior quarter county restaurant and bar employment *(within employer size category)*	–0.1 (0.04)	–0.1 (0.1)	0.08** (0.01)	0.1 (0.1)	0.1** (0.01)	0.1* (0.04)	0.01 (0.01)	0.03 (0.04)	0.01 (0.01)	–0.04 (0.07)
County smoking prevalence	–	–3.1 (3.6)	–	–7.6 (4.3)	–	–18.6 (14.3)	–	–28.5 (28.8)	–	–11.0 (28.5)
County non-hospitality employment *(in units of 10,000)*	30.8** (4.4)	8.8 (10.1)	113.6** (2.1)	82.0** (12.7)	380.2** (8.2)	259.2** (36.3)	897.9** (17.2)	586.7** (58.1)	549.1** (10.0)	405.9** (81.7)
Years included	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012	2001-2014	2001-2012
N (counties)	95	94	93	93	96	95	92	91	61	56
N (county-quarter observations)	1,991	1,682	3,925	3,325	4,309	3,664	4,082	3,461	2,071	1,721

* $P < .05$, ** $P < .01$

Quarter and county fixed effects not shown.

Table A1. State Availability of QCEW Data by Employer Size

State	Website	Available[a]	Geographic Level	NAICS Code Level	Time Period
Alaska	http://laborstats.alaska.gov/qcew/qcew.htm	no	–	–	–
Alabama	http://www2.labor.alabama.gov/cew/default.aspx	no	–	–	–
Arkansas	http://www.discoverarkansas.net/cgi/dataanalysis/AreaSelection.asp?tableName=Industry	no	–	–	–
Arizona	https://laborstats.az.gov/quarterly-census-employment-wages	yes	state	2-digit (72)	2001-2015
California	http://www.labormarketinfo.edd.ca.gov/LMID/Size_of_Business_Data.html	yes	state	3-digit (722)	2005-2014
Colorado	https://www.colmigateway.com/admin/gsipub/htmlarea/uploads/SzCls.htm	yes	state	2-digit (72)	2001-2011
Connecticut	http://www1.ctdol.state.ct.us/lmi/202/worksites.asp	yes	county	none (all industries)	1996-2014
District of Columbia	https://www.dcnetworks.org/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Delaware	https://lmi.delawareworks.com/Content/Information/QCEW.php	no	–	–	–
Florida	http://www.floridajobs.org/labor-market-information/data-center/statistical-programs/quarterly-census-of-employment-and-wages	no	–	–	–
Georgia	https://explorer.gdol.ga.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Hawaii	https://www.hiwi.org/gsipub/index.asp?docid=422	yes	state	2-digit (72)	2001-2014
Iowa	https://www.iowaworkforcedevelopment.gov/quarterly-census-employment-and-wages	no	–	–	–
Idaho	http://lmi.idaho.gov/qcew	no	–	–	–
Illinois	http://www.ides.illinois.gov/LMI/Pages/Quarterly_Census_of_Employment_and_Wages.aspx	yes	state	none (all industries)	2015
Indiana	http://www.hoosierdata.in.gov/dpage.asp?id=61&page_path=&path_id=&menu_level=&panel_number=2&view_number=3	yes	county	none (all industries)	2006-2015
Kansas	https://klic.dol.ks.gov/gsipub/index.asp?docid=419	no	–	–	–
Kentucky	https://kylmi.ky.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Louisiana	http://www.laworks.net/Downloads/Downloads_LMI.asp#EmployWageQtr	yes	state	none (all industries)	2002-2015
Massachusetts	http://lmi2.detma.org/lmi/lmi_es_a.asp	no	–	–	–
Maryland	https://www.dllr.state.md.us/lmi/emppay/	yes	state	none (all industries)	2002-2015
Maine	http://www.maine.gov/labor/cwri/qcew.html	yes	county	2-digit (72)	2000-2015
Michigan	http://milmi.org/datasearch/firmsize	yes	state	none (all industries)	2014
Minnesota	http://mn.gov/deed/data/data-tools/qcew/	no	–	–	–
Missouri	https://www.missourieconomy.org/industry/qcew/	no	–	–	–
Mississippi	https://mdes.virtuallmi.com/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Montana	http://lmi.mt.gov/Industry/QCEWAvgWage_Employment	no	–	–	–
North Carolina	http://d4.nccommerce.com/QCEWSelection.aspx	yes	county	4-digit (7221/7225, 7224)	2001-2015
North Dakota	https://www.ndworkforceintelligence.com/gsipub/index.asp?docid=354	yes	state	2-digit (72)	1990-2015
Nebraska	https://neworks.nebraska.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
New Hampshire	http://www.nhes.nh.gov/elmi/statistics/fbs.htm	yes	county	none (all industries)	2000-2015
New Jersey	https://lwd.state.nj.us/labor/lpa/employ/qcew/qcew_index.html	yes	state	2-digit (72)	2015
New Mexico	http://www.dws.state.nm.us/Labor-Market-Information/Data-and-Statistics/Economic-Data	yes	state	none (all industries)	2000-2015
Nevada	http://nevadaworkforce.com/QCEW	yes	county	none (all industries)	2002-2015
New York	http://www.labor.ny.gov/stats/lsqcew.shtm	no	–	–	–
Ohio	http://ohiolmi.com/cep/CEP_NAICS.htm	yes	state	2-digit (72)	2004-2015
Oklahoma	https://www.ok.gov/oesc_web/Services/Find_Labor_Market_Statistics/QCEW/qcewdata2.html	no	–	–	–
Oregon	https://www.qualityinfo.org/ed-ewind/	no	–	–	–
Pennsylvania	http://www.workstats.dli.pa.gov/Products/EmploymentBySize/Pages/default.aspx	yes	state	2-digit (72)	2001-2014
Rhode Island	http://www.dlt.ri.gov/lmi/es202/size.htm	yes	state	none (all industries)	2015
South Carolina	https://jobs.scworks.org/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
South Dakota	http://dlr.sd.gov/lmic/menu_covered_workers.aspx#annsum	yes	state	1-digit (7)	2004-2014
Tennessee	https://www.jobs4tn.gov/vosnet/analyzer/results.aspx?session=ind202	no	–	–	–
Texas	http://www.tracer2.com/cgi/dataanalysis/AreaSelection.asp?tableName=Industry	no	–	–	–
Utah	http://jobs.utah.gov/wi/pubs/em/ueews/	yes	state	2-digit (72)	2006-2015
Virginia	http://bi.virginialmi.com/rdPage.aspx?rdReport=lmitools_industry&tabsIndustry=tpnlLargestEmployers#rdTabPanel-tpnlIndustryBySize	yes	county	2-digit (72)	1990-2015
Vermont	http://www.vtlmi.info/indnaics.htm#size	yes	state	2-digit (72)	2000-2015
Washington	https://fortress.wa.gov/esd/employmentdata/reports-publications/industry-reports/establishment-size	yes	state	3-digit (722)	2010-2015
Wisconsin	http://worknet.wisconsin.gov/worknet/downloads.aspx?menuselection=da&pgm=QCEW	no	–	–	–
West Virginia	http://lmi.workforcewv.org/EandWAnnual/SizeOfFirm.html	yes	state	none (all industries)	2015
Wyoming	https://doe.state.wy.us/lmi/QCEW_size/toc.htm	yes	state	none (all industries)	2000-2015

[a] Based on data publicly available through state government websites as of June 2016

Table A2. State accommodation and food services employment models, IV

	State accommodation and food services employment by employer size category, *b* (SE)			
	100-249 employees	*250-499 employees*	*500-999 employees*	*≥1,000 employees*
	(6)	(7)	(8)	(9)
Percentage of state population covered by any smoke-free air law	–0.4 (2.9)	–0.5 (4.5)	–6.2 (11.6)	–21.4 (16.1)
Prior year state accommodation and food services employment *(within employer size category)*	0.6** (0.1)	0.3** (0.1)	0.4** (0.1)	0.4** (0.1)
State cigarette pack sales per capita	–3.8 (9.2)	1.6 (16.9)	–1.3 (23.3)	–44.3 (96.3)
Real total cigarette excise tax *(federal plus state)*	–32.3 (313.5)	–470.1 (245.6)	–1,299.7* (590.6)	–1,765.7 (1,859.3)
State non-hospitality employment *(in units of 10,000)*	72.1** (15.3)	22.8** (6.3)	27.6** (9.3)	5.6 (22.0)
Years included	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	49	36	19	16
N (state-year observations)	1,070	474	216	157

* $P < .05$, ** $P < .01$

State non-hospitality employment instrumented for by its lagged value. State fixed effects not shown.

Table A3. State accommodation and food services employment models, LSDVc

	State accommodation and food services employment by employer size category, *b* (SE)			
	100-249 employees	*250-499 employees*	*500-999 employees*	*≥1,000 employees*
	(6)	(7)	(8)	(9)
Percentage of state population covered by any smoke-free air law	–0.9 (7.1)	–1.2 (4.2)	–7.1 (7.7)	–23.0 (22.5)
Prior year state accommodation and food services employment *(within employer size category)*	0.6** (0.03)	0.4** (0.03)	0.4** (0.03)	0.5** (0.1)
State cigarette pack sales per capita	3.0 (18.1)	6.8 (12.1)	11.5 (28.1)	11.3 (98.0)
Real total cigarette excise tax *(federal plus state)*	51.3 (441.8)	–434.4 (285.7)	–1,157.2* (585.1)	–1,034.5 (1,995.1)
State non-hospitality employment *(in units of 10,000)*	83.7** (7.9)	26.2** (3.0)	31.5** (3.8)	18.2 (13.1)
Years included	1990-2014	1990-2014	1990-2014	1990-2014
N (states)	49	36	19	16
N (state-year observations)	1,070	474	216	157

* $P < .05$, ** $P < .01$
State fixed effects not shown.