

Mind the Gap: Changes in Cigarette Prices after California's Tax Increase

Lisa Henriksen, PhD
Nina C. Schleicher, PhD
Trent O. Johnson, MPH
Elizabeth Andersen-Rodgers, MA, MSPH
Xueying Zhang, MD, MS, MPH
Rebecca J. Williams, DrPH, MPH

Objective: In this study, we investigated whether California's 2017 cigarette tax increase was passed onto smokers equally. **Methods:** Auditors recorded 4 cigarette prices in the same random sample of licensed tobacco retailers (N = 1049) before the tax increase (January-March 2017) and after (April-September 2018): Natural American Spirit (ultra-premium), Newport menthol (premium), and Pall Mall (value) all from the same manufacturer, and Marlboro (premium). Ordinary least squares regressions examined how the gap in prices varied by market segment and neighborhood demographics, controlling for store type and months since implementation. Paired t-tests assessed whether industry/retail revenue increased. **Results:** Over-shifting (increase greater than tax) was evident for all 4 brands and was significantly greater for ultra-premium (Mean = \$0.40, SD = 0.75) than premium (Mean = \$0.25, SD = 0.78) and greater for premium than value brand (Mean = \$0.16, SD = 0.67). However, under-shifting (increase less than tax) was evident for Newport in African-American neighborhoods and Pall Mall in Hispanic neighborhoods. After the tax increase, prices were significantly more likely to be discounted and significantly more stores advertised a discount on cigarettes. **Conclusion:** California's tax increase was not passed onto consumers equally. Non-tax mechanisms to increase price could support intended effects of tobacco taxes.

Key words: cigarettes; taxation; tobacco industry; race/ethnicity

Tob Regul Sci.™ 2019;5(6):532-540

DOI: <https://doi.org/10.18001/TRS.5.6.5>

The World Health Organization and the US Community Preventive Services Task Force recommend legislative interventions to increase tobacco prices on the basis of strong evidence for reducing tobacco use prevalence, consumption, initiation among young people, tobacco-related morbidity/mortality, as well as increasing the number of users who quit.^{1,2} At least 2 systematic reviews support the conclusion that price increases have a greater impact on smokers with lower so-

cioeconomic status (SES).^{3,4} However, the effect of each \$0.25 increase in state cigarette tax on smoking prevalence (2001-2015) was weakest among low-income adults (earning less than \$25,000 annually) and weaker among non-Hispanic Blacks than among Hispanics and non-Hispanic Whites.⁵ After Minnesota's tax increase, socially disadvantaged adults reported being more motivated to quit, but were more likely to report price minimizing (eg, switching to cheaper brands/products) and

Lisa Henriksen, Senior Research Scientist, Stanford Prevention Research Center, Stanford University School of Medicine, Palo Alto, CA. Nina C. Schleicher, Statistician, Stanford Prevention Research Center, Stanford University School of Medicine, Palo Alto, CA. Trent O. Johnson, Program Manager, Stanford Prevention Research Center, Stanford University School of Medicine, Palo Alto, CA. Elizabeth Andersen-Rodgers, Research Scientist III, Surveillance Unit, Center for Healthy Communities, California Tobacco Control Program, California Department of Public Health, Sacramento, CA. Xueying Zhang, Chief, Surveillance Unit, Center for Healthy Communities, California Tobacco Control Program, California Department of Public Health, Sacramento, CA. Rebecca J. Williams, Chief, Evaluation and Surveillance Section, Center for Healthy Communities, California Tobacco Control Program, California Department of Public Health, Sacramento, CA.
Correspondence Dr Henriksen; lhriksen@stanford.edu

less apt to become tobacco-free.^{6,7}

There is global concern that intended effects of tobacco taxes are undermined by industry practices to retain price-sensitive customers.^{8,9} This study focuses on 3 pricing strategies that could contribute to differential effects of tax increases across consumer groups: (1) price segmentation (charging different prices for different brands in the same stores); (2) price localization (charging different prices for the same brands to different consumers); and (3) increasing retail prices by more than the tax amount (over-shifting) or by less than the tax amount (under-shifting).^{10,11}

Patterns of over-shifting and under-shifting across different market segments are evident in proprietary sales data^{8-10,12} and in observational data from stores.¹³⁻¹⁵ For example, analyses of retail sales data in the United Kingdom (UK) and Canada illustrate under-shifting tax on the lower-priced cigarettes to keep the products attractive to price-sensitive customers and over-shifting tax on the more expensive cigarettes to maximize profits.⁸⁻¹⁰ Studies that purchase products or observe prices before and after tax increases reveal similar patterns. In New Zealand, the median increase in price after a 10% tax increase was 11% for mainstream and 8% for premium brands as opposed to 3% for a budget brand.¹⁴ Over-shifting was also evident following the \$1.75 (109%) tax increase in Minnesota, where an average price difference (including excise tax) was \$1.89 for Marlboro Gold and \$1.81 for Camel Blue, the 2 premium brands studied.¹³ Whether over/under shifting cigarette prices varies by market segment has not been examined in the United States (US).

Controlling for neighborhood income, price of the same cigarette brand varies by racial/ethnic neighborhood demographics in US stores.¹⁶ In California, for example, Newport (menthol) typically costs less in African-American neighborhoods,¹⁷⁻¹⁹ with some exceptions.^{20,21} However, researchers have not studied the degree to which a cigarette tax is passed onto smokers equally across neighborhoods with different demographics.

For the first time in 17 years, California voters approved a ballot referendum that increased the state excise tax by \$2.00 (from \$0.87 to \$2.87) effective April 1, 2017. This study examines the extent to which the increase in cigarette prices varied from

the \$2.00 tax: (1) across market segments defined by ultra-premium, premium, and value brands from the same manufacturer and (2) in relation to store-neighborhood demographics. This research is important to understand how industry's compensatory responses to tax increases may dampen their impact on price-sensitive groups. In addition, the current study examined whether price discounts for cigarettes were more common after the tax increase.

METHODS

Sample

The California Tobacco Retail Surveillance Survey is a longitudinal statewide marketing assessment that has been conducted 5 times since 2005. In 2017, we verified whether 562 stores that were last assessed in 2014 still sold cigarettes (telephone contact = 67.9%) and increased the sample size by randomly selecting from the 2017 state tobacco retail licensing list maintained by California's Department of Tax and Fee Administration. In 2018, the sampling frame was similarly verified to confirm that 1203 of 1277 stores that were visited in 2017 still sold tobacco (retention rate = 94.2%). Stores lost to follow-up (5.8%) were replenished by telephoning a subset of licensed tobacco retailers that were randomly selected.

Data Collection

At both waves, approximately 10 professional auditors participated in a day-long training, including classroom instruction, a detailed manual, online quizzes, field practice and debriefing. Using iPad minis with surveys programmed in iSurvey in 2017 or Qualtrics in 2018, data collectors recorded store type, the price of multiple products, and the presence of price discounts. Before the state tax increase, data were collected from January 2017 through March 2017 (completion rate = 98.1%, N = 1277). After the state tax increase, data were collected from April 2018 through September 2018 (completion rate = 95.4%, N = 1199). Repeat visits by independent data collectors were conducted in a random sample of stores in 2017 (N = 74) and 2018 (N = 100).

Measures

Prices. Auditors recorded the single-pack price

for 3 brands from the same manufacturer (Reynolds American) that represent different market segments: (1) ultra-premium Natural American Spirit (mellow yellow); (2) premium Newport (menthol); and (3) value brand Pall Mall (red). In addition, auditors recorded the price of the most popular premium brand, Marlboro (red, Altria). For all prices, auditors noted whether sales tax was included, following the protocol in the Standard Tobacco Assessment for Retail Settings (STARS) in the PhenX Toolkit for Tobacco Regulatory Research.^{22,23} Good reliability was obtained for observed prices in 2017²⁰ and in 2018: Natural American Spirit (ICC = 0.86), Newport (ICC = 0.87), Pall Mall (ICC = 0.90) and Marlboro (ICC = 0.89).

Discounts. Auditors recorded whether the single-pack price for each cigarette brand was discounted (eg, 50 cents off or “special price”). In addition, auditors recorded whether any interior and exterior advertisements offered a discount on cigarettes. For analysis, we recoded the responses to indicate whether the store advertised at least one discount for cigarettes, which is similar to the STARS measure.^{22,23} The measure had moderate reliability: 82.4% agreement in 2017 and 72.0% agreement in 2018.

Store-neighborhood demographics. ArcGIS version 10.4 was used to create a half-mile roadway buffer around each store (buffer mapping rate = 99.9%). We used 5-year census tract estimates from the American Community Survey (2013-2017) to describe the neighborhoods in terms of poverty (percent with income <185% of the federal poverty level), ethnicity (% Hispanic) and non-Hispanic race (% African-American, % Asian/Pacific Islander, % Alaskan Native/American Indian/multiple/other races, % white). If a buffer intersected more than one census tract, values were weighted in proportion to tract area.¹⁸ Store neighborhoods also were categorized as rural or non-rural based on 2010 primary rural-urban commuting area (RUCA) codes for US census tracts. Rural store neighborhoods were located in a tract with RUCA code 4-10 and compared to non-rural stores (codes 1-3, which pertain to metropolitan areas).²⁴

Data Analysis

Of the 1134 stores with complete surveys at both time points, we excluded 7.4% of stores that did not

sell cigarettes from the analysis sample (N = 1050). Observational data about price were converted to price without sales tax because cigarette prices were typically advertised “plus tax.”²⁵ In 2018, the average rate for state and local sales tax was 8.00% (min = 7.25%, max = 10.25%).²⁶ There were no local excise taxes on tobacco in California. The consumer price index was used to adjust 2017 prices to 2018 dollars (inflation value = 2.8%). Within each store, the primary outcome measured the change in prices relative to the \$2.00 tax by computing for each brand the 2018 price minus 2017 price in 2018 dollars minus the \$2.00 tax. Thus, positive values represent an over-shift and negative values represent an under-shift. The analysis sample size varies by outcome and brand, ranging from 607 to 1049. For both years and all 4 brands, we computed the amount and percent of pack price that was tobacco industry/retail revenue – that is, price in excess of total state and federal excise taxes (\$1.88 in 2017; \$3.88 in 2018).

Descriptive statistics for each brand summarized: (1) pack prices before and after the tax increase and (2) the gap in price from the \$2.00 tax (the amount of over- or under-shifting). Before and after the tax increase, we also computed (3) the percent of price that was industry revenue in both years, (4) the percent of stores in which brand prices were discounted, and (5) percent of stores with at least one advertised discount for cigarettes, regardless of brand. Paired t-tests assessed the relative difference between brand prices within stores (market segmentation) and tested whether revenue per pack increased after the tax.

Ordinary least squares regressions examined the gap in price (increase greater or less than the \$2.00 tax) for each brand and associations with store-neighborhood demographics. Neighborhood demographics for poverty and race/ethnicity were tertiled to address skewed distributions and for ease of interpretation. All models controlled for store type and months since tax increase (standardized). Store type was dummy coded, with convenience stores as the referent category. For the 16.5% of cases that had different values of store type at 2 time points, the baseline value was used.

Different from the price outcomes, discounts were conceptualized as repeated measures nested within stores. To assess whether prices were more

Table 1
**Cigarette Price (Excluding Sales Tax), Deviation from Tax and Industry/
 Retail Revenue before and after \$2.00 Tax Increase in California (2017-2018)**

Market segment, brand (manufacturer)	Price and Revenue, Mean (Standard Deviation)					
	Before \$2 tax (2017)	After \$2 tax (2018)	Gap in price from \$2 tax	Revenue per pack (2017)	Revenue per pack (2018)	Percent revenue (2018)
Ultra-premium						
Natural American Spirit (RAI) (N = 692)	\$7.24 (0.69)	\$9.64 (0.80)	\$0.40 (0.75)	\$5.31 (0.68)	\$5.76 (0.80)	59.5% (3.1)
Premium						
Marlboro (Altria) (N = 991)	\$6.28 (0.69)	\$8.49 (0.77)	\$0.22 (0.73)	\$4.35 (0.69)	\$4.61 (0.77)	54.0% (4.0)
Newport menthol (RAI) (N = 829)	\$6.40 (0.78)	\$8.65 (0.94)	\$0.25 (0.78)	\$4.47 (0.78)	\$4.77 (0.94)	54.6% (4.6)
Value						
Pall Mall (RAI) (N = 608)	\$5.29 (0.80)	\$7.45 (0.89)	\$0.16 (0.67)	\$3.36 (0.80)	\$3.57 (0.89)	47.3% (5.5)

Note.

Gap in price measures the increase greater or less than the tax: 2018 price minus 2017 price in 2018 dollars minus \$2.00. RAI = Reynolds American International. Tax increased from \$0.87 to \$2.87 (329.9%) effective April 1, 2017. Revenue is price in excess of federal and state excise taxes (2017 = \$1.88; 2018 = \$3.88). Price (before sales tax) and revenue adjusted to 2018 dollars using the consumer price index from April 2017 to April 2018. A \$0.25 litter-mitigation fee was included in prices from San Francisco stores (N = 22).

likely to be discounted after the tax increase, generalized linear models were estimated using PROC GLIMMIX in SAS 9.4, with random intercepts, and the primary predictor was time (2017 = 0 and 2018 = 1). Due to low event rates for discounts on some brands, store type was dichotomized to compare convenience stores and small markets with others and neighborhood demographics were not included. With a higher event rate for the presence of any cigarette discount, the model that tested whether this increased after the state tax included neighborhood demographics. Analyses were performed using SPSS v25 and generalized linear mixed models were fit using SAS 9.4.

RESULTS

The sample was 47.8% convenience stores, 13.9% liquor stores, 11.9% small grocery, 9.6% supermarkets, 8.1% tobacco shops, 4.7% pharmacies, 1.1% discount/big box, and 2.9% other. In 2017, prices from the same manufacturer were consistent with market segmentation: Natural American Spirit cost more than Newport (mean difference = \$0.75, $p <$

.001), which cost more than Pall Mall (mean difference = \$0.98, $p <$.001). Within the premium market segment, Marlboro cost less than Newport (mean difference = \$0.17, $p <$.001). On average, the range from ultra-premium to value brands was \$0.17 larger (SD = 0.68, $p <$.001) after the tax increase.

On average, cigarette prices increased by more than the \$2.00 tax across all brands, with greater over-shifting at higher price points (Table 1). For brands from the same manufacturer, the over-shift on the ultra-premium brand was greater than on the premium brand (mean difference = \$0.14, SD = 0.69, $p <$.001), and greater for the premium than for the value brand (mean difference = \$0.06, SD = 0.65, $p = .019$).

In 2018 dollars, the average tobacco company/retail revenue per pack before the tax increase ranged from \$3.36 for Pall Mall to \$5.31 for Natural American Spirit. After the tax increase, revenue per pack increased significantly for all brands (p -values $<$.001) and varied by market segment. For brands from the same manufacturer, the average

Table 2
Neighborhood Correlates of Gap in Price from \$2.00 Tax Increase by
Market Segment: California, 2017-2018

	Ultra-premium		Premium				Value	
	Natural American Spirit (N = 689)		Marlboro (N = 987)		Newport (menthol) (N = 827)		Pall Mall (N = 607)	
	Coef	95% CI	Coef	95% CI	Coef	95% CI	Coef	95% CI
Intercept (convenience store = ref)	0.50	(0.29, 0.70)	0.23	(0.06, 0.40)	0.23	(0.03, 0.43)	0.13	(-0.07, 0.33)
Time since tax increase (13-17 months)	0.11	(0.05, 0.17)	-0.03	(-0.08, 0.01)	-0.06	(-0.11, 0.00)	0.00	(-0.06, 0.05)
Neighborhood characteristics								
Rural tract (yes)	-0.21	(-0.42, 0.00)	0.02	(-0.15, 0.19)	-0.10	(-0.31, 0.11)	0.06	(-0.14, 0.25)
Below 185% FPL (<26.44%)								
Tertile 2 (26.48-43.96%)	-0.06	(-0.20, 0.09)	-0.04	(-0.17, 0.08)	-0.08	(-0.23, 0.06)	0.02	(-0.12, 0.16)
Tertile 3 (43.98 or more)	-0.07	(-0.24, 0.11)	0.03	(-0.12, 0.17)	0.08	(-0.09, 0.25)	0.02	(-0.15, 0.19)
% African American (<1.63%)								
Tertile 2 (1.64-4.97%)	-0.08	(-0.22, 0.06)	-0.17	(-0.28, -0.05)	-0.20	(-0.34, -0.06)	-0.05	(-0.19, 0.09)
Tertile 3 (4.98 or more)	-0.07	(-0.23, 0.08)	-0.11	(-0.23, 0.02)	-0.31	(-0.46, -0.16)	-0.05	(-0.20, 0.11)
% AIAN, multiracial, other (<2.27%)								
Tertile 2 (2.28-3.95%)	-0.08	(-0.23, 0.08)	0.02	(-0.11, 0.14)	0.06	(-0.08, 0.21)	0.11	(-0.04, 0.26)
Tertile 3 (3.96 or more)	0.04	(-0.12, 0.21)	0.04	(-0.10, 0.18)	0.09	(-0.07, 0.26)	0.04	(-0.13, 0.20)
% Asian/PI (<4.22%)								
Tertile 2 (4.22-11.74%)	0.01	(-0.14, 0.16)	0.13	(0.01, 0.25)	0.08	(-0.06, 0.22)	0.02	(-0.12, 0.16)
Tertile 3 (11.75 or more)	0.14	(-0.02, 0.29)	0.17	(0.05, 0.30)	0.09	(-0.05, 0.24)	0.10	(-0.05, 0.25)
% Hispanic (<23.99%)								
Tertile 2 (24.06-50.20%)	-0.05	(-0.20, 0.09)	-0.07	(-0.20, 0.06)	0.05	(-0.10, 0.20)	-0.12	(-0.26, 0.03)
Tertile 3 (50.23 or more)	-0.10	(-0.29, 0.09)	-0.05	(-0.21, 0.11)	-0.09	(-0.28, 0.09)	-0.19	(-0.37, 0.00)

Note.

Gap in price measures the increase greater or less than the tax: 2018 price minus 2017 price in 2018 dollars minus \$2.00. Cell entries are \$. Models control for store type with the most common category, convenience stores, as the referent category. The intercept represents the estimated over/under shifting of price for convenience stores in non-rural tracts with values from tertile 1 for all other demographics (poverty, race/ethnicity), and mean months since tax increase. For example, the model estimates that Pall Mall was \$0.19 cheaper at convenience stores in neighborhoods with the most Hispanic residents, which represents an undershift compared to the \$0.13 overshift in neighborhoods with the least Hispanic residents. Bolded entries indicate $p < .05$. FPL measures percent of population with income <185% of federal poverty level. AIAN=American Indian Alaska Native. PI=Pacific Islander.

revenue for ultra-premium increased more than for premium ($p < .001$), which increased more than for the value brand ($p = .013$).

Table 2 estimates how much more or less than

the \$2.00 tax increase was passed on to consumers, separately for each brand. As expected, over-shifting was evident for ultra-premium (Natural American Spirit) and premium (Marlboro, New-

Table 3
Discounts for Cigarettes by Brand and Year: California 2017-2018

	Percent of stores with discounted single-pack price								At least one advertised discount for cigarettes	
	Natural American Spirit		Marlboro		Newport		Pall Mall		2017 (N = 1049)	2018 (N = 1049)
	2017 (N = 887)	2018 (N = 803)	2017 (N = 1043)	2018 (N = 1024)	2017 (N = 962)	2018 (N = 893)	2017 (N = 754)	2018 (N = 742)		
Percent of stores	3.9%	11.0%	4.5%	6.6%	18.2%	23.4%	17.6%	20.8%	59.5%	64.6%
Generalized linear mixed models										
	AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)		AOR (95% CI)	
Intercept	0.05		0.06		0.19		0.20		1.16	
Year (2018 vs 2017)	3.06 (2.03, 4.60)		1.52 (1.03, 2.25)		1.38 (1.10, 1.74)		1.23 (0.95, 1.60)		1.27 (1.06, 1.53)	
Store type										
Convenience & small market vs all others	0.74 (0.49, 1.10)		0.46 (0.30, 0.69)		1.22 (0.94, 1.57)		1.11 (0.84, 1.48)		1.59 (1.26, 2.01)	

Note.

Cell entries are percent of stores and adjusted odds ratios (AOR) and 95% confidence intervals (CI) from generalized mixed linear models.

port) brands. In convenience stores, for example, the estimated over-shift of a \$2.00 tax was \$0.50 for Natural American Spirit and \$0.23 on the premium brands, controlling for neighborhood demographics. Contrary to expectation, no statistically significant over-shifting was observed for the value brand (Pall Mall) in convenience stores when other variables were controlled.

Notably, the gap in price (increase greater or less than the \$2.00 tax) varied by store-neighborhood demographics in adjusted models (Table 2). Brand-specific patterns of over-shifting and under-shifting were evident in neighborhoods with a higher proportion of African Americans, Asian/Pacific Islanders and Hispanics. For Newport (menthol), significantly less tax was passed on to smokers in neighborhoods with higher proportions of African-American residents, yielding under-shifting at the highest tertile. Similarly, there was under-shifting of tax on Pall Mall price at convenience stores in neighborhood with the highest proportion of Hispanic residents. For Marlboro, there was significantly greater over-shifting in neighborhoods with higher proportions of Asian/Pacific Islander residents (eg, \$0.13 in tertile 2 and \$0.17 in tertile 3) and the amount of over-shift was \$0.17 less in neighborhoods with more African Americans (tertile 2)

compared to stores in the lowest tertile. There was no statistically significant over- or under-shifting of cigarette prices at stores in rural tracts or neighborhoods with more residents living in poverty.

In 2018, the percent of stores that discounted the single-pack price ranged from 6.6% for Marlboro to 23.4% for Newport menthol (Table 3). For all 3 premium/ultra-premium brands, the odds that the single-pack price was discounted was significantly greater in 2018 (after tax increase) than in 2017 (before tax increase). As Table 3 shows, the percent of stores with at least one advertised discount for cigarettes was 59.5%, in 2017 and 64.6% in 2018. Controlling for store type, the odds that a store advertised were significantly greater after the tax increase (AOR = 1.27, 95% CI = 1.06, 1.53). However, an increase in the presence of advertised price discounts was not related to neighborhood demographics (data not shown).

DISCUSSION

After California's \$2.00 excise tax increase in 2017, a pattern of over-shifting the prices of all 4 cigarette brands studied was evident in 2018. Consistent with price segmentation, the amount of over-shift was greater for ultra-premium than for the premium brand and greater for premium than

for the value brand from the same manufacturer.^{9,11} These strategies for over-shifting price in response to tax increases are evident in tobacco industry documents and in other US studies.^{13,15,27} However, the current study offers the first evidence that we are aware of that change in cigarette prices after a state tax increase varied by neighborhood demographics. Specifically, under-shifting was evident in neighborhoods with more African-American residents (for Newport menthol) and more Hispanic residents (for Pall Mall). California's \$2.00 tax increase was not passed through to smokers equally, which suggests that the benefit of the tax increase was undermined for some priority populations. In addition, statistically significant over-shifting on the price of Marlboro in neighborhoods with a higher proportion of Asian/Pacific Islanders would maximize industry profits for a popular brand in this population.^{28,29}

After the \$2.00 tax increase, tobacco industry/retail revenue per pack increased for all 4 brands, with larger increases at higher price points. In 2018, industry/retail revenue per pack on ultra-premium and premium brands was more than half of the average pack price. Although discounts on single-pack prices were not common, the prices for all 3 premium/ultra premium brands were significantly more likely to be discounted after the tax increase than before. This pattern is consistent with a previously documented higher proportion of discounted sales for cigarettes in US states with higher excise taxes.³⁰ In addition, California stores were more likely to advertise discounts for cigarettes after the tax increase than before. The same industry response was noted after the 1998 federal tax increase.³¹

Strengths and Limitations

Strengths of the study are the assessment of cigarette prices across 3 market segments, including 3 brands from the same manufacturer in a representative, statewide sample of stores. The main value of observational data about price is to examine variation as a function of store-neighborhood demographics. Such analyses cannot be accomplished with proprietary sales data for designated market areas, which are comprised of multiple, large counties in California.

The main limitation of the current study is the

lack of an out-of-state comparison, which is characteristic of other studies with no control group or few out-of-state observations.^{13,14} Lack of a comparison group makes it difficult to infer that observed results were caused by industry/retailer compensatory responses to California's tax increase. Replication with repeated measures (both pre- and post-tax), and comparisons in nearby states where cigarette taxes did not increase, are needed. Data for more cigarette brands at multiple price points would improve generalizability.

Philip Morris USA and RJ Reynolds increased US cigarette prices by \$0.10 in September 2017 and by \$0.09 in March 2018.^{32,33} According to industry reports, the September 2017 cigarette price increase was in anticipation of California's tax increase, because the state is the second largest by tobacco sales volume, representing approximately 7% of the total US tobacco market.³² At least some of the change in cigarette prices that was observed in California may be attributable to across-the-board increases (\$0.19). However, that amount is roughly the same as our adjustment for 2.8% inflation from 2017 to 2018.

IMPLICATIONS FOR TOBACCO REGULATION

California's \$2.00 tobacco tax increase resulted in comparable or even larger increases in cigarette prices statewide. However, the amount of over-shift was greater at higher price points. In addition, evidence of under-shifting for some brands in some neighborhoods provide further evidence that the state tax increase was not passed through equally to all smokers. Non-tax policies to increase price, such as eliminating price discounts and coupon redemption, are recommended to support the intended effects of tobacco tax increases.^{6,34} Such policies could be expected to have pro-equity benefits for smokers with lower income/education as well as African Americans and other racial groups that are disproportionately targeted by tobacco industry discounts.³⁵⁻³⁹ Including menthol in sales restrictions of flavored tobacco would further limit the industry's use of pricing strategies to target smokers in African-American neighborhoods and others where menthol cigarette advertisements are more prevalent.^{17,40-42}

Raising awareness among community members

and local decision makers about inequities in price (different prices for the same brands in different neighborhoods) and the gap between change in price and tax increase for priority populations, is fundamental to solving these issues. To this end, state governments could support funding to local organizations working to inform and improve health equity. For example, as of April 2019, the California Tobacco Control Program's Priority Populations Initiative has funded over \$100 million to more than 100 local and statewide projects to address tobacco-related disparities.⁴³ Future research should consider how establishing a floor price for tobacco products in combination with a tax increase, as in New York City, could be used to maximize public health gains.⁴⁴ In addition, future research should consider how inequity in the pass-through of tobacco tax contributes to tobacco-related disparities.

Human Subjects Statement

The Institutional Review Board at Stanford University School of Medicine determined this research does not involve human subjects.

Conflict of Interest Disclosure Statement

The authors have no conflicts of interest to report.

Acknowledgements

Funds from the California Department of Public Health (CDPH), Contracts #14-10313 and #17-10041, and the National Cancer Institute (P01-CA225597) supported this research. CDPH was involved in the study design, data collection, analysis, interpretation and writing. The funders had no involvement in the study design, collection, analysis, writing, or interpretation. CDPH reviewed the text prior to submission and did not influence whether and where to submit for publication. Authors had full access to all of the data in the study and take responsibility for the integrity of the data and the accuracy of the data analysis. For data collection, thanks are due to Ewald & Wasserman, LLC, Lindsey Winn, MS for geocoding and to Amna Ali, MPH, for assistance with manuscript preparation.

References

1. World Health Organization. Framework Convention on Tobacco Control. Guidelines for Implementation of Article 6: Price and Tax Measures to Reduce the Demand for Tobacco. 2014. Available at: https://www.who.int/fctc/guidelines/adopted/Guidelines_article_6.pdf. Accessed September 26, 2019.
2. Community Preventive Services Task Force. Reducing Tobacco Use and Secondhand Smoke Exposure: Interventions to Increase the Unit Price for Tobacco Products. 2014. Available at: <https://www.thecommunityguide.org/sites/default/files/assets/Tobacco-Increasing-Unit-Price.pdf>. Accessed September 26, 2019.
3. Hill S, Amos A, Clifford D, Platt S. Impact of tobacco control interventions on socioeconomic inequalities in smoking: review of the evidence. *Tob Control*. 2014;23(e2):e89-e97.
4. Chaloupka FJ, Straif K, Leon ME, Working Group IA for R on C. Effectiveness of tax and price policies in tobacco control. *Tob Control*. 2011;20(3):235-238.
5. Sharbaugh MS, Althouse AD, Thoma FW, et al. Impact of cigarette taxes on smoking prevalence from 2001-2015: a report using the Behavioral and Risk Factor Surveillance Survey (BRFSS). *PLoS One*. 2018;13(9):e0204416.
6. Choi K, Boyle RG. Changes in cigarette expenditure minimizing strategies before and after a cigarette tax increase. *Tob Control*. 2018;27(1):99-104.
7. Parks MJ, Kingsbury JH, Boyle RG, Choi K. Behavioral change in response to a statewide tobacco tax increase and differences across socioeconomic status. *Addict Behav*. 2017;73:209-215.
8. Gilmore AB, Tavakoly B, Taylor G, Reed H. Understanding tobacco industry pricing strategy and whether it undermines tobacco tax policy: the example of the UK cigarette market. *Addiction*. 2013;108(7):1317-1326.
9. Hiscock R, Branston JR, McNeill A, et al. Tobacco industry strategies undermine government tax policy: evidence from commercial data. *Tob Control*. 2017 Oct 9. pii: tobaccocontrol-2017-053891. doi: 10.1136/tobaccocontrol-2017-053891. [Epub ahead of print]
10. Callard CD, Collishaw N. Cigarette pricing 1 year after new restrictions on tobacco industry retailer programmes in Quebec, Canada. *Tob Control*. 2019;28(5):562-565.
11. Ross H, Tesche J, Vellios N. Undermining government tax policies: common legal strategies employed by the tobacco industry in response to tobacco tax increases. *Prev Med*. 2017;105S:S19-S22.
12. Amato MS, Boyle RG, Brock B. Higher price, fewer packs: evaluating a tobacco tax increase with cigarette sales data. *Am J Public Health*. 2015;105(3):e5-e8.
13. Brock B, Choi K, Boyle RG, et al. Tobacco product prices before and after a statewide tobacco tax increase. *Tob Control*. 2016;25(2):166-173.
14. Marsh L, Cameron C, Quigg R, et al. The impact of an increase in excise tax on the retail price of tobacco in New Zealand. *Tob Control*. 2016;25(4):458-463.
15. Hanson A, Sullivan R. The incidence of tobacco taxation: evidence from geographic micro-level data on JSTOR. *Natl Tax J*. 2019;62(4):677-698.
16. Lee JGL, Henriksen L, Rose SW, et al. A systematic review of neighborhood disparities in point-of-sale tobacco marketing. *Am J Public Health*. 2015;105(9):e8-e18.
17. Henriksen L, Schleicher NC, Dauphinee AL, Fortmann

- SP. Targeted advertising, promotion, and price for menthol cigarettes in California high school neighborhoods. *Nicotine Tob Res.* 2012;14(1):116-121.
18. Henriksen L, Schleicher NC, Barker DC, et al. prices for tobacco and nontobacco products in pharmacies versus other stores: results from retail marketing surveillance in California and in the United States. *Am J Public Health.* 2016;106(10):1858-1864.
 19. Cantrell J, Ganz O, Anesetti-Rothermel A, et al. Cigarette price variation around high schools: evidence from Washington DC. *Health Place.* 2015;31:193-198.
 20. Epperson AE, Johnson TO, Schleicher NC, Henriksen L. The price of Natural American Spirit relative to other cigarette brands. *Nicotine Tob Res.* 2019 Feb 13. doi: 10.1093/ntr/ntz018. [Epub ahead of print]
 21. Lipperman-Kreda S, Grube JW, Friend KB, Mair C. Tobacco outlet density, retailer cigarette sales without ID checks and enforcement of underage tobacco laws: associations with youths' cigarette smoking and beliefs. *Addiction.* 2016;111(3):525-532.
 22. Lee JGL, Henriksen L, Myers AE, et al. A systematic review of store audit methods for assessing tobacco marketing and products at the point of sale. *Tob Control.* 2014;23(2):98-106.
 23. PhenX Toolkit. Standardized Tobacco Assessment for Retail Settings. Available at : <https://www.phenxtoolkit.org/protocols/view/741001>. Accessed September 26, 2019.
 24. US Health Resources & Services Administration. Defining Rural Population. Available at: <https://www.hrsa.gov/rural-health/about-us/definition/index.html>. Accessed September 26, 2019.
 25. Schleicher NC, Johnson TO, D'Angelo H, et al. Concordance of advertised cigarette prices with purchase receipts in the United States. *Tob Regul Sci.* 2018;4(3):3-9.
 26. California Department of Tax and Fee Administration. Business Taxes and Fees in California. Available at: <https://www.cdtfa.ca.gov/taxes-and-fees/>. Accessed September 26, 2019.
 27. Chaloupka FJ, Cummings KM, Morley CP, Horan JK. Tax, price and cigarette smoking: evidence from the tobacco documents and implications for tobacco company marketing strategies. *Tob Control.* 2002;11(Suppl 1):i62-i72.
 28. US Centers for Disease Control and Prevention (CDC). Tobacco Industry Marketing. 2018. Available at: https://www.cdc.gov/tobacco/data_statistics/fact_sheets/tobacco_industry/marketing/index.htm. Accessed March 27, 2019.
 29. Muggli ME, Pollay RW, Lew R, Joseph AM. Targeting of Asian Americans and Pacific Islanders by the tobacco industry: results from the Minnesota Tobacco Document Depository. *Tob Control.* 2002;11(3):201-209.
 30. Loomis BR, Farrelly MC, Mann NH. The association of retail promotions for cigarettes with the Master Settlement Agreement, tobacco control programmes and cigarette excise taxes. *Tob Control.* 2006;15(6):458-463.
 31. Chaloupka F, Slater S, Wakefield M. USA: price cuts and point of sale ads follow tax rise. *Tob Control.* 1999;8(3):242.
 32. Craver R. Manufacturers raise cigarette list prices by 8 cents per pack. *Winston-Salem Journal.* 2016. Available at: https://www.journalnow.com/business/business_news/local/manufacturers-raise-cigarette-list-prices-by-cents-per-pack/article_e8e12355-5504-5214-bd90-1453b2ae2928.html. Accessed September 26, 2019.
 33. Convenience Store News. Altria Leads First Round of List Price Hikes for 2018. Convenience Store News. Available at: <https://csnews.com/altria-leads-first-round-list-price-hikes-2018>. Accessed July 12, 2019.
 34. Marynak KL, Xu X, Wang X, et al. Estimating the impact of raising prices and eliminating discounts on cigarette smoking prevalence in the United States. *Public Health Rep.* 2016;131(4):536-543.
 35. Wang TW, Falvey K, Gammon DG, et al. Sales trends in price-discounted cigarettes, large cigars, little cigars, and cigarillos – United States, 2011-2016. *Nicotine Tob Res.* 2018;20(11):1401-1406.
 36. Xu X, Pesko MF, Tynan MA, et al. Cigarette price-minimization strategies by U.S. smokers. *Am J Prev Med.* 2013;44(5):472-476.
 37. Caraballo RS, Wang X, Xu X. Can you refuse these discounts? An evaluation of the use and price discount impact of price-related promotions among US adult smokers by cigarette manufacturers. *BMJ Open.* 2014;4(6):e004685.
 38. Ribisl KM, D'Angelo H, Feld AL, et al. Disparities in tobacco marketing and product availability at the point of sale: Results of a national study. *Prev Med.* 2017;105:381-388.
 39. Feighery EC, Schleicher NC, Boley Cruz T, Unger JB. An examination of trends in amount and type of cigarette advertising and sales promotions in California stores, 2002-2005. *Tob Control.* 2008;17(2):93-98.
 40. Waddell EN, Sacks R, Farley SM, Johns M. Point-of-sale tobacco marketing to youth in New York State. *J Adolesc Health.* 2016;59(3):365-367.
 41. Mills SD, Henriksen L, Golden SD, et al. Disparities in retail marketing for menthol cigarettes in the United States, 2015. *Health Place.* 2018;53:62-70.
 42. Seidenberg AB, Caughey RW, Rees VW, Connolly GN. Storefront cigarette advertising differs by community demographic profile. *Am J Health Promot.* 2010;24(6):e26-e31.
 43. California Tobacco Control Program (CTCP). CTCP Tobacco Control Funding opportunities and Resources. Available at: <https://tcfor.catcp.org/index.cfm?fuseaction=opportunities.viewOpp&oppID=56>. Accessed March 26, 2019.
 44. Kilgore EA, Mandel-Ricci J, Johns M, et al. Making it harder to smoke and easier to quit: the effect of 10 years of tobacco control in New York City. *Am J Public Health.*

2014;104(6):e5-e8.