WHO PAYS CIGARETTE TAXES? THE IMPACT OF CONSUMER PRICE SEARCH

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NBER Working Paper No. 15942
April 2010
JEL No. H22,I18

ABSTRACT

We conduct an empirical study of the impact of consumer price-search on the shifting of cigarette excise taxes to consumer prices. We use novel data on the prices smokers report actually paying for cigarettes. We document substantial price dispersion. We find that cigarette taxes are shifted at lower rates to the prices paid by consumers who undertake more price search – carton buyers, and especially, smokers who buy cartons of cigarettes in a state other than their state of residence. We also find suggestive evidence that taxes are shifted at slightly higher rates to the prices paid by non-daily smokers, less addicted smokers, and smokers of light cigarettes.

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1. Introduction

Economists emphasize that the behavior of buyers and sellers in market, not statutes, determines who really pays a tax (Fullerton and Metcalf 2002). For excise and sales taxes, one of the most basic questions is whether taxes are shifted forwards to consumers, or backwards to suppliers and factors of production. A general principle is that taxes tend to be shifted away from the economic agents most able to change their behavior in response to the tax. For example, in a competitive industry with free entry and exit and perfectly elastic supply, in equilibrium the tax is shifted away from suppliers, towards consumers. Empirical studies of the most common excise taxes in the U.S. – taxes on alcohol, cigarettes, and gasoline – usually conclude that they are fully shifted to consumers. In fact, most studies of alcohol and cigarette taxes find that they are over-shifted, i.e passed through to consumer prices at a rate higher than one-for-one.[1] Empirical studies also conclude that general sales taxes are fully shifted to consumer prices, with evidence of over-shifting in some markets.[2]

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[1]Cook (1981), Young and Bielinska-Kwapisz (2002), and Kenkel (2005) find evidence that alcohol excise taxes are over-shifted. Similarly, Barzel (1976), Johnson (1978), Sumner and Ward (1981), Keeler et al. (1996), Delipalla and O'Donnell (2001) and Hanson and Sullivan (2009) find evidence that cigarette excise taxes are over-shifted. In contrast to previous research, Harding, Leibtag, and Lovenheim (2010) use unique transaction-level data and find under-shifting for both alcohol and cigarette taxes. Alm, Senoga, and Skidmore (2009) find evidence that in urban states gasoline taxes are fully passed through to prices, but their estimates suggest that in rural states gasoline taxes are under-shifted.

[2] Poterba (1996) finds that sales taxes are shifted to retail prices of clothing and personal care items at a rate of about one-for-one. Besley and Rosen (1999) find evidence of tax over-shifting in about half of the 12 goods markets they study.

The observed over-shifting in many goods markets is consistent with theoretical

analyses of tax shifting under oligopoly and imperfect competition.[3]

The standard approach in empirical studies of the shifting of excise and sales

taxes is to compare prices across markets with different tax rates, observing a single

price (e.g. the average price) in each market.[4] However, there can be substantial

within-market dispersion in the prices paid by consumers. In a review of research on

the extent of price dispersion in various markets, including on-line markets, Baye,

Morgan, and Scholten (2006, pp.44-45) conclude that: "price dispersion is ubiquitous

and persistent....[and] is still the rule rather than the exception...." Search-theoretic

models help explain why price differences are not completely arbitraged away. Like

equilibrium tax shifting, the behavior of buyers and sellers in markets, including

buyers' search behavior, determines equilibrium price dispersion.

In this paper we conduct an empirical study of the impact of price-search

behaviors on the shifting of cigarette excise taxes to consumer prices.   Theoretical

models and empirical research suggest that consumer price search is especially

common for frequently purchased items like cigarettes. In addition to the price search

common in many markets, cigarette consumers can shop for volume discounts by

buying cartons instead of packs, and they can even cross state borders to avoid excise

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[3]In market conditions other than perfect competition, theory predicts a number
of possible outcomes, including both over- or under-shifting of taxes to consumer
prices (Katz and Rosen 1985, Stern 1987, Besley 1989).

[4]Of the 13 studies cited in footnotes 1 and 2, 10 use data with a single price
per market. Kenkel (2005) and Hanson and Sullivan (2009) use data with multiple
prices, collected from surveys of retailers. Harding, Leibtag, and Lovenheim (2010)
use transaction-level prices from scanner data.

taxes (Lovenheim 2008, DeCicca, Kenkel and Liu 2010). If more price-sensitive consumers engage in more search, the general principle of tax shifting implies that cigarette excise taxes will be shifted at a lower rate to the prices paid by consumers who engage in more search. However, to the best of our knowledge, previous public finance and health economics research has not explored the impact of price-search behavior on tax shifting, either in general or for the cigarette market in particular.

We use novel data from the 2003 and 2006-07 cycles of the Tobacco Use Supplements to the Consumer Population Survey (TUS-CPS). The TUS-CPS contains data on the prices paid for cigarettes by a national pooled sample of about 60,000 smokers. As described in more detail in section 2, our first contribution is simply to document that cigarette prices show substantial dispersion that is not entirely due to differences in state- or local-taxes. The TUS-CPS also contains data on some behaviors consumers adopt to lower the prices they pay for cigarettes, including buying by the carton instead of the pack and buying cigarettes across state borders. Consumers who adopt these behaviors report paying substantially lower prices for cigarettes.

In section 3 we use the TUS-CPS data to examine the degree to which state cigarette excise taxes are shifted to consumers who engage in different search behaviors. Consistent with previous estimates, for the full sample we find evidence that taxes are fully shifted to consumer prices. However, the average rate of shifting masks substantial differences by search behavior. We estimate that the rate at which

taxes are shifted to consumer prices is only 0.79 for the prices paid by home-state carton buyers, and only 0.26 for the prices paid by away-state carton buyers.

In section 4, we take a different cut at the data and explore whether tax shifting is related to smoking behavior. We find that taxes are shifted to consumer prices at about the same rates across most groups of smokers, but there is some evidence of slight over-shifting to non-daily and less-addicted smokers and smokers of light cigarettes. Combined with the results of the Section 3 model, the empirical evidence suggests that for tax shifting, search behavior appears to be more important than smoking behavior.

Section 5 concludes and discusses directions for future work.

2. Cigarette Price Dispersion

The 2003 and 2006-2007 cycles of the TUS-CPS provide novel data on the prices consumers report actually paying for the cigarettes they purchased, and on some price-search behaviors. The Tobacco Use Supplements (TUS) have been sponsored by the National Cancer Institute and administered as part of the Current Population Survey (CPS), the U.S. Census Bureau's continuing labor force survey (Hartman et al. 2002, US Department of Commerce, Census Bureau 2006). Questions about cigarette prices were included in the 2003 cycle (conducted in February, June, and November 2003) and the 2006 - 2007 cycle (conducted in May and August 2006 and January 2007). Smokers were asked to report how much they paid for their last pack or carton of cigarettes, after using discounts or coupons. Smokers were also asked whether they usually buy their cigarettes by the pack or by the carton, whether

their last purchase was in their state of residence or some other state, and whether they

bought cigarettes over the internet or by other means. We use these responses to

create four mutually exclusive categories of smokers: pack buyers; home-state carton

buyers; away-state carton buyers; and buyers over the internet or other means.[5] Our

analysis samples consist of about 32,000 smokers from the 2003 TUS-CPS and about

28,000 from the 2006-2007 TUS-CPS.

Table 1 describes the TUS-CPS data on cigarette prices. Cigarette prices are

standardized as price per pack.[6] In addition to average prices paid, Table 1 also

reports the coefficient of variation (the mean divided by the standard deviation),

which is a common measure of price dispersion (Baye, Morgan and Scholten 2006).

For the full sample of reported prices paid, the coefficient of variation is about 33

percent in 2003 and 36 percent in 2006 - 2007. This degree of price dispersion is

roughly comparable to that seen for other goods (Baye, Morgan and Scholten 2006,

Table 1a). For example, Lach (2002) find coefficients of variation from 11 to 20

percent for coffee prices in Israel, and Scholten and Smith (2002) find coefficients of

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[5]About five percent of smokers report that they usually buy both packs and cartons; we categorize them as pack buyers. We pool home-state and away-state pack buyers together, because of relatively small samples of away-state pack buyers (about 450 smokers in each TUS cycle). About 2.5 percent of smokers, mainly non-daily smokers, report that they usually do not buy their own cigarettes, so they do not report prices and are not included in our analysis.

[6]We also imposed consistent top-coding across the 2003 and 2006-2007 TUS-CPS data. In the 2003 survey coding, the highest possible prices were $9.99 per pack and $99.99 per carton. In the 2006 - 2007 survey coding, the highest possible prices were $99.99 per pack and $999.99 per carton. Imposing the 2003 top codes involved less than one percent of the 2006 - 2007 sample (226 observations) and did not change most empirical results. However, if we do not impose the 2003 top codes, the calculated coefficient of variation is much higher in 2006 - 2007.

variation from 2 to 42 percent for the prices of consumer sundries in Bloomington, Indiana retail markets.

Looking across price-shopping behaviors, in round numbers about 65 percent of smokers report buying packs, about 30 percent report buying cartons of cigarettes in their home state, another 3 percent report buying cartons of cigarettes in another state, and less than one percent report buying cigarettes over the internet or by other means. Compared to consumers who buy cigarettes by the pack, consumers who buy cartons in their home state report paying about $1.00 less per pack, or about 25 percent less. Consumers who travel across state borders to purchase their cartons of cigarettes report paying even lower prices. The small number of consumers who report that they buy their cigarettes over the internet or by other means report the lowest prices paid.[7]   Measured price dispersion is not too different across pack buyers, home-state carton buyers, and non-home state carton buyers. There is greater dispersion in the prices paid by consumers who report buying their cigarettes over the internet or by other means. This is not surprising, because by definition this category appears inherently more heterogeneous.

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[7]The low prevalence of internet purchases might seem surprising, and could reflect TUS-CPS respondents' reluctance to report actions of questionable legality. As Goolsbee, Lovenheim, and Slemrod (2007) point out, there is very little systematic evidence about the volume of internet cigarette sales.   Goolsbee, Lovenheim and Slemrod estimate a model of state taxable cigarette sales that includes a measure of internet penetration in the state. Their model implies that, compared to a counter-factual with no internet sales, in 2000 internet sales reduced home-state cigarette sales by 3.3 percent.

Part of the observed price dispersion in the TUS-CPS data reflects variation in state excise taxes on cigarettes. In a simple descriptive regression (not reported but available upon request), variation in state excise taxes explains 33 percent of the variation in prices paid (i.e. the $R^2 = 0.33$). Of the remaining variation, an additional 11 percent is explained by adding to the descriptive regression indicator variables for home-state and away-state carton buyers. The improvement in the R^2 to 0.44 is substantial in the context of a large microdata set.

Because the TUS-CPS is representative by state, we can also examine the average price and coefficient of variation by state (Appendix Table). The coefficients of variation for cigarette price paid across states are in a fairly narrow range from around 20 to 40 percent. The price dispersion within most states is only slightly less than the price dispersion in the entire sample, again suggesting that excise tax differences do not drive all of the measured price dispersion.[8]

We can also compare the TUS-CPS state-average prices to the average price by state reported in the *Tax Burden on Tobacco* [*TBOT*] (Orzechowski and Walker 2008). *TBOT* is the standard source of cigarette price data used in virtually every study of U.S. cigarette demand.   The two state-average price series are highly correlated (r = 0.94), but the *TBOT* state-average prices are systematically higher.[9]

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[8]In some states, localities impose additional excise taxes. Some of the within-Illinois price dispersion is due to sizeable taxes imposed by Chicago and Cook County. Some of the within-New York price dispersion is due to the sizeable tax in New York City. A number of other cities and counties, mainly in Alabama, Missouri, and Virginia, also impose local taxes, but these are very small.

[9]The methodology of the *TBOT* price series is not reported, so we can only speculate why the prices are systematically higher. Possible reasons the *TBOT* prices

We only observe some of the sources of the observed dispersion in the TUS-CPS cigarette price data. While the TUS-CPS instructed consumers to report the price paid after using discounts or coupons, it did not collect information on who used discounts and coupons. The TUS-CPS also did not collect information on brand preferences. The cigarette market includes standard-priced brands such as Marlboro and Camel and discount and deep discount brands (Bulow and Klemperer 1998). From several sources, we estimate that discounted sales and sales of discount brands account for about 30 percent of total sales. The price differences due to discounts and brand choice are about $1.00 per pack, the same size difference as we report in Table 2 for pack- versus- carton buyers. A back-of-the-envelope calculation suggests that these unobserved factors alone would lead to a coefficient of variation in prices of about 12 percent, substantially below the 33 - 36 percent we observe in the TUS-CPS price data.[10] Finally, we note that consumers may pay different prices for the exact

might be higher include: they do not include the volume discounts for carton purchases; they do not reflect other price discounts and coupons; or they come from an unrepresentative sample of retailers. Even after we restrict the TUS - CPS sample to include only pack prices, the *TBOT* prices are still about $0.30 per pack higher than the TUS-CPS state average prices. As discussed below and in footnote 10, price discounts and coupons are probably not common enough and large enough to explain the differences between the state-average prices. Future work could explore the implications of measurement error in the *TBOT* price series for previous estimates of the price-elasticity of cigarette demand.

[10] In supermarket scanner data from 49 geographic markets from 1997 - 2005, Lillard and Sfekas (2010) report that discounted sales make up just under two percent of total sales, with the average discount offer being worth about $1.00 per pack. The price difference between standard and discount brands also appears to be about $1.00 per pack (authors' calculations from Euromonitor 2003). For the back-of-the-envelope calculation, based on Euromonitor's (2003) market report we assume that 72 percent of smokers buy standard brands at an average price of about $4.00 per pack and 28 percent buy discount brands at an average price of about $3.00 per pack.

same brand, and there may be idiosyncratic differences in self-reports of the price

paid for cigarettes. Although we can not observe these other sources, the results in

Table 2 demonstrate important price differences associated with the search behaviors

we observe.

3. Tax Shifting and Price-Shopping Behaviors

To describe tax shifting, we follow Poterba (1996) and Belsey and Rosen

(1999) and estimate reduced-form equations that show the price paid by consumer i in

state s as a function of the tax rate T and a vector X of demand- and supply-shifters, to

which we add a vector S of search-cost shifters:

(1) $\quad\quad\quad P_{is} = \beta_0 + \beta_1 T_s + \beta_2 X_{is} + \beta_3 S_{is} + \varepsilon_{is}$

The main focus of our analysis is on our estimates of β_1. In our linear specification,

full shifting of taxes to consumer prices implies $\beta_1 = 1$.

Table 2 contains the definitions and means of the explanatory variables, and

the sources for the state-level variables. The tax T is measured as the tax rate in the

state of purchase. The vector X includes individual characteristics such as age,

schooling, and income, indicators for size of the metropolitan area, region of

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Based on Lillard and Sfekas (2010), we assume that two percent of all purchases
involve a discount of about $1.00 per pack, and that only standard brand purchases are
discounted. Assuming that 70 percent of the sample pays $4.00 per pack and 30
percent of the sample pays $3.00 per pack yields a coefficient of variation of 0.12. Of
course, there is additional dispersion from several sources. Interestingly, the market
report claims that: "Standard cigarettes in the US display little or no price variation
between brands....Price variation is instead determined by what state the consumer
lives in, and what channel is being used for the purchase. Therefore, a pack of
Marlboros is likely to be the same price as a pack of Camels within the same store"
(Euromonitor 2003, p. 3).

residence, and survey year. [11] The vector S includes state-level variables that may shift price search-costs: an indicator for whether the state has a minimum price law for cigarettes; and the per capita density of retail outlets that sell cigarettes. However, our reduced-form approach does not allow us to give purely structural interpretation to the elements of the estimated vectors β_2 and β_3.

To describe the extent to which excise taxes are shifted to consumer cigarette prices on average, we first estimate equation (1) for the full sample, where we have pooled together the 2003 and 2006 - 2007 data. To describe the impact of price search on tax shifting, we next estimate equation (1) over different sub-samples: pack buyers; home-state carton buyers; and away-state carton buyers. [12] Like standard empirical tax incidence studies, our approach is, in a sense, descriptive. We take observed search behaviors as given (exogenous), and describe the rates at which taxes are shifted to the prices paid in equilibrium by different groups of consumers.

Table 3 contains estimates of equation (1) for the full sample and different sub-samples. Our point estimate of 1.02 implies that on average, state cigarette excise taxes are very slightly over-shifted to consumer prices; we can not reject the hypothesis that the rate of shifting is 1. We find that cigarette taxes are under-shifted

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[11]In additional specifications (not reported but available upon request) we add state fixed effects to X, or alternatively a measure of state anti-smoking sentiment (DeCicca et al. 2008). The patterns of results are similar to those reported in Table 3, with somewhat lower estimated pass-through rates.

[12]Table 2 includes another group who report buying their cigarettes over the internet or by other means. We do not estimate equation (1) for this sub-sample because even pooling together the 2003 and 2006 - 2007 data provides a sample of less than 300 observations.

to the prices paid by consumers who engage in more price search. For consumers

who buy cartons in their home state, taxes are shifted to prices at an estimate rate of

0.79. For consumers who buy cartons in a state other than their state of residence, the

estimated rate of shifting rate is 0.26. Because we measure tax in the purchase tax,

this result means that not only do these consumers avoid their higher home-state

cigarette tax, but that the lower away-state tax is not fully shifted to the price they

paid. For both groups of carton buyers, we can reject the hypothesis that the rates of

shifting equal 1.0. These patterns are consistent with the general principle of tax

shifting, that taxes are shifted away from economic agents who are most able to

change their behavior.

We do not find evidence that the search-cost shifters – state minimum price

laws and cigarette retail outlet density – are statistically significantly related to the

prices consumers report paying. In addition to their possible effect on the conditional

mean prices in the regression, it is reasonable to hypothesize that the search cost-

shifters might also increase price dispersion (variance). In other words,

heteroskedasticity is a prediction, not just a potential problem. We report

heteroskedastic-consistent standard errors (from Stata's *robust* command), so it is not

a problem for the results reported in Table 3. When we test for heteroskedasticity, our

results support the prediction that higher cigarette retail outlet density reduces

cigarette price dispersion.[13]

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[13]Although the relationship between the number of sellers and price dispersion
is "model specific" in theory, Baye, Morgan and Scholten (2006, p. 40) review several
empirical studies that find that more competition reduces dispersion.

Although they can not be given structural interpretations, the estimated effects of the other explanatory variables in equation (1) are also interesting. Compared to white smokers, Black and Hispanic smokers on average pay about $0.30 more (almost ten percent more) per pack. Residents of the largest cities (with populations over 2.5 million) pay an additional $0.34 more per pack. The price paid also tends to decrease with age and increases with schooling and income. The patterns for age, schooling, and income might mainly reflect brand preferences rather than differences in price search; for example, younger smokers are more likely to smoke the higher-priced premium brands (Cummings et al. 1997). Perhaps reflecting economies of scale in price search, smokers who live in households with other smokers report paying lower prices.

4. Tax Shifting and Smoking Behavior

Instead of categorizing smokers by their search behavior, in this section we take several different cuts at the data, based on smoking behaviors. The price-elasticity of demand might tend to vary with smoking behavior. At the same time, the benefits and costs of consumer price search might also tend to vary with smoking behavior. As in section 3, our approach is to describe the rates at which taxes are shifted to the prices paid in equilibrium by different groups of consumers, now defined by their smoking behaviors.

Table 4 reports the estimated pass-through rates (i.e., the estimated coefficient β_1 on the tax variable) from our re-estimates of equation (1) for the new sub-samples defined by smoking behaviors. Complete results are available upon request. In the

first panel of Table 4, smokers are categorized as: non-daily smokers; daily light smokers; daily moderate smokers; and daily heavy smokers. In the second panel, we categorize smokers based on whether they report attempting to quit smoking within the past year, and whether they report seriously planning to quit smoking within the next six months. In the third panel of Table 4, we take a slightly different cut and categorize smokers by a proxy for their degree of addiction. To measure the degree of addiction to smoking, the TUS-CPS and other health surveys ask smokers: "How soon after you wake up do you typically smoke your first cigarette of the day?" In the fourth and fifth panels of Table 4, we categorize smokers by their choices of light cigarettes versus regular cigarettes, and menthol versus non-menthol cigarettes.

The point estimates tend to suggest that taxes are somewhat over-shifted to non-daily smokers, less addicted smokers, and smokers of light cigarettes: the estimated rates of pass-through to prices paid are 1.12, 1.11, and 1.13 respectively. Similarly, there appears to be a slight gradient with quitting behavior and intents: taxes are passed through at a slightly higher rate (1.04) to smokers who report quit attempts and intents. However, none of these estimates in Table 4 is statistically significantly different than 1. For the other groups of smokers, the estimated pass-through rates are always about 1. The suggestive pattern is a little surprising, because it might be expected that heavier and more addicted smokers are less able to adjust their behavior in response to taxes. However, this might be offset by more price search, so that in equilibrium we observe some tendency for cigarette taxes to be shifted more towards lighter smokers.

5. Conclusion

Using novel data on reported prices paid for cigarettes, we find that cigarette excise taxes are shifted at lower rates to the prices paid by consumers who undertake more price search behavior – carton buyers, and especially, smokers who buy cartons of cigarettes in a state other than their state of residence. Although generally search behavior seems to matter more than smoking behavior for tax shifting, we also find suggestive evidence that taxes are shifted at slightly higher rates to the prices paid by non-daily smokers, less addicted smokers, and smokers of light cigarettes. Echoing the basic economic insight that taxes do not necessarily stay where legislatures place them, our results sound some cautions for cigarette tax policy. In equilibrium, cigarette excise taxes may be differentially shifted towards groups of consumers whose smoking is of less concern for policy (e.g. non-daily and less addicted smokers).

Future work could take several directions, depending upon data availability. Our descriptive analysis of tax shifting in equilibrium could be extended by embedding the analysis in a structural model of the jointly endogenous choices of price search and smoking on the demand side, as well as modeling the supply side of the retail cigarette market. A structural approach would provide predictions about consumer behavior under new tax policies and environments and allow a more complete policy analysis (Heckman and Vytlacil 2005). For example, because we estimate that cigarette taxes are under-shifted to the prices paid by cigarette carton-buyers, some policy advocates might be tempted to consider a special tax on cartons.

However, the endogenous sorting of pack- versus carton-buying means that it might not be possible to exploit the observed equilibrium relationship between price search and tax shifting. The same market forces could keep the new tax from being fully shifted too. Although structural estimation addresses this limitation in principle, in practice identification would be challenging. In particular, it would be difficult to find suitable instrumental variables to separately identify search behaviors and smoking behavior and to identify behavior on the supply-side of the market.

Another direction for future work is to explore the implications of price search for the incidence of cigarette taxes across income groups. Standard analyses conclude that because smokers have lower incomes in the U.S., cigarette taxes are regressive (Lyon and Schwab 1995, Colman and Remler 2008). These standard analyses are incomplete if taxes are differentially passed through to the prices paid by consumers with different incomes. Indeed, Heiding, Leibtag and Lovenheim (2010) find that cigarette taxes are fully shifted to the prices middle-income consumers pay, but less than fully shifted to the prices paid by both low- and high-income consumers. Future work could further explore the role of consumer price search in these patterns of tax incidence and income.

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Table 1: Cigarette price dispersion, TUS-CPS

	2003			2006/2007		
	Proportion (N)	Average price per pack	CV of prices	Proportion (N)	Average price per pack	CV of prices
Purchasers of packs	64.31% (20349)	$3.49	0.28	67.05% (18734)	$3.96	0.31
Purchasers of cartons in home state	31.72% (10037)	$2.51	0.33	29.40% (8215)	$2.86	0.35
Purchasers of cartons in border state	3.44% (1087)	$2.20	0.34	3.13% (875)	$2.59	0.38
Purchasers by some other means	0.53% (167)	$2.08	0.59	0.41% (115)	$2.37	0.68
Full sample	100% (31640)	$3.13	0.33	100% (27939)	$3.59	0.36

Table 2: Summary Statistics

Variable	Mean
Cigarette price ($ per pack)	3.352
Cigarette tax in purchase state ($ per pack)	0.779
Female	0.521
Age 15-24	0.112
Age 25-34	0.198
Age 35-44	0.233
Age 45-54	0.233
Age 55-64	0.141
Age 65 or more (omitted category)	0.082
Non-Hispanic white (omitted category)	0.799
Non-Hispanic black	0.083
Hispanic	0.063
Other races	0.055
Less than high school	0.180
High school (omitted category)	0.404
Some college	0.296
College or higher	0.120
Family income < 20k (omitted category)	0.247
Family income 20k-35k	0.216
Family income 35k-60k	0.235
Family income 60k+	0.216
Family income missing	0.086
Married (omitted category)	0.445
Divorced, widowed, or separated	0.293
Never married	0.262
Household size	2.650
Number of smokers in the household	1.392
Year 2003 (omitted category)	0.531
Year 2006	0.298
Year 2007	0.172
Non-MSA (omitted category)	0.351
MSA population < 0.5 million	0.189
MSA population 0.5-2.5 million	0.286
MSA population > 2.5 million	0.173
Northeast (omitted category)	0.185
Midwest	0.280
South	0.319
West	0.216
Minimum cigarette price law	0.484
Number of tobacco outlets per thousand people	0.824

Source: Data on state minimum cigarette price law are from Michael (2000). Data on tobacco outlets are from Economic Census 2002.

Table 3: Taxes and Other Determinants of Cigarette Prices, by Price-Search Behavior

VARIABLES	Full sample	Pack buyers	Home-state carton buyers	Away-state carton buyers
Cigarette tax	1.016***	0.972***	0.785***	0.257***
	(0.064)	(0.074)	(0.089)	(0.095)
Female	-0.015*	0.008	0.022*	0.095***
	(0.009)	(0.010)	(0.013)	(0.031)
Age 15-24	0.568***	0.305***	0.167***	0.262*
	(0.035)	(0.037)	(0.036)	(0.136)
Age 25-34	0.473***	0.286***	0.079***	0.238***
	(0.030)	(0.032)	(0.029)	(0.085)
Age 35-44	0.320***	0.200***	0.035	0.178**
	(0.025)	(0.029)	(0.023)	(0.070)
Age 45-54	0.180***	0.101***	-0.008	0.080
	(0.021)	(0.025)	(0.020)	(0.079)
Age 55-64	0.064***	0.055*	-0.035	-0.076
	(0.022)	(0.029)	(0.025)	(0.050)
Black	0.326***	0.139***	0.075	0.376***
	(0.039)	(0.039)	(0.048)	(0.066)
Hispanic	0.305***	0.176***	-0.108	-0.130
	(0.065)	(0.058)	(0.083)	(0.217)
Other races	0.110	0.125	-0.052	-0.071
	(0.072)	(0.078)	(0.048)	(0.086)
Less than high school	-0.028***	-0.019	-0.068***	-0.099
	(0.010)	(0.013)	(0.016)	(0.067)
Some college	0.037***	0.031**	0.023	0.022
	(0.011)	(0.012)	(0.014)	(0.056)
College or higher	0.187***	0.174***	0.125***	0.168**
	(0.022)	(0.028)	(0.018)	(0.063)
Family income 20k-35k	0.079***	0.083***	0.174***	0.126**
	(0.014)	(0.018)	(0.016)	(0.055)
Family income 35k-60k	0.147***	0.158***	0.264***	0.227***
	(0.014)	(0.020)	(0.027)	(0.057)
Family income 60k+	0.244***	0.213***	0.445***	0.361***
	(0.016)	(0.026)	(0.035)	(0.076)
Family income missing	0.131***	0.151***	0.193***	0.130
	(0.019)	(0.019)	(0.028)	(0.089)
Divorced, widowed, separated	0.039***	0.012	0.009	0.003
	(0.012)	(0.012)	(0.014)	(0.046)

Never married	0.112***	0.085***	0.014	-0.002
	(0.015)	(0.017)	(0.020)	(0.078)
Household size	-0.000	-0.010***	-0.034***	-0.051**
	(0.004)	(0.004)	(0.007)	(0.019)
Number of smokers in household	-0.086***	-0.033***	-0.037**	-0.015
	(0.009)	(0.010)	(0.014)	(0.044)
Year 2006	0.177***	0.181***	0.154***	0.269***
	(0.027)	(0.035)	(0.030)	(0.043)
Year 2007	0.267***	0.290***	0.177***	0.452***
	(0.026)	(0.034)	(0.033)	(0.083)
MSA pop < 0.5 million	0.030	0.013	0.039	0.034
	(0.033)	(0.037)	(0.034)	(0.074)
MSA pop 0.5-2.5 million	0.067	0.055	0.046	-0.043
	(0.040)	(0.051)	(0.041)	(0.083)
MSA pop > 2.5 million	0.344***	0.338***	0.229**	0.252**
	(0.115)	(0.111)	(0.095)	(0.102)
Midwest	-0.236***	-0.348**	0.049	-0.199*
	(0.082)	(0.143)	(0.161)	(0.099)
South	-0.318***	-0.402**	-0.095	-0.324***
	(0.093)	(0.152)	(0.158)	(0.102)
West	-0.104	-0.160	0.105	-0.159
	(0.103)	(0.161)	(0.202)	(0.159)
Minimum price law	-0.025	-0.066	-0.007	-0.125*
	(0.039)	(0.050)	(0.044)	(0.073)
Number of outlets per 1000 people	0.037	-0.059	0.200	0.119
	(0.131)	(0.162)	(0.213)	(0.230)
Constant	2.159***	2.717***	1.731***	1.987***
	(0.180)	(0.278)	(0.331)	(0.221)
Observations	59115	39006	18221	1888
R-squared	0.397	0.413	0.298	0.177

Robust standard errors (clustered at state level) in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Table 4: Estimated Tax Pass-through Rates, by Smoking Behaviors

	Cigarette tax	N
Frequency of cigarettes smoked		
- Non daily	1.015	9876
- Daily light (<10)	1.018	6670
- Daily moderate (10-30)	1.013	39347
- Daily heavy (>30)	0.922	3017
Quitting behavior and intents		
- smokers who attempted to quit and have a plan to quit	1.043	13745
- smokers who attempted to quit but no future plan to quit	1.016	6471
- smokers with a future plan but who had not attempted to quit in past year	1.027	11599
- smokers who did not attempt to quit in the past and who do not plan to quit in the future	0.988	27300
How soon to smoke 1st cigarette after wake up		
- < 30 minutes	1.001	22213
- 30-60 minutes	1.007	20774
- >60 minutes	1.033	16128
Type of cigarettes 1		
- Light/mild	1.152	17313
- Regular/full flavor	1.039	13315
Type of cigarettes 2		
- Menthol	0.974	15014
- Non menthol	1.029	38561

Note: The information on light cigarettes is only available in 2003.

Appendix Table: Average and Coefficient of Variation of Cigarette Prices, by State

State	2003			2006/2007		
	Mean	CV	TBOT price	Mean	CV	TBOT price
AL	2.66	0.24	3.23	3.11	0.34	3.54
AK	4.08	0.26	4.42	5.38	0.25	5.82
AZ	3.61	0.26	4.03	4.22	0.30	4.35
AR	2.69	0.28	3.60	3.07	0.31	3.71
CA	3.62	0.26	3.95	3.95	0.29	3.95
CO	2.67	0.24	3.21	3.45	0.26	4.03
CT	4.19	0.22	4.68	4.52	0.24	4.67
DE	2.66	0.25	3.53	3.09	0.31	3.56
DC	3.58	0.27	4.10	4.15	0.26	4.24
FL	2.74	0.28	3.31	2.92	0.34	3.44
GA	2.62	0.24	3.31	2.95	0.30	3.50
HI	3.84	0.24	4.72	4.35	0.25	5.27
ID	2.73	0.30	3.65	3.21	0.29	3.65
IL	3.53	0.25	4.06	4.00	0.36	4.82
IN	2.82	0.24	3.51	3.17	0.31	3.49
IA	2.64	0.25	3.33	2.87	0.29	3.36
KS	2.98	0.31	3.87	3.27	0.38	3.99
KY	2.12	0.31	3.10	2.59	0.35	3.32
LA	2.78	0.26	3.41	3.08	0.32	3.50
ME	3.5	0.26	4.28	4.54	0.27	5.28
MD	3.38	0.26	4.11	3.64	0.27	4.11
MA	4.31	0.28	5.15	4.65	0.24	5.00
MI	3.61	0.23	4.33	4.44	0.26	5.29
MN	3	0.24	3.43	3.87	0.24	4.59
MS	2.46	0.25	3.22	2.78	0.34	3.22
MO	2.64	0.28	3.16	2.62	0.32	3.25
MT	2.84	0.26	3.83	4.20	0.28	4.91
NE	2.97	0.26	3.79	3.22	0.33	3.72
NV	3.01	0.29	3.77	3.55	0.30	3.78
NH	2.93	0.20	3.57	3.50	0.31	3.76
NJ	4.36	0.24	5.47	5.46	0.22	5.99
NM	2.88	0.32	3.79	3.45	0.38	3.82
NY	4.29	0.43	5.54	4.59	0.35	5.44
NC	2.36	0.28	3.11	2.88	0.40	3.29
ND	2.72	0.30	3.53	2.96	0.31	3.37
OH	2.93	0.25	3.59	3.63	0.25	4.19
OK	2.37	0.32	3.23	3.19	0.34	4.04
OR	3.49	0.23	4.24	3.69	0.28	4.21
PA	3.36	0.23	3.91	3.98	0.25	4.30
RI	4.08	0.21	4.80	5.14	0.20	5.71
SC	2.42	0.25	3.17	2.60	0.40	3.09

SD	2.87	0.23	3.48	3.36	0.32	3.50
TN	2.48	0.29	3.18	2.63	0.34	3.24
TX	2.96	0.26	3.49	3.36	0.33	3.33
UT	3.31	0.30	3.70	3.61	0.24	3.72
VT	3.59	0.30	4.35	4.28	0.30	4.85
VA	2.47	0.30	3.22	2.98	0.30	3.50
WA	3.76	0.32	4.66	4.52	0.31	5.40
WV	2.43	0.29	3.46	2.79	0.29	3.48
WI	3.25	0.21	3.81	3.37	0.27	3.87
WY	2.66	0.25	3.56	3.26	0.29	3.72

Sources: Authors calculations from the Tobacco Use Supplements to the Current Population Survey, 2003 and 2006-2007 cycles; and Orzechowski and Walker (2008). The Tax Burden on Tobacco