WHO PAYS CIGARETTE TAXES? THE IMPACT OF CONSUMER PRICE SEARCH

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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 that smokers report paying and document substantial price dispersion. We find that cigarette taxes are shifted at lower rates to carton buyers and, especially, smokers who buy cartons of cigarettes in a state other than their state of residence. We also find evidence that taxes are shifted at somewhat lower rates to the prices paid by heavier smokers and at somewhat higher rates to the prices paid by smokers of light cigarettes.

I. Introduction

ECONOMISTS emphasize that the behavior of buyers and sellers in markets, not statutes, determines who really pays a tax (Fullerton & Metcalf, 2002). For excise and sales taxes, one of the most basic questions is whether taxes are shifted forward to consumers or backward 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 toward consumers. Empirical studies of the most common excise taxes in the United States—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 overshifted—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 overshifting in some markets.[2] The observed overshifting in many goods markets is consistent with theoretical analyses of tax shifting under oligopoly and imperfect competition.[3]

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[1] Cook (1981), Young and Bielinska-Kwapisz (2002), and Kenkel (2005) find evidence that alcohol excise taxes are overshifted. 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 overshifted. In contrast to previous research, Harding, Leibtag, and Lovenheim (2012) use unique transaction-level data and find that cigarette taxes might be undershifted, at a rate of 0.85-for-one in their preferred specification. 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 undershifted.

[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 overshifting in about half of the twelve goods markets they study.

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

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 (for example, the average price) in each market.[4] However, there can be substantial within-market dispersion in the prices that consumers pay. In a review of research on the extent of price dispersion in various markets, including online 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 search for volume discounts by buying cartons instead of packs, and they can cross state borders to avoid excise taxes (Lovenheim, 2008; DeCicca, Kenkel, & Liu, 2010a). 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 in general or for the cigarette market in particular.

We use novel data from the 2003 and 2006–2007 cycles of the Tobacco Use Supplements to the Consumer Population Survey (TUS-CPS), which 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 II, our first contribution is simply to document that cigarette prices show substantial dispersion that is not entirely due to differences in taxes or variation in average price levels across local markets. 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. In section III, we provide a descriptive analysis of what types of consumers adopt these behaviors and the prices they report paying for cigarettes.

[4] Of the thirteen studies cited in notes 1 and 2, ten 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 et al. (2012) use transaction-level prices from scanner data.

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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% (20,349)	$3.49	0.28	67.05% (18,734)	$3.96	0.31
Purchasers of cartons in home state	31.72% (10,037)	$2.51	0.33	29.40% (8,215)	$2.86	0.35
Purchasers of cartons in away state	3.44% (1,087)	$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% (31,640)	$3.13	0.33	100% (27,939)	$3.59	0.36

In section IV, 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 0.8 for the prices paid by home-state carton buyers and only 0.17 for the prices paid by away-state carton buyers.

In section V, 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 that taxes are shifted at somewhat lower rates to the prices paid by heavier smokers and at somewhat higher rates to the prices paid by smokers of light cigarettes.

Section VI concludes and discusses directions for future work.

II. Cigarette Price Dispersion

The 2003 and 2006-2007 cycles of the TUS–CPS provide novel data on the prices consumers report 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; U.S. Department of Commerce, 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 most recent pack or carton of cigarettes after using discounts or coupons. They 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 (that is, state-of-residence) carton buyers, away-state (not state-of-residence) 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 smokers 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 standard deviation divided by the mean), a common measure of price dispersion (Baye et al., 2006). For the full sample of reported prices paid, the coefficient of variation is about 33% in 2003 and 36% in 2006–2007. This degree of price dispersion is roughly comparable to that seen for other goods (Baye et al., 2006, table 1a). For example, Lach (2002) find coefficients of variation from 11% to 20% for coffee prices in Israel, and Scholten and Smith (2002) find coefficients of variation from 2% to 42% for the prices of consumer sundries in Bloomington, Indiana, retail markets.

Looking across price-search behaviors, in round numbers about 65% of smokers report buying packs, about 30% report buying cartons of cigarettes in their home state, another 3% report buying cartons of cigarettes in another state, and less than 1% report buying cigarettes over the Internet or by other means.[7] As discussed in more detail in DeCicca, Kenkel, and Liu (2010a), using the direct measure from the TUS-CPS suggests a higher rate of cross-border

[5] About 5% 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% of smokers, mainly nondaily 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 1% 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.

[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 (2010) point out, there is very little systematic evidence about the volume of Internet cigarette sales. They 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 counterfactual with no Internet sales, in 2000 Internet sales reduced home-state cigarette sales by 3.3%.

purchases than in many previous studies, but not as high as in Merriman and Chernick's (2011) and Merriman's (2010) estimates based on littered cigarette packs in New York City and Chicago. The littered-pack estimates might be higher because of organized smuggling not fully captured in the TUS-CPS data, or they might reflect a higher rate of cross-border purchases among smokers who litter.

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% 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. Measured price dispersion is not too different across pack buyers, home-state carton buyers, and away-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.

Part of the observed price dispersion in the TUS-CPS data reflects variation in excise taxes on cigarettes across states and variation in average price levels across local markets. To explore the extent of price dispersion within geographic areas, we examine the coefficient of variation by state and Metropolitan Statistical Area (MSA) (see tables A1 and A2 in the table appendix).[8] The coefficients of variation for cigarette prices paid across states are in a fairly narrow range from around 20% to 40%. Not surprisingly, the price dispersion within MSAs is somewhat less than price dispersion within states: the coefficients of variation for cigarette price paid across MSAs generally range from 20% to 30%. However, it is notable that the price dispersion within most states and MSAs is only slightly less than the price dispersion in the full sample. Excise taxes and other differences across geographic areas do not drive most of the measured price dispersion. This points to the possible importance of price dispersion due to individual-level behaviors such as price search.[9]

We observe only 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 & Klemperer, 1998). From several sources, we estimate that discounted sales and sales of discount brands account for about 36% of total sales.[10] The price differences due to discounts and brand choice appear to be about $1.00 per pack, the same size difference as we report in table 1 for pack versus carton buyers.[11] A back-of-the-envelope calculation suggests that these unobserved factors alone would lead to a coefficient of variation in prices of about 13%, substantially below the 33% to 36% we observe in the TUS-CPS price data.[12] Although we cannot observe all of the sources of price dispersion, the results in table 1 demonstrate important price differences associated with the search behaviors we can observe.

Finally, we note that the price dispersion we observe might be partly spurious and due to mistakes in consumers' self-reports of the price they paid for cigarettes. To provide some evidence on the accuracy of the self-reported prices, we compare them to two other sources of price data (appendix tables A1 and A2). First, we compare the TUS-CPS state-average prices to the average price by state reported in *Tax Burden on Tobacco (TBOT)* (Orzechowski & 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.[13] Second, we

[8] The TUS-CPS is representative by state, but the CPS documentation notes that estimates for geographic areas smaller than states are not as reliable.

[9] In some states, localities impose additional excise taxes. Some of the within-Illinois price dispersion is due to sizable taxes imposed by Chicago and Cook County. Some of the within–New York price dispersion is due to the sizable 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.

[10] We estimate that sales of discounted brands account for 28% of total sales and that another 8% of sales involve retail price discounts or coupons. The estimate for the proportion of discounted brands is from the U.S. part of the International Tobacco Control Four Country Survey conducted in 2006–2007 (Licht et al., 2011). This estimate is consistent with Euromonitor's (2003) market report. We are unaware of any direct estimates of the national prevalence of purchases that involve price discounts or coupons, so we piece this together. According to the FTC's (2009) data, the cigarette industry's 2006 expenditures on retail price discounts and coupons amounted to about $0.08 per pack of cigarettes sold. From supermarket scanner data from 49 geographic markets from 1997 to 2005, Lillard and Sfekas (2010) report that the average retail discount offer was worth about $1.00 per pack. We assume the typical coupon is also worth $1.00. Putting these estimates together implies that about 8% of cigarette purchases involve retail price discounts or coupons.

[11] Lillard and Sfekas (2010) report that the average retail discount offer is 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).

[12] For a back-of-the-envelope calculation, we assume that 64% of the sample pays $4.00 per pack and 36% of the sample pays $3.00 per pack. This yields a coefficient of variation of 0.13. Of course, there is additional dispersion from several sources. Interestingly, the Euromonitor (2003) 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" (p. 3). Price dispersion across stores might be driven by price discounts paid by cigarette manufacturers to cigarette retailers or wholesalers, which amount to about $0.54 per pack sold (authors' calculations from FTC, 2009).

[13] The methodology of the *TBOT* price series is not reported, so we can only speculate why the prices are systematically higher. Possible reasons are that they do not include the volume discounts for carton purchases, do not reflect other price discounts and coupons, or 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 in note 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.

compare the TUS-CPS MSA-average prices to the average price by MSA in Nielsen supermarket scanner data.[14] Like the state-average price series, the two MSA-average price series are again highly correlated ($r = 0.86$). Neither series is systematically higher. The comparisons of the different price series tend to support the accuracy of the self-reported prices in the TUS-CPS on average, but some of the dispersion in the TUS-CPS data could still be due to mistaken reports. We return to this issue in section IV.

III. Descriptive Analyses of Price-Search Behaviors and Prices Paid

Before turning to the question of how cigarette excise taxes are shifted to prices, in this section we report multivariate analyses that describe what types of consumers adopt price search behaviors and the prices they report paying for cigarettes. Table 2 contains the definitions and means of the variables used in these analyses and in later sections.

Table 3 presents results from multinomial logit models of price search behavior. In these models, the dependent variable is an unordered categorical variable with three possible outcomes: pack buying (the base category), home-state carton buying, and away-state carton buying. For ease of interpretation, in table 3 the logit coefficients are expressed as marginal effects (or the effect of changing a discrete explanatory variable from 0 to 1). The reported marginal effects show the changes in the probabilities of the price search behaviors: home-state and away-state carton buying.[15] Specification 1 models the price search choices as a function of demographic characteristics; in specifications 2 to 6, we extend the descriptive analysis to include alternative measures of smoking behavior.

The results from specification 1 in table 3 show a strong age pattern in search behavior: younger consumers are much less likely to purchase cigarettes by the carton in their home state or in another state. The differences in search behaviors across age groups are large: compared to the oldest group, consumers in the youngest age group are 27 percentage points less likely to be home-state carton buyers and almost 3 percentage points less likely be away-state carton buyers. Blacks and Hispanics are also much less likely to engage in these search behaviors. The search behaviors tend to increase with income and also vary with marital status and household composition, including the number of other smokers in the household.

In specification 2, we extend the descriptive multinomial logit model to include a set of measures that categorize smokers as. nondaily (occasional) smokers, daily light smokers, daily moderate smokers, and daily heavy smokers. Consistent with the theoretical prediction that search is more common for more frequently purchased items, the results show a strong gradient between heavier smoking and the probability of home- or away-state carton buying. The results for the demographic variables are similar across specifications 1 and 2. For example, even after specification 2 controls for the fact that young adults are lighter smokers,

TABLE 2.—SUMMARY STATISTICS

Variable	Mean
Cigarette price ($ per pack)	3.352
Cigarette tax in purchase state ($ per pack)	0.779
Nondaily (occasional) smoker	0.168
Daily light daily smoker (< 10 cigarettes per day)	0.113
Daily moderate smoker (10–30 cigarettes per day)	0.668
Daily heavy smoker (> 30 cigarettes per day)	0.051
Attempted to quit in last year and plan to quit in next 6 months	0.233
Attempted to quit in last year but no future plan to quit	0.109
Plan to quit in next 6 months but no past-year attempt	0.196
No past-year attempt and no plan to quit	0.462
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 < $20,000 (omitted category)	0.247
Family income $20,000–$35,000	0.216
Family income $35,000	0.235
Family income $60,000 and over	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
February 2003 (omitted category)	0.153
June 2003	0.194
November 2003	0.184
May 2006	0.170
August 2006	0.128
January 2007	0.171
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
South (omitted category)	0.319
Northeast	0.185
Midwest	0.280
West	0.216
State—minimum cigarette price law	0.484
State—number of tobacco outlets per thousand people	0.824
State—household income per year in thousand dollars	46.121
State—proportion of divorced	0.096
State—proportion of female	0.517
State—proportion of elder (age > 60)	0.177
State—proportion of high school graduates	0.305
State—proportion of having some college or higher	0.491
State—proportion of black	0.109
State—unemployment rate (%)	5.108

Data on state minimum cigarette price law are from Michael (2000). Data on tobacco outlets are from Economic Census 2002. Data on state demographics are from Current Population Survey, Annual Social and Economic Supplements. Data on state unemployment rate are from Bureau of Labor Statistics.

[14] We thank Eamon Molloy and Dean Lillard for making the Nielsen supermarket scanner data available to us for this exercise.

[15] Because the changes in probabilities must sum to 0, the marginal effect on the probability of pack buying can be backed out from the marginal effects reported in table 3.

TABLE 3.—MARGINAL EFFECTS OF MULTINOMIAL LOGIT MODELS OF SEARCH BEHAVIORS

	Specification 1		Specification 2		Specification 3	
Variables	Home-State Carton Buying	Away-State Carton Buying	Home-State Carton Buying	Away-State Carton Buying	Home-State Carton Buying	Away-State Carton Buying
Light daily smoker			0.188***	0.027***		
			(0.014)	(0.008)		
Moderate daily smoker			0.315***	0.029***		
			(0.010)	(0.004)		
Heavy daily smoker			0.539***	0.051***		
			(0.016)	(0.012)		
Attempted to quit in the past but not plan to quit in the future					0.100***	0.013***
					(0.010)	(0.003)
Not attempted to quit in the past but plan to quit in the future					0.081***	0.009***
					(0.006)	(0.003)
Not attempted to quit in the past and not plan to quit in the future					0.168***	0.018***
					(0.006)	(0.003)
Female	0.040***	0.003**	0.062***	0.005***	0.045***	0.003**
	(0.004)	(0.001)	(0.004)	(0.001)	(0.004)	(0.001)
Age 15–24	−0.265***	−0.026***	−0.250***	−0.025***	−0.256***	−0.025***
	(0.008)	(0.004)	(0.009)	(0.004)	(0.008)	(0.004)
Age 25–34	−0.237***	−0.023***	−0.237***	−0.023***	−0.228***	−0.022***
	(0.007)	(0.004)	(0.008)	(0.004)	(0.007)	(0.004)
Age 35–44	−0.175***	−0.018***	−0.194***	−0.019***	−0.167***	−0.017***
	(0.007)	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)
Age 45–54	−0.119***	−0.014***	−0.147***	−0.016***	−0.112***	−0.013***
	(0.006)	(0.003)	(0.006)	(0.003)	(0.006)	(0.003)
Age 55–64	−0.055***	−0.005*	−0.082***	−0.007***	−0.048***	−0.004
	(0.008)	(0.002)	(0.007)	(0.002)	(0.008)	(0.002)
Black	−0.225***	−0.017***	−0.191***	−0.014***	−0.220***	−0.016***
	(0.009)	(0.004)	(0.008)	(0.004)	(0.009)	(0.004)
Hispanic	−0.177***	−0.019***	−0.123***	−0.015***	−0.179***	−0.019***
	(0.014)	(0.003)	(0.014)	(0.003)	(0.014)	(0.003)
Other races	−0.051***	−0.005	−0.022	−0.002	−0.051***	−0.004
	(0.015)	(0.004)	(0.016)	(0.004)	(0.015)	(0.004)
Less than high school	−0.007	0.002	−0.015***	0.001	−0.010*	0.001
	(0.006)	(0.002)	(0.006)	(0.002)	(0.006)	(0.002)
Some college	−0.010**	−0.002	0.004	−0.000	−0.002	−0.001
	(0.005)	(0.001)	(0.005)	(0.001)	(0.005)	(0.001)
College or higher	−0.034***	−0.000	0.009	0.003	−0.026***	0.000
	(0.007)	(0.003)	(0.007)	(0.003)	(0.007)	(0.003)
Family income $20,000–$35,000	0.040***	0.004*	0.043***	0.004**	0.042***	0.004*
	(0.007)	(0.002)	(0.007)	(0.002)	(0.007)	(0.002)
Family income $35,000–$60,000	0.055***	0.007**	0.061***	0.007**	0.059***	0.007**
	(0.008)	(0.003)	(0.008)	(0.003)	(0.008)	(0.003)
Family income $60,000 and over	0.051***	0.008**	0.065***	0.009**	0.057***	0.009**
	(0.010)	(0.004)	(0.010)	(0.004)	(0.010)	(0.004)
Family income missing	0.041***	0.003	0.044***	0.004	0.034***	0.003
	(0.010)	(0.003)	(0.010)	(0.003)	(0.010)	(0.003)
Divorced, widowed, separated	−0.034***	−0.003**	−0.043***	−0.004***	−0.036***	−0.003**
	(0.006)	(0.001)	(0.006)	(0.001)	(0.006)	(0.001)
Never married	−0.060***	−0.006***	−0.059***	−0.006***	−0.064***	−0.007***
	(0.008)	(0.002)	(0.007)	(0.002)	(0.008)	(0.002)
Household size	−0.022***	−0.004***	−0.021***	−0.004***	−0.021***	−0.004***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)
Number of smokers in household	0.067***	0.007***	0.044***	0.005***	0.062***	0.006***
	(0.005)	(0.002)	(0.004)	(0.001)	(0.005)	(0.002)
MSA population < 0.5 million	−0.008	−0.008**	−0.006	−0.008**	−0.008	−0.008**
	(0.011)	(0.004)	(0.010)	(0.004)	(0.011)	(0.004)
MSA population 0.5–2.5 million	−0.020	−0.010**	−0.018	−0.009**	−0.022	−0.010**
	(0.014)	(0.005)	(0.013)	(0.005)	(0.014)	(0.005)
MSA population > 2.5 million	−0.070***	−0.004	−0.057***	−0.003	−0.068***	−0.004
	(0.014)	(0.005)	(0.013)	(0.005)	(0.014)	(0.005)
Northeast	−0.160***	0.018	−0.150***	0.017	−0.152***	0.019
	(0.025)	(0.014)	(0.024)	(0.013)	(0.025)	(0.014)
Midwest	−0.072***	0.010	−0.064***	0.009	−0.067***	0.010
	(0.022)	(0.011)	(0.022)	(0.010)	(0.022)	(0.011)
West	−0.049**	−0.011	−0.032*	−0.009	−0.040**	−0.009
	(0.020)	(0.010)	(0.019)	(0.009)	(0.020)	(0.010)

TABLE 3.—(CONTINUED)

Variables	Specification 1		Specification 2		Specification 3	
	Home-State Carton Buying	Away-State Carton Buying	Home-State Carton Buying	Away-State Carton Buying	Home-State Carton Buying	Away-State Carton Buying
How soon to smoke first cigarette after wake-up?—30–60 minutes	0.213***	0.015***				
	(0.009)	(0.004)				
How soon to smoke first cigarette after wake-up?—less than 30 minutes	0.295***	0.026***				
	(0.010)	(0.005)				
Smoke regular/full flavor cigarettes			0.018**	0.001		
			(0.008)	(0.002)		
Smoke nonmenthol cigarettes					0.022***	0.001
					(0.005)	(0.001)
Female	0.040***	0.003**	0.055***	0.004***	0.043***	0.003
	(0.004)	(0.001)	(0.005)	(0.001)	(0.005)	(0.002)
Age 15–24	−0.265***	−0.026***	−0.258***	−0.026***	−0.282***	−0.029***
	(0.008)	(0.004)	(0.009)	(0.004)	(0.010)	(0.005)
Age 25–34	−0.237***	−0.023***	−0.238***	−0.023***	−0.247***	−0.024***
	(0.007)	(0.004)	(0.007)	(0.004)	(0.008)	(0.004)
Age 35–44	−0.175***	−0.018***	−0.189***	−0.019***	−0.180***	−0.019***
	(0.007)	(0.003)	(0.007)	(0.003)	(0.010)	(0.004)
Age 45–54	−0.119***	−0.014***	−0.138***	−0.016***	−0.122***	−0.014***
	(0.006)	(0.003)	(0.007)	(0.003)	(0.011)	(0.004)
Age 55–64	−0.055***	−0.005*	−0.072***	−0.007***	−0.050***	−0.004
	(0.008)	(0.002)	(0.008)	(0.002)	(0.012)	(0.003)
Black	−0.225***	−0.017***	−0.220***	−0.016***	−0.239***	−0.018***
	(0.009)	(0.004)	(0.009)	(0.004)	(0.010)	(0.005)
Hispanic	−0.177***	−0.019***	−0.143***	−0.016***	−0.183***	−0.022***
	(0.014)	(0.003)	(0.015)	(0.003)	(0.016)	(0.004)
Other races	−0.051***	−0.005	−0.039***	−0.003	−0.040**	−0.010**
	(0.015)	(0.004)	(0.014)	(0.004)	(0.020)	(0.004)
Less than high school	−0.007	0.002	−0.017***	−0.000	−0.017**	0.004
	(0.006)	(0.002)	(0.006)	(0.002)	(0.007)	(0.003)
Some college	−0.010**	−0.002	0.003	−0.001	−0.010	−0.002
	(0.005)	(0.001)	(0.005)	(0.001)	(0.006)	(0.002)
College or higher	−0.034***	−0.000	−0.000	0.003	−0.034***	0.000
	(0.007)	(0.003)	(0.008)	(0.003)	(0.010)	(0.003)
Family income $20,000–$35,000	0.040***	0.004*	0.050***	0.005**	0.046***	0.008**
	(0.007)	(0.002)	(0.007)	(0.002)	(0.010)	(0.003)
Family income $35,000–$60,000	0.055***	0.007**	0.069***	0.008**	0.062***	0.007
	(0.008)	(0.003)	(0.009)	(0.003)	(0.011)	(0.004)
Family income $60,000 and over	0.051***	0.008**	0.076***	0.011**	0.042***	0.008*
	(0.010)	(0.004)	(0.011)	(0.004)	(0.013)	(0.004)
Family income missing	0.041***	0.003	0.055***	0.005	0.042***	0.003
	(0.010)	(0.003)	(0.011)	(0.004)	(0.015)	(0.004)
Divorced, widowed, separated	−0.034***	−0.003**	−0.042***	−0.004***	−0.031***	−0.003
	(0.006)	(0.001)	(0.006)	(0.002)	(0.007)	(0.003)
Never married	−0.060***	−0.006***	−0.064***	−0.007***	−0.061***	−0.003
	(0.008)	(0.002)	(0.008)	(0.002)	(0.010)	(0.003)
Household size	−0.022***	−0.004***	−0.022***	−0.004***	−0.023***	−0.003***
	(0.002)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)
Number of smokers in household	0.067***	0.007***	0.051***	0.005***	0.066***	0.007***
	(0.005)	(0.002)	(0.005)	(0.002)	(0.006)	(0.002)
MSA population < 0.5 million	−0.008	−0.008**	−0.003	−0.008*	−0.018	−0.003
	(0.011)	(0.004)	(0.011)	(0.004)	(0.015)	(0.006)
MSA population 0.5–2.5 million	−0.020	−0.010**	−0.013	−0.009*	−0.035**	−0.008
	(0.014)	(0.005)	(0.015)	(0.005)	(0.014)	(0.005)
MSA population > 2.5 million	−0.070***	−0.004	−0.060***	−0.003	−0.076***	0.003
	(0.014)	(0.005)	(0.013)	(0.005)	(0.018)	(0.007)
Northeast	−0.160***	0.018	−0.158***	0.018	−0.164***	0.017
	(0.025)	(0.014)	(0.026)	(0.013)	(0.028)	(0.014)
Midwest	−0.072***	0.010	−0.067***	0.010	−0.074***	0.008
	(0.022)	(0.011)	(0.023)	(0.011)	(0.023)	(0.012)
West	−0.049**	−0.011	−0.037*	−0.010	−0.046**	−0.010
	(0.020)	(0.010)	(0.020)	(0.010)	(0.023)	(0.010)

For ease of interpretation, the logit coefficients are expressed as marginal effects (or the effect of changing a discrete explanatory variable from 0 to 1). Robust standard errors (clustered at state level) in parentheses. ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$. Omitted categories for specifications 1–3 for frequency of cigarettes smoked is nondaily smokers. Omitted category for quitting behavior is smokers who attempted to quit in the past and plan to quit in the future.

Omitted categories for specifications 4–6 are how soon to smoke first cigarette after wake-up is more than 60 minutes, opposed to regular/full flavor cigarettes is light/mild cigarettes, and opposed to nonmenthol cigarettes is menthol cigarettes. On average, home-state carton buying is 30.82% and away-state carton buying is 3.19%.

the results still show that young adults are much less likely to be carton buyers.

In specifications 3 to 6, instead of measuring how heavily someone smokes, we measure other aspects of smoking behavior. Specification 3 uses measures related to past quit attempts and future intentions to quit. Specification 4 uses a measure of the degree of addiction to smoking based on smokers' responses to the question, "How soon after you wake up do you typically smoke your first cigarette of the day?" Specification 5 uses a measure of whether the smoker's regular brand is a so-called light cigarette, which might reflect concern with the health consequences of smoking and intention to quit in the future. Specification 6 uses a measure of whether the smoker's regular brand is a menthol cigarette. The results from specifications 3 to 5 show that smokers with less interest in quitting (either past attempts or future intentions), more addicted smokers, and smokers of regular (nonlight) cigarettes are more likely to make home- and away-state carton purchases and less likely to make pack purchases. The pattern of results for future intentions to quit is consistent with Khwaja, Silverman, and Sloan's (2007) suggestion from behavioral economics that smokers who are interested in quitting might purchase their cigarettes by the pack instead of the carton as a commitment device to limit their smoking. The results from specification 6 show that smokers of nonmenthol cigarettes are more likely to make a carton purchase. Menthol brands account for a very large share of the African American market, so it is notable that choice of menthol and black are independently associated with a lower probability of making a carton purchase.

Table 4 presents results from three specifications of a descriptive model of the reported price of cigarettes. As a baseline, specification 1 includes only the search behaviors of home-state and away-state carton buying relative to the omitted category of pack buying. The regression coefficients reproduce the cross-tabulations presented in table 1 and show that on average, home-state carton buyers report paying about \$1.00 less per pack, while away-state carton buyers report paying about \$1.30 less per pack. Specification 2 in table 4 includes the demographic variables but not the search behaviors. This specification shows strong associations between a number of demographic variables and reported prices. For example, holding other demographics constant, younger consumers report paying about \$0.50 more per pack, while black and Hispanic consumers report paying about \$0.30 more per pack.

The models in table 4 also show that cigarette prices tend to increase over time and are higher in large MSAs and the Northeast. For example, cigarette prices are about \$0.64 per pack higher in the largest-population MSAs and about \$1.26 per pack higher in the Northeast than in the South (the omitted region). Some of these differences are due to differences in taxes, which we explore below.

Specification 3 in table 4 includes the search behaviors and the demographic variables. After controlling for search behaviors, there are no longer large differences in the price paid associated with most of the demographic variables we observe. In specification 3, most of the demographics are associated with price differences of \$0.10 to \$0.20 per pack or less. This is suggestive evidence that the effect of demographic characteristics such as age is mainly through the search behaviors, although once again, we caution that

TABLE 4.—SEARCH BEHAVIORS AND DEMOGRAPHIC DETERMINANTS OF CIGARETTE PRICES

Variables	Specification 1	Specification 2	Specification 3
Home-state carton buyers	−1.046***		−0.865***
	(0.073)		(0.047)
Away-state carton buyers	−1.336***		−1.327***
	(0.080)		(0.079)
Female		−0.014	0.023**
		(0.010)	(0.010)
Age 15–24		0.504***	0.136***
		(0.044)	(0.035)
Age 25–34		0.451***	0.150***
		(0.034)	(0.025)
Age 35–44		0.296***	0.079***
		(0.028)	(0.020)
Age 45–54		0.171***	0.023
		(0.025)	(0.019)
Age 55–64		0.073***	0.013
		(0.023)	(0.020)
Black		0.330***	0.103***
		(0.038)	(0.036)
Hispanic		0.321***	0.157**
		(0.078)	(0.071)
Other races		0.218**	0.167*
		(0.101)	(0.091)
Less than high school		−0.036**	−0.041***
		(0.014)	(0.013)
Some college		0.037***	0.025**
		(0.013)	(0.011)
College or higher		0.166***	0.135***
		(0.026)	(0.025)
Family income \$20,000–\$35,000		0.069***	0.103***
		(0.016)	(0.014)
Family income \$35,000–\$60,000		0.146***	0.195***
		(0.017)	(0.017)
Family income \$60,000 and over		0.270***	0.317***
		(0.023)	(0.024)
Family income missing		0.127***	0.162***
		(0.022)	(0.019)
Divorced, widowed, separated		0.058***	0.022*
		(0.014)	(0.012)
Never married		0.165***	0.113***
		(0.020)	(0.019)
Household size		0.004	−0.016***
		(0.005)	(0.004)
Number of smokers in household		−0.088***	−0.029***
		(0.011)	(0.010)
MSA population < 0.5 million		0.084	0.064
		(0.060)	(0.056)
MSA population 0.5–2.5 million		0.146*	0.115
		(0.076)	(0.071)
MSA population > 2.5 million		0.639***	0.579***
		(0.117)	(0.114)
Northeast		1.257***	1.145***
		(0.147)	(0.139)
Midwest		0.400***	0.353***
		(0.096)	(0.088)
West		0.729***	0.677***
		(0.132)	(0.128)
Constant	3.717***	2.273***	2.828***
	(0.099)	(0.065)	(0.057)
R^2	0.187	0.250	0.369

Robust standard errors (clustered at state level) in parentheses. ***$p < 0.01$, **$p < 0.05$, and *$p < 0.1$.

these models are descriptive exercises. With that caveat in mind, we note that the patterns across specifications in table 4 tend to suggest that the search behaviors we examine in this study are empirically important determinants of the price paid for cigarettes.

IV. Tax Shifting and Price Search Behavior

To describe tax shifting, we 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 market-level cost and demand shifters, to which we add a vector S of search-cost shifters:

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

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 $\beta_1 = 1$.

In equation (1), the tax T is measured as the tax rate in the state of purchase. Following the general specification used in Poterba (1996) and Besley and Rosen (1999), the vector X includes a set of cost shifters; in our data, we assume costs vary over time, with MSA size, and across regions of the country. Following Keeler et al. (1996), we add a set of state-level demand shifters such as income and the percentage with a high school diploma. 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 subsamples: pack buyers, home-state carton buyers, and away-state carton buyers.[16] Like standard empirical tax incidence studies, our approach is still, 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 5 contains estimates of equation (1) for the full sample and different subsamples. Our point estimate of 1.02 implies that on average, state cigarette excise taxes are very slightly overshifted to consumer prices; we cannot reject the hypothesis that the rate of shifting is 1 (at above the 95% confidence level). We find that cigarette taxes are undershifted 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 0.8. For consumers who buy cartons in a state other than their state of residence, the estimated rate of shifting rate is 0.17.[17] Because we measure tax in the purchase state, 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 pay in the away state.[18] For both groups of carton buyers, we can reject the hypothesis that the rates of shifting equal 1.0 (at the 95% confidence level). 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.

In additional results not reported but available in the online appendix, we find that our main estimates of the degree of tax shifting are not sensitive to various alternative specifications. The reduced-form approach we adopt does not provide much guidance about the appropriate variables to be included in the set of control variables X in equation (1). So in a set of alternative specifications, we are fairly agnostic about the correct specification. We reestimate equation (1) with only the cost shifters, with the cost shifters and state fixed effects, and with the cost shifters and individual-level demographics as demand shifters. The patterns of results across these specifications are similar to those reported in table 5.

We also explore the sensitivity of our results to measurement error due to mistakes in the self-reported prices. Because price is the dependent variable, classical measurement error will not lead to bias but will only increase the standard error of the regression models.[19] Still, it seems

[16] Table 1 includes another group that reports buying their cigarettes over the Internet or by other means. We do not estimate equation (1) for this subsample because even pooling together the 2003 and 2006–2007 data provides a sample of fewer than 300 observations.

[17] It might seem surprising that the rate of shifting for the full sample in column 1 of table 5 is larger than for any of the subsamples. This is because the column 1 model does not control for price search behaviors. When we extend the column 1 model to control for these behaviors, the rate of shifting is estimated to be 0.88, the weighted average of rates of shifting for pack buyers, home-state carton buyers, and away-state carton buyers.

[18] We have reestimated equation (1) for the sample of away-state carton buyers and use the tax rate in state of residence instead of state of purchase. We find that the tax is "shifted" at a slightly higher rate of 0.2. It is unclear how to interpret this result. One possibility is that it reflects the fact that the state-of-residence tax tends to be correlated with the state-of-purchase tax because of the political economy of state taxation (Benjamin & Dougan, 1997). We also note that the very low rate of shifting for state-of-purchase taxes might partly reflect attenuation bias due to measurement error in the assigned tax rate. For example, 7% of away-state carton purchases are made in New York, even though New York's tax is not particularly low. Some of these purchases might have been on Indian reservations where the New York state tax is not applied (DeCicca, Kenkel, & Liu, 2010b). If we assume that the correct away-state tax rate is actually 0 for these observations, the estimated rate of tax shifting for away-state carton buyers increases to 0.64.

[19] We note the possibility that nonclassical measurement error that is correlated with state taxes could bias our estimates of the rate of tax shifting. Another possible form of nonclassical measurement error might be correlated with the search behaviors, for example, if consumers who search more carefully are more likely to accurately recall and report the prices they paid. If consumers' reports are on average unbiased, more accuracy reduces the variance in the unexplained portion of reported prices, that is, the variance of the error term in equation (1). In an additional specification, we find evidence of a form of heteroskedasticity in equation (1) consistent with the idea that carton buyers' reported prices reflect less measurement error (results available on request).

TABLE 5.—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	1.020***	0.949***	0.802***	0.174
	(0.053)	(0.061)	(0.074)	(0.110)
June 2003	−0.061***	−0.078***	−0.014	0.000
	(0.013)	(0.015)	(0.018)	(0.063)
November 2003	−0.082***	−0.073***	−0.075***	−0.026
	(0.020)	(0.020)	(0.020)	(0.063)
May 2006	0.105**	0.125**	0.109**	0.370***
	(0.042)	(0.048)	(0.045)	(0.073)
August 2006	0.092**	0.123***	0.080*	0.312***
	(0.036)	(0.041)	(0.046)	(0.077)
January 2007	0.202***	0.247***	0.106	0.566***
	(0.060)	(0.064)	(0.066)	(0.086)
MSA population < 0.5 million	0.065*	0.032	0.068**	0.077
	(0.033)	(0.038)	(0.032)	(0.065)
MSA population 0.5–2.5 million	0.144***	0.119***	0.096***	0.046
	(0.033)	(0.040)	(0.033)	(0.072)
MSA population > 2.5 million	0.391***	0.344***	0.259**	0.223*
	(0.145)	(0.126)	(0.111)	(0.130)
Northeast	0.288***	0.446**	−0.131	0.290**
	(0.103)	(0.174)	(0.204)	(0.111)
Midwest	0.081	0.060	0.011	0.175*
	(0.092)	(0.103)	(0.097)	(0.097)
West	0.247***	0.250***	0.134	0.302**
	(0.078)	(0.091)	(0.092)	(0.149)
State-minimum price law	0.008	−0.007	−0.029	−0.088
	(0.037)	(0.049)	(0.052)	(0.083)
State—number of outlets per 1,000 people	0.288**	0.140	0.381*	0.982***
	(0.138)	(0.198)	(0.208)	(0.204)
State—household income per year in thousand dollars	0.007*	−0.000	0.023***	0.016**
	(0.004)	(0.007)	(0.007)	(0.006)
State—proportion of divorced	−1.978	−1.838	−2.205	−3.630**
	(1.493)	(2.253)	(2.092)	(1.784)
State—proportion of female	−6.241*	−8.843**	−5.813	−0.806
	(3.454)	(4.337)	(5.019)	(5.060)
State—proportion of elder (age > 60)	−0.102	−0.214	0.626	−0.568
	(1.570)	(1.719)	(1.524)	(1.676)
State—proportion of high school graduates	−1.300	−1.251	1.537	−4.001**
	(1.414)	(1.838)	(1.381)	(1.555)
State—proportion of having some college or higher	−0.310	0.551	−0.506	−1.907
	(0.922)	(1.175)	(1.079)	(1.319)
State—proportion of black	0.742***	0.808**	0.174	0.691
	(0.235)	(0.315)	(0.531)	(0.461)
State—unemployment rate (%)	0.017	0.021	0.040	0.100***
	(0.033)	(0.037)	(0.030)	(0.029)
Constant	5.520***	7.186***	3.348	2.762
	(1.542)	(2.089)	(2.665)	(2.753)
Observations	59,115	39,006	18,221	1,888
R^2	0.359	0.400	0.279	0.165

Robust standard errors (clustered at state level) in parentheses. ***$p < 0$.

useful to explore the idea that very high and very low self-reported prices might be mistakes. We trimmed the data by excluding the highest 1% and the lowest 1% of reported prices. The trimming eliminated prices above $7 per pack (including all of the top-coded prices) and prices below $1 per pack. The estimated rates of tax shifting are not too sensitive to this trimming.

Turning to other results in table 5, even after controlling for state tax rates, we continue to find that cigarette prices tend to increase over time and are higher in large MSAs and the Northeast. In our reduced-form approach, these variables are somewhat loosely interpreted as cost shifters. Under this interpretation, it is interesting to compare the estimated coefficients on these variables across the subsamples of pack and carton buyers. The cost increases over time and across markets tend to be shifted at a higher rate to the prices paid by pack buyers than to the prices paid by home-state carton buyers.[20] The pattern of results is consistent with the prediction that any cost increases, whether due to taxes or other factors, are shifted toward consumers who engage in less price search. However, our proxies for cost shifters might also be capturing other effects.

Finally, in table 5 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

[20] The pattern is less clear for away-state carton buyers. However, for the cost shifters, the home- and away-state distinction loses importance, because unlike state tax rates, most cost shifters do not sharply vary with state borders.

TABLE 6.—ESTIMATED TAX PASS-THROUGH RATES, BY SMOKING BEHAVIORS

	Cigarette Tax	*N*
Frequency of cigarettes smoked		
Nondaily	1.005 (0.069)	9,876
Daily light (<10)	1.024 (0.064)	6,670
Daily moderate (10–30)	1.015 (0.050)	39,347
Daily heavy (>30)	0.914 (0.073)	3,017
Quitting behavior and intents		
Smokers who attempted to quit and have a plan to quit	1.036 (0.058)	13,745
Smokers who attempted to quit but no future plan to quit	1.031 (0.059)	6,471
Smokers with a future plan but who had not attempted to quit in past year	1.014 (0.063)	11,599
Smokers who did not attempt to quit in the past and do not plan to quit in the future	1.004 (0.052)	27,300
How soon to smoke first cigarette after wake-up		
< 30 minutes	1.002 (0.052)	22,213
30–60 minutes	1.018 (0.055)	20,774
>60 minutes	1.023 (0.062)	16,128
Type of cigarettes 1		
Light/mild	1.178 (0.065)	17,313
Regular/full flavor	1.072 (0.065)	13,315
Type of cigarettes 2		
Menthol	0.992 (0.052)	15,014
Nonmenthol	1.027 (0.052)	38,561

Standard errors are in parentheses. The information on light cigarettes is available only for 2003.

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 5. When we test for heteroskedasticity, our results support the prediction that higher cigarette retail outlet density reduces cigarette price dispersion.[21]

V. 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 IV, 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 6 reports the estimated rates of tax shifting (the estimated coefficient β_1 on the tax variable) from our reestimates of equation (1) for the new subsamples defined by smoking behaviors. Complete results are available on request. In the first panel of table 6, smokers are categorized as nondaily 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 6, we categorize smokers by a proxy for their degree of addiction based on their responses to how soon after waking they smoke their first cigarette. In the fourth and fifth panels of table 6, we categorize smokers by their choices of light cigarettes versus regular cigarettes and menthol versus nonmenthol cigarettes.

The point estimates tend to suggest that taxes are somewhat undershifted to daily heavy smokers and somewhat overshifted to smokers of light cigarettes: the estimated rates of pass-through to prices paid are 0.91 and 1.18, 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 a quit attempt and intend to quit in the future. However, except for the rate for smokers of light cigarettes, none of the other estimates in table 6 is statistically significantly different from 1 (at the 95% confidence level). 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 mainly offset by more price search, so that in equilibrium, we observe some tendency for cigarette taxes to be shifted more toward lighter smokers.[22]

VI. Conclusion

The novel combination of individual-level price data with data on search behaviors and smoking behaviors allows us to contribute a set of new empirical findings about cigarette excise tax shifting. First, we find that taxes are shifted at lower rates to the prices paid by consumers who

[21] Although the relationship between the number of sellers and price dispersion is model specific in theory, Baye et al. (2006) review several empirical studies that find that more competition reduces dispersion.

[22] In the descriptive models discussed in section III, we find that heavier smokers are indeed much more likely to make home-state and away-state carton purchases. In another specification, we find some evidence that controlling for search behaviors, taxes tend to be overshifted to heavier smokers (results available on request).

undertake more price search behavior: carton buyers and, especially, smokers who buy cartons of cigarettes in a state other than their state of residence. In their analysis of scanner data, Harding et al. (2012) find a similar pattern: they estimate that cigarette taxes are shifted to prices at a much lower rate to consumers who live near the border of a lower-tax state. Because these results are consistent with the general principle that taxes are shifted away from economic agents most able to change their behavior, search behavior might also be important for tax shifting in other markets. In fact, the other common excise taxes in the United States—alcohol taxes and gasoline taxes—are also imposed in goods markets where price search is likely to be important. Price search might also affect how general sales taxes are shifted to consumer prices. As scanner price data become more available for search studies and tax studies, our results suggest it will be crucial to consider the interaction of price search and tax shifting.

The second set of empirical findings we contribute concerns how cigarette tax shifting varies with smoking behaviors. Although generally search behavior seems to matter more than smoking behavior for tax shifting, we also find suggestive evidence that taxes are undershifted to heavier smokers and overshifted to 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 toward groups of consumers whose smoking is of less concern for policy: less-than-heavy smokers and smokers of light cigarettes. Because there might be similar patterns in other markets, differential tax shifting might also limit the usefulness of current excise taxes on alcohol to discourage heavy drinking and on gasoline to encourage fuel economy. Differential tax shifting should also be considered when evaluating policy proposals to tax fast foods or other obesity-related taxes.

Future work could take several directions depending on 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 & Vytlacil, 2005). For example, because we estimate that cigarette taxes are undershifted 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 for policymakers 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 identify behavior on the supply side of the market.

Another direction for future work is to explore the implications of price search for the vertical and horizontal equity of cigarette taxation. Standard analyses conclude that because smokers have lower incomes in the United States, cigarette taxes are regressive (Lyon & Schwab, 1995; Remler, 2004; Colman & Remler, 2008). These standard analyses are incomplete if taxes are differentially passed through to the prices paid by consumers with different incomes. Indeed, Harding et al. (2012) find that cigarette taxes are shifted less to the prices low-income families pay relative to the prices paid by middle- and high-income families, which tends to make cigarette taxes somewhat less regressive. In addition to differences across income groups, our descriptive analysis in section III suggests other differences relevant to discussions of tax equity. For example, we find that blacks and Hispanics are less likely to purchase cigarettes by the carton and that even controlling for their pack versus carton purchases, they tend to pay higher prices for cigarettes. Future work could explore the role of consumer price search in the patterns of tax incidence with income, race/ethnicity, and other consumer demographics.

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TABLE APPENDIX

TABLE A1.—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

TABLE A1.—(CONTINUED)

State	2003			2006—2007		
	Mean	CV	TBOT Price	Mean	CV	TBOT Price
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

Authors calculations from the Tobacco Use Supplements to the Current Population Survey, 2003 and 2006–2007 cycles; Orzechowski and Walker (2008).

TABLE A2.—AVERAGE AND COEFFICIENT OF VARIATION OF CIGARETTE PRICES, BY METROPOLITAN STATISTICAL AREA (MSA)

MSA	2003			2006–2007		
	Mean	CV	Scanner Data Price	Mean	CV	Scanner Data Price
Albany, NY	4.16	0.23	4.59	4.21	0.24	4.35
Atlanta, GA	2.69	0.25	2.62	3.07	0.30	2.71
Baltimore, MD	3.47	0.21	3.74	3.63	0.23	3.68
Birmingham, AL	2.62	0.27	2.73	3.00	0.31	2.92
Boise City, ID	2.9	0.28	2.91	3.16	0.17	3.26
Buffalo, NY	3.13	0.52	4.19	3.14	0.55	4.28
Charlotte, NC	2.49	0.31	2.34	2.93	0.39	2.67
Chicago, IN	3.73	0.22	3.82	4.44	0.35	3.93
Cincinnati, OH	2.64	0.3	2.8	3.39	0.34	3.40
Cleveland, OH	3.06	0.21	2.93	3.76	0.22	3.80
Columbus, OH	3.04	0.25	2.91	3.69	0.27	3.85
Dallas, TX	3.07	0.24	2.88	3.32	0.34	3.24
Denver, CO	2.7	0.22	2.5	3.50	0.28	3.36
Des Moines, IA	2.79	0.25	2.57	2.92	0.24	2.90
Detroit, MI	3.75	0.21	3.83	4.62	0.21	4.63
Grand Rapids, MI	3.67	0.21	3.89	4.43	0.20	4.62
Houston, TX	2.99	0.24	2.81	3.41	0.33	3.04
Indianapolis, IN	2.96	0.2	3.02	3.32	0.36	3.13
Jacksonville, FL	2.87	0.21	2.87	2.92	0.38	2.99
Kansas City, MO	2.93	0.28	2.76	3.09	0.31	2.74
Little Rock, AR	2.81	0.26	2.69	3.33	0.37	2.99
Los Angeles, CA	3.68	0.24	4.03	4.02	0.26	4.23
Louisville, KY	2.27	0.32	2.27	2.77	0.37	2.57
Memphis, TN	2.71	0.21	2.46	2.72	0.30	2.52
Miami, FL	3.02	0.32	3.03	3.04	0.29	3.17
Milwaukee, WI	3.4	0.22	3.43	3.38	0.16	3.52
Minneapolis, MN	3.12	0.24	2.99	3.93	0.20	3.98
Mobile, AL	2.87	0.18	2.85	3.68	0.44	2.97
Nashville, TN	2.62	0.25	2.37	2.74	0.37	2.61

TABLE A2.—(CONTINUED)

MSA	2003			2006–2007		
	Mean	CV	Scanner Data Price	Mean	CV	Scanner Data Price
New Orleans, LA	2.88	0.23	2.85	3.15	0.22	2.97
New York, NY	5.85	0.26	4.87	5.54	0.24	5.27
Oklahoma City, OK	2.54	0.3	2.69	3.58	0.31	3.58
Omaha, NE	3.1	0.23	2.98	3.26	0.34	3.17
Orlando, FL	2.77	0.23	2.91	3.08	0.40	3.04
Philadelphia, PA	3.74	0.27	3.79	3.90	0.34	4.14
Phoenix, AZ	3.7	0.23	3.93	4.34	0.29	4.39
Pittsburgh, PA	3.29	0.22	3.1	3.99	0.25	3.73
Portland, OR	3.59	0.22	4.36	4.00	0.26	4.36
Raleigh-Cary, NC	2.41	0.24	2.3	3.26	0.54	2.65
Richmond, VA	2.61	0.19	2.52	2.87	0.23	3.04
Rochester, NY	3.34	0.44	4.19	4.08	0.31	4.28
Sacramento, CA	3.65	0.23	4.18	3.98	0.32	4.03
St. Louis, MO	2.87	0.28	2.39	2.88	0.26	2.39
Salt Lake City, UT	3.28	0.33	2.91	3.71	0.23	3.27
San Antonio, TX	3.04	0.24	2.91	3.52	0.29	2.62
San Diego, CA	3.75	0.24	3.97	3.98	0.26	4.14
San Francisco, CA	3.91	0.29	4.51	4.25	0.23	4.44
Seattle, WA	4.09	0.26	4.8	4.72	0.29	5.38
Syracuse, NY	3.56	0.33	4.25	3.94	0.23	4.17
Tampa, FL	2.67	0.27	2.95	2.98	0.36	3.03
Tulsa, OK	2.41	0.3	2.69	3.12	0.30	3.58
Washington, DC	3.43	0.28	3.24	3.85	0.28	3.48