The Effect of Cigarette Excise Taxes on Smoking among Pregnant and non-Pregnant Women

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Prenatal smoking is the most important modifiable risk factor for poor pregnancy outcomes in the United States (U.S. Department of Health and Human Services, 1990). At least 20 percent of all low birth weight births are attributable to smoking, and the risk of Sudden Infant Death Syndrome (SIDS) is three times greater for women who smoke (Institute of Medicine 1985; DiFranza and Lew 1995). Nor is the impact of maternal smoking limited to the perinatal period. The American Academy of Pediatrics considers environmental tobacco smoke (ETS) a major risk factor for lower respiratory illness, middle ear effusion and asthma in children (American Academy of Pediatrics 1977).

Maternal smoking has also become an important element of the debate over the optimal level of cigarette excise taxes. Unlike the public health community, economists tend to include only the external costs of smoking in the calculation of optimal tax levels (Manning et al. 1991; Viscusi 1995). It is assumed that parents take into account the possible damage smoking may cause to the fetus or infant, and thus those damages cannot justify higher cigarette taxes.[1] The classification of the costs of maternal smoking as internal to the family has significant implications. If taxes are viewed as external to the family, Evans et al. (1999) find that maternal smoking adds between 42-72 cents per pack to the costs of smoking in 1994 dollars. Since state and federal excise taxes averaged 75 cents in 2000 (Orzechowski and Walker 2001), the consequences of maternal smoking alone, if treated as external, would justify the present level of taxation.

Recent work by economists suggests that increases in the excise tax for cigarettes may be an effective means of lowering the prevalence of smoking among pregnant women. In two papers (Evans and Ringel 1999; Ringel & Evans 2000), authors use national natality files and report participation elasticities of -0.5 and -0.7, which exceed the consensus estimate of aggregate elasticities of -0.3 to -0.5 (Chaloupka and Warner 2000). Another study that also uses national natality files reports a participation elasticity of -.35 (Gruber and Köszegi 2001) The obvious advantage of national natality data are the size of the sample and its national coverage.

[1] The obvious exception would be the medical and remedial costs of maternal smoking borne by taxpayers.

However, with data only on pregnant women, it is unclear whether the prevalence of smoking during pregnancy associated with state excise taxes reflects the response to taxes by women of reproductive age, or a particular response by pregnant women (Ebrahim et al. 2000). For instance, approximately three-quarters of all women that quit smoking during pregnancy do so upon learning that they are pregnant (Fingerhut et al. 1990; Quinn, Mullen and Ershoff 1991). An important correlate of quitting upon the realization of pregnancy is the belief that smoking harms the fetus (Quinn, Mullen and Ershoff 1991). It is unclear what role cigarette taxes play in this decision.

Understanding whether women's smoking behavior around pregnancy is sensitive to financial incentives is important. Policies directed specifically at pregnant women may be more welfare enhancing than excise taxes directed at all smokers. In addition, pregnancy may be an important motivation for women to permanently quit. If taxes increase quit rates during pregnancy and lower relapse rates postpartum, then the health impact of taxes will extend beyond pregnancy. If, on the other hand, taxes have no effect on quit rates during pregnancy, but do lower the prevalence of smoking among women of reproductive age, then efforts to lower smoking during pregnancy might best be directed at smoking initiation.

In this paper, we undertake two analyses. In the first, we examine the effect of cigarette taxes on the smoking behavior of women of reproductive age. Despite an extensive literature on smoking and prices, there are remarkably few published analyses of smoking among women (Lewit and Coate 1982; Farrelly and Bray 1998; Chaloupka and Pacula 1998; Glied 2002). We use the Behavioral Risk Factor Surveillance System from 1987 to 2000 to examine the sensitivity of non-pregnant women of reproductive age to increases in cigarette excise taxes. Some women in the BRFSS are pregnant at the time of the interview. Thus, we also present results with taxes interacted by pregnancy status, although the number pregnant women is relatively small.

We then move to a detailed examination of smoking before, during and after pregnancy. In these analyses we test whether cigarette taxes are associated with quitting just before and during pregnancy. We also test whether taxes are correlated with postpartum relapse rates. This is the first

analysis to associate taxes with changes in maternal smoking during and after pregnancy. Data are from the Pregnancy Risk Assessment Monitoring System (PRAMS): a random, stratified monthly survey of recent mothers overseen by the Centers for Disease Control and Prevention (CDC). We combine data from 10 states over 8 years (1993-1999) and construct a sample of 115,000 women. In addition to containing more detailed data on smoking, PRAMS contains information on income, insurance status, and pregnancy intention. Women that intend to become pregnant should be more likely to quit in anticipation of conception than women whose pregnancy is unintended. We interpret this as evidence of forward-looking behavior.

Background

The U.S. Surgeon General's 675-page report, Women and Smoking, is predicated on the distinctive hazards faced by women who smoke. "Although women and men who smoke share excess risks for diseases such as cancer, heart disease, and emphysema, women also experience unique smoking related disease risks related to pregnancy, oral contraceptive use, menstrual function and cervical cancer" (U.S. Department of Health and Human Resources 2001, p. 5). As a result, women may be less sensitive to changes in the price of cigarettes than men because the monetary costs of smoking among women of reproductive age are a smaller portion of the total costs of smoking.

The modest literature on differences in the price sensitivity of cigarettes by gender is consistent with this conjecture. Farrelly and Bray (1998) use available panels from the National Health Interview Survey of individuals 18 years and older between 1976-1993 and obtain an overall elasticity of -0.26 for men and -0.19 for women. Participation elasticities are less: -0.18 and -0.09 for men and women, respectively. Lewit and Coate (1982) find participation elasticities between -0.13 and -0.39 for women 20 to 35 years of age, neither of which is statistically significant. The comparable elasticities for men range from -0.29 to -1.28. Chaloupka and Pacula report smoking participation elasticities of -0.59 for women and -0.93 for men. All three studies use cross-state variation in prices to estimate elasticities. Thus they assume that the unmeasured factors that influence smoking in West Virginia are the same as in Maine. This leaves the studies vulnerable to significant omitted variable bias. Glied (2002) analyzes the

effect of taxes at age 14 on subsequent smoking and finds women less sensitive than men to taxes around the time of initiation. In sum, we know relatively little about the sensitivity of smoking by women to changes in cigarette prices. Studies to date have used single cross-sections or have examined the persistence of smoking overtime. In either case, they serve as a less useful comparison to recent work on maternal smoking, to which we turn.

Evans and Ringel (1999) are the first to exploit the smoking indicator that was added to national natality files in 1989. With over 10 million births they estimate participation elasticities and conditional demand elasticities for women that gave birth between 1989 and 1992. They include a full set of state and month fixed effects and thus rely on within-state and month variation to identify effects of taxation. They find that a 10 percent increase in cigarette excise taxes lowers smoking participation by 5 percent, but has no effect of the number of cigarettes smoked. Their estimates are unaffected by adjustments for border crossing or clean indoor air laws. In a more recent version with this design, Ringel and Evans (2001) add three more years of natality data in order to explore the heterogeneity of responsiveness to taxes by pregnant women. In this analysis they report a participation elasticity of –0.7, which the authors note is several times greater than the participation elasticity that is generally obtained. Moreover, the absolute value of the elasticity increases with socio-economic status. Women that are married, older, and more educated have elasticities that generally exceed one. As before, taxes have no effect on the number of cigarettes smoked during pregnancy.

Evans and Rignel's elasticities have important policy implications. If pregnant women are more sensitive to changes in prices than non-pregnant women, then other financial incentives in addition to taxes could achieve significant declines. For instance, health insurance premiums could be raised for women that continue to smoking during pregnancy or bonuses awarded for women that quit.

However, other evidence suggests that Evans and Ringel's estimates are optimistic. Real cigarette prices have risen 60 percent since 1997. Given an elasticity of –0.7, we could expect a 42 percent drop in maternal smoking. In fact, the proportion of women that smoke during pregnancy has fallen from 13.2 in 1997 to 12.2 percent in 2000, a 7.6 percent decline. Clearly, other factors besides

price affect prenatal smoking. Gruber and Köszegi (2001) also use natality data and obtain an overall elasticity of -0.35 , which implies an even lower participation elasticity. Beside the extra year of data, Gruber and Köszegi aggregate data into monthly cells, which may explain differences with Ringel and Evans (2001).

The other surprising result obtained by Ringel and Evans (2001) is the positive relationship between the absolute value of the elasticities and socio-economic status. For instance, the elasticity of participation is -3.39 for college educated pregnant women and -0.49 for women with a high school degree. Part of the discrepancy is attributable to the low prevalence of smoking among college-educated women and its effect on the elasticity computation. However, even the marginal effects of taxes on smoking (in absolute value) are greater for the highly educated. This finding is counter to the result that low-income smokers are more sensitive to the price of cigarettes than higher income smokers (Farrelly and Bray 1998; Evans et al. 1999).

The study by Gruber and Köszegi (2001) merits note because the authors find that pregnant women are forward looking in their smoking behavior. Excise taxes that have been enacted, but not yet in effect reduce smoking among pregnant women. The elasticity of cigarette consumption with respect to prices is -0.15.

Another recent study uses longitudinal data from the National Maternal and Infant Health Survey to examine the relationship between cigarette prices and maternal smoking (Bradford 2002). Women that gave birth in 1988 are surveyed again in 1991. Since some women have had a child or become pregnant again, the author is able to analyze the effect of pregnancy on smoking and the interaction of pregnancy and prices. He finds that the price elasticity of smoking is almost identical for both pregnant and recently pregnant women at about -0.30. The most significant limitation to this analysis is the lack of controls for national trends. Real cigarette prices rose between 1987 and 1991 while smoking prevalence declined. In an earlier draft, the author acknowledged that dummy variables for time wipe out the effect of price. With approximately 6,000 women at four points in time in the sample, there may be insufficient within-state variation in prices to identify price effects.

In summary, the literature on the effect of cigarette taxes on smoking by women of reproductive age is remarkably sparse. There is consistent evidence that pregnant and non-pregnant women are sensitive to cigarette prices and taxes. Nevertheless, several important questions remain. First, do pregnant and non-pregnant women respond differently to taxes? The relatively large elasticities obtained by Evans and Ringel imply an interaction between pregnancy and taxes in a model of smoking participation. Ebrahim et al. (2000) question such interactions. They show that the ratio of smoking prevalence between pregnant to non-pregnant women is stable between 1987 and 1996, which they interpret as a decline in ever-smoking among women of reproductive age. We can address this question more directly by analyzing the association between taxes and quit rates during pregnancy.

We can also follow up on Gruber and Köszegi (2001) and examine forward-looking behavior among women who are about to become pregnant. PRAMS has information on whether the pregnancy is intended or unintended. We also know whether women who were ever smokers have stopped smoking three months before pregnancy. Many women consider the risk to the fetus as the most important reason to quit. In addition, smoking is known to interfere with conception. Thus, we expect that women who are trying to become pregnant will be more likely to stop smoking in anticipation of these costs than women whose pregnancies are unintended.

Finally, we can test whether taxes are associated with post-partum relapse rates. Approximately 40 percent of women quit smoking upon the realization that they are pregnant. Such behavior points to the importance of fetal damage as a "cost" of smoking to which women respond. The fact that about approximately 75 percent of women who quit smoking during pregnancy relapse within one year of delivery suggests that these costs are viewed as largely temporary, or at least greater than the costs of second hand smoke on the newborn. Consequently, taxes as a proportion of the total costs of smoking are probably greater in the post-partum than the prenatal period and may have a greater impact on smoking. The analysis of taxes and post-partum relapse rates represents a novel contribution of this analysis.

Analytical Framework

We develop a simple model to study cigarette consumption decisions made by women in each of three periods surrounding pregnancy: the period before (b), the period during (d), and the period after (a). In each period (p = b, d, a), her current period utility function (U) depends on the number of cigarettes smoked (C_p) and another good (X_p) and is quadratic in these two goods:

$$U = \alpha_x X_p - (1/2)\alpha_{xx} X_p^2 + \alpha_c C_p - (1/2)\alpha_{cc} C_p^2 - \beta_d Z_d C_p - \beta_a Z_a C_p. \quad (1)$$

The parameters α_x, α_{xx}, α_c, α_{cc}, β_d, and β_a are positive. The variables Z_d and Z_a are dichotomous indicators that equal one in the period during pregnancy and in the period after pregnancy, respectively. Hence $\beta_d c_d$ represents the cost in utility terms imposed on her fetus by a pregnant woman who smokes, and $\beta_a c_a$ represents the cost in utility terms imposed on her child by a mother who smokes. If there are other costs of smoking, we assume $\beta_b < \beta_a < \beta_d$. This guarantees that some women will quit smoking during pregnancy and also guarantees that not all quitters will restart.

Let T_p be the price of a pack of cigarettes, let μ be the marginal utility of wealth, and let the market rate of interest equal the rate of time preference for the present. Then a woman will not smoke in the period before pregnancy if the monetary value of the marginal utility of cigarettes evaluated at C = 0 (α_c/μ)—termed her 'reservation price'—is smaller than or equal to T_b, and she will smoke if her reservation price exceeds T_b. In symbols

$$C_b = 0 \text{ if } (\alpha_c/\mu) \leq T_b$$

$$C_b > 0 \text{ if } (\alpha_c/\mu) > T_b. \quad (2)$$

During the pregnancy period (d), condition (2) becomes

$$C_d = 0 \text{ if } (\alpha_c/\mu) - (\beta_d/\mu) \leq T_d$$

$$C_d > 0 \text{ if } (\alpha_c/\mu) - (\beta_d/\mu) > T_d. \quad (3)$$

According to equation (3), with the money price of a pack of cigarettes held constant, a woman is less likely to smoke when she is pregnant than when she is not pregnant because her reservation price—the

maximum price at which she is willing to become a consumer of cigarettes—falls from α_c/μ to $\alpha_c/\mu - \beta_d/\mu$.

This simple framework generates demand functions for smoking participation and for the number of cigarettes smoked conditional on positive consumption. Price is expected to have a negative effect on each outcome, and both should fall during the pregnancy period. However, we are interested on the effect of cigarette excise taxes on the decision to quit smoking during pregnancy and to restart after delivery. The framework we have presented highlights that, as a first approximation, the decision to stop smoking or for that matter to stop consuming any good depends on changes in the reservation and money prices of that good between two consecutive periods rather than on the absolute levels of these prices. In particular, a reduction in the reservation price of cigarette smoking between periods t and t+1 or an increase in the money price of cigarettes between these two periods will cause some people to quit smoking. The quit rate in period t+1 should, however, be zero if these two variables remain the same. We know, however, that between 30 to 40 percent of smokers quit when they become pregnant. This points to a decrease in the reservation price of smoking caused by an increase in the health costs of this behavior (β_d/μ exceeds β_b/μ in our notation) since rarely is there a change in the price of cigarettes in the brief period from before pregnancy to the realization of conception. The question, therefore, is what role does the level of the price play, if any, in the decision to quit smoking during pregnancy. Put differently, why might high-tax states have higher quit rates than low-tax states?

If the money price of cigarettes affects quit behavior, then the above analysis must be modified to take account of interactions between money price and reservation price changes. Consider Figure 1.

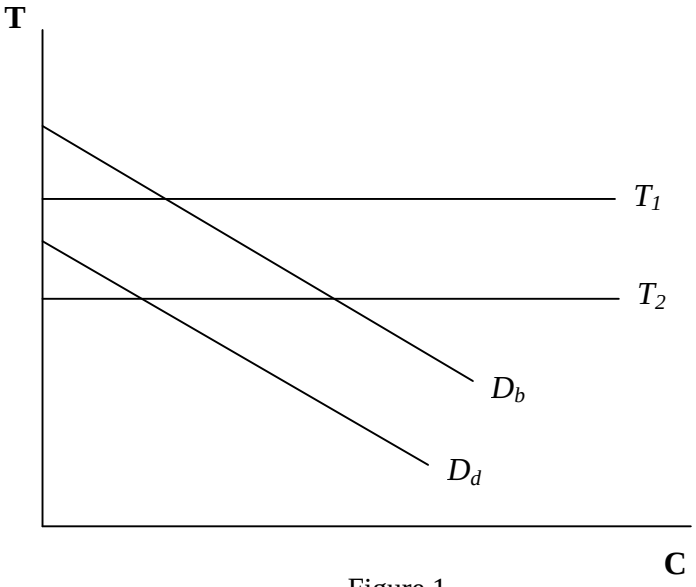

Figure 1

There we depict the behavior of two pregnant women with the same demand functions for cigarettes before and during pregnancy (D_b and D_d, respectively). The first woman resides in a state with a higher price than the second woman (T_1 compared to T_2). Price in each state is the same in the periods before and during pregnancy. The woman in the high price state quits smoking when she becomes pregnant, while the woman in the low price state does not.

In Figure 2 we show the behavior of two pregnant women who reside in a state in which

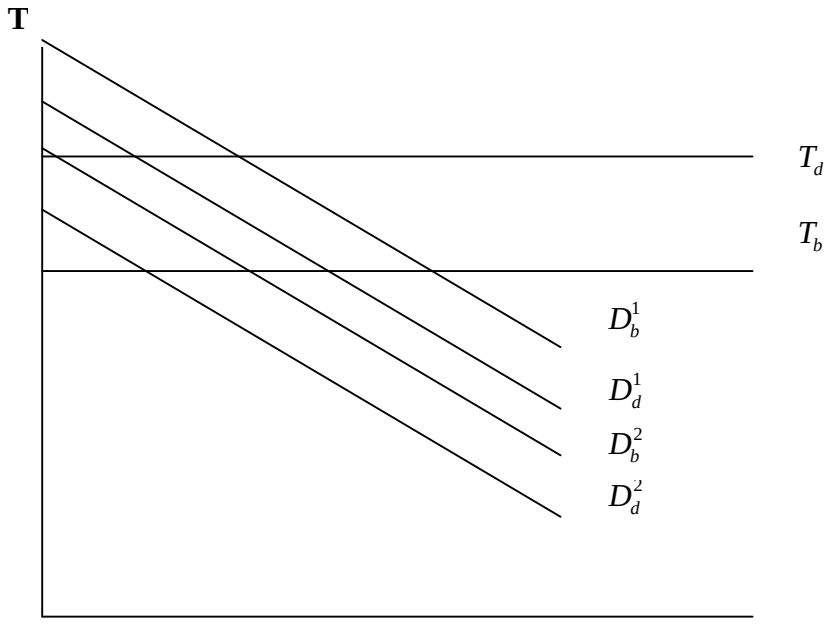

Figure 2

the price of cigarettes increases between the periods before and during pregnancy from T_b to T_d. The first woman has a greater taste for smoking and a higher reservation price than the second woman. (Compare demand functions D_b^1 and D_d^1 to D_b^2 and D_d^2.) In the diagram, at any given value of C, the vertical distance between D_b^1 and D_d^1 equals the vertical distance between D_b^2 and D_d^2. Hence, in response to an increase in price, the woman with the lower initial reservation price quits, while the woman with the higher initial reservation price does not.

Let Q* be a latent variable governing the outcome that a woman who smoked before pregnancy quits. The preceding analysis suggests an equation for Q* of the form

$$Q^* = \phi_1(R_b - R_d) + \phi_2(T_d - T_b) + \phi_3 T_b(R_b - R_d) + \phi_4 R_b(T_d - T_b). \qquad (4)$$

The parameters ϕ_1, ϕ_2, and ϕ_3 are expected to be positive, while ϕ_4 is negative. Empirically, our primary data set, described in the next section, contains smoking three months before pregnancy and three months before delivery. Very few price changes occur in this short period. Hence, we omit $T_d - T_b$ as a regressor and focus on the effects of T_b or T_d on the decision to stop smoking. Note that our prediction of a positive current or past money price effect on the quit probability when these two prices are the same applies only to a situation in which the reservation price changes between periods.

Of course, reservation prices before and during pregnancy are not observed and must be replaced by their determinants. One of these determinants is the unobserved propensity or taste for smoking. Denote this propensity by V_Q and define it such that an increase in V_Q causes an increase in the quit probability. Note that this disturbance term surely is negatively correlated with the disturbance term in the equation for smoking participation before pregnancy (V_S), where S is a latent variable governing the propensity to smoke before pregnancy, and an increase in V_S causes S to rise. In a sample of women who smoked prior to pregnancy, a woman from a high price state is likely to have a high value of V_S. Hence T_b and V_S are positively correlated in the quit sample (and T_b and V_Q are negatively correlated) even if

they are uncorrelated in the population at large. Since T_b and T_d are bound to be positively correlated, the price effect is biased downward in the quit equation.[2]

In the simple framework above, the probability of quitting during pregnancy should be positively related to the money price of smoking. This quit probability can be viewed as a conditional participation equation with implications for the elasticity of smoking participation before and during pregnancy.

To illustrate, let Π be the probability of continuing to smoke in the pregnancy period and note that Π is equal to 1 - Q, where Q is the quit rate. As an identity,

$$\Pi = \frac{S_d}{S_b}, \tag{5}$$

where S_d is the probability of smoking during pregnancy or the smoking participation rate during this period at the aggregate level and S_b is the smoking participation rate in the period prior to pregnancy.[3] The smoking participation rate in each period is negatively related to the "full price" of cigarettes in that period. The latter price is defined as

$$F_i \ (i = b, d) = T_i + (\beta_i/\mu) = T_i + M_i, \tag{6}$$

where M_i is the monetary value of the utility or health cost of smoking in period i.

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[2] One way to account for the bias just outlined is to fit a bivariate probit model with sample selection (Wynand and van Praag 1981; Greene 2000). The model is identified if smoking participation in the period before pregnancy depends on the price in that period, while quitting depends on the tax in the period during pregnancy.[2] As pointed out above, very few price changes occur in this short period. Thus, we do not attempt to estimate this sample selection model, and our price effects in the equation for quitting during pregnancy should be viewed as conservative lower-bound estimates.

[3] Let N_b be the number of smokers before pregnancy and let N_d be the number of smokers during pregnancy. Assume nobody starts smoking or resumes smoking after getting pregnant. Then $N_d = N_b - Q$, where Q is the number of women who quit. Let N be the total number of women. Then

$$\frac{N_d}{N} = \frac{N_b}{N} - \frac{Q}{N_b}\frac{N_b}{N}.$$

Rewrite this as $S_d = S_b(1 - Q)$ or $S_d = S_b\Pi$.

Suppose that T_b is equal to T_d. Differentiate equation (5) with respect to the common value T and convert all terms to elasticities to obtain

$$\rho = \eta_d - \eta_b. \tag{7}$$

According to equation (7), the elasticity of the probability of continuing to smoke during pregnancy with respect to money price (ρ) is negative if the elasticity of smoking participation during pregnancy with respect to money price (η_d) is larger in absolute value than the elasticity of smoking participation with respect to money price before becoming pregnant (η_b).[4] The reverse holds if η_b is larger than η_d. A zero elasticity for the probability of smoking continuation implies that taxes have no differential effect on pregnant women. This would support the contention that the decline in smoking participation during pregnancy reflects the general decline among women of reproductive age (Ebarhim et al 2000). Let ε_i be the elasticity of smoking participation with respect to <u>full</u> price and let K_i be the share of money price in full price. Then

$$\rho = K_d\varepsilon_d - K_b\varepsilon_b. \tag{8}$$

Clearly K_d is smaller than K_b since the health cost of smoking is greater in the period during pregnancy than in the period before it. Hence, if the full price elasticity were the same in each period, one obtains the somewhat counterintuitive result that an increase in the money price of cigarettes raises the probability of continuing to smoke during the pregnancy period or lowers the probability of quitting. The full price elasticity is unlikely, however, to be constant because this implies that the probability of smoking is specified as a log-linear function. This specification does not constrain the probability to fall between zero and one.

[4] The money price elasticity of smoking participation in period i is defined to be negative:

$$\eta_i = \frac{\partial \ln S_i}{\partial \ln T}.$$

Note that the elasticity of Q with respect to T (φ) is given by

$$\varphi = -\rho\frac{\Pi}{1-\Pi} = (\varepsilon_b - \varepsilon_d)\left(\frac{\Pi}{1-\Pi}\right)$$

Suppose that the constraint just mentioned is taken into account by specifying the probability of smoking in each period as a probit function. Let ϕ_i be the probit coefficient of money price in each period. Then

$$\rho = T(\phi_d\lambda_d - \phi_b\lambda_b), \tag{9}$$

where λ_i is the inverse of the Mills ratio. Since λ_i is negatively related to the probability of smoking and since women are less likely to smoke in the pregnancy period, λ_d exceeds λ_b. Thus, ρ is negative if ϕ_d equals ϕ_b and could be negative even if ϕ_d is smaller in absolute value than ϕ_b. Moreover, given the strong possibility of lagged as opposed to instantaneous adjustment, ϕ_d might well exceed ϕ_b.

To summarize, we have outlined a framework in which the conditional probability of quitting during pregnancy may be positively related to cigarette taxes. Yet, the simple identity between quit and participation rates implies that this relationship need not hold. If it does, then we should expect to find that elasticity of smoking participation during pregnancy exceeds in absolute value the elasticity of participation before. This would be consistent with recent work based on natality files in which the elasticity of smoking participation during pregnancy appears substantially greater than the elasticity of participation among women of reproductive age (Evans and Ringel 1999; Ringel and Evans 2001).

Empirical Implementation

1. Data

The Behavioral Risk Factor Surveillance System (BRFSS) is a monthly telephone survey of adult health practices and behaviors by the Centers for Disease Control and Prevention and State health departments. Initiated in the early 1980's, the BRFSS interviews approximately 125 adults per month in each state (Remington et al. 1988). Fifty states now participate. We use data from 1987 to 2000. There are 33 states in 1987, a number which rises to 50 by 1993. We limit the sample to women 18 to 44 years of age.

Classification of individuals as current smokers is based on two questions. The first establishes that the individual has smoked at least 100 cigarettes in her entire life. Women are characterized as current smokers between 1987 and 1995 if they answer yes when asked, "Do you smoke cigarettes now?" After 1995 the latter question is changed to, "Do you smoke cigarettes everyday, some days or not at all?" Those that answer everyday or someday are considered current smokers. There is a noticeable increase in smoking participation after 1995 that appears related to the subtle change in the question as to current smoking. We thus created an alternative measure of current smoking based on whether the woman smoked one or more cigarettes per day. The question we use is, "On average, how many cigarettes per day do you smoke?" This question was unchanged between 1987 and 2000. We present results with both measures of smoking participation. We also use the number of cigarettes smoked on average per day as a measure of consumption.

The Pregnancy Risk Assessment Monitoring System (PRAMS) is a random, stratified monthly survey of recent mothers selected from birth certificates. PRAMS was initiated by the Centers for Disease Control in 1987 as a response to the slowdown in the rate of decline in infant mortality and the absence of any decline in the rate of low birth weight births. PRAMS surveys are carried out by participating states following explicit guidelines developed by the CDC. Each month the PRAMS staff in each state selects between 100 and 250 recent mothers from birth certificates by stratified systematic sampling with a random start. Stratification variables, such as birth weight and race or ethnicity, vary among states. All states over-sample women at increased risk for adverse pregnancy outcomes. Sampled mothers are then sent a self-administered questionnaire two to six months after delivery; non-respondents are followed up by telephone. Response rates average between 70 and 80 percent after follow up. http://www.cdc.gov/nccdphp/drh/methodology.htm

Twenty-five states participated in PRAMS in 2000 up from five states in 1988. We use surveys from 10 states that participated for at least 5 of the six years between 1993 and 1999: Alabama, Alaska, Florida, Georgia (1993-1997), Maine, New York State (excluding New York City) Oklahoma, South

Carolina, Washington and West Virginia. There are 115,000 observations, a total that, when weighted, represents approximately 4,605,470 births, or 17 percent of deliveries in the U.S. over the same period.

The questionnaire in PRAMS asks women if they ever smoked at least 100 cigarettes in their entire life. Those that answer 'yes' are asked to record the number of cigarettes or packs of 20 cigarettes they smoked per day, on average, in the three months before they were pregnant. They may also respond by indicating that they smoked less than one cigarette per day, that they didn't smoke at all, or that they do not know. The same set of questions are asked about the period three months before delivery and at the time of the survey, which occurs between 2 and 6 months after delivery.

We are primarily interested in the change in smoking behavior.[5] We create four dichotomous indicators of change. The first is one if the woman ever-smoked but did not smoke three months before pregnancy (*Quit_ever_before*). The second is one if the woman smoked three months before pregnancy but not three months before delivery (*Quit_before_during*). The third indicator is one if the woman stopped during pregnancy, but resumed between 2 to 6 months postpartum (*Resume*). And the final indicator is one if the woman smoked before but not postpartum (*Quit_before_after*).

We do not analyze smoking intensity with PRAMS, but we do control for pre-pregnancy cigarette consumption in the *Quit_before_during* , *Resume*, and *Quit_before_after* equations. Consumption before pregnancy is a measure of the stock of smoking capital (Becker, Grossman and Murphy 1994). The clinical literature indicates that the lightest smokers prior to pregnancy are the most likely to quit during and least likely to resume (Li et al. 1993; Dolan, Quinn and Ershoff 1990; Fingerhut, Kleinman and Kendrick 1990). We create a trichotomous indicator of pre-pregnancy consumption: less than 10 cigarettes per day, between 10 and 20 cigarettes per day and more than 20 per day. We eliminated women that that did not know how much they smoked before pregnancy (n=4325), during pregnancy (n=2808) and after delivery (n=2381).

PRAMS also contains covariates in addition to those on birth certificates. These include health insurance status at delivery, family income, and pregnancy intention. We use pregnancy intention to test

[5] We analyze smoking participation three months before delivery in order to compare PRAMS to published works.

for forward-looking behavior. Women are asked whether at the time that they first realized that they were pregnant if they wanted to become pregnant then, or at some other time (mistimed) or not at all (unwanted). We characterize pregnancies that are mistimed or unwanted as unintended. Smoking imposes two potential costs on women that want to have children. First, smoking inhibits conception. Second, and more well known, is the risk of adverse birth outcomes (U.S. Department of Health and Human Resources 2001). Thus, women who are trying to become pregnant may be more likely to quit in the three months before pregnancy due to these anticipated costs, than women whose pregnancies are unintended.

Finally, we run participation regressions based on birth certificates for nine of the10 PRAMS states. New York, which is included in our PRAMS sample, does not report smoking on the birth certificate. We use these regressions to aid comparison between our work and that of previous analyses with natality data. Data on cigarette taxes and prices are from the Orzechowski and Walker (2001). Both taxes and price are expressed in constant 1982-84 dollars.

a. Reported Smoking

A limitation of self-reported smoking is the potential for underreporting. Clinical studies or prenatal smoking that use biological markers to estimate exposure find that a little as 10 and as much as 30 percent of prenatal smoking is not reported by the women. Birth certificates capture less smoking than hospital medical charts (Piper et al. 1993; Buecher et al. 1993) and the prevalence of smoking as reported in PRAMS exceeds that reported on birth certificates. The latter is likely an underestimate of the true difference between birth certificates and PRAMS since birth certificates ask about smoking during pregnancy and PRAMS specifically asks about smoking in the three months before delivery. Technically, a woman that smokes in the first four months of pregnancy, but then quits should be classified as a prenatal smoker on birth certificates, but not on PRAMS.

Figure 1 shows the percent of non-pregnant women that have ever smoked as well as the percent of those that smoke now. For PRAMS smoking now refers to smoking three months before pregnancy. The BRFSS and PRAMS are quite close. We would expect that some women in PRAMS would have

quit in anticipation of pregnancy and thus data from the two surveys are not directly comparable. In addition these are not adjusted for differences in the distribution of age between the two surveys. Figure 2 compares smoking during pregnancy from three sources: BRFSS, PRAMS and birth certificates. Women in the BRFSS are asked about smoking and later asked whether they are pregnant at this time. If we accept that there are few false positives, then PRAMS is superior to birth certificates and the BRFSS as a screen for smoking. Smoking in the last three months of pregnancy is between 1 and 2 percentage points higher than what is recorded for smoking during pregnancy on birth certificates. Also noteworthy is that the prevalence of smoking based on birth certificates is similar in nine of the 10 PRAMS states to all available states.[6]

2. Econometric model

Following much of the literature we estimate three equations for smoking with the BRFSS: participation, smoking consumption among all women and smoking consumption among only women that smoke (Lewitt and Coate 1982; Evans et al. 1999). We use probits to estimate models in which the dependent variable is dichotomous and ordinary least squares otherwise. In the analysis of quit probabilities in PRAMS, we use only probit analysis. All analyses are weighted with the survey weights and we use robust procedures for the standard errors that cluster on state.

Results

1. Women in the BRFSS

Table 1 shows the results of our participation and consumption regressions using the BRFSS. Means for the regressors are in the Appendix. The estimated effect of taxes on participation varies significantly depending on how one defines 'participation.' For 'smoker', which equals one if the number of cigarettes per day is greater than zero, the elasticity is –0.27 for non-pregnant women, near the usual range for all persons (–0.3 to –0.5). For 'smoke now', the elasticity among non-pregnant women is much

[6] New York , one of the 10 PRAMS states, did not report smoking on the birth certificate.

smaller. We put more faith in the results using 'smoker' because, although it moves erratically for some years, as does 'smoke now', at least it is defined consistently over the whole study period.

The results give no clear indication of whether pregnant women are more or less sensitive to taxes than non-pregnant women of reproductive age. The interaction terms on smoking *times* pregnant in the participation regressions are negative, implying that pregnant women are more sensitive to taxes, although the differences are not statistically significant. In contrast, where the dependent variable is cigarettes smoked per day (column 6), the coefficient is positive, significant, and large—so large, in fact, that the implied total elasticity for pregnant women is positive, which is hard to accept. One difficulty is that only 4.3 percent of women ages 18 to 44 in the sample are pregnant (n=17,820), which may limit our ability to detect robust effects of taxes on smoking among this subgroup.

2. Smoking participation in PRAMS

We first use PRAMS to analyze the effect of state cigarette excise taxes on smoking participation before, during and after pregnancy. To facilitate comparison with previous analyses we also include estimates obtained from birth certificates for the states in PRAMS less New York, which did not report smoking on its birth certificate. Results are shown in Table 2. For each outcome in PRAMS, we present separate regressions for a contemporaneous tax and taxes lagged six months. Estimates should be interpreted as the marginal change in probability of each outcome given a one cent change in the real tax. We also present price elasticities for each outcome under the assumption that a one cent increase in taxes causes a commensurate increase in price (Evans et al. 1999).

Taxes are negatively related to smoking before, during and after pregnancy. Of the seven estimates based on PRAMS (columns 1-7), five have t-ratios greater than one, although only two are statistically significant at conventional levels ($p<.05$). Elasticities range from -0.23 to -0.91. Our estimate of taxes measured at conception on smoking during pregnancy is about four times larger than the estimate obtained from birth certificates (columns 4 and 8), although neither is statistically significant. The most robust estimates of marginal effects are associated with "lagged" taxes. The marginal effect of a tax 9 months before conception on smoking participation three months before conception (column 2) is

relatively large; similarly, smoking during pregnancy is most responsive to taxes three months before conception (column 5).

3. Quit behavior in PRAMS

As we argued above, pregnancy causes a large decrease in the reservation price of smoking due to the risks it poses for the fetus. Thus, even if taxes and prices remained unchanged, we can expect between 30 and 40 percent of women that smoke prior to pregnancy to quit during pregnancy. The question we address in this section is whether states with high taxes have higher quit rates and lower relapse rates than states with lower taxes.

Figures 3 through 6 display four outcomes related to changes in smoking behavior around the time of birth. In each Figure, we show separate series for New York and Washington, Alaska and Maine and the other six states in PRAMS. The grouping is based on changes in state excise taxes. New York and Washington raised taxes between 1993 and 1995; Alaska and Maine raised taxes one month apart in 1997. The other six states did not increase state excise taxes at all over this time period.[7]

There is no apparent association between state excise taxes and quit rates three months before pregnancy among ever smokers (Figure 3). Quit rates during pregnancy rise sharply after 1994 in New York and Washington and are relatively flat in the other states between 1993 and 1996 (Figure 4); and although there is an increase in quit rates in Alaska and Maine after 1996, it is difficult to distinguish the rise from the upward trend in quit rates in the non-tax-changing states (Figure 4). There is no obvious association between the rate of postpartum relapse and the timing of the state tax changes. Nevertheless, relapse rates are similar in 1993 among all states but noticeably less among the tax-changing states in 1999 (Figure 5). Finally, permanent quit rates defined as the percent of women that smoked before pregnancy but who do not smoke postpartum jumped sharply in New York and Washington after 1995 (Figure 6). In short, there is some visual evidence that smoking behavior changed in the wake of state

[7] Federal tax increases bracket our study period. The federal excise tax increased from 20 to 24 cents in January, 1993 and from 24 to 32 cents in January, 2000.

excise taxes, but the strength of the association is not apparent. We turn, therefore, to the regressions of quit behavior.

Table 3 shows the means for the covariates that we use in the quit regressions stratified by year and tax-changing states. A salient feature is that the intensity of smoking prior to pregnancy in the two groups of states was similar in 1993. Approximately 20 percent of pregnancy smokers in tax-changing and non-tax-changing states smoked less than 11 cigarettes (light smokers) and 16 percent smoked more than a pack per day (heavy smokers) in 1993. By 1999 there are more light smokers and fewer heavy smokers in the tax-changing states relative to the non-tax-changing states. There is also a noticeable shift in the age distribution of pre-pregnancy smokers. The proportion of teens among pre-pregnant smokers increases from 12 to 18 percent between 1993 and 1999 in the tax-changing states and from 16 to 19 percent in the non-tax-changing states. The shift in age may explain in part the relative increase in light smoking. We turn therefore, to the multivariate estimates in order to adjust for the changing characteristics of pre-pregnant smokers in the quit models.

The probit regressions pertain to the four quit probabilities shown in Figures 3 through 6. For each covariate in Table 4, we display changes in the probability of quitting or relapsing. We associate taxes at the beginning of each quit period with quitting behavior. We also show estimates with lagged taxes. For the outcome that measures quitting three months before pregnancy among women that ever smoked, we use taxes at age 14. This is problematic since we don't know the state the mother lived in at age 14. Nevertheless, as shown in table 4, taxes at age 14 are strongly and positively corrected with quitting prior to pregnancy. The elasticity is 0.66 (column 1). However, taxes three months before pregnancy have no effect on quits from ever to before (column 2).

Taxes before pregnancy significantly increase the likelihood that a woman will quit when she becomes pregnant (columns 3 and 4). The implied elasticities are large, between .94 and 1.04 depending on whether we use contemporaneous or lagged taxes. These responses are large enough to account for a significant part of the rise in quit rates in recent years. From 1993 to 1999 among PRAMS states the quit rate during pregnancy rose from 37.3 to 46.4 percent and the average tax rose from about $0.33 to $0.40.

The coefficient on tax in column 1 implies that quit rates would have risen by about 2.5 percentage points due to taxes alone, or over a quarter of the actual change.

Taxes are also associated with a lower probability that a woman will resume smoking between 2 to 6 months postpartum, although neither estimate is statistically significant (columns 5 and 6). The last two estimates associate taxes with what we call "permanent" quits: women that smoked before pregnancy but not after. Permanent quits include women that smoked during pregnancy and stopped postpartum. However, 90 percent of women that "permanently" quit did so during pregnancy. The importance of this outcome is that women who stop smoking during pregnancy, but resume postpartum, are still at double the risk for SIDS (Schoendorf and Kiley 1992). Again, taxes increase the likelihood of permanent quitting (columns 7 and 8). Thus, permanent quits as we have defined them yield substantial benefits in terms of infant health and should be the obvious goal of prenatal smoking cessation interventions.

We also display the marginal effects of selected covariates in Table 4. As alluded to above, women who intend to become pregnant are much more likely to quit smoking prior to pregnancy, than women whose pregnancy is unintended. Once conception is known, however, there is no difference in smoking behavior by pregnancy intention. We interpret this finding as support for the importance of future "prices" on current behavior. Another notable finding is the robust impact of first births on quit behavior. Although women delivering their first child are 7 percentage points less likely to quit prior to pregnancy, once pregnant their smoking behavior changes much more than women of higher order births. Specifically, women having a first birth are 14 percentage points more likely to quit during pregnancy, 10 percentage points less likely to resume after delivery and 10 percentage points more likely to quit permanently relative to women that deliver a higher order birth. As a percentage of the mean of each quit behavior, these effects are very large. One speculation is that women use previous birthing experience to adjust the expected costs of smoking. Even for women that smoke, the probability of a low birth weight birth is only about 0.10, or double of those that don't. Thus, the high probability of a good birth outcome despite smoking may lead women to discount the risk of prenatal smoking. One way to test this would be to include a measure of previous adverse birth outcomes. We lacked such data on PRAMS. However, in

a study of consecutive births in Georgia, researchers found that women who smoked during their first pregnancy were less likely to smoke in the second, if the first infant had died. Interestingly, a first birth of low birth weight had no effect on smoking during the second pregnancy (Dietz et al. 1997).

The other noteworthy result pertains to prior smoking behavior among those who quit. . As shown in Table 4, light smokers, those that smoke less than a half a pack a day, are much more likely to quit than heavier smokers. In our sample, for instance, 71 percent of light smokers, 36 percent of moderate smokers and 22 percent of heavy smokers quit during pregnancy.

4. Sensitivity analysis

One concern is that our results are sensitive to the inclusion or exclusion of a particular state, since we have only 4 states in which tax changes were enacted (Alaska, Maine, New York and Washington). In Table 5 we present estimates of the marginal effect of taxes on the probability of quitting during pregnancy. We focus on quits from before to during pregnancy given the health consequences of quitting and the robustness of our initial findings. Each row is from a separate regression in which we have altered the specification or the sample. Row 1 repeats the estimate from Table 4 for convenience. The specification in row 2 includes no covariates other than state and year fixed effects. In rows 3 through 6 we drop one of the tax-changing states and in rows 7 through 10 we include only one of the tax-changing states. Except for when we include New York (row 9), the marginal effects range from .0020 to .0042 and in 6 of the 8 specifications, the marginal effects are statistically significant. In the last row we include on the tax-changing states. In this case we rely on the variation in the timing of the taxes increases to provide the relevant "comparison" state. Marginal effect fall by almost half when we include only the four tax-changing states. Nevertheless, changes in taxes still explain almost a quarter of the increase in quits over the study period.[8]

The positive quit elasticity or negative continuation elasticity implies that the participation elasticity during pregnancy exceeds in absolute value the participation elasticity three months before

[8] The weighted average of real state taxes rose by 15.5 cents between 1993 and 1999 in Alaska, Maine, New York and Washington. The percent of women that quit smoking during pregnancy increased by 13.0 percentage points, from 34.3 in 1993 to 47.3 in 1999. Thus, .0019*15.5 = 0.029 which is 22 percent of the change.

pregnancy (see equation 7). We obtain this result if you compare the response to the price before pregnancy [(Table 2, columns (1) and (5)]. The implied continuation elasticity, -0.61 [-0.91--0.30)], is close to what we obtain from the quit model, -0.78.[9]

The next set of analyses explores the heterogeneity of taxes on quit probabilities by parity, maternal schooling and pre-pregnancy smoking. We consider only binary stratification because of sample size limitations. Estimates are shown in Table 5. Although none of the differences within each category is statistically significant**,** we find that the marginal effect of taxes on quit probabilities are greater among women with first births, less education and more pre-conception smoking.

Conclusion

In this paper we examine whether increasing cigarette taxes is an appropriate way to reduce smoking among pregnant women. One justification for raising taxes would be that they influence pregnant women more, and thus change behavior most where the externalities are greatest. We obtain relatively modest elasticities for smoking participation among women of reproductive age in the BRFSS. We find that smoking participation among women is more sensitive to taxes in the period before, during and after child birth in PRAMS than among non-pregnant in the BRFSS, but our estimates are sensitive to whether taxes are lagged or contemporaneous.

We find much stronger support for the use of taxes in our quit equations. We estimate that a 10 percent increase in cigarette taxes would increase the probability of a women quitting by 10 percent, a result that holds up in separate regressions stratified by education, parity, and pre-pregnancy smoking and with various combinations of states. Since higher costs of smoking appear to be quite effective in inducing women to quit smoking during pregnancy, direct financial incentives to stop smoking during and after pregnancy should be considered.

[9] The implied continuation elasticity can be obtained by reversing the sign of the marginal effect on quits (Table 4, column 4) and multiplying by (126.66 cents/.575) or [mean price/(1-mean quit)].

We also find that women who smoke during pregnancy are not a random cross-section of reproductive-age smokers. In particular, more women who intend to become pregnant quit prior to pregnancy than women whose pregnancy was unintended. We also find that women delivering their first child are much more likely to quit during pregnancy and less likely to resume postpartum than women with previous live births. Perhaps cessation policies aimed specifically at first-time mothers would persuade more women to quit than a general program aimed at all pregnant women.

Taxes appear to be nearly as effective in reducing relapse rates as in encouraging quitting. We find that a 10 percent rise in taxes reduces the likelihood of resuming smoking by from 10 percent. However, despite the increased taxes of recent years, half of all quitters resume smoking within six months of delivery and 75 percent resume within a year, suggesting that their reservation prices tend to return to pre-pregnancy levels. One interpretation is that new mothers do not perceive postpartum smoking to be as harmful as prenatal smoking despite recent research on the relationship between smoking and SIDS, asthma and lower respiratory infections. This suggests that doctors and public agencies should better advertise the dangers of postpartum smoking.

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Table 1: Changes in Smoking Participation and Consumption Among Women 18-44 Years of Age in the BRFSS, 1987-2000

	Smoking Participation				Smoking Consumption			
	Yes if Cigs/day>0 (1)	Yes if Cigs/day>0 (2)	Yes if smoke now (3)	Yes if smoke now (4)	# of Cigs all women (5)	# of Cigs all women (6)	Ln # Cigs smokers (7)	Ln # Cigs smokers (8)
Real tax	-0.00044	-0.00044	-0.00020	-0.00021	-0.0066	-0.0078	-0.0007	-0.0008
	(1.80)	(1.76)	(1.05)	(1.09)	(1.87)	(2.30)*	(1.27)	(1.61)
Pregnant		-0.0778		-0.0823		-1.7238		-0.1840
		(7.12)**		(6.84)**		(9.69)**		(4.25)**
Tax*pregnant		-0.00045		-0.0009		0.0135		0.0004
		(0.75)		(1.25)		(2.82)**		(0.27)
Mean dependent variable	0.22	0.21	0.25	0.24	3.51	3.43	16.07	16.01
Elasticities								
Non-pregnant	-0.27	-0.27	-0.11	-0.12	-0.23	-0.29	-0.02	-0.02
Pregnant		-0.54		-0.21		0.21		-0.02
R^2					0.08	0.08	0.09	0.10
N	392734	410554	393875	410555	393873	410553	88925	90781

The smoking participation models were estimated by Probits. Figures are d(Prob smoke=1)/dtaxes$_i$. T-ratios are in parentheses. Models include indicator variables for family income (5), education (5), age (2), race (2), marital status (1), plus state and year fixed effects. Samples in columns (1), (3), (5) and (7) exclude pregnant women. All models are weighted by survey weights and standard errors have been adjusted for clustering by state.

Table 2: Smoking Before, During, and After Pregnancy in PRAMS and Birth Certificates (PRAMS States), 1993-1999

	PRAMS							Birth Certificates
	Smoked three months before conception		Smoked three months before delivery			Smoked at interview date		Smoked during pregnancy
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Real tax, 3 months before conception	-0.00063 (1.21)				-0.00108 (3.13)			
Real tax, 9 months before conception		-0.00070 (2.07)*						
Real tax, 3 months before delivery			-0.00023 (0.58)				-0.00057 (1.15)	
Real tax at conception				-0.00055 (1.18)				-0.00014 (0.83)
Real tax at interview date						-0.00111 (1.53)		
Observations	96895	96895	100960	98153	98153	95886	101259	3895763
Elasticity	-0.30	-0.34	-0.23	-0.46	-0.91	-0.36	-0.69	-0.12
Mean of the dependent variable	0.26	0.26	0.15	0.15	.15	0.22	0.22	0.14

The participation models were estimated with Probits for PRAMS and with linear probability models for birth certificate data. Values are marginal effects with robust z-statistics in parentheses. All models include indicator variables for family income (5), health insurance (4) maternal education (5), age (2), race (2), marital status (1), parity (1), pregnancy intention (1) as well as state and year fixed effects. All models but column 6 also include indicator variables (5) for income. The ten PRAMS states are AL, AK, FL, GA (1993-97), ME, NY, OK, SC, WA and WV. All models are weighted by survey weights and standard errors have been adjusted for clustering by state. The sample based on birth certificates does not include NY. * significant at 5%

Table 3. Mean Characteristics of Women that Smoked Three Months before Pregnancy by Year (1993 and 1999) and Tax-Changing versus Non-Tax-Changing State:

	Tax-Changing States: AK, ME, NY, WA		Non-Tax-Changing States: AL, FL, GA, OK, SC, WV	
Variable:	**1993** (N=1576)	**1999** (N=1557)	**1993** (N=3047)	**1999** (N=2418)
Quit during pregnancy	0.344	0.473	0.388	0.458
Family income (000's)				
<10	0.374	0.381	0.460	0.334
11-20	0.240	0.225	0.171	0.295
20-30	0.287	0.331	0.131	0.082
31-40	0.008	0.006	0.039	0.051
41-50	0.000	0.000	0.001	0.002
>50	0.000	0.000	0.002	0.002
Unknown	0.090	0.057	0.196	0.233
Mother's education				
0-8 years	0.042	0.028	0.044	0.029
9-11 years	0.162	0.193	0.269	0.248
12 years	0.465	0.420	0.415	0.392
13-15 years	0.219	0.214	0.183	0.231
≥16 years	0.074	0.090	0.079	0.089
Unknown	0.038	0.055	0.010	0.012
Mother's age				
<20	0.117	0.178	0.156	0.192
20-29	0.669	0.511	0.577	0.585
≥30	0.213	0.312	0.267	0.223
Insurance coverage				
Medicaid	0.502	0.438	0.569	0.539
Other public	0.046	0.016	0.021	0.020
Private	0.372	0.467	0.316	0.380
Uninsured	0.077	0.076	0.081	0.054
Insurance unknown	0.003	0.004	0.013	0.008
First birth (yes=1)	0.435	0.456	0.430	0.436
Maternal race				
White	0.887	0.874	0.873	0.869
Black	0.071	0.061	0.111	0.094
Other	0.042	0.064	0.016	0.037
Married (yes=1)	0.493	0.500	0.622	0.569
Pregnancy unintended (yes=1)	0.501	0.512	0.501	0.516
Pre-pregnancy smoking				
<11	0.207	0.282	0.195	0.250
11-20	0.632	0.626	0.635	0.621

>20	0.161	0.092	0.170	0.129
Real tax $ (1982-84)	40.375	55.452	29.135	28.532

Table 4: Changes in Quit Probabilities Before, During and After Pregnancy, 10 PRAMS States, 1993-1999

	Quit_ever_before		Quit_before_during		Resume		Quit_before_after	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Taxes at various points in time								
Real tax at age 14	0.0016 (5.63)**							
Real tax 9 months pre-conception			0.0032 (2.31)*				0.0014 (2.43)*	
Real tax 3 months pre-conception		-0.0003 (0.56)		0.0035 (2.90)**				0.0026 (2.69)**
Real tax 3 months pre-delivery					-0.0033 (1.56)			
Real tax at interview date						-0.0038 (1.40)		
Selected covariates								
Unintended pregnancy	-0.065 (5.15)**	-0.065 (5.11)**	0.006 (0.49)	0.006 (0.48)	-0.004 (0.01)	-0.009 (0.27)	0.005 (0.34)	0.005 (0.33)
First birth	-0.071 (9.52)**	-0.071 (8.74)**	0.144 (15.42)**	0.144 (15.46)**	-0.099 (9.14)**	-0.106 (9.72)**	0.101 (12.48)**	0.101 (12.44)**
10-20 cigarettes/day pre-pregnancy			-0.347 (15.07)**	-0.347 (15.10)**	0.094 (4.43)**	0.099 (4.64)**	-0.201 (10.30)**	-0.201 (10.40)**
21 + cigarettes/day pre-pregnancy			-0.384 (16.21)**	-0.384 (16.25)**	-0.016 (0.57)	-0.003 (0.12)	-0.165 (11.17)**	-0.165 (11.19)**
Elasticity	0.66	-0.14	0.94	1.04	-1.00	-1.00	0.79	1.46
Mean of dependant variable	0.30	0.30	0.42	0.42	0.51	0.51	0.23	0.23
Observations	38099	37040	27514	27514	10927	10927	27550	27550

All models were estimated as Probits. Figures are d(Prob Quit=1)/dtaxes$_i$. T-ratios are in parentheses. Models include indicator variables for family income (5), health insurance (4), education (5), age (2), race (2), marital status (1), plus state and year fixed effects. Resume models also include the time in days between delivery and the postpartum intervew. All models are weighted by survey weights and standard errors have been adjusted for clustering by state.

Table 5. Cigarette Taxes Three Months before Delivery and Probability of Quitting Smoking during Pregnancy: Sensitivity to Specification and Sample of PRAMS States

	Marginal effect	t-ratio	Price elasticity
1. Full sample (from Table 3)	.0035	2.90	1.04
2. Only state and year fixed effects	.0028	3.18	0.84
3. Full sample less Alaska	.0042	2.88	1.26
4. Full sample less Maine	.0037	2.73	1.10
5. Full sample less New York	.0032	2.83	0.90
6. Full sample less Washington	.0039	1.49	1.14
7. Only Alaska and non-tax changing states	.0020	1.95	0.55
8. Only Maine and non-tax changing states	.0023	0.77	0.63
9. Only New York and non-tax changing states	.0110	3.86	3.44
10. Only Washington and non-tax changing states	.0041	3.89	1.17
11. Only AK, ME, NY and WA	.0019	3.27	0.67

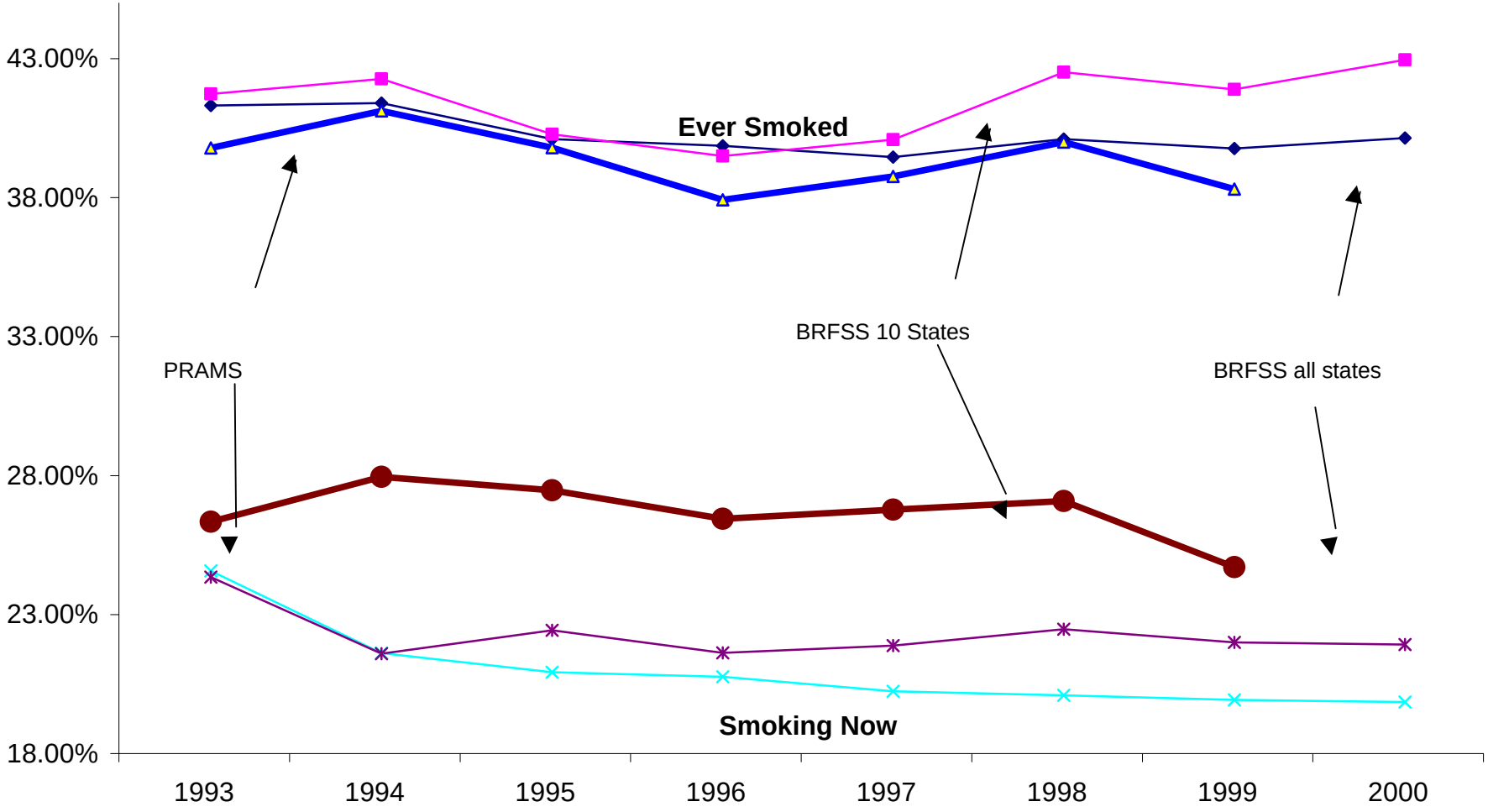
All models were estimated as Probits. Marginal effects are the $d(Quit=1)/dTax_I$. Except for row 2, all models include indicator variables for parity (1), pregnancy intentions (1), and pre-pregnancy smoking (2), family income (5), health insurance (4), education (5), age (2), race (2), marital status (1), plus state and year fixed effects. All models are weighted by survey weights and standard errors have been adjusted for clustering by state.

Table 6. Cigarette Taxes and Probability of Quitting Smoking during Pregnancy: By Parity, Maternal School and Pre-pregnancy Smoking, 10 PRAMS States 1993-1999

	Parity		*Maternal Schooling*		*Pre-Pregnancy Smoking*	
	First Birth	Second and higher order birth	High school education or less	More than high school	Less than 10 cigarettes/day	10 or more cigarettes/day
	(1)	(2)	(3)	(4)	(5)	(6)
Real tax 3 months before conception	0.0043 (3.02)**	0.0028 (2.37)*	0.0038 (2.92)**	0.0021 (0.89)	0.0028 (1.68)	0.0032 (3.02)**
Elasticity	1.03	1.02	1.29	0.49	0.50	1.22
Mean Dep var	0.53	0.35	0.38	0.54	0.72	0.34
Observations	12465	15049	19813	7198	6385	21129

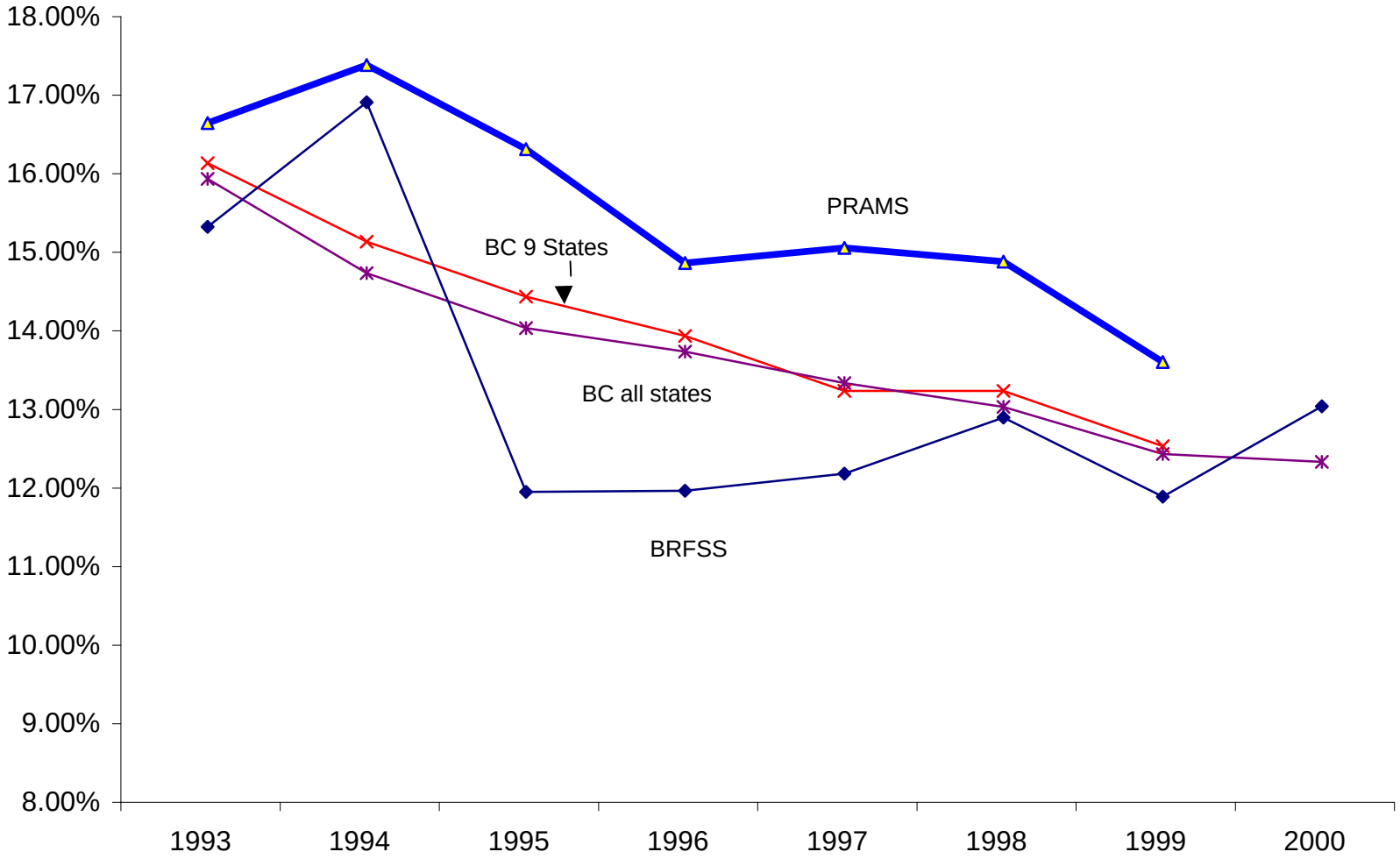
All models were estimated as Probits. Figures are dQ/dX_i. T-ratios are in parentheses. Models include indicator variables for family income (5), health insurance (4), education (5), age (2), race (2), marital status (1), parity (1), pregnancy intentions (1), pregnancy smoking (2) and state and year fixed effects. All models are weighted by survey weights and standard errors have been adjusted for clustering by state.

FIGURE1: Ever Smoked and Smoking Now in BRFSS, BRFSS 10 States and PRAMS*



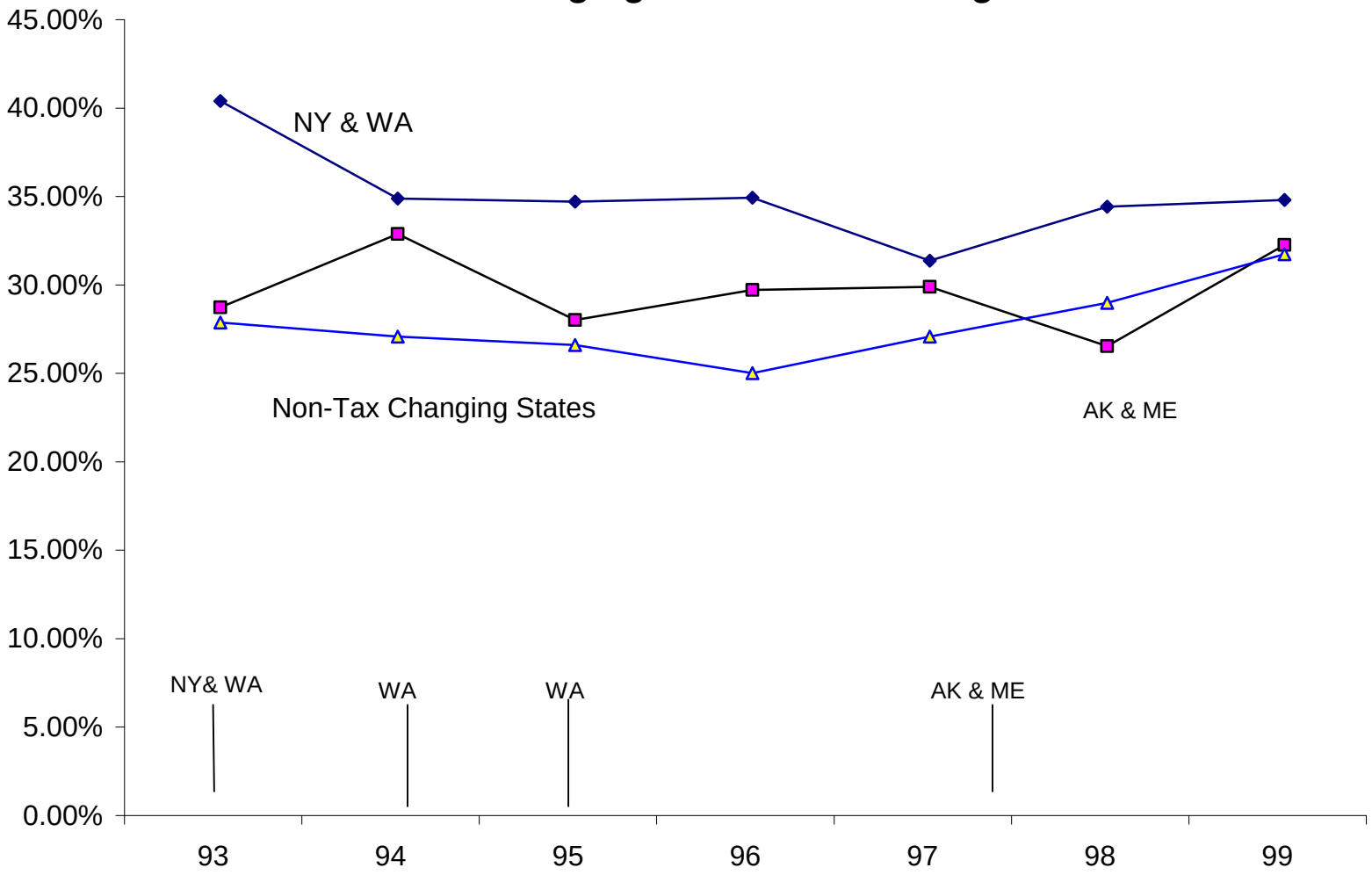
*10 States in PRAMS and BRFSS 10 are AL,AK,FL,GA,ME,NY,OK, SC, WA and WV

FIGURE 2: Smoking During Pregnancy, BRFSS, PRAMS and Birth Certificates



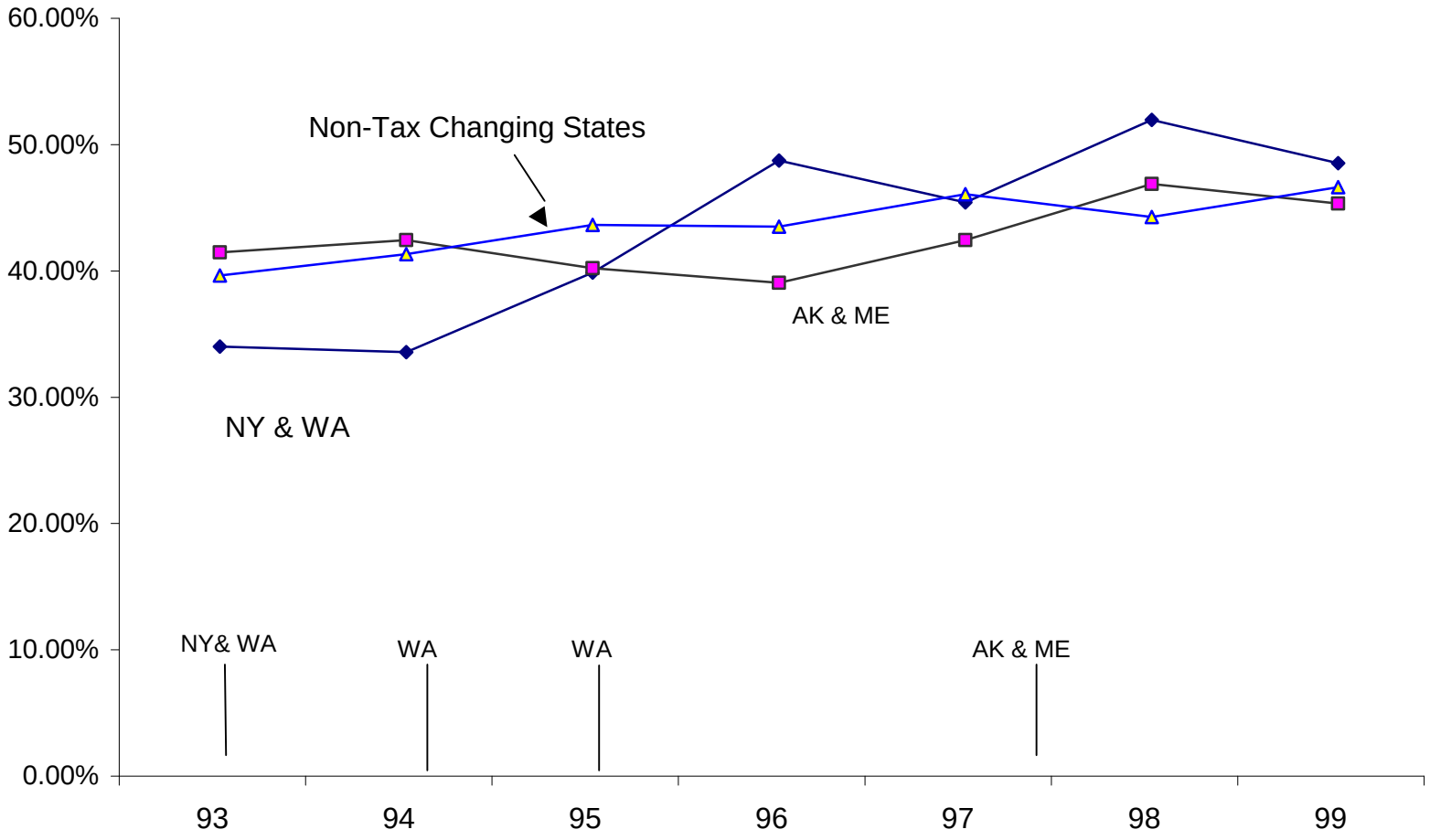
*9 States in BC 9 are AL,AK, FL, GA, ME, ? K,SC,WA,WV

Figure 3: Quit rates Three Months Before Pregnancy among Ever Smokers: Tax Changing vs. Non-Tax Change States in PRAMS*



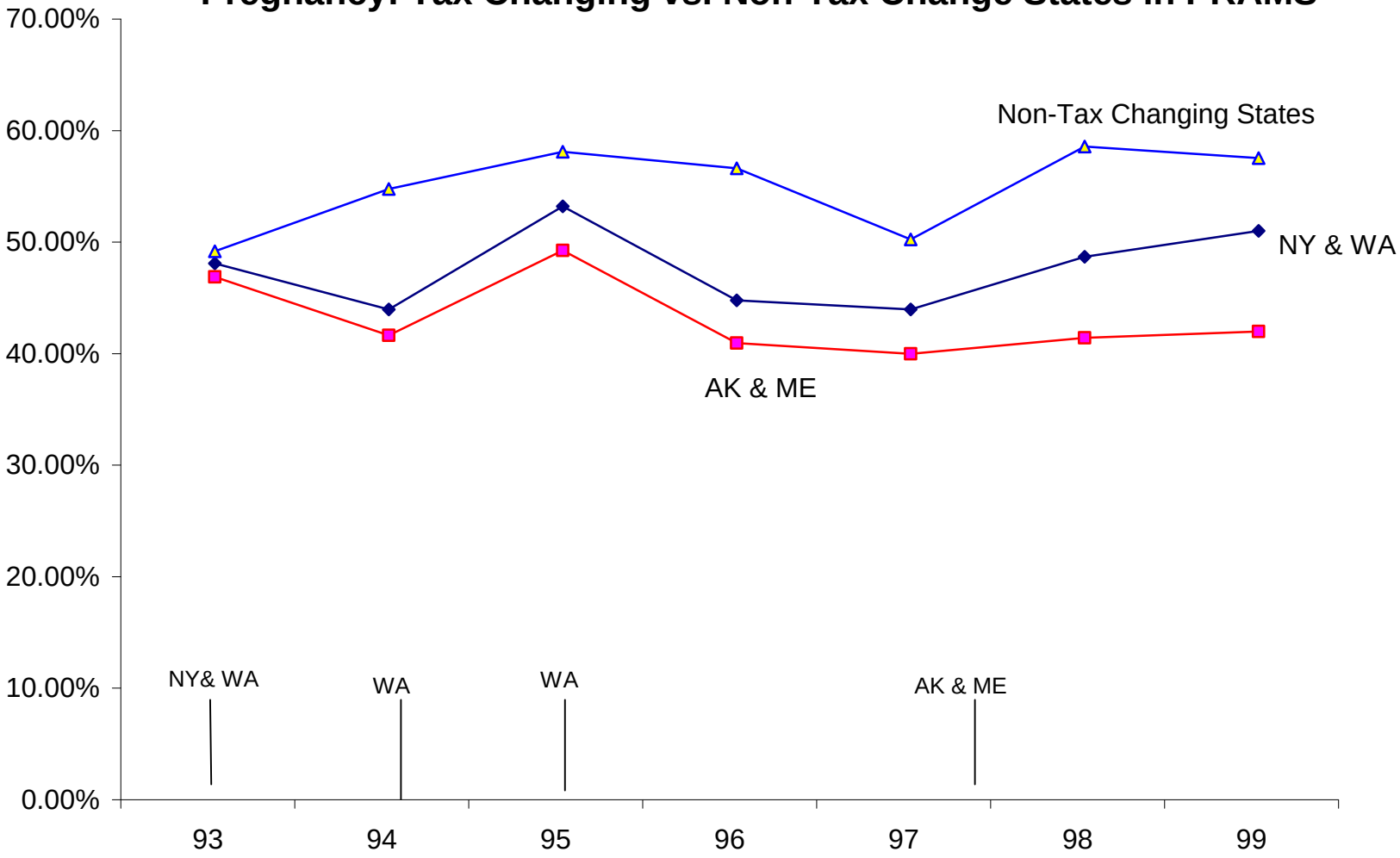
*Tax Changes NY 39-56 6/1/93: WA 34-54 7/1/93, 54-56.5 7/1/94 56.5-81.5 7/1/95: AK 29-100 10/1/97: ME 37-74 11/1/97

Figure 4: Quit rates During Pregnancy among Women that Smoked Three Months Before Pregnancy: Tax Changing vs. Non-Tax Change States in PRAMS*



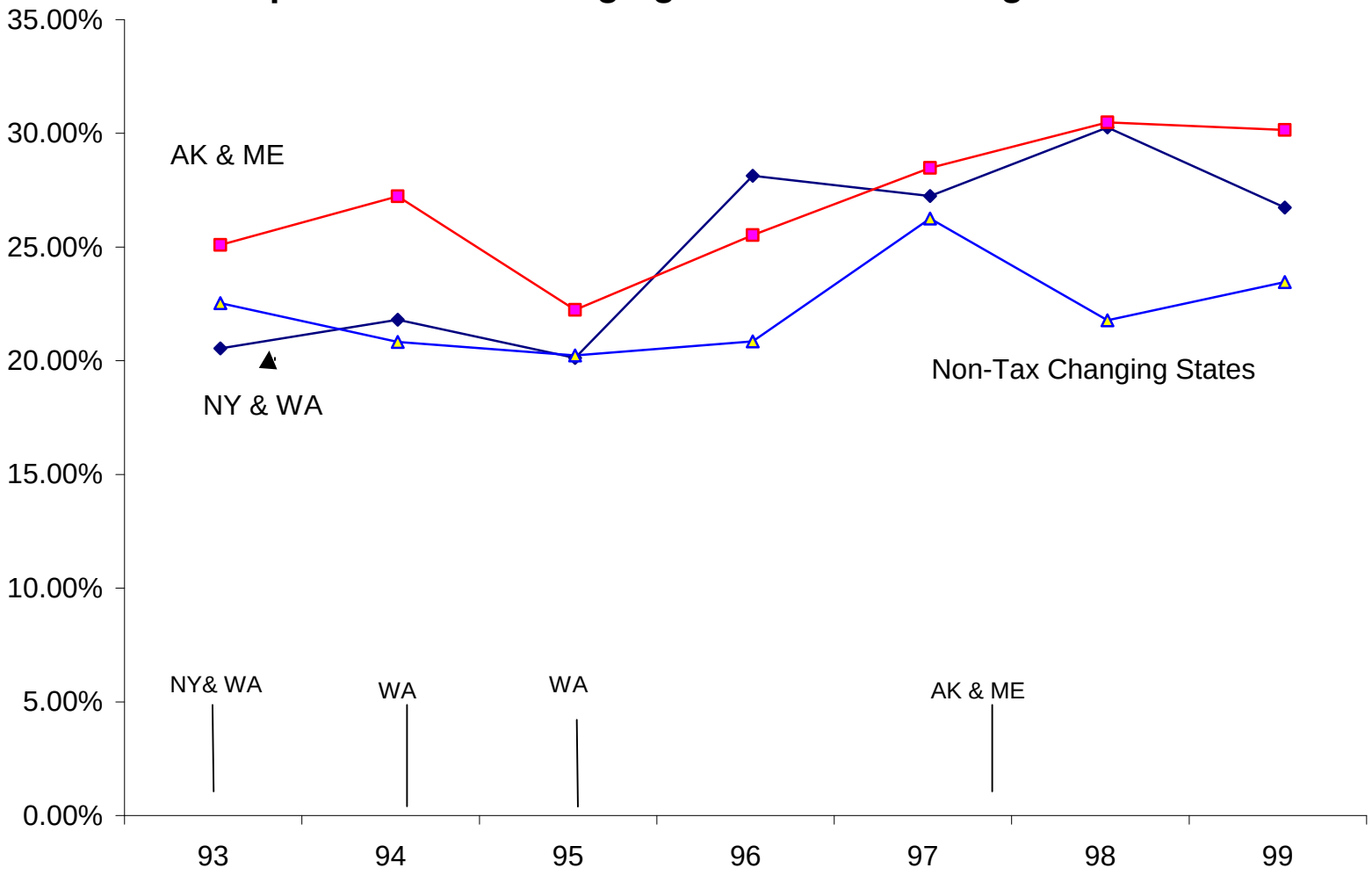
*Tax Changes NY 39-56 6/1/93: WA 34-54 7/1/93, 54-56.5 7/1/94 56.5-81.5 7/1/95: AK 29-100 10/1/97: ME 37-74 11/1/97

Figure 5: Postpartum Relapse Rates among Women that Quit during Pregnancy: Tax Changing vs. Non-Tax Change States in PRAMS*



*Tax Changes NY 39-56 6/1/93: WA 34-54 7/1/93, 54-56.5 7/1/94 56.5-81.5 7/1/95: AK 29-100 10/1/97: ME 37-74 11/1/97

Figure 6: Quit rates from Three Months Before Pregnancy to Postpartum : Tax Changing vs. Non-Tax Change States in PRAMS*



*Tax Changes NY 39-56 6/1/93: WA 34-54 7/1/93, 54-56.5 7/1/94 56.5-81.5 7/1/95: AK 29-100 10/1/97: ME 37-74 11/1/97

Appendix

Table 1. Characteristics of variables from the Behavioral Risk Factor Surveillance System (BRFSS), 1987-2000

Variable:	Weighted Mean	Robust Std. Err.
Smoking Habits:		
Smoked 1 or more cigarettes per	0.22	0.001
Number of cigarettes per day	3.54	0.019
Currently smokes	0.25	0.001
Ever smoked 100 cigarettes	0.40	0.001
Family Income:		
= $10,001	0.15	0.001
$10,001 - $20,000	0.27	0.001
$20,001 - $30,000	0.20	0.001
$30,001 - $40,000	0.21	0.001
$40,001 - $50,000	0.07	0.001
Unknown	0.11	0.001
Educational Attainment:		
= 8 years	0.03	0.000
9-11 years	0.08	0.001
12 years	0.33	0.001
13-15 years	0.30	0.001
= 16 years	0.27	0.001
Unknown	0.00	0.000
Age:		
< 20 years old	0.07	0.001
20 - 29 years old	0.56	0.001
= 30 years old	0.37	0.001
Race:		
White	0.81	0.001
Black	0.12	0.001
Other race	0.07	0.001
Woman is married	0.57	0.001
Woman is employed	0.68	0.001
Real tax	21.49	0.027
Real price	131.97	0.064
Woman is pregnant	0.05	0.001
Maximum N = 446010		