Sins of the Mother: The Effect of Early Life Cigarette Taxes on Asthma and Inequality

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Abstract

Decades of research have established a link between early life smoke exposure and health at birth. Yet, only a paucity of research has credibly examined outcomes later in childhood. I exploit exogenous variation in state-level cigarette taxes to estimate the causal impact of early life cigarette taxes on multiple measures of children's well-being such as asthma, asthma severity, and health status. Overall, I find an economically and statistically significant reduction in asthma prevalence. A one dollar increase in state excise taxes reduces the prevalence of asthma by 1.7 percentage points with larger reductions for non-white children and children from poorer households.

JEL Codes: I12, I14, I18

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1. Introduction

Asthma by far remains the most common chronic disease affecting children in the United States (CDC, 2012). Examining the prevalence of asthma by both socioeconomic status (SES) and race reveals significant disparities (Case, Lubotsky, and Paxson, 2002; Condliffe and Link, 2002). Children from wealthier households have lower rates of asthma than their counterparts from poorer households. Racial comparisons show a similar pattern of disparities in asthma prevalence as white children have lower rates of asthma than their Hispanic or black counterparts. Although the etiology of asthma includes both genetic and environmental influences, purely genetic explanations are uninteresting from a policy perspective. Maternal smoking during pregnancy, an environmental explanation, has often been hypothesized as a causal factor that been extensively studied since the early 1950s. The consensus from the early research indicates that early life smoke exposure is linked to poor child health outcomes (Law, 1996). Yet, the consensus on early life smoke exposure should be interpreted with caution because the early research emphasizes simple comparisons that lack a rigorous research design.

To estimate the causal impact of maternal smoking during pregnancy on later outcomes, I use quasi-experimental variation from changes in state-level cigarette taxes during the prenatal period of life to examine health outcomes for children such as asthma, severity of asthma, and health status. Using data from the National Survey of Children's Health (NSCH) I estimate reduced form intention to treat models employing a differences-in-differences research design. I find a one dollar ($2007) increase in cigarette taxes during the prenatal period measured reduces the prevalence of asthma by 1.7 percentage points off of a mean of nearly fourteen percent. Further analyzing the results by SES reveals that children from the poorest households drive the result since cigarette taxes substantially reduce the prevalence of asthma in low SES children by roughly around 3.5 percentage points, whereas the impacts for high SES children are a much smaller reduction by 1.1 percentage points. Estimating the effect of cigarette taxes separately based on race, on the other hand, produces more consistent reductions in prevalence as Hispanic and black children show a higher responsiveness to cigarette taxes at negative 2.4 and 1.8 percentage points than white children at a negative 1.6 percentage points, respectively. On the other hand, the effects of early life cigarette taxes on self-reported health and asthma severity are statistically indistinguishable from zero.

The analysis in this paper has several important implications for health and human capital policy. First, the dynamic production of health capital makes childhood health a salient policy issue because poor health in childhood persists into adulthood (Case, Fertig, and Paxson 2005; Smith, 1998), which means unhealthy children tend to become unhealthy adults. Explorations of the socioeconomic gradient illustrate a similar trajectory. Poor children tend to be sicker than their non-poor counterparts with the gap in health widening with age (Currie, Shields, Price, 2004; Chen et. al., 2004). Health gradients based on socioeconomic status as seen in the U.S. are also ubiquitous in the international context (Currie and Stabile, 2004; Farrell et al., 2008). Moreover, the analysis in this study between child health and cigarette smoking is also timely because rising incomes in the developing world have resulted in an increase in smoking prevalence.

In addition to health capital, the effects of poor health can spillover and influence the production of human capital. Respiratory illnesses such as asthma along with gastrointestinal disorders are the main causes of absences from school (Currie, Hanushek, Kahn, and Rivkin, 2009). Besides causing children to miss school, poor health can also affect cognition as sicker children may have a harder time learning in school (Currie, et. al, 2013). Children from low SES backgrounds have lower rates of academic achievement and educational attainment, and poor health has been offered as an explanation. Therefore, policies addressing health outcomes such as asthma could also influence and reduce cognitive gaps both based on race and SES.

Lastly, this paper contributes to the burgeoning literature on the fetal origins hypothesis and the intergenerational transmission of success while credibly identifying one causal factor contributing to the SES gradient for childhood asthma. Most studies on fetal origins have focused primarily on how negative prenatal shocks have lasting impacts through adulthood. This study, on the other hand, explores the effects of a positive shock during childhood, an intermediate phase in life preceding adulthood. Understanding the effects of shocks during childhood can be useful in designing optimal remediation policies during younger ages when the returns on investment to interventions are likely to be higher than in adulthood. By examining the role of parental health behaviors on the impact of children's health, this study also contributes to the recently developed literature on the intergenerational transmission of success. Parental investments in health have important implications for children's health, especially if adverse shocks show a pattern of persistence.

2. Conceptual Framework

2.1 The Production of Health

Since the seminal work of Barker (1986) theorizing the link between adverse prenatal conditions and later life outcomes such as heart disease, a large body of literature[1] has empirically explored and extended the Barker hypothesis, also commonly referred to as the fetal origins hypothesis, to pollution, disease, health insurance, and other shocks. Notable studies have credibly demonstrated that prenatal shocks that restrict nutrition such as from famine (van den Berg et. Al, 2006; Chen and Zhou, 2007) and exposure to the Islamic fasting (Mazumdar, 2011) can have long lasting negative impacts on both health and human capital. Other extensions beyond nutritional deficits have examined disease, such as the 1918 Spanish flu (Almond, 2006; Neelsen and Strattman, 2012), and shorter run impacts of air pollution (Coneus and Spiess, 2012) among others.

The dynamic production of health and human capital theorized by Becker (2007) and Heckman (2007) forms the conceptual framework underlying the current analysis. The conceptual model consists of two periods, early childhood and late childhood, and focuses solely on health capital and, for simplicity, ignores potential human capital effects. A common assumption in studies dealing with shocks to children is the absence of parental behavioral responses, i.e. that parents do not reinforce or compensate for early life adverse shocks. Cigarette prices work through changing parental investments in the prenatal period given by I_0^H and affect subsequent periods by affecting both the stock of health capital and investments in health capital. As equation 1 shows, cigarette taxes influence parental investments because smoking is a negative health investment for child *i* at time *0* which is the prenatal phase of life. Quitting smoking, therefore, serves as a positive investment because it reduces exposure to smoke, but also because consumption changes from reduction in spending on cigarettes to alternative goods may also serve as an investment in child health that may promote health development or possibly through an income effect[2]. Equation 2 shows that at birth the child's stock of health given by θ_1^H depends on both fixed genetic endowments of health and adjustable environmental prenatal investments shown by I_0^H.

$$(1) \qquad I_0^H = f(t_0^H)$$

$$(2) \qquad \theta_1^H = f(\theta_0^H, I_0^H)$$

$$(3) \qquad I_1^H = f(\theta_1^H)$$

[1] Almond and Currie (2011) and Currie and Almond (2003) provide an overview of the rich literature in economics on the fetal origins hypothesis.

[2] Bhai (2020) and a body of literature shows that smoking reduces income.

$$(4) \quad \theta_2^H = f(\theta_1^H, I_1^H)$$

Health in childhood given by θ_2^H in Equation 4 follows a similar trajectory. Equation 3 shows that investments during early childhood, given by I_1^H depend on the child's stock of health in the preceding period or early childhood. The stock of health during later childhood denoted by θ_2^H depends on both the stock of health in early childhood and flows, such as parental investments in health during early childhood. Thereby, cigarette taxes serve as an exogenous positive shock since they mitigate exposure to cigarette smoke (either from maternal smoking or indirect secondhand smoke exposure) and changes in household consumption patterns as individuals substitute away from smoking. Even though negative health shocks may occur during the prenatal period, because of the iterative nature in the production of health capital, the impact of the shocks extend to health capital in later childhood. Further, if there was another period for adulthood, they would adversely affect the production of health capital in adulthood.

From the conceptual framework, the impact of changes in cigarette taxes during the prenatal period can be derived and decomposed into two parts as shown in Equation 5, a change from endowments and a change from parental investments. The first term represents self-productivity because the value of health capital depends on the value of health capital in the preceding period. By raising the stock of health capital in early childhood, the productivity of the stock of health capital in the second period is greater. The second term represents cross productivity and captures the change in the stock of health during late childhood that happens from changes in the investment profile resulting from cigarette tax changes. Therefore, changes in prenatal investments alter both endowments and investments through the life of the child.

$$(5) \ \frac{d\theta_2^H}{\partial t_0^H} = \frac{\partial \theta_2^H}{\partial \theta_1^H}\frac{\partial \theta_1^H}{\partial I_1^H}\frac{\partial I_1^H}{\partial t_0^H} + \frac{\partial \theta_2^H}{\partial I_1^H}\frac{\partial I_1^H}{\partial \theta_1^H}\frac{\partial \theta_1^H}{\partial I_0^H}\frac{\partial I_0^H}{\partial t_0^H}$$

2.2 *The Empirical Evidence on Smoke Exposure*

Early work exploring maternal smoking and child health employs simple research designs that compare health outcomes of children from mothers that smoke versus children from mothers that did not smoke and finds a strong negative association between maternal smoking and child health; notably, children whose mothers smoke tend to have lower birth weight and shorter gestational ages (Weitzman et al, 2002). The negative effects of exposure still appear even if the exposure arises from paternal smoking (Martinez, 1996). The causal pathway from cigarette smoke and child health is hypothesized to occur because smoke exposes the fetus to notable teratogens such as nicotine, lead, and cyanide, and raises the possibilities of miscarriages. Such exposure alters the amount of nutrients the fetus receives, and teratogens can also hamper organ development during the second trimester. Nevertheless, it is possible that the effect of smoking on child health can be ambiguous if it influences the composition of births, more specifically, if the selection effect dominates (smoking causes miscarriages among weaker fetuses) versus a scarring effect (fetuses are sicker). Overall, the empirical evidence overwhelmingly suggests that the scarring effect dominates.

Studies employing more advanced research designs to account for potential confounders find a similar relationship between cigarette taxes and infant health. Using exogenous variation in state-level excise taxes on cigarettes, a series of papers have found a positive relationship between tax hikes and rising birth weight in children (Evans, 2000; Ringel and Evans 1995; Ringel and Evans 2000). They find that increasing cigarette taxes have contributed to rising birth weight for children that are born to women who were induced to quit by nearly 200 to 400 grams (Lien and Evans, 2005).

Despite the broad evidence linking maternal smoking and health in infancy, limited research has rigorously examined outcomes after infancy. One notable study by David Simon (2016) employs a novel event study framework using a differences-in-differences research design to examine the impact of prenatal exposure to cigarette smoke on child health. Using variation in excise taxes on cigarettes, he concludes increases in cigarette taxes led to reductions in hospitalizations for asthma, and increased school attendance, thereby providing indirect evidence in showing the relationship between early smoke exposure and reductions in children's asthma. It provides evidence linking early life smoke exposure to health in childhood.

3. Estimating Early Life Smoke Exposure

3.1 How do Smokers Respond to Cigarette Taxes?

The role of cigarette taxes on smoking behavior has been extensively studied on both the extensive margin of whether individuals decide to smoke (Chaloupka, 1991; Levy et. al 2002; Chaloupka et al, 2010; Chaloupka et al, 2012), and the intensive margin of how much individuals smoke (Mullahy, 1997; Tauras, 2006). The general findings of the literature, especially for studies whose time-period overlaps with this current study, are negative effects on both intensive and extensive margins with only disputes on the magnitudes of the effect sizes. Increases in cigarette taxes do induce behavioral responses such as substitution towards high tar cigarettes (Evans and

Farrelly, 1998), and changes in inhalation patterns (Adda, 2006), but the net effect on smokers suggests that they are responsive to cigarette taxes and as prices of cigarettes increase due to taxes, then consumption of cigarettes falls.

Although elasticities for the whole population for smokers are interesting, the more pertinent elasticities for the purposes of this study are elasticities for maternal smoking. The research on maternal responsiveness to cigarette taxes has been less explored than general elasticities, however considerable evidence (Decicca and Smith, (2012); Gruber and Zinman (2000); Markowitz et. al, (2011)) finds that pregnant women, like other smokers, also respond to higher prices[3]. The elasticities for maternal smoking range from -.81 on the high end to about -.14 on the low end, with additional variation based on age, race, socioeconomic status, and survey time-period. Other work (Bharadwaj, Johnsen, and Loken, 2014) exploring how women respond to higher costs of smoking such as through smoking bans, also finds positive effects of tobacco control policy on child health.

In Figure 1, I show the large decline in U.S. smoking prevalence during this study's time-period for all Americans and separately by race. During this study's time-period, smoking prevalence declines from approximately 32 percent to about 18 percent. Figure 2 shows the large magnitude of the changes occurring over time in nominal state-level taxes. In terms of the absolute value of the hikes, for much of the 1980s cigarette tax hikes were infrequent, and the real value of the cigarette tax was much lower than during 1990s. Beginning in the late 1990s with the Master Tobacco Settlement of 1998, large rises in cigarette taxes occur affecting nearly all states. Large federal tax hikes on cigarette also concurrently occur during this time. Figures 3 shows the frequency of the cigarette tax hikes in this study's time-period. Lastly, in Figure 4, I show that considerable geographic variation in cigarette taxes occurs during these years.

Taken as a whole, the graphical evidence shows that this study's time period has some strengths for the research question. First, because of the Master Tobacco Settlement, there is considerable variable in state-level cigarette tax hikes over time. Second, the size of the cigarette taxes is considerable in the dollar amount which overcomes the criticism that a lot of analysis on cigarette taxes relies on variation from small and infrequent increases. Finally, the considerable geographic variation in cigarette taxes allows for another test of the research design by comparing states with high cigarette taxes versus states with low cigarette taxes.

3.2 The National Survey of Children's Health

[3] Simon and Lakdawalla (2016) review the literature on cigarette taxes and maternal smoking in detail.

The National Survey of Children's Health (NSCH) is a representative cross section study of children conducted in three waves in 2003-04, 2006-07, and 2011-12 with an overall large sample size of 289,210 over the three waves. The survey attempts to measure the health of children from birth to 17 years of age. The NSCH includes large samples of both Hispanic and African-American children in addition to children from very poor SES households. Measures of children's health are obtained by asking a member of the household to respond to the survey via telephone. Mothers were most likely to provide answers on their child, as around 78% of the respondents were the mothers and 20% being fathers, with other relatives at roughly 2%, respectively. The large sample provides enough statistical power to capture small differences in prevalence of diseases which is important because of the low prevalence of most childhood illnesses and the intent to treat research design.

The survey respondent provided demographic information to NSCH that described the race of the child, and the selected child's race was identified as white, black, mixed race, Hispanic, or other. The responding adult also provided information on age, measured in years, and the gender of the child. Asthma, behavior or conduct issues, hearing issues, and whether the household contains a smoker are binary variables. For asthmatic children, the responding parent also provides the severity of asthma on a three-point Likert scale. The responses for health status are on a five-point Likert scale.

The NSCH also contains household characteristics on income relative to poverty level. Such a variable indirectly measures income since it is conditional on family size. The poverty level data are characterized as deviations from the poverty level and are calculated based on the relevant poverty benchmark per the survey year. I use this measure of the poverty level to create three categories. Low SES are households that are at or below 100% of the federal poverty level, mid SES are households that are between 100% and 300% above the poverty level, and high SES households are 300% above the poverty level.

Descriptive statistics from the NSCH are shown in Table 1. Overall, the asthma prevalence rate in the full sample is roughly fourteen percent (Appendix Table A1 displays the dependent variables based on race and SES and shows the large differences in asthma prevalence by both SES and race). As the graph in Figure 5A shows, the incidence of asthma rises with the age of children. The age profile is common with childhood diseases because diagnoses increase with age. The race gap between blacks, Hispanics, and whites begins at birth and widens with age. However, the gap between Hispanics and whites is considerably smaller than the gap between blacks and whites.

Next, similar differences in asthma prevalence are visible by measures of socioeconomic status in Figure 5B. Figure 5B shows the variation in both the prevalence of asthma between low, middle, and high SES households. As expected, children from the poorest households have substantial higher rates of asthma than the non-poor households. The prevalence of asthma for children from the middle SES group tends to be between the poorest and affluent children.

The severity measure, as shown in figures 6A, illustrate similar gaps as minority children have self-reported cases of more severe asthma, but unlike asthma prevalence these differences do not change with age. Asthma severity remains roughly at the same level throughout childhood. Severity of asthma by SES as shown in Figure 6B follows a similar pattern as for race. Severity remains stable around the mean with children from poorer households reporting a higher severity of asthma with children from more affluent households reporting a lower severity of asthma. Finally, I examine health status by race in Figure 7A and SES in 7B. The gradient for health status follows the gradient for asthma for race and SES. Both figures tend to confirm the previous literature's finding of gradient in children's health status by race and SES.

3.3 Estimation Strategy

To measure the effect of early life smoke exposure and childhood health, I exploit plausibly exogenous variation in state cigarette taxes at time of birth to estimate two-way fixed effects models. Equation 6 presents the baseline regression model where Y_{ist} represents the dependent variable such as asthma, severity of asthma, and health status for child *i* in state *s* at time *t*. The model contains state fixed effects to address time invariant state attributes that could confound the relationship between cigarette taxes and childhood health. It also includes a full set of age dummies to account for the nonlinearity in disease prevalence and time fixed effects which are based on the survey year. I define the early life cigarette tax as the state cigarette tax during the prenatal period. The vector X_{ist} contains demographic characteristics such as age, race, and the gender of the key selected child to improve precision of the estimates. The coefficient of interest is on the cigarette taxes, β, measured in 2007 dollars. Ultimately, the framework can be interpreted as a generalized difference in difference model examining the effect of treatment intensity (tax rates) on child health outcomes.

$$Y_{ist} = \alpha_s + \tau_t + Cigtax_{ist}\beta + X_{ist} + \varepsilon_{ist} \quad (6)$$

Since the responsiveness to cigarette taxes varies by different socioeconomic groups, I re-estimate the regression model in Equation 6 by SES groups and race to explore if cigarette taxes have heterogeneous impacts on health outcomes. Children from lower SES households are presumably more likely to be affected by cigarette taxes since the poor tend to reside in smaller households, are more sensitive to taxation, and have higher rates of parental smoking. Similarly, I estimate separately by race to assess the potential differential responses in children's health from changes in cigarette taxes. Such racial differences are likely to capture underlying socioeconomic differences. Since the unit of variation is at state by age by survey year, I also estimate models with state by year fixed effects to account for possible changes in trends in a non-parametric manner.

The sampling technique of the NSCH is its primary advantage because it provides large samples from each state which consist of 1800-2200 respondents per survey year. Since the "bite" of cigarette taxes varies based on the original level of the cigarette tax and the proportion of smokers, I can take advantage of the geographic variation in the number of smokers and the baseline levels of cigarette taxes. This means tests using geographic variation are powered to detect modest effect sizes and can provide additional support for the research design. The main disadvantage of the NSCH is that it has been only conducted three times, which makes it difficult to more rigorously challenge the common trends assumption of a DID research design since the estimates in the analysis are identified on the seventeen cohorts across fifty states observed at three points in time. To address this concern, I include a state by cohort linear trend in addition to state by year fixed effects to assess the common trends assumption based on the available data. I perform additional falsification tests to support my research design. First, I assess for the validity of DID assumptions by using lag cigarette taxes to evaluate whether states that increase cigarette taxes versus states that do not increase cigarette taxes have similar time trends. I also use leads or cigarette tax in early childhood to examine whether post-natal exposure also influences childhood health.

Besides the main identification assumption of parallel trends, another potential threat to identification would arise if cigarette tax increases are correlated with other attempts to improve children's health. Such contemporaneous investments are highly unlikely, because most revenues from cigarette taxes contribute directly to the state's general funds. I conduct placebo tests on other highly prevalent measures of children's health such as hearing deficits and behavioral or conduct issues as diagnosed by a doctor. Since early life cigarette taxes affect exposure to smoke which can affect birth weight, choosing the diseases for the placebo tests that satisfy the exclusion restriction of the test is challenging. The general low prevalence of illness also creates an additional challenge of choosing a disease where the placebo tests have adequate statistical power.

Additional minor concerns include measurement error and interpretation. First, because the prenatal period or early is measured with error, and since this error is likely to be classical, then estimates of the effect of early life smoke exposure on child health are likely to be attenuated. The early years of life are critical period with potentially differential impacts based on exposure during different time-periods, and it might be interesting to separate effects from prenatal to postnatal exposure. Because of the imprecise measurement of time of birth, I cannot separate the effect of cigarette taxes into different trimesters, and thus I interpret the coefficient to be the effect of cigarette taxes in early life[4]. Furthermore, data limitations which result in the omission of local state tax rates such as county and city tax rates that are common in certain metropolitan contribute to the concerns of measurement error. These taxes are more of a concern in the later years when taxes rise at both the county and city levels during the 1990s, and these omissions can produce downward biases provided the measurement error is classical.

4 The Effects of Early Life Smoke Cigarette Taxes on Childhood Outcomes

4.1 Early Life Exposure and Measures of Asthma

Households with smokers have children with higher rates of asthma and lower health status than households with non-smokers as shown in Appendix Table 1. This raise concerns that factors other than parental smoking might influence asthma and child health. For example, smoking households may differential invest in children than non-smoking households which may affect child development. Such differential investments could occur because smoking households tend to differ from smoking households on observable attributes such as education and income. More importantly, they might also differ on unobservable characteristics, which poses a challenge in identifying the effects of smoke exposure on childhood asthma.

The results from the difference in differences (DID) model exploit state-level variation in cigarette taxes (which shifts smoking behavior) and therefore are likely to be uncorrelated household unobservables. Thus, the DID model generates estimates of early life smoke exposure on childhood asthma through these within state-level changes in cigarette taxes. The baseline DID specification in column 1 of Table 3 shows that a one dollar ($2007) increase in cigarette taxes produces an economically and statistically significant reduction in the prevalence of asthma by 1.7 percentage

[4] Cigarette tax increases happen infrequently to differentiate between effects in potentially prenatal period or variation that happens by each year. Even in specifications that include tax leads and tax lags, the identifying variation is arising from much fewer observations than in the whole sample.

points. To address concerns about changes in the composition of cohorts over time and changes in diagnoses over time, I include state by cohort linear trends and state by year fixed effects in addition to controls for state level macroeconomic variables in column 2. I find the inclusion of these controls does not influence magnitude of the effect as the coefficient changes to a 1.8 percentage point reduction, and the effect remains statistically different from zero. Despite differences in self-reported severity of asthma, which follows a pattern like for the prevalence of asthma, the impact of cigarette taxes on the severity of asthma produces effect sizes that are small and statistically indistinguishable from zero. Likewise, the effect of early life cigarette taxes on health status is also small and statistically indistinguishable from zero.

To provide evidence in support of the DID research design, I also use leads and lags of cigarette taxes. The leads function as a falsification test and provide auxiliary evidence that the findings do not capture a trend for improving health. I find the coefficient on the lead term to have a solid economically and statistically insignificant zero across different specifications from columns 3 to 6. Concurrently, the coefficient on the early life or prenatal cigarette tax changes to a 2.2 percentage point reduction in asthma in specifications columns 3 and 4 even with additional controls. Nevertheless, the coefficient remains statistically similar to the baseline specification.

Next, I include a one-year lag of the cigarette tax in columns 5 and 6. The coefficients on these lags are negative and modestly sized but are not statistically different from zero which suggests the largest effects of cigarette taxes on asthma are during the prenatal period. The coefficient in for the early life or prenatal tax still shows that a one dollar increase reduces asthma prevalence by 1.9 percentage point in column 5. The inclusion of the state by cohort linear trends and macroeconomic controls does not influence the coefficient in a significant manner as the coefficient changes slightly to 1.7 percentage point in column 6. Despite the moderate and insignificant effect on the tax lag, it is still possible that post-natal exposure has adverse health consequences, however the effect size is likely to be small and the current study would be underpowered to detect such an effect. The change in statistical significance also should be expected as the correlation between the early life tax and the tax lead and tax lag is above .90. All coefficients on severity and health status are statistically indistinguishable from zero.

The estimates presented in Table 3 and the rest of the paper are from a reduced form research design and can be interpreted as Intention to treat (ITT). For studies that employ intention to treat research designs, a natural concern emerges whether the effect sizes estimated in the reduced form models are plausible. While these reduced form ITT estimates provide a lower bound for the impact of prenatal smoke exposure on child health, the deeper estimates of interest are for the Treatment Effect on the Treated (TOT). If the effect of early life cigarette taxes works only through maternal smoking, then elasticities on maternal smoking can be used to scale up the ITT coefficient to obtain the treatment effect on the treated (TOT). Because of secondhand smoke exposure, to recover the TOT, the reduced form estimate should also be scaled by pregnant non-smokers (which is impossible to calculate).

During this study's time-period, the average cigarette tax in real 2007 dollars was approximately $0.48. The approximate effect size of 1.7 percentage point reduction off of a mean of nearly 14 percent suggests a one dollar increase reduces asthma by 12 percent. Therefore, a *doubling* of the cigarette tax during this time-period would have reduced prevalence of asthma by about 12 percent. One can speculate that the effective TOT would be considerably larger for children of women who were induced to quit as result of changes in cigarette taxes. This first stage is likely driven by women who are induced to quit, women who reduce intensity of smoking, and the reduced occurrence of secondhand smoke.

To recover TOT, smoking rates and the changes in asthma be combined to produce a rough estimate. Smoking rates averaged about 25% during the study's time-period. A crude TOT estimate would be the 12% reduction in asthma scaled by the 25% estimate of smokers, which would imply a TOT of 50% reduction in asthma prevalence. While the primary pathway is likely through maternal smoking (both on the intensive and extensive margin), secondhand smoke exposure would also decline which makes scaling the intention to treat estimate by the proportion of smokers inaccurate. But there are likely effects being driven by reduction in secondhand smoke exposure that affects non-smoking pregnant women, which makes it difficult to scale for a TOT. Nevertheless, this exercise does indicate that the reduced form effect size of early life cigarette taxes from Table 3 is in a plausible range.

4.2 Does the Effect of Cigarette Taxes on Child Health vary based on Race and SES?

Because of the known heterogeneity in responsiveness to cigarette taxes by race and SES, I evaluate if early life cigarette taxes produce differential reductions in childhood asthma[5] by race and SES. First beginning by race in column 1 of Panel A in Table 4, I find that an increase in the

[5] Chaloupka and Pacula (1999) examine heterogeneity by race and gender in responsiveness to cigarette taxes. Figure 1 in this paper also shows the differential declines in smoking by race. Appendix Table A3 presents the differential means by race and SES.

cigarette tax by one dollar ($2007) produces a negative and statistically significant reduction in asthma prevalence for white children by 1.7 percentage points. Results for African-American children in column 3 reveal that a one dollar increase in the cigarette tax reduces the prevalence of asthma by 2.5 percentage points. The effects for Hispanic children in column 5 are in between the estimates for black and white children, with a one dollar increase in cigarette taxes reducing childhood asthma by 1.8 percentage points. The differences in these magnitudes are generally consistent with historical elasticities for responsiveness to cigarette taxes by race. All regressions by race for asthma are robust to the inclusion of macroeconomic controls and state by cohort linear trends along with state by year fixed effects. Similarly, in all regressions the impact of early life cigarette taxes on measures of severity and health status are small and statistically insignificant for blacks and whites, however, small reductions in severity are found for Hispanic children in columns 5 and 6, but these reductions are marginally significant.

Unlike estimates based on race, estimates based on SES reveal substantially variation in the effect of early life cigarette taxes on children's asthma. For children from the lowest SES level as shown in Panel B of Table 4 in column 1, a one dollar increase in the cigarette tax has a large statistically significant reduction in asthma prevalence by 3.2 percentage points. But for children in the middle SES group as shown in column 3, the impact of cigarette taxes remains large, negative, and significant but is diminished with a reduction in asthma prevalence by 1.9 percentage points. Lastly, for children that are in the highest SES group, cigarette taxes have smaller but significant impact of about 1.2 percentage point reduction in asthma as seen in column 5. Like the analysis by race, estimates on the impact of cigarette taxes by SES are robust to the inclusion of macroeconomic controls, state by year fixed effects, and cohort by state linear trends. The impact of early life cigarette taxes on measures of severity and health status is also small and statistically insignificant for all SES groups. Importantly, the pattern for asthma reductions for cigarette taxes coincides with the pattern between household smoking status and asthma by SES (as shown in Appendix Table A2).

4.3 Assessing the Identification Strategy: Placebo Tests

Alternatively, states may have enacted policies that aim to improve children's health concurrently with changes in cigarette taxes. If cigarette taxes are correlated with other measures that improve children's health, then the estimated effects in this study would include the effects of cigarette taxes and other improvements in children's health. Such a scenario is highly unlikely since a large portion of cigarette tax revenues are not invested in health investments. Nevertheless, to assess if other conditions in childhood that should not be influenced by cigarette taxes are affected by cigarette taxes, I conduct falsification tests using childhood behavior and hearing issues. Since exposure to cigarette smoke affects birth weight, which is a strong predictor of health and cognitive abilities, satisfying the exclusion restrictions for the placebo tests is challenging. The NSCH contains rich information on alternative diseases, and I choose diseases that have a high occurrence but that are unlikely to be affected by birth weight, such as hearing and behavior or conduct issues as diagnosed by a physician.

Table 5 presents the results from the placebo tests. Beginning with behavior and conduct issues, the impact of one dollar increase in cigarette taxes produces a very precise zero effect. In the next two specifications, the addition of the tax leads and lags along with the state by survey year fixed effects and cohort linear trends does not alter the coefficients as the effect of cigarette taxes on behavior and conduct issues remains economically and statistically insignificant. Next, the placebo test on hearing issues produces similar findings as with behavior or conduct issues. The effect of cigarette taxes during the prenatal period of life produces effects that are statistically indistinguishable from zero. The zero effects on the prenatal period for both diseases provides suggestive support for the claim that cigarette taxes are driving the variation in reducing asthma rates instead of alternative investments that could be improving children's health.

4.4 Gender and Variation in Asthma Outcomes

The literature on the fetal origins hypothesizes that gender can influence the impact of prenatal shock (Almond and Currie, 2011), because male fetuses may be more sensitive to adverse shocks than female fetuses. In table 6, I analyze the differences in outcomes between males and females to early life cigarette taxes. For boys in column 1, a one dollar increase in the cigarette tax reduces the prevalence of asthma by a statistically significant 2.1 percentage points (off a mean of roughly fifteen percent for boys). After accounting for macroeconomic conditions, cohort linear trends, and the inclusion of state by year fixed effects, the coefficient for boys is statistically unchanged with a 2.1 percentage point reduction for asthma in column 2. The baseline specification for girls in column 3 shows that a one dollar increase in cigarette taxes produces a 1.4 percentage point reduction in asthma (off a mean of roughly 11 percent for girls). The estimates in column 2 for girls are similarly robust to economic controls, state by cohort linear trends, and state by year fixed effects, with a one dollar increase in cigarette taxes producing a 1.7 percentage point reduction in asthma prevalence. Additionally, there is some evidence of improved health status for girls, but no statistical differences are found for boy's health status and for asthma severity.

4.5 Does the Effect on Asthma change by Smoking Prevalence and the Intensity of Taxation?

The substantial variation in smoking prevalence and the intensity of cigarette taxes provide additional opportunities to assess the role of early life cigarette taxes on childhood asthma. The motivation for this analysis arises from the fact that the relative increases in cigarette prices is higher for low tax states which would induce more marginal smokers to quit than in high tax states. In Table 7, I compare outcomes between the ten highest and ten lowest tax states. For high tax states, an increase in the cigarette tax during early life has a modestly negative coefficient on childhood asthma in the baseline specification with about a marginally significant 1 percentage point reduction in asthma. In column 2 with controls, the effect is significant at a 1.4 percentage point reduction in asthma. In low tax states, however, an increase in the cigarette taxes has a large statistically significant negative effect of 5.6 percentage point reduction in asthma. Inclusion of macroeconomic variables, state by cohort linear trend, and state by year fixed effect reduces the size to 4.6 percentage point reduction in asthma prevalence which is within the error bounds of the earlier estimate. Changes in cigarette taxes during early life have statistically distinguishable effects from zero on both severity of asthma and health status in high and low tax states.

Alternatively, the number of responsive smokers should vary by the state's rate of smoking prevalence. Therefore, I create a group of ten high smoking states and ten low smoking states based on smoking prevalence at the beginning of the study time-period. Incidentally, the overlap between high smoking prevalence and low cigarette taxes states is considerable as most states with low cigarette taxes generally have high smoking prevalence. I compare the effects of early life cigarette taxes between the ten states with the highest smoking prevalence and the ten states with the lowest smoking prevalence in Table 8. Because higher prevalence states should have a larger number of responsive smokers, thus the effect of cigarette taxes should be larger vis-à-vis low smoking prevalence states. Beginning with column 1 for low smoking prevalence states, a statistically significant reduction in both asthma prevalence and severity of asthma is seen at 3.7 percentage points. Accounting for cohort trends in column 2 changes the effect size to 3.0 percentage point reduction in asthma prevalence. In high smoking states, the coefficient on asthma is negative and a modestly sized at 1.4 percentage point. Again, the effects are robust to the inclusion of macroeconomic controls and state by year fixed effects at approximately a 1.7 percentage point reduction in asthma. Lastly, the effects on severity and health status is small and statistically indistinguishable from zero in both high and low smoking prevalence states.

4.6 Do Cigarette Taxes Influence Racial and Socioeconomic Inequality in Childhood Asthma?

In this section, I employ an Oaxaca-Blinder decomposition to decompose the gaps in asthma prevalence by both SES and race using an using cigarette taxes. Since the variation in state-level cigarette taxes is plausibly random, the decomposition allows for a causal counterfactual comparison of the asthma gap based on race and SES. The decomposition separates the impacts of cigarette taxes into a coefficient effect or people's responsiveness to cigarette taxes, the unexplained portion of the gap, and an endowment effect which is the explained portion. I present the decomposition results in Table 9.

First beginning with SES, I classify children coming from the lowest income level as being poor, and the children from the two highest income levels as non-poor. Poor children tend to reside in states that have slightly higher cigarette taxes on the whole, but this small difference is statistically distinguishable from zero. The difference in the cigarette tax endowment has a negligible effect on the asthma gap between poor and non-poor children. A notable and large statistically significant difference occurs in how poor and the non-poor children respond to cigarette taxes. Children from poorer households tend to be very responsive to cigarette taxes, and in the absence of cigarette taxes the asthma gap between the poor and nonpoor would have been significantly larger. Therefore, the heterogeneous responses indicate that children from the poorest households have benefited from the changes in cigarette taxes.

In contrast, decomposing the asthma gap produces negligible impact of cigarette taxes based on race. Again in Table 9, I decompose the gap in asthma between whites and non-whites. The non-white category includes Blacks, Hispanics, and multi-racial individuals. The outcomes of the decomposition are robust to exclusion of multi-racial individuals. The decomposition shows that White and Non-White gap cannot be explained by cigarette taxes. Both the coefficient and endowment effects are very small and statistically indistinguishable from zero. Conducting the decomposition by race implies that racial differences are likely socioeconomic differences because the racial gap reflects an underlying difference in behavioral responses by SES. Thus, cigarette taxes and tobacco control policies do not have a significant impact on the asthma gap between whites and non-whites.

5. Conclusion

It is a stylized fact of human development that negative shocks in early life have adverse impacts on development in infancy and adulthood, but very few studies have focused on outcomes in childhood. This study is one of the few that investigates how adverse conditions in early life affect health in childhood, an intermediate phase to adulthood. By using exogenous variation in state-level cigarette taxes during the prenatal stage of life, this study credibly estimates the effect of early life smoke exposure on children's health and asthma. The findings demonstrate that a one dollar increase in cigarette taxes produces sizeable reductions in asthma prevalence of 1.7 percentage points. Since poorer households are more likely to be responsive to changes in cigarette taxes, the effect of cigarette taxes on asthma varies considerably based on SES and race. Increases in the cigarette tax produce larger improvements in health for children from the poorer households.

In addition to tax policy considerations, reducing asthma prevalence can also have social returns in childhood through reductions in public spending on health expenditures. The social value from reducing asthma prevalence is substantial. A child without asthma incurs about $608 in medical expenditures per annum, whereas a child with asthma incurs costs of over $1,042 per annum, respectively a seventy percent increase from non-asthmatic children (PediatricAsthma.org). The total cost to treat asthma per annum in the United States is 3.2 billion dollars, and a fifteen percent reduction would provide social value of approximately $480 million dollars a year. Such an estimate is clearly a lower bound because it neglects the value of improved leisure from better health for children in addition to the dynamic improvements for future health and income.

Besides improving health outcomes, the empirical findings from this study raise several implications for public policy, one of which involves the contentious discussions on optimal tax policy for cigarettes. The usual cost-benefit analysis for cigarette tax analysis focuses on the costs and benefits to the smoker and ignores the secondary effects of smoking on child health. An omission of such a large intergenerational spillover that arises from maternal smoking in governmental cost-benefit calculations would then understate the benefits from cigarette tax hikes and result in less optimal tax policy.

Lastly, the results from this study have implications for health disparities and inequality. The differential impacts of cigarette taxes on asthma prevalence by SES illustrate that cigarette taxes have identified one main dimension of childhood health inequality through asthma. Addressing child health can also be an important approach to reducing inequality. Thus, enacting smoking reduction interventions also double as human capital interventions that can raise both the production of health and human capital in children and reduce inequality.

References

Adda, J., & Cornaglia, F. (2006). Taxes, cigarette consumption, and smoking intensity. *The American Economic Review*, *96*(4), 1013-1028.

Almond, D., & Currie, J. (2011). Killing me softly: The fetal origins hypothesis. *The Journal of Economic Perspectives, 25*(3), 153.

Almond, D., & Mazumder, B. (2011). Health capital and the prenatal environment: the effect of Ramadan observance during pregnancy. *American Economic Journal: Applied Economics*, 56-85.

Barker, D. J., & Osmond, C. (1986). Infant mortality, childhood nutrition, and ischaemic heart disease in England and Wales. *The Lancet, 327*(8489), 1077-1081.

Becker, G. S. (2007). Health as human capital: synthesis and extensions. *Oxford Economic Papers, 59*(3), 379-410.

Bhai, M. (2020). The Earning Losses of Smokers. *IZA Journal of Labor Economics, 9*(1).

Bharadwaj, P., Johnsen, J. V., & FLøken, K. V. (2014). Smoking bans, maternal smoking and birth outcomes. *Journal of Public Economics*, *115*, 72-93.

Case, A., Fertig, A., & Paxson, C. (2005). The lasting impact of childhood health and circumstance. *Journal of Health Economics, 24*(2), 365-389.

Case, A., Lubotsky, D., & Paxson, C. (2002). Economic Status and Health in Childhood: The Origins of the Gradient. *American Economic Review*, 1308-1334.

Centers for Disease Control and Prevention. Current Cigarette Smoking Among Adults—United States, 2005–2014. Morbidity and Mortality Weekly Report 2015;64(44):1233–40

Chaloupka, F. (1991). Rational Addictive Behavior and Cigarette Smoking. *Journal of Political Economy*, 722-742.

Chaloupka, F. J., & Pacula, R. L. (1999). Sex and race differences in young people's responsiveness to price and tobacco control policies. *Tobacco Control, 8*(4), 373-377.

Chaloupka, F. J., & Warner, K. E. (2000). The economics of smoking. *Handbook of health economics, 1*, 1539-1627.

Condliffe, S., & Link, C. R. (2008). The relationship between economic status and child health: evidence from the United States. *The American Economic Review, 98*(4), 1605-1618.

Coneus, K., & Spiess, C. K. (2012). Pollution exposure and child health: evidence for infants and toddlers in Germany. *Journal of Health Economics,31*(1), 180-196.

Currie, A., Shields, M. A., & Price, S. W. (2007). The child health/family income gradient: Evidence from England. *Journal of health economics, 26*(2), 213-232.

Currie, J., & Almond, D. (2011). Human capital development before age five. *Handbook of labor economics, 4*, 1315-1486.

Currie, J., & Stabile, M. (2003). Socioeconomic Status and Child Health: Why Is the Relationship Stronger for Older Children? *The American Economic Review, 93*(5), 1813.

Currie, J., Hanushek, E. A., Kahn, E. M., Neidell, M., & Rivkin, S. G. (2009). Does pollution increase school absences? *The Review of Economics and Statistics*, *91*(4), 682-694.

Evans, W. N., & Farrelly, M. C. (1998). The compensating behavior of smokers: taxes, tar, and nicotine. *The Rand journal of economics*, 578-595.

Evans, W. N., & Ringel, J. S. (1999). Can higher cigarette taxes improve birth outcomes? *Journal of Public Economics, 72*(1), 135-154.

Farrelly, M. C., Pechacek, T. F., & Chaloupka, F. J. (2003). The impact of tobacco control program expenditures on aggregate cigarette sales: 1981–2000. *Journal of health economics, 22*(5), 843-859.

Gruber, J., & Zinman, J. (2001). Youth smoking in the United States: evidence and implications. In *Risky behavior among youths: An economic analysis* (pp. 69-120). University of Chicago Press.

Heckman, J. J. (2007). The economics, technology, and neuroscience of human capability formation. *Proceedings of the National Academy of Sciences, 104*(33), 13250-13255.

Law, M. R., & Hackshaw, A. K. (1996). Environmental tobacco smoke. *British medical bulletin*, *52*(1), 22-34.

Lien, D. S., & Evans, W. N. (2005). Estimating the impact of large cigarette tax hikes the case of maternal smoking and infant birth weight. *Journal of Human resources, 40*(2), 373-392.

Markowitz, S., Adams, E. K., Dietz, P. M., Kannan, V., & Tong, V. (2011). *Smoking policies and birth outcomes: estimates from a new era* (No. w17160). National Bureau of Economic Research.

Mullahy, J. (1997). Instrumental-variable estimation of count data models: Applications to models of cigarette smoking behavior. *Review of Economics and Statistics, 79*(4), 586-593.

Neelsen, S., & Stratmann, T. (2012). Long-run effects of fetal influenza exposure: Evidence from Switzerland. *Social Science & Medicine, 74*(1), 58-66.

Ringel, J. S., & Evans, W. N. (2001). Cigarette taxes and smoking during pregnancy. *American Journal of Public Health, 91*(11), 1851-1856.

Simon, D. (2016). Does early life exposure to cigarette smoke permanently harm childhood health? Evidence from cigarette tax hikes *American Economic Journal (fix)*

Simon, D. & Lakdawalla, L. (2016). Cigarette Taxation and Pregnancy: Policy Based Estimates of the Price Elasticity of Smoking during Pregnancy. *Forthcoming Southern Economic Journal*

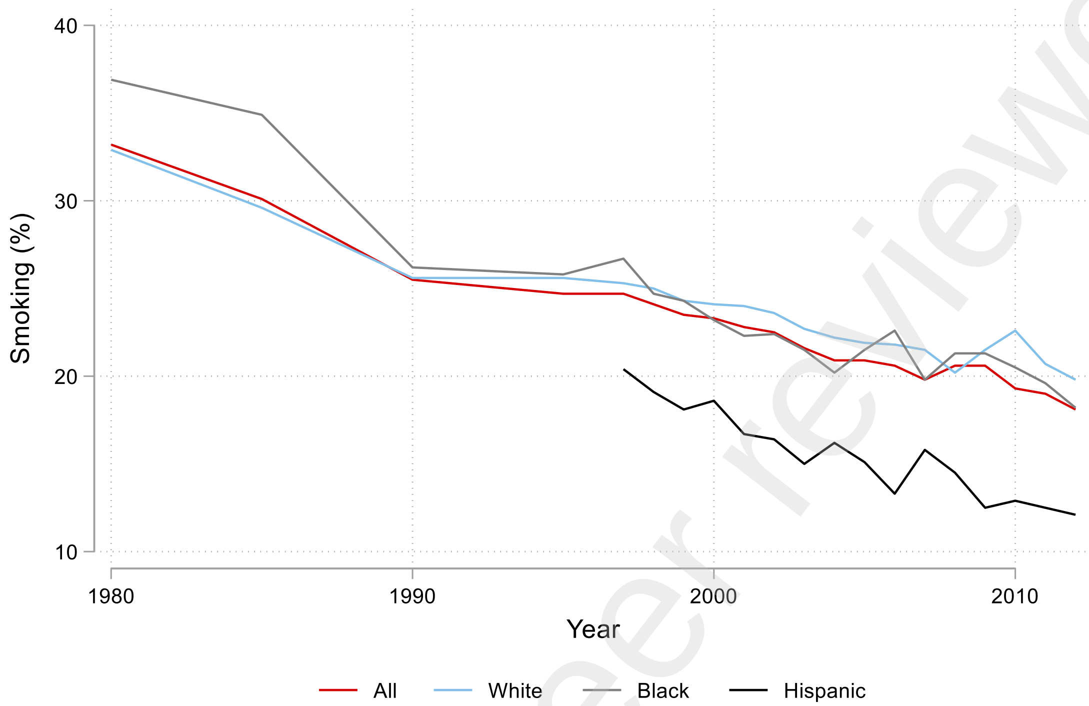
Tauras, J. A. (2006). Smoke Free Air Laws, Cigarette Prices, and Adult Cigarette Demand. *Economic Inquiry, 44*(2), 333-342.

United States Department of, H., Human Services. Centers for Disease, C., & Prevention. National Center for Health, S. (2007). *National Survey of Children's Health, 2003*. Retrieved from: http://doi.org/10.3886/ICPSR04691.v1

van den Berg, Gerard J., Maarten Lindeboom, and France Portrait. 2006. "Economic Conditions Early in Life and Individual Mortality." *American Economic Review*, 96(1): 290-302.

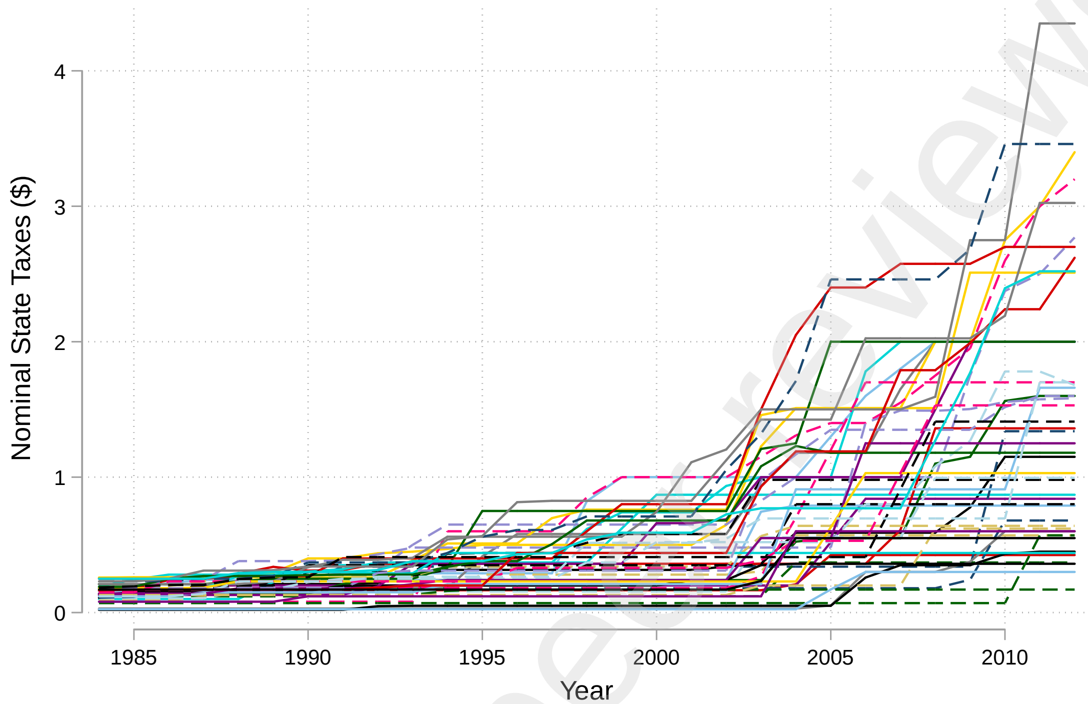
Wakefield, M., & Chaloupka, F. (2000). Effectiveness of comprehensive tobacco control programmes in reducing teenage smoking in the USA. *Tobacco Control, 9*(2), 177-186

Figure 1
The Falling Rate of Smoking in the U.S. 1983-2012



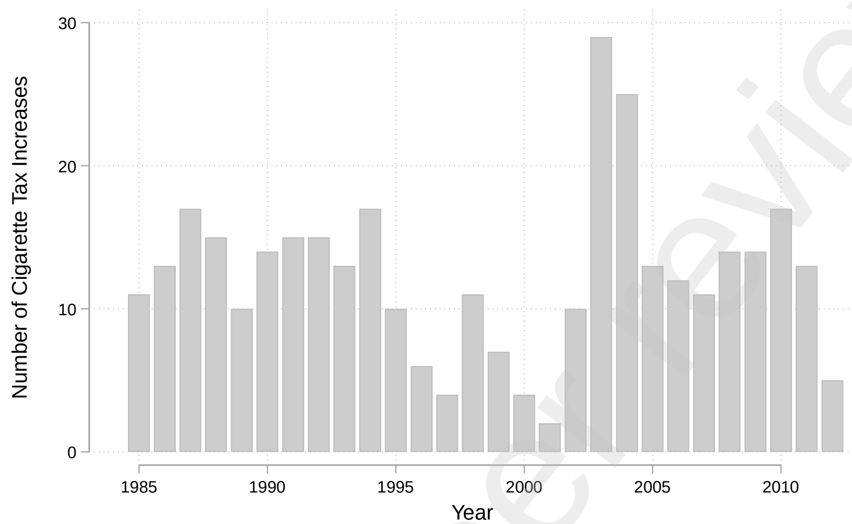
Source: Centers for Disease Control (2016).

Figure 2
Real Cigarette Taxes from 1986-2012



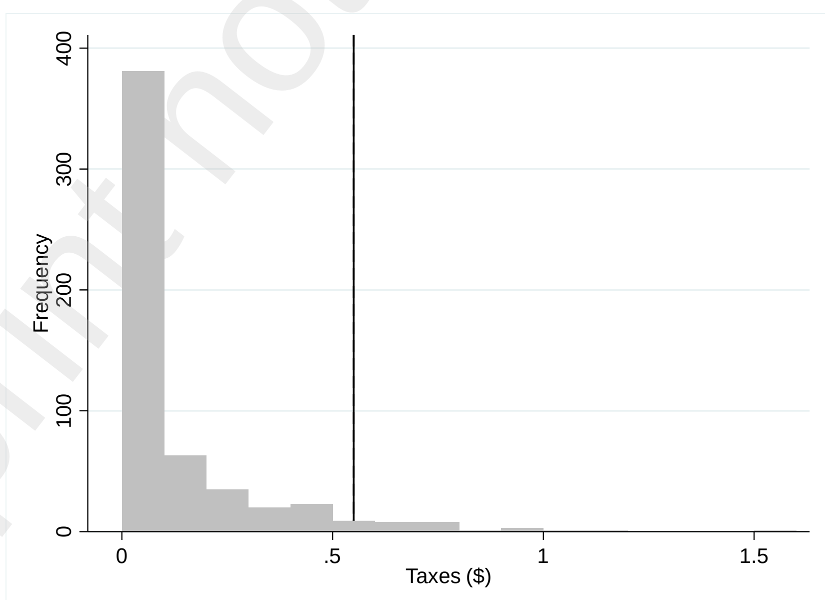
Source: Impacteen (2016). Notes: Nominal cigarette taxes (in dollars) over time.

Figure 3A
Frequency of Cigarette Taxes (in nominal dollars) from 1986-2012



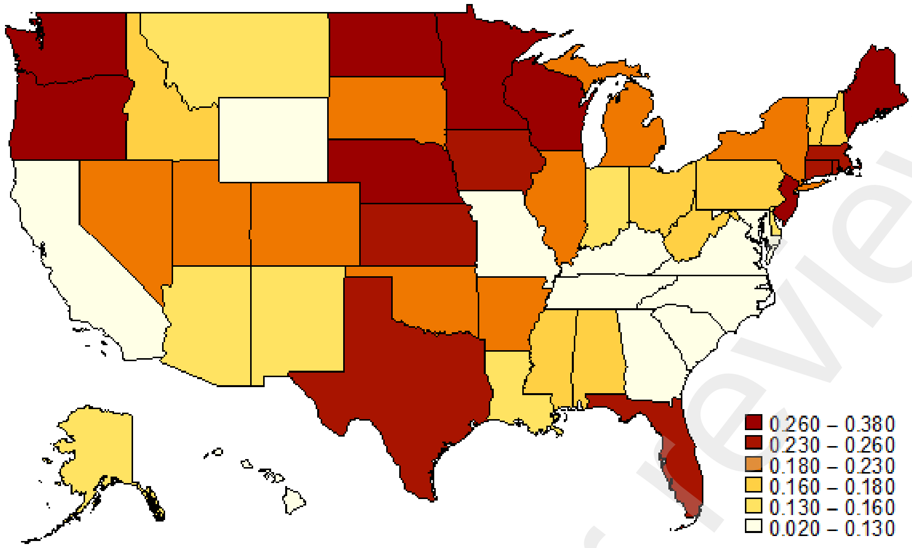
Source: Impacteen (2016)

Figure 3B
Magnitude of Cigarette Tax Hikes (in nominal dollars) from 1986-2012



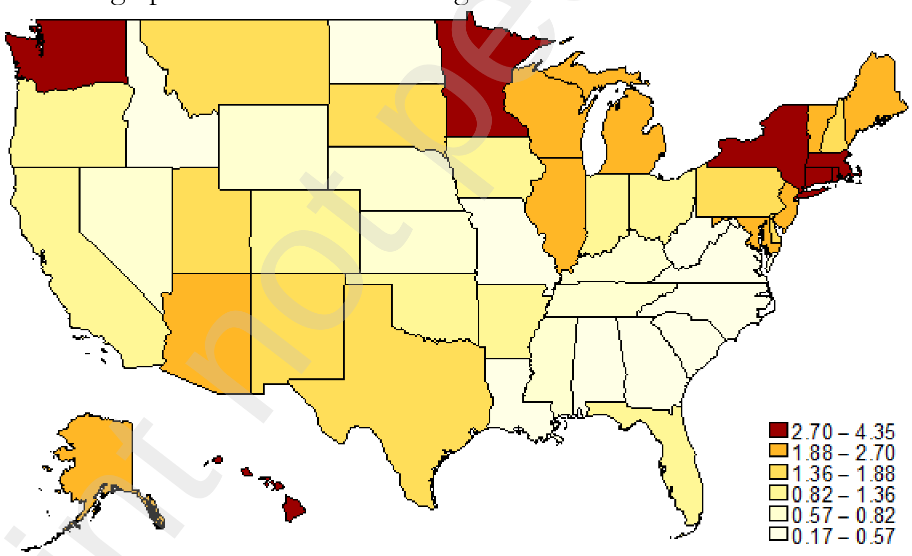
Source: Impacteen (2016)

Figure 4A
Geographic Variation in Real Cigarette Taxes in the U.S. in 1985



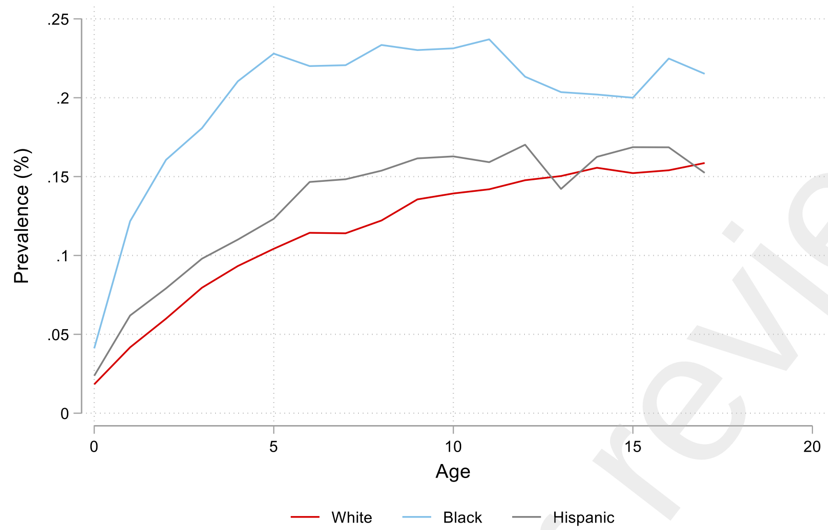
Source: Impacteen (2016)

Figure 4B
Geographic Variation in Real Cigarette Taxes in the U.S. in 2010



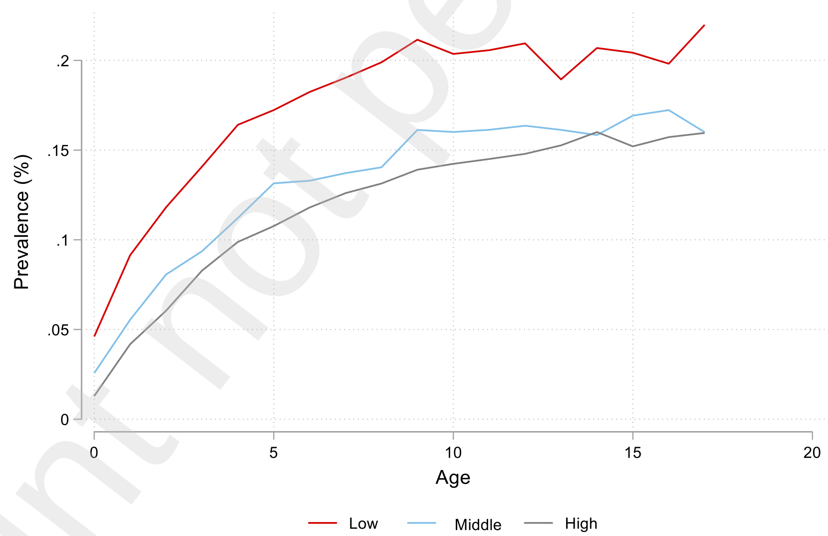
Source: Impacteen (2016)

Figure 5A
Age Profile of Asthma Prevalence for by Race



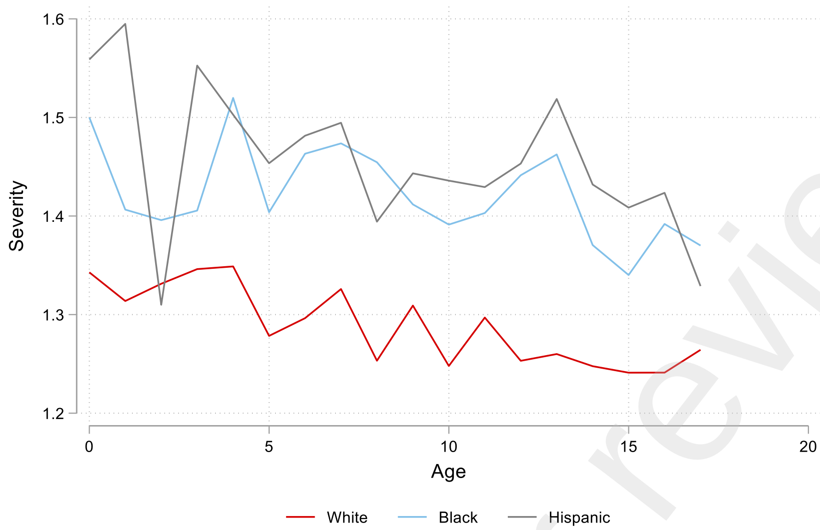
Source: National Survey of Children's Health (2003, 2007, and 2012).

Figure 5B
Age Profile of Asthma Prevalence for by Socioeconomic Status



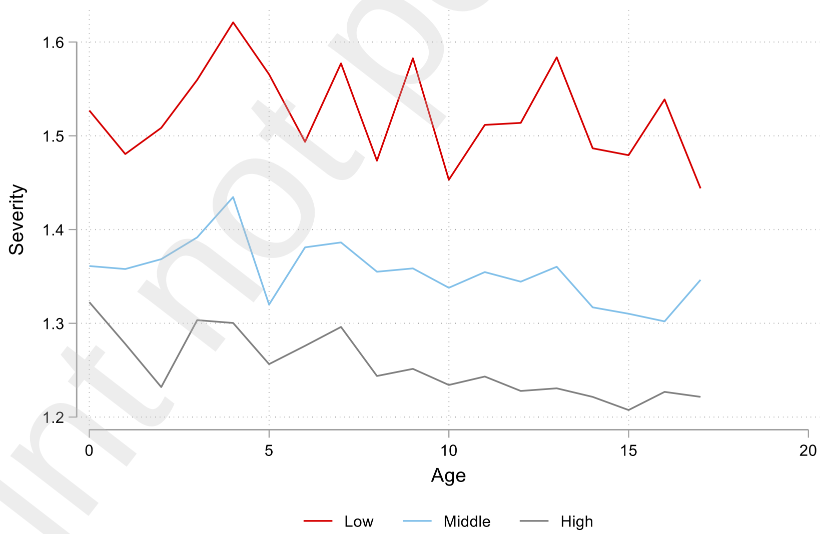
Source: National Survey of Children's Health (2003, 2007, and 2012).

Figure 6A
Age Profile of Asthma Severity by Race



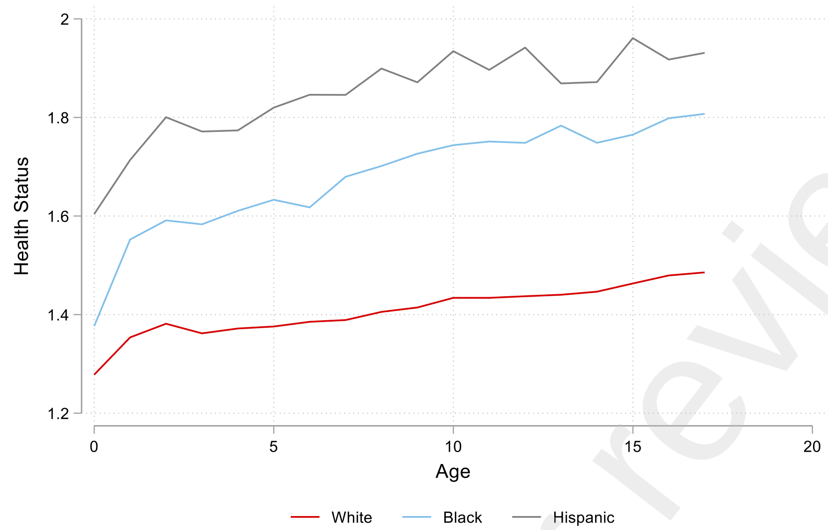
Source: National Survey of Children's Health (2003 ,2007, and 2012). Notes: Lower values show a less severe form of asthma

Figure 6B
Age Profile of Asthma Severity by Socioeconomic Status



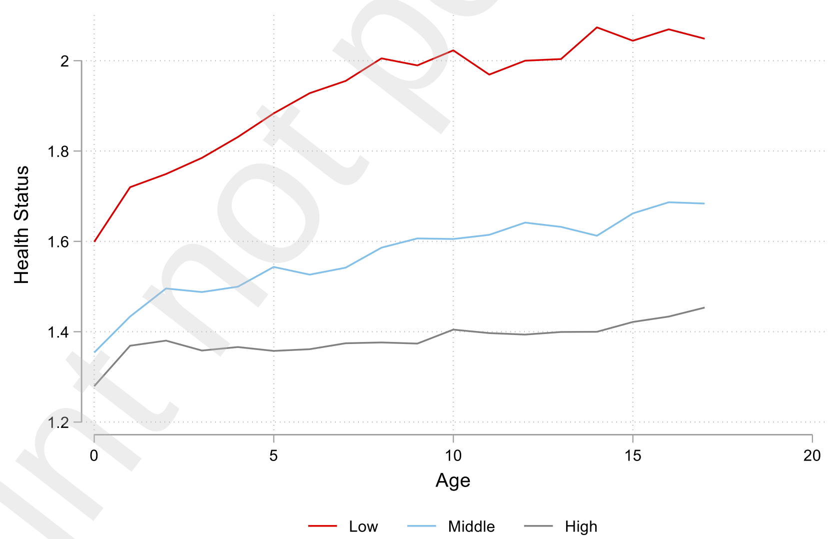
Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Lower show a less severe form of asthma

Figure 7A
Age Profile of Health Status by Race



Source: National Survey of Children's Health (2003, 2007, and 2012). Lower values represent better health.

Figure 7B
Age Profile of Health Status by Socioeconomic Status



Source: National Survey of Children's Health (2003, 2007, and 2012). Lower values represent better health.

Table 1
Descriptive Statistics for the NSCH Whole Sample

Variables	Mean	STD
Demographics		
Low SES	0.117	-
Middle SES	0.330	-
High SES	0.460	-
Male	0.514	-
Age	8.930	5.310
White	0.732	-
Black	0.100	-
Hispanic	0.129	-
Household Smoker	0.260	-
Dependent Variables		
Asthma	0.137	-
Severity	1.324	0.552
Health Status	2.109	0.969
Hearing	0.032	-
Behavior	0.046	-
Cigarette Taxes		
Early Life Tax	0.858	0.483
Lag Tax	0.815	0.430
Lead Tax	0.901	0.501

Sources: National Survey of Children's Health (2003, 2007, and 2012) and Impacteen (2015). Notes: The standard deviation of the variable is next to the mean of the observations. *n*=289,210

Table 2
Maternal Responses to Cigarette Taxes

Study	Cohort	Data	Group	Elasticity
Markowitz et. Al (2011)	2000-2005	PRAMS	Tenn Moms	-0.81
			Age 20-24	-0.23
			Age 25-34	-0.59
			Age 35 +	-0.13
Decicca and Smith (2009)	1999-2003	Vital Statistics	All Moms	-0.14
			Dropouts	-0.24
Lien and Evans (2005)	1990-2007	Vital Statistics	Select States	-0.62
Gruber and Zinman (2000)	1991-1999	Vital Statistics	Age 13-15	-0.24
			Age 16-18	-0.37
Ringel and Evans (2001)	1989-1995	Vital Statistics	All Moms	-0.70
			Black	-0.55
			White	-0.79
			Hispanic	-0.64
			Other	-0.54
			Married	-1.12
			Unmarried	-0.37

Source: Simon and Lakdawalla (2016)

Table 3
The Effect of Early Life Cigarette Taxes on Childhood Health

Dependent Variable: Child Outcomes						
	1	2	3	4	5	6
Asthma (n=257981)						
Tax	-0.017***	-0.018***	-0.022***	-0.022***	-0.019**	-0.017*
	(0.003)	(0.003)	(0.004)	(0.005)	(0.006)	(0.006)
Tax (One Year Lead)			0.005	0.006	0.005	0.005
			(0.005)	(0.006)	(0.005)	(0.006)
Tax (One Year Lag)					-0.004	-0.006
					(0.006)	(0.006)
Severity (n=21804)						
Tax	-0.009	-0.033	-0.053	-0.053	-0.056	-0.058
	(0.017)	(0.021)	(0.038)	(0.041)	(0.048)	(0.049)
Tax (One Year Lead)			0.051	0.028	0.051	0.029
			(0.040)	(0.047)	(0.040)	(0.047)
Tax (One Year Lag)					0.004	0.006
					(0.031)	(0.031)
Health Status (n=257910)						
Tax	-0.007	-0.007	-0.002	-0.004	0.019	0.018
	(0.006)	(0.007)	(0.012)	(0.012)	(0.014)	(0.014)
Tax (One Year Lead)			-0.006	-0.005	-0.007	-0.009
			(0.013)	(0.013)	(0.012)	(0.012)
Tax (One Year Lag)					-0.025	-0.026
					(0.013)	(0.014)
Economic Controls	No	Yes	No	Yes	No	Yes
State by Year	No	Yes	No	Yes	No	Yes
State by Cohort Linear Trend	No	Yes	No	Yes	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Each column represents a separate regression for the respective dependent variable. All regressions include full set of dummies for age, sex, year, and state. Economic controls include log per capita income and the local unemployment rate at the year of birth. Huber-White standard errors clustered at the state level are below the coefficients. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.001.

Table 4
The Effect of Early Life Cigarette Taxes on Childhood Health by SES and Race

Dependent Variables: Childhood Outcomes						
	1	2	3	4	5	6
Panel A: Race	**White**		**Black**		**Hispanic**	
Asthma	-0.017***	-0.017***	-0.025*	-0.028*	-0.018*	-0.018*
	(0.003)	(0.003)	(0.010)	(0.013)	(0.007)	(0.007)
n	*193024*	*193024*	*27395*	*27395*	*37562*	*37562*
Severity	0.002	-0.030	0.059	0.058	-0.100*	-0.090
	(0.019)	(0.023)	(0.037)	(0.052)	(0.045)	(0.063)
n	*14811*	*14811*	*4125*	*4125*	*2868*	*2868*
Health Status	-0.004	0.003	0.011	-0.008	-0.022	-0.013
	(0.006)	(0.007)	(0.023)	(0.022)	(0.021)	(0.024)
n	*192978*	*192978*	*27385*	*27385*	*37547*	*37547*
Panel B: SES	**Low**		**Middle**		**High**	
Asthma	-0.032***	-0.037***	-0.019***	-0.017**	-0.012**	-0.014***
	(0.008)	(0.007)	(0.004)	(0.005)	(0.003)	(0.004)
n	*29871*	*29871*	*86477*	*86477*	*141633*	*141633*
Severity	-0.012	0.006	-0.016	-0.048	0.010	0.007
	(0.038)	(0.056)	(0.026)	(0.032)	(0.023)	(0.029)
n	*3521*	*3521*	*7501*	*7501*	*10782*	*12290*
Health Status	-0.020	-0.005	0.002	-0.007	-0.010	-0.008
	(0.019)	(0.024)	(0.009)	(0.009)	(0.006)	(0.009)
n	*29857*	*29857*	*86456*	*86456*	*141597*	*141597*
State and Year	Yes	No	Yes	No	Yes	No
State by Year	No	Yes	No	Yes	No	Yes
State by Cohort Trend	No	Yes	No	Yes	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Each column represents a separate regression for the respective dependent variable. All regressions include full set of dummies for age, sex, year, and state. Economic controls include log per capita income and the local unemployment rate at the year of birth. Huber-White Standard errors clustered at the state are included in parenthesis under the coefficients. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.001.

Table 5
The Effects of Early Life Cigarette Taxes on Other Childhood Ailments

Dependent Variable: Child Outcomes						
	1	2	3	4	5	6
Behavior (n=230150)						
Tax	-0.0001	0.003	-0.002	0.000	0.011	0.011
	(0.002)	(0.004)	(0.006)	(0.006)	(0.008)	(0.008)
Tax (One Year Lead)			0.002	0.004	0.000	0.002
			(0.006)	(0.006)	(0.006)	(0.006)
Tax (One Year Lag)					-0.015*	-0.013
					(0.007)	(0.007)
Hearing (n=247715)						
Tax	0.0001	0.001	-0.001	-0.000	0.002	0.001
	(0.001)	(0.002)	(0.004)	(0.004)	(0.005)	(0.005)
Tax (One Year Lead)			0.001	0.003	0.001	0.003
			(0.004)	(0.004)	(0.004)	(0.004)
Tax (One Year Lag)					-0.004	-0.002
					(0.004)	(0.004)
Economic Controls	No	Yes	No	Yes	No	Yes
State by Year	No	Yes	No	Yes	No	Yes
State by Cohort Trend	No	Yes	No	Yes	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Each column represents a separate regression for the respective dependent variable. All regressions include full set of dummies for age, sex, year, and state. Economic controls include log per capita income and the local unemployment rate at the year of birth. Huber-White Standard errors clustered at the state are included in parenthesis under the coefficients. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.001.

Table 6
Variation in the Effects of Early Life Cigarette Tax by Gender

Dependent Variables: Childhood Outcomes	Male		Female	
	1	2	3	4
Asthma	-0.021***	-0.021***	-0.014***	-0.017***
	(0.004)	(0.004)	(0.004)	(0.005)
n	*133472*	*133472*	*124284*	*124284*
Severity	-0.013	-0.009	-0.001	-0.076
	(0.021)	(0.031)	(0.027)	(0.038)
n	*12478*	*12478*	*9302*	*9302*
Health Status	0.001	0.008	-0.014	-0.023*
	(0.008)	(0.012)	(0.010)	(0.009)
n	*133430*	*133430*	*124255*	*124255*
Economic Controls	No	Yes	No	Yes
State by Year	No	Yes	No	Yes
State by Cohort Trend	No	Yes	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Each column represents a separate regression for the respective dependent variable. Economic controls include log per capita income and the local unemployment rate at the year of birth. Huber-White Standard errors clustered at the state are included in parenthesis under the coefficients. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.001.

Table 7
Geographic Variation in Early Life Cigarette Taxes by Level of Cigarette of Taxes

Dependent Variables: Childhood Outcomes	High Tax		Low Tax	
	1	2	3	4
Asthma	-0.009	-0.014*	-0.059***	-0.046**
	(0.005)	(0.005)	(0.011)	(0.011)
n	*48324*	*48324*	*51002*	*51002*
Severity	-0.013	-0.027	0.064	-0.000
	(0.018)	(0.018)	(0.074)	(0.096)
n	*4459*	*4459*	*4214*	*4214*
Health Status	-0.009	-0.006	-0.062	-0.079
	(0.007)	(0.005)	(0.037)	(0.048)
n	*48314*	*48314*	*50983*	*50983*
Economic Controls	No	Yes	Yes	Yes
State by Year	No	Yes	No	Yes
State by Cohort Trend	No	Yes	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Each column represents a separate regression for the respective dependent variable. Economic controls include log per capita income and the local unemployment rate at the year of birth. The high tax states include Alaska, Connecticut, Hawaii, Maine, Massachusetts, Michigan, New York, New Jersey, Rhode Island, and Washington. The low tax states include Alabama, Georgia, Kentucky, Mississippi, Missouri, North Carolina, South Carolina, Tennessee, Virginia, and Wyoming. Huber-White Standard errors clustered at the state are included in parenthesis under the coefficients. Statistical significance denoted by the following * $p<0.05$, ** $p<.01$, *** $p<.001$.

Table 8
Geographic Variation in Early Life Cigarette Taxes by Smoking Prevalence

Dependent Variables: Childhood Outcomes				
	Low Smoking		**High Smoking**	
	1	2	3	4
Asthma	-0.014**	-0.018*	-0.037**	-0.028**
	(0.004)	(0.007)	(0.009)	(0.009)
n	*52743*	*52743*	*56330*	*56330*
Severity	-0.056	-0.040	-0.080	-0.114
	(0.035)	(0.041)	(0.052)	(0.073)
n	*4158*	*4158*	*4926*	*4926*
Health Status	-0.007	0.001	-0.010	-0.021
	(0.010)	(0.009)	(0.023)	(0.033)
n	*52729*	*52729*	*56318*	*56318*
Economic Controls	No	Yes	No	Yes
State by Year	No	Yes	No	Yes
State by Cohort Trend	No	Yes	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012). Each column represents a separate regression for the respective dependent variable. Economic controls include log per capita income and the local unemployment rate at the year of birth. The high prevalence states are the following Kentucky, W. Virginia, Arkansas, Tennessee, Louisiana, Indiana, Mississippi, Missouri Alabama, Michigan, Ohio, and Oklahoma. The low prevalence states are the following: New Hampshire, Washington, Arizona, Vermont, Idaho, Massachusetts, Maryland, New York, Connecticut, Utah Hawaii, California.) Huber-White Standard errors clustered at the state are included in parenthesis under the coefficients. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.00.1

Table 9
Decomposing the Asthma Gap by Race and Socioeconomic Status

Asthma Gaps					
	Coefficient	S.E.		Coefficient	S.E.
By Socioeconomic Status			*By Race*		
Non-Poor	0.127***	(0.003)	White	0.123***	(0.003)
Poor	0.170***	(0.006)	Non-White	0.160***	(0.005)
Differences	-0.043***	(0.005)	Differences	-0.036***	(0.005)
Explained	0.005***	(0.001)	Explained	0.0001	(0.002)
Unexplained	-0.048***	(0.004)	Unexplained	-0.036	(0.004)
Explained			*Explained*		
Cigarette Tax	0.001***	(0.0003)	Cigarette Tax	0.0002	(0.0004)
Unexplained			*Unexplained*		
Cigarette Tax	0.016*	(0.007)	Cigarette Tax	0.004	(0.006)

Source: National Survey of Children (2003, 2007, and 2012). Selected coefficients presented for the asthma gap by SES and race. Both decompositions include controls for age, year, and gender of child. Huber-White standard errors clustered at the state. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.001.

Appendix Table A1
Descriptive Statistics of Outcomes by Race and SES

	White		**Black**		**Hispanic**	
	Mean	STD	Mean	STD	Mean	STD
Asthma	0.120	-	0.201	-	0.129	-
Severity	1.286	0.519	1.421	0.613	1.446	0.642
Health Status	2.040	0.935	2.241	1.007	2.396	1.084
Hearing	0.033	-	0.034	-	0.033	-
Behavior	0.046	-	0.050	-	0.042	-
	Low SES		**Mid. SES**		**High SES**	
	Mean	STD	Mean	STD	Mean	STD
Asthma	0.170	-	-	-	0.132	-
Severity	1.524	0.676	1.350	0.563	1.243	0.479
Health Status	2.509	1.083	2.198	0.959	1.922	0.887
Hearing	0.037	-	0.032	-	0.031	-
Behavior	0.047	-	0.048	-	0.045	-

Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Standard deviations are next to the mean of the observations. *n=289,210*

Appendix Table A2
The Association between Household Smoking Status and Childhood Asthma

Dependent Variable: Health and Well-Being		
	1	2
Asthma	0.027***	0.027***
	(0.002)	(0.002)
Severity	0.065***	0.062***
	(0.007)	(0.008)
Health Status	0.139***	0.137***
	(0.007)	(0.007)
Economic Controls	No	Yes
State by Year	No	Yes
State by Cohort Linear Trend	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012) Notes: Household smoking is a binary variable of whether anyone in the household currently smokes. All regressions include full set of age, sex, and state dummies. Column 2 contains additional controls for state-level log per capita income and the local unemployment rate during the year of birth. Huber-White standard errors clustered at the state level. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.00.

Appendix Table A3
The Association between Household Smoking Status and Childhood Asthma by Race and SES

Dependent Variable: Measures of Asthma						
	1	2	3	4	5	6
By Race	**White**		**Black**		**Hispanic**	
Asthma	0.025***	0.025***	0.022**	0.024**	0.026***	0.025***
	(0.002)	(0.002)	(0.007)	(0.007)	(0.007)	(0.007)
Severity	0.074***	0.070***	0.062**	0.056*	0.020	0.025
	(0.009)	(0.009)	(0.021)	(0.022)	(0.028)	(0.028)
Health Status	0.183***	0.182***	0.118***	0.114***	-0.023	-0.024
	(0.005)	(0.005)	(0.017)	(0.016)	(0.016)	(0.016)
By SES	**Low**		**Middle**		**High**	
Asthma	0.034***	0.033***	0.020***	0.020***	0.016***	0.016***
	(0.006)	(0.006)	(0.003)	(0.003)	(0.002)	(0.002)
Severity	-0.032	-0.030	0.029*	0.027*	0.016***	0.016***
	(0.019)	(0.020)	(0.012)	(0.012)	(0.002)	(0.001)
Health Status	-0.046**	-0.047**	0.080***	0.080***	0.109***	0.106***
	(0.014)	(0.015)	(0.009)	(0.009)	(0.006)	(0.006)
State and Year	Yes	Yes	Yes	Yes	Yes	Yes
State by Year	No	Yes	No	Yes	No	Yes
Controls	No	Yes	No	Yes	No	Yes

Source: National Survey of Children's Health (2003, 2007, and 2012). Notes: Household smoking is a binary variable of whether anyone in the household smokes. All regressions include full set of age, sex, year, and state dummies. Economic controls include log per capita income and the local unemployment rate at the year of birth. Huber White standard errors clustered at the state level. Statistical significance denoted by the following: * p<0.05, ** p<.01, *** p<.001.