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Does the Minimum Cigarette Purchase Age of 21 Protect Young Mothers from Cigarettes, Help Their Babies?

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Does the Minimum Cigarette Purchase Age of 21 Protect Young Mothers from Cigarettes, Help Their Babies? *

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Abstract

A key target of the U.S. health policies is to reduce costly adverse birth outcomes to which prenatal smoking is one of the most significant contributors. This paper represents the first attempt to examine whether implementing the minimum cigarette purchase age of 21 can curb smoking among young mothers and thus improve their newborn's health. The research question is crucial because young mothers are heavily engaged in smoking and have poorer birth outcomes, and because the smoking prevalence and intensity among Pennsylvania young childbearing women have also exceeded the national average. I find robust evidence that the 21 smoking age leads to a 15 percent decline in the daily cigarettes smoked, a 19 percent decrease in the probability of having a low birth weight baby among all the mothers, and improvements on other birth outcomes such as longer gestation and higher APGAR scores. Such results contribute to the growing literature on the important role of a healthy fetal environment in the newborn well-beings. The uncovered large intergenerational benefits due to this regulation also shed new light on the current political debate in many states on whether shifting the legal smoking age up to 21.

Keywords: Prenatal Smoking, Infant Health, Minimum Cigarette Purchase Age

JEL Numbers: I12, I18.

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1. INTRODUCTION

Improving infant health is one of the crucial targets in the U.S. health policies, because poor birth outcomes especially low birth weight (LBW) infants who weigh below 2500 grams (g) are very costly in both the short and long run. Almond *et al.* (2005) shows the excessive healthcare cost for a newborn with body weight between 2000 and 2500 g is $600-3400[1], with even higher excessive costs at lower birth weight segments. Children with LBW at birth are more likely to suffer from cognitive deficits (Hack *et al.*, 1995), experience health problems (Corman and Chaikind, 1998), and have low educational attainments (Currie and Hyson, 1999). Finally, a poor birth outcome also negatively affects one's adulthood health, employment and socioeconomic status (Behrman and Rosenzweig, 2004; Case *et al.*, 2005)[2].

One of the most significant contributors for adverse birth outcomes is prenatal smoking. It is not only the single largest modifiable factor for LBW (Kramer, 1987) but also a key risky contributor for small for gestational age, preterm delivery, birth defects, and infant mortality (CDC, 2001). While the magnitudes of the impact estimates of prenatal smoking on infant health vary with the applied empirical approaches, even the most conservative one implies a huge economic burden in the United State. Therefore, how to curb prenatal smoking is an extremely important problem for the entire public health community. For instance, a prevalent intervention is to facilitate the childbearing women's access to prenatal smoking cessation services[3]. There is also a variety of state level anti-smoking policies on a more general smoking population such as state cigarette taxes, youth access laws, restrictions on tobacco products, educational programs, and smoke free indoor air laws, etc. All of them may effectively reduce cigarette use among

[1] LBW babies are often placed into neonatal intensive care units which incur costs in respiratory therapy, laboratory, radiology, pharmacy and accommodation. This is one of the most expensive types of hospitalization.

[2] Similar findings are provided in the context of other developed countries. See Black *et al.* (2007) for a Norwegian study.

[3] In 36 states, the Medicaid program has covered at least one treatment for prenatal smoking cessation by 2001 (Halpin *et al.*, 2003). From April 2000 to September 2005, American College of Obstetricians and Gynecologists (ACOG) provided training for clinicians to integrate a five step smoking cessation guideline with the routine prenatal care.

pregnant women and thus have the potential to improve birth outcomes. So far the literature has only focused on the impact of raising state cigarette taxes (Evans and Ringel, 1999; Lien and Evans, 2005; Ringel and Evans, 2001), while surprisingly little is known about to what extent the prenatal smokers and their babies can benefit from any other aforementioned anti-smoking intervention.

This study makes the first attempt to estimate the causal effects of the minimum cigarette purchase age (MCPA) of 21 on prenatal smoking and infant health. In general, the minimum cigarette purchase age is a key youth tobacco access restriction which prohibits anyone under a specific age from purchasing tobacco products. Table AI in the appendix shows most states established the smoking age as 18 in the last three decades, four states set it to be 19 recently, whereas Pennsylvania is the only state which had raised this legal age to 21 between 1992 and 2002[4]. The age 21 smoking legislation is evaluated with a regression discontinuity method in this research. It is not subject to any policy endogeneity that a third confounding factor drives both the change in the minimum cigarette purchase age and that in prenatal smoking. This approach is also immune to the changes in other state or county level tobacco control policies because none of them can disproportionately affect young women around the 21 smoking age induced cutoff. Actually there was little change in such policies over that decade in Pennsylvania except the smoking free air protection at public schools.

There are three important reasons to carefully examine MCPA 21 ever implemented at Pennsylvania. First, the young adult pregnant women whom this law can directly intervene were more heavily engaged in prenatal smoking than another other age group over that decade. One third of the childbearing women aged 19-21 smoked and the smokers consumed on average 10 cigarettes

[4]Private correspondence with Pennsylvania Legislation Bureau and the State Department of Public Health provides me with the detailed history of MCPA 21. This regulation was initiated in June 1, 1992, with the public unprepared for it. Later on the state had kept a good effort to enforce this legal age, especially since 1994 when facing the threatened loss in the federal block funding (DiFranza and Dussault, 2005). Such an anti-smoking effort was however strongly counteracted by the tobacco companies which were actively pursuing the young adult market. As a result, the state legislation shifted the minimum cigarette purchase age from 21 back to 18 on July 10, 2002.

daily. This group of young women tended to have lighter babies and delivered more LBW infants. The smoking prevalence and intensity among Pennsylvania young childbearing women also exceeded the national average. Therefore the scope for this age 21 legislation to intervene was potentially large. Second, this paper contributes to the meager literature on the 21 smoking age by uncovering its intergenerational benefits. Ahmad and Billimek (2007) is so far the only published piece which evaluates this regulation. It shows shifting up the legal age to 21 can substantially reduce the adult smoking and increase the quality adjusted life years. However, no study has accessed whether and how much enforcing this regulation can improve the newborn well-beings through curbing prenatal smoking among the young women. Third, understanding the impact of MCPA 21 can shed new light on the current political concern on the minimum cigarette purchase age. Increasing this legal age to 21 has been recently proposed in California, Connecticut, Oregon and North Dakota. In the meantime, the final stipulations of the 2009 Family Smoking Prevention and Tobacco Control Act call for studies on the "public health implications of raising the minimum age to purchase tobacco products" from the current 18 years[5].

The remainder of the paper is organized as follows. Section 2 describes the empirical methods and data. Section 3 reports the findings. Section 4 concludes.

2. EMPIRICAL METHODS AND DATA

In order to evaluate the impact of MCPA 21 on prenatal smoking, I estimate the following first stage model:

$$S_{ij} = \alpha_0 + \alpha_1 A_{ij} + \alpha_2 A_{ij}^2 + \alpha_3 Over21_{ij} + \alpha_4 Over21_{ij} A_{ij} + \alpha_5 Over21_{ij} A_{ij}^2 + \theta X_{ij} + t_j + csize_i + \varepsilon_{ij} \quad (1)$$

where S_{ij} is one measure of prenatal smoking for mother i who becomes pregnant in year j.

[5]Gutierrez-Folch, Anita. "Obama Approves Anti-Smoking Law to Keep Youngsters From Smoking", FindingDulcinea, 23 June, 2009.

A is the mother's age at conception normalized by the cutoff of 20.75 years[6]. $Over21$ is an indicator function which equals 1 if A is nonnegative, otherwise 0. The normalized variable A is a weekly measure in the regression analysis. In the graphical presentation of the discontinuities below, I use the original mother's conception age measured by years. The group of younger women just below the 21 legal age induced cutoff has no legal access to cigarette for at least one to two weeks more than the elder just above, at which period smoking cessation or reduction can remarkably decrease the adverse impact of fetal exposure to smoking. This is because the medical literature consistently points out a sharp accumulation of the negative prenatal smoking impact on infant health primarily occurs at the onset of the second trimester rather than the third trimester (McDonald *et al.*, 1992; Wang *et al.*, 2002; Wisborg *et al.*, 2001)[7]. The parameter of α_3 in Equation (1) captures how much each woman in the former group who are sensitive to this regulation cut smoking during this pregnancy[8], using the latter on the right side of the cutoff as the counterfactual (Imbens and Lemiuex, 2008; Lee and Lemiuex, 2010). X is a vector of the covariates such as infant birth characteristics, parental demographics and socioeconomic status, mother's fertility, other prenatal health behavior, etc. Below they are added sequentially in Equation (1) to check the sensitivity of the original estimate on α_3 with no such additional covariates of X. Besides, t is the mother's conception year fixed effect, $csize$ is the mother's residential county size fixed effect, and ε is a random error. In short, the specification in Equation (1) allows a flexible piecewise quadratic polynomial in conception age fully interacted $Over21$.

The second step is to estimate the reduced form model which links the 21 smoking age and

[6]It divides the young pregnant women into two groups which differ in the legal exposure to cigarette due to the 21 smoking age at the beginning of the second trimester.

[7]Below the results are very similar when one weekly cell to each side of the cutoff is dropped.

[8]Due to the data limitation, the timing on prenatal smoking cessation or reduction is not available such that the mothers who quit smoking in the first trimester are coded as "prenatal smokers". Given that early cessation in the first trimester can nullify the negative smoking impact and most prenatal smoking cessation occurs in the first trimester, the effect of MCPA 21 on smoking at the extensive (participation) margin may be understated (since more "nonsmoker" equivalent smokers below the cutoff are treated as "prenatal smokers" than those above the cutoff).

infant health:

$$BO_{ij} = \beta_0+\beta_1 A_{ij}+\beta_2 A_{ij}^2+\beta_3 Over21_{ij}+\beta_4 Over21_{ij}A_{ij}+\beta_5 Over21_{ij}A_{ij}^2+\lambda X_{ij}+t_j+csize_i+\epsilon_{ij} \quad (2)$$

where BO_{ij} is a birth outcome measure for mother i who conceives in year j. The parameter β_3 indicates the magnitude of the birth outcome improvement for the women just below the cutoff who curb smoking due to the age 21 smoking legislation. One concern of this empirical approach is that switching from MCPA 18 to 21 in 1992 can alter women's pre-pregnancy age trajectory of tobacco use due to addiction. Nonetheless, more than 70 percent of the women in the samples were prohibited from buying cigarettes prior to pregnancy before age 21, no matter which policy regime is. Below I also focus on year 1994-1999 when nearly all the young women in this sample had no legal access to cigarette prior to as well as throughout the pregnancy and find similar results. Also note this approach is neither subject to policy endogeneity nor the changes of other state or county level tobacco control policies. Finally, the presence of MCPA 21 does not affect those subject to this law yet intending to quit or reduce smoking over the critical period of a sharp accumulation of the adverse smoking impact. But it leads to a decline in smoking among those who would not do so without this regulation. Such compliers are likely to heavily rely on cigarettes but be able to compensate for the large negative smoking influence on the newborn. The acute response of birth outcomes to prenatal smoking cessation or reduction due to MCPA 21 in this very group of mothers is an important driving force for the large estimates on β_3 revealed in the next section[9].

The data of this study comes from a restricted version of the natality birth sample which consists of all the live births in the state of Pennsylvania between 1992 and 2002. As a unique

[9] As shown below, the age 21 smoking legislation sizably reduces smoking at the intensive margin (quantity effect) and moderately affects the extensive margin (participation effect), so it cannot be used to uncover the effect of smoking participation on infant health given that smoking reduction among the existing smokers also improves infant health.

feature of this original universe birth sample, it contains the exact birth dates of the mothers and babies that are not publicly released. I then use their birth dates and maternal length of gestation to calculate the normalized conception age A in Equation (1) and (2). Several restrictions are placed in constructing the final samples for the regression analysis. First, mothers who were born outside the U.S. or resided in states other than Pennsylvania are excluded. Second, I only keep the women whose conception ages fall in a very narrow interval (10 months) to both sides of the cutoff to reduce any model misspecification. Third, for the benchmark analysis the sample is restricted to women who conceived between Oct 1, 1992 and July 10, 2001. This is because the diffusion of establishing MPCA 21 among the public is assumed to have taken four months, and backing one year from the law ending day can guarantee none of the included women was facing the shifting of MCPA from 21 to 18 during pregnancy in 2002. Fourth, only the women with singleton births are kept.

Table I lists the summary statistics. There are two measures on prenatal smoking in each birth certificate: whether a mother smoked during this pregnancy and if yes how many cigarettes were smoked per day. The response rate to each item is above 98 percent. About 27 percent of the young women were prenatal smokers, who consumed on average 10.4 cigarettes per day. This study uses six infant health measures: birth weight, LBW, weeks of gestation, premature birth (weeks of gestation less than 37), 1-minute (Min) and 5-Min APGAR score. Birth weight is the primary measure of infant health. LBW is a costly birth outcome which has a lifetime adverse impact on one's health, educational attainment and earnings. It is caused by either intrauterine growth retardation or prematurity. Prenatal smoking is found to be a key contributor to the former factor, while the evidence of its impact on the latter is mixed and the corresponding mechanism is not well understood (Kramer, 1987). However, prematurity is still an important poor birth outcome because it is responsible for impediments in mental development and nearly one half of all the cases of congenital neurological disability. The APGAR score is a critical measure for a doctor to determine whether a newborn requires immediate medical care. Such a score is calculated by summing up the test results of every infant's appearance, pulse, grimace, activity and respiration. The tests are usually conducted at 1 and 5 minutes immediately after birth. A rich set of controls are used including birth characteristics, parental demographics, family socioeconomic background, mother's fertility, maternal health status and health behavior. The original natality dataset separately codes mother's Hispanic origin and race. I construct three non-mutually exclusive indicators to differentiate the race/ethnicity of each parent: non-Hispanic white, non-Hispanic black, and Hispanic. The indicator of father's age missing is a good proxy for any unplanned pregnancy (Watson and Fertig, 2009). Later it is used to check whether the unintended pregnancy can drive the sudden jump in prenatal smoking or infant health at the cutoff. The analysis below is based on two final samples: one with 60710 young pregnant women and the other with all the 16262 smokers.

[Insert Table I Here]

3. RESULTS

3.1. The Effect of MCPA 21 on Prenatal Smoking

Figure 1 plots the conception age profiles of prenatal smoking. In each graph the dots are the averages of one prenatal smoking measure over weekly cells of the conception age. Over such averages there is a superimposed fitted line from a piecewise quadratic regression on the underlying data, weighted by the number of observations within each weekly cell. The graph at the upper left shows there is a noticeable discrete decline in cigarette smoked for the women just above the cutoff. The one at the upper right exhibits some visual evidence of a decrease in prenatal smoking participation due to this regulation. In contrast, the bottom left graph shows a remarkable break in the number of cigarettes consumed for the smokers at the cutoff.

[Insert Figure 1 Here]

Table II reports the estimates on α_3 of Equation (1). The regression in each panel's first column is the one which has generated the fitted line in each corresponding graph of Figure 1. Column (1) shows the 21 smoking age significantly reduces prenatal smoking by 0.453 cigarettes per day for all the mothers. It amounts to about a 15 percent decline in the daily cigarette consumption at the cutoff. Column (2)-(4) sequentially add a variety of controls. The estimates are always statistically significant at 1 percent and do not differ statistically from Column (1). The middle panel examines the change due to MCPA 21 at the extensive margin. Column (5) shows there is a decrease of about 2 percentage points in the fraction of prenatal smokers in the benchmark specification of Equation (1). When the full set of controls is added, Column (8) indicates the estimated impact becomes insignificant. In contrast, enforcing this regulation has a large effect at the intensive margin. Column (9) shows it leads to a decline of about 1 cigarette per day (9.3 percent) among prenatal smokers at the cutoff. The results are not statistically different and highly significant in Column (10) to (12) with additional controls included.

[Insert Table II Here]

Table III reports a number of robustness checks for Table II. Column (1) presents similar results cross three panels except for cigarettes per day conditional on smokers, when cubic terms are added to Equation (1). However, I also conduct three Wald tests and find the quadratic model is preferred than this cubic polynomial specification. Column (2) considers an expanded sample with the timing of conception as early as June 1, 1992 such that young women were supposed to become immediately aware of this regulation upon its initiation. All the corresponding estimates are very close to Table II. Next one weekly cell of the observations is dropped to each side of the cutoff. In this case, those just above the cutoff who would not cut smoking without the regulation then more clearly perceive a sudden and fast accumulation of smoking impact over the longer critical period. Young mothers are also more precisely placed around the cutoff. So the estimated impacts of the age 21 legislation on smoking should be no smaller than before. Column (3) confirms it as expected. Column (4) focuses on a sample period between 1994 and 1999 when a continuous federal initiative on enforcing the state MCPAs had come into effect. This sample restriction also excludes the women who became pregnant in 1992-1994 and had legal exposure to cigarette in their early 20s under MCPA 18. If they had higher age trajectories of tobacco use prior to pregnancy than those with no legal access, the previous estimates in Table II can be biased. The corresponding estimates across all the three panels are slightly larger than Table II, consistent with the story of MCPA 21 having been seriously implemented. Yet it appears unlikely that the potential different age trajectories due to MCPA 18 can substantially alter the estimated impacts in Table II. Column (5) to (7) examine the two other potential cutoffs at the beginning ($Cutoff_2$) or the middle ($Cutoff_3$) of the third trimester. Neither is statistically significant. Column (8) and (9) carry on two placebo experiments. The sample is split by the original cutoff, with the median in either subsample as its own new cutoff. No evidence of a break at either cutoff is found.

[Insert Table III Here]

I also check the smoothness of all the covariates around the cutoff. Table IV reports the results using the specification in Equation (1) and each covariate as the dependent variable. The tests are conducted for both the final samples. None of the forty regressions suggests there is any statistically significant discontinuity. The finding of no discrete change in alcohol drinking among pregnant women is comforting, since the minimum drinking age of 21 has not driven the break in smoking, given that the two substances are complementary to each other among the youth (Dee, 1999). The final robustness check examines the continuity of the forcing variable's density. Mothers can delay conception to guarantee legal access to cigarette to reduce the stress or anxiety at the early stage of pregnancy, or conversely, they might try to conceive earlier and utilize the regulation to help curbing smoking over the critical period during pregnancy. If there is a manipulation of conception age, it poses a threat to the identification assumption at the cutoff. However, no such visual evidence of a non-random clustering of conception age is found to either side of the cutoff, whichever final sample is used. The figures are available upon request.

[Insert Table IV Here]

3.2. The Effect of MCPA21 on Infant Health

Figure 2 to 4 plot the relationship between mother's conception age and a variety of infant health measures. The upper panel of Figure 2 shows a larger break in infant birth weight among the smoking mothers than the one of all the mothers. A similar pattern on LBW is evident in the lower panel. Figure 3 indicates the age 21 smoking legislation increases gestation in both samples. In contrast, the smoking mothers below the cutoff are not less likely to have premature births. So the law induced reduction in the smoking participation contributes more to the moderate discontinuity in the birth prematurity of all the mothers. Figure 4 shows there are noticeable jumps on the 1-Min and 5-Min APGAR scores of all the mothers. It also suggests a key factor for such an improvement is less smoking at the intensive margin.

[Insert Figure 2 Here]

[Insert Figure 3 Here]

[Insert Figure 4 Here]

Table V presents the estimates on β_3 of Equation (2). The results in Column (1) and (5) capture the discontinuities in Figure 2 to 4. Row (1) shows infants born to all the mothers just below the cutoff are on average 11 to 17 g heavier although the estimates are not significant. However, the improvement is about 60 g conditional on existing smokers and it is always precisely estimated even when all the controls are added. Row (2) indicates there is generally a decrease of 1.5 percentage points (19 percent decrease) in LBW due to the 21 smoking age, for which an important driving force is the 2.7 percentage points decline (29 percent decrease) conditional on the smokers. Row (3) and (4) suggest enforcing MCPA 21 significantly increases the length of gestation in both samples, while its impact on premature births mainly operates through less smoking at the extensive rather than the intensive margin. Finally, the smoking legislation is found to increase the newborn 1-Min (5-Min) APGAR scores, as shown in Row (5) and (6).

[Insert Table V Here]

Then the similar robustness checks are conducted with the results not reported for brevity. First, the findings are very similar in the cubic polynomial specification. Yet this specification is less preferred than the quadratic model in almost all the cases, except for the 5-Min APGAR score conditional on the smoking mothers where the positive impact of MCPA 21 is even larger. Second, the results are nearly unchanged when either using the earlier date of the public awareness in the 21 smoking age or dropping the middle two weeks at the cutoff. Third, there is stronger evidence in the sample period between 1994 and 1999. For example, the improvement on infant birth weight of all the mothers is now precisely estimated, about a 29 to 31 g increase due to this regulation. Fourth, none of the other two potential cutoffs (Cutoff_2 and Cutoff_3) is statistically significant. Fifth, the same two placebo experiments do not give any significant break. To summarize, the results in Table V are quite robust.

4. Conclusion

This study provides the first evaluation on whether and how much MCPA 21 ever implemented at Pennsylvania has curbed prenatal smoking and improved infant health. It shows a discrete 15 percent decrease in cigarettes smoked among all the mothers at this smoking legislation induced cutoff. An important contributor to this change is a 9.3 decline in prenatal smoking at the intensive margin. Consequently, the 21 smoking age can remarkably improve infant health. The reduced from estimation shows this regulation generally leads to a 19 percent decrease in LBW.

This smoking legislation is also found to increase the length of gestation, reduce prematurity birth and improve the newborn 1-Min (5-Min) APGAR scores. All the estimates are robust to a variety of controls, alternative specifications, earlier public awareness in MCPA 21, the key period of enforcing this regulation, multiple potential cutoffs and the possible manipulation of conception date, etc.

Broadly, this research contributes to the growing literature in social sciences on the important role of a healthy fetal environment in the newborn well-beings. It has been suggested that while current health policies steer much healthcare resources directly to children or adolescent, the more cost-effective interventions on the next generation may be those which help children through helping their mothers (Almond and Currie, 2011). The 21 smoking age is found to be such a policy, which can provide large intergenerational benefits especially in the states where prenatal smoking is prevalent among young mothers. For future research, it will be interesting to examine the savings in infant healthcare costs and the improvements in the longer term lifetime outcomes due to this regulation, or extend the analysis to the impact of 18(or 19) smoking age on prenatal smoking and birth outcomes of the teen mothers.

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Table I: Descriptive Statistics

Variables	All Mothers		Mothers(Smokers)	
	Mean	Std.Dev	Mean	Std.Dev
Prenatal Smoking				
Smoker	0.268	0.443	1	0
Cigarettes Per Day	2.792	5.832	10.423	6.888
Birth Outcomes				
Birth Weight(grams)	3302.224	559.141	3173.197	549.912
Low Birth Weight	0.064	0.245	0.089	0.285
Gestation(weeks)	39.071	2.046	38.961	2.137
Premature Birth	0.074	0.251	0.083	0.276
1-Minute APGAR Score	8.056	1.306	8.079	1.303
5-Minute APGAR Score	8.987	0.728	9	0.732
Birth Characteristics				
Infant Male	0.512	0.500	0.514	0.500
Live Birth Order	1.617	0.811	1.773	0.878
Maternal Characteristics				
Mother's Age	20.982	0.620	20.978	0.618
Mother Non-Hispanic White	0.753	0.431	0.847	0.360
Mother Non-Hispanic Black	0.179	0.384	0.108	0.310
Mother Hispanic Origin	0.066	0.249	0.041	0.199
Mother Years of Education= 12	0.567	0.495	0.537	0.499
Mother Years of Education> 12	0.246	0.430	0.126	0.332
Mother Married	0.390	0.488	0.289	0.453
Maternal Fertility				
Number of Terminations	0.317	0.660	0.382	0.727
Father Age Missing(unplanned birth)	0.008	0.086	0.011	0.104
Previous Infant Preterm of Small	0.018	0.132	0.026	0.158
Maternal Health Status and Health Behavior				
Drinker	0.008	0.086	0.019	0.136
Drinks Per Week	0.018	0.417	0.040	0.399
Weight Gain(pounds)	31.255	13.776	30.449	14.288
Paternal Characteristics				
Father's Age	24.156	4.089	24.550	4.438
Father Non-Hispanic White	0.702	0.457	0.779	0.415
Father Non-Hispanic Black	0.218	0.413	0.157	0.364
Father Hispanic Origin	0.078	0.268	0.059	0.235
Father Years of Education= 12	0.567	0.495	0.592	0.492
Father Years of Education> 12	0.207	0.405	0.126	0.332
Number of Observations	60710		16262	

Table II: The Effect of MCPA 21 on Prenatal Smoking

	Dependent Variables											
	Cigarettes Per Day				Smoker				Cigarettes Per Day (Smokers)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Over21	0.453	0.463	0.402	0.387	0.018	0.019	0.014	0.013	0.983	0.933	0.876	0.901
	(0.141)***	(0.137)***	(0.134)***	(0.132)***	(0.011)*	(0.011)*	(0.010)	(0.010)	(0.334)***	(0.316)***	(0.315)***	(0.310)***
Year of Conception?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Size of Residence County?	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Birth Characteristics?	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Basic Parental Controls?	No	Yes	Yes	Yes	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Parent Socioeconomic Status?	No	No	Yes	Yes	No	No	Yes	Yes	No	No	Yes	Yes
Fertility History?	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
Mother Health Status?	No	No	No	Yes	No	No	No	Yes	No	No	No	Yes
Num of Observations	60710	60710	60710	60710	60710	60710	60710	60710	16262	16262	16262	16262

Note: Each regression includes a quadratic in age at conception fully interacted with an indicator of Over21, year of conception effect and size of residence county effect. Robust standard errors clustering in age-at-conception cells are reported in parentheses. *** means statistically significant at 1%, ** at 5%, * at 10%. Birth characteristics include infant male and live birth order. The basic parental controls include mother's race/ethnicity, father's race/ethnicity, and father's age. The parental socioeconomic controls include mother's education equal to 12 years, mother's education more than 12 years, mother married, father's education equal to 12 years, and father's education more than 12 years. The controls on mother's fertility consist of the number of terminations, father's age missing(unplanned birth), and previous infant preterm of small. Mother's health status and health behavior include prenatal alcohol use, drinks per week and weight gain.

Table III: The Effect of MCPA 21 on Prenatal Smoking (Robustness Checks)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	Dependent Variable of Panel 1: Cigarettes per Day								
Over21	0.398	0.439	0.460	0.538	0.513	0.483	0.513	-0.183	-0.254
	(0.193)**	(0.137)***	(0.132)***	(0.163)***	(0.252)**	(0.173)***	(0.252)**	(0.185)	(0.182)
$Cutoff_2$	No	No	No	No	0.209	No	0.095	No	No
					(0.203)		(0.223)		
$Cutoff_3$	No	No	No	No	No	0.040	0.184	No	No
						(0.206)	(0.229)		
Piecewise Polynomial	Cubic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic
Num of Observations	60710	63486	59411	40905	60710	60710	60710	31283	29315
	Dependent Variable of Panel 2: Prenatal Smoker								
Over21	0.024	0.016	0.017	0.026	0.034	0.025	0.034	-0.016	-0.011
	(0.015)*	(0.011)	(0.011)	(0.013)**	(0.018)*	(0.013)*	(0.018)*	(0.015)	(0.015)
$Cutoff_2$	No	No	No	No	0.018	No	0.021	No	No
					(0.015)		(0.017)		
$Cutoff_3$	No	No	No	No	No	-0.001	0.008	No	No
						(0.014)	(0.016)		
Piecewise Polynomial	Cubic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic
Num of Observations	60710	63486	59411	40905	60710	60710	60710	31283	29315
	Dependent Variable of Panel 3: Cigarettes per Day(Smokers)								
Over21	0.569	1.029	1.101	1.018	0.643	0.845	0.643	-0.123	-0.520
	(0.441)	(0.324)***	(0.323)***	(0.387)***	(0.531)	(0.400)**	(0.531)	(0.413)	(0.448)
$Cutoff_2$	No	No	No	No	0.058	No	-0.452	No	No
					(0.527)		(0.612)		
$Cutoff_3$	No	No	No	No	No	0.150	0.347	No	No
						(0.531)	(0.632)		
Piecewise Polynomial	Cubic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic	Quadratic
Num of Observations	16262	16985	15896	10860	16262	16262	16262	8366	7868

Note: Each regression includes a quadratic in age at conception fully interacted with an indicator of Over21, year of conception effect and size of residence county effect. Robust standard errors clustering in age-at-conception cells are reported in parentheses. *** means statistically significant at 1%, ** at 5%, * at 10%.

Table IV: Conception Age Profiles of the Potential Confounders

Dependent Variables	"Over 21" Coefficient Estimate	
	All Mothers	Mothers(Smokers)
Infant Male	-0.011	-0.004
	(0.011)	(0.023)
Live Birth Order	0.021	0.055
	(0.020)	(0.041)
Mother Non-Hispanic White	-0.014	-0.003
	(0.010)	(0.016)
Mother Non-Hispanic Black	0.009	0.010
	(0.009)	(0.014)
Mother Hispanic Origin	0.005	-0.006
	(0.007)	(0.010)
Mother Years of Education$=12$	-0.019	-0.023
	(0.012)	(0.021)
Mother Years of Education>12	-0.004	-0.007
	(0.011)	(0.016)
Mother Married	-0.016	-0.015
	(0.012)	(0.021)
Father's Age	0.003	0.021
	(0.105)	(0.199)
Father Non-Hispanic White	-0.006	0.017
	(0.011)	(0.019)
Father Non-Hispanic Black	0.008	-0.002
	(0.011)	(0.017)
Father Hispanic Origin	-0.002	-0.015
	(0.007)	(0.012)
Father Years of Education$=12$	-0.017	-0.032
	(0.012)	(0.024)
Father Years of Education>12	-0.001	-0.011
	(0.011)	(0.016)
Number of Terminations	0.015	-0.036
	(0.015)	(0.035)
Father Age Missing(unplanned birth)	-0.002	-0.001
	(0.002)	(0.006)
Previous Infant Preterm of Small	0.004	0.01
	(0.003)	(0.007)
Drinker	0.003	0.002
	(0.002)	(0.006)
Drinks per Week	-0.007	-0.008
	(0.014)	(0.031)
Weight Gain(pounds)	0.038	0.195
	(0.359)	(0.677)
Num of Observations	60710	16262

Note: Each regression includes a quadratic in age at conception fully interacted with an indicator of Over21, year of conception effect and size of residence county effect. Robust standard errors clustering in age-at-conception cells are reported in parentheses. *** means statistically significant at 1%, ** at 5%, * at 10%.

Table V: The Effect of MCPA 21 on Infant Health

Dependent Variables	Coefficient Estimates on "Over 21"							
	All the Mothers				Mothers(Smokers)			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Birth Weight	-16.669	-13.785	-11.723	-11.387	-60.097	-60.157	-58.349	-60.422
	(12.787)	(12.714)	(12.893)	(12.161)	(27.556)**	(27.507)**	(27.592)**	(25.809)**
Low Birth Weight	0.015	0.015	0.015	0.014	0.027	0.028	0.027	0.027
	(0.006)***	(0.006)**	(0.006)**	(0.006)**	(0.012)**	(0.012)**	(0.013)**	(0.012)**
Gestation	-0.101	-0.096	-0.095	-0.092	-0.195	-0.189	-0.188	-0.191
	(0.049)**	(0.049)**	(0.049)*	(0.049)*	(0.114)*	(0.115)	(0.115)	(0.112)*
Premature Birth	0.013	0.013	0.013	0.012	0.005	0.005	0.005	0.004
	(0.007)**	(0.007)*	(0.007)*	(0.007)*	(0.013)	(0.013)	(0.013)	(0.013)
1-Min APGAR Score	-0.087	-0.088	-0.087	-0.086	-0.127	-0.133	-0.131	-0.130
	(0.029)***	(0.029)***	(0.029)***	(0.029)***	(0.066)*	(0.066)**	(0.066)**	(0.066)**
5-Min APGAR Score	-0.036	-0.036	-0.036	-0.036	-0.073	-0.076	-0.074	-0.075
	(0.017)**	(0.017)**	(0.017)**	(0.017)**	(0.038)*	(0.038)**	(0.038)**	(0.038)**
Num of Observations	60710	60710	60710	60710	16262	16262	16262	16262

Note: Regressions (1) and (5) only include a quadratic in age at conception fully interacted with an indicator of Over21, year of conception effect and size of residence county effect. Robust standard errors clustering in age-at-conception cells are reported in parentheses. *** means statistically significant at 1%, ** at 5%, * at 10%. Regressions (2) and (6) add infant male, live birth order, and the basic parental controls which include mother's race/ethnicity, father's race/ethnicity, and father's age. Regressions (3) and (7) further include parental socioeconomic controls such as mother's education equal to 12 years, mother's education more than 12 years, mother married, father's education equal to 12 years, and father's education more than 12 years. Finally, regressions (4) and (8) have additional controls on mother's fertility, health status, and health behavior.

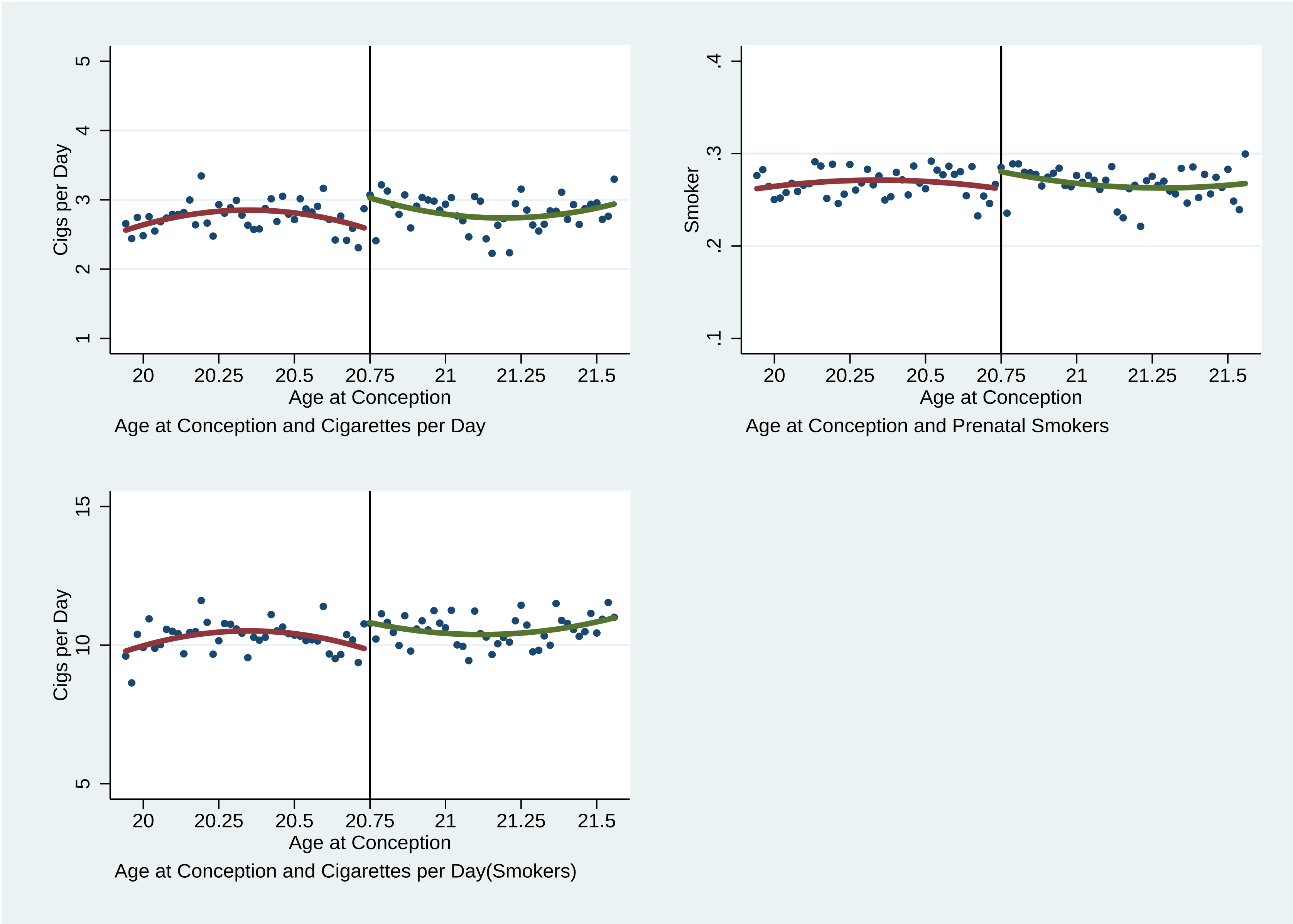

Figure 1: Mother's Age at Conception and Prenatal Smoking

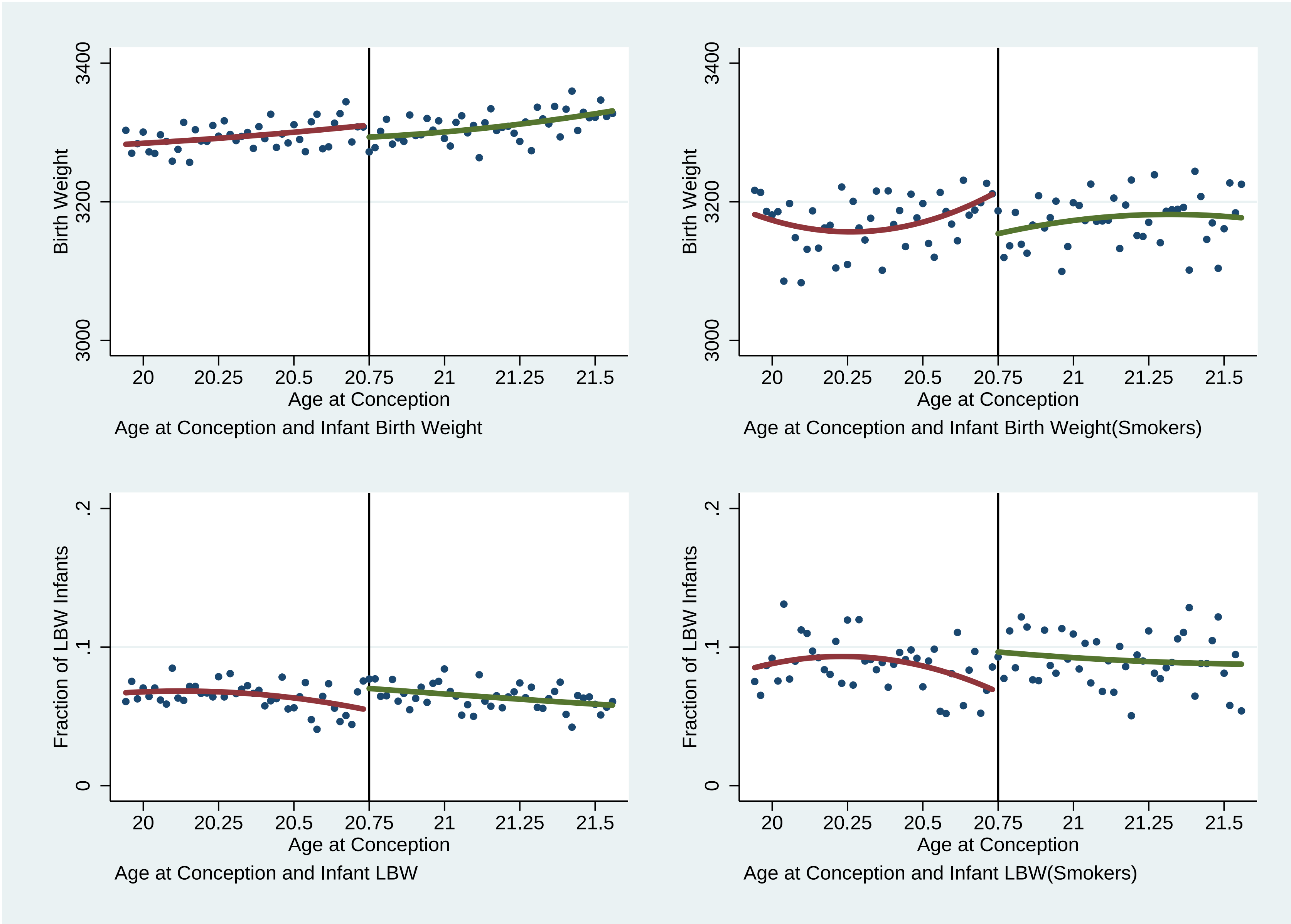

Figure 2: Mother's Age at Conception and Infant Health (1)

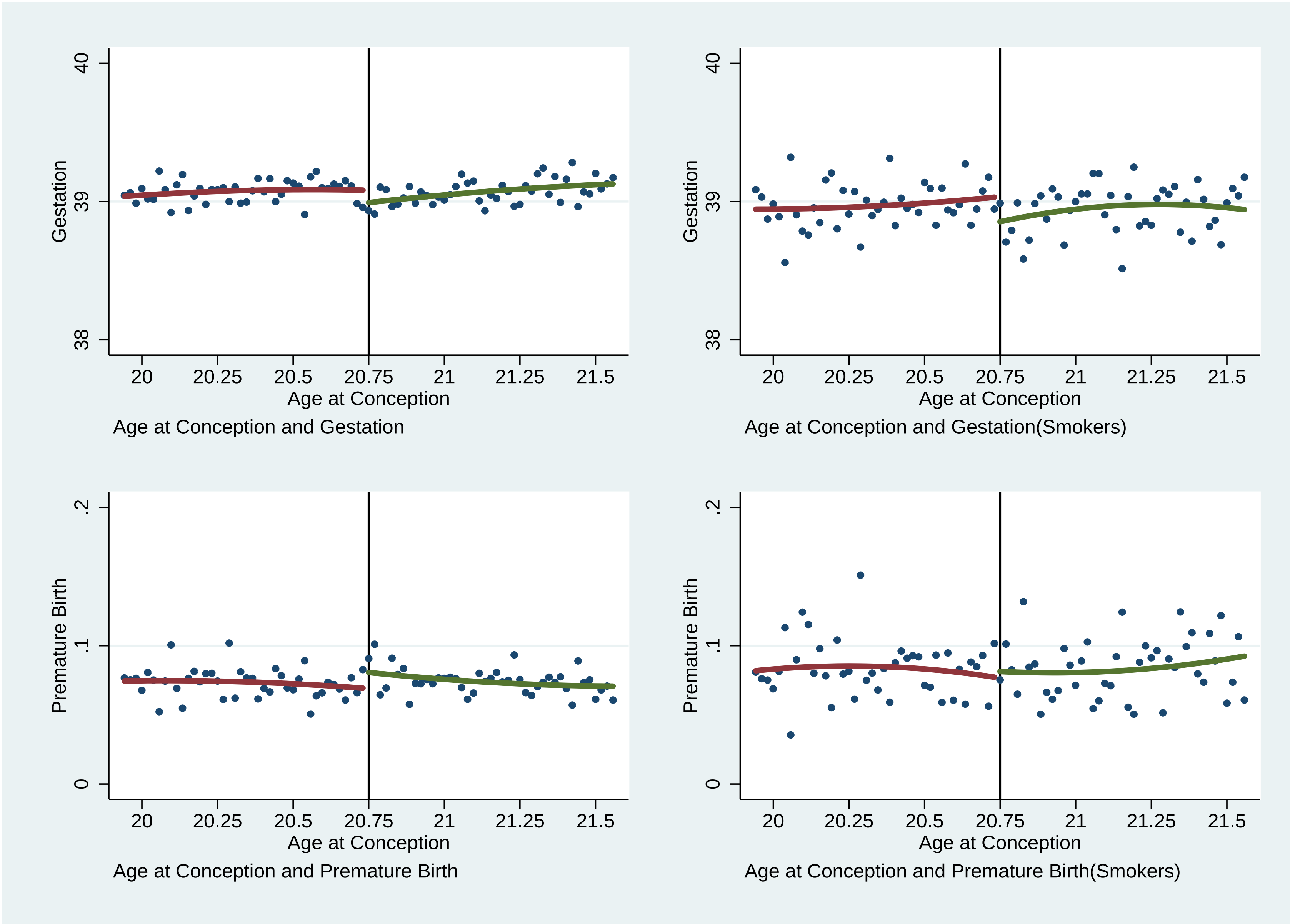

Figure 3: Mother's Age at Conception and Infant Health (2)

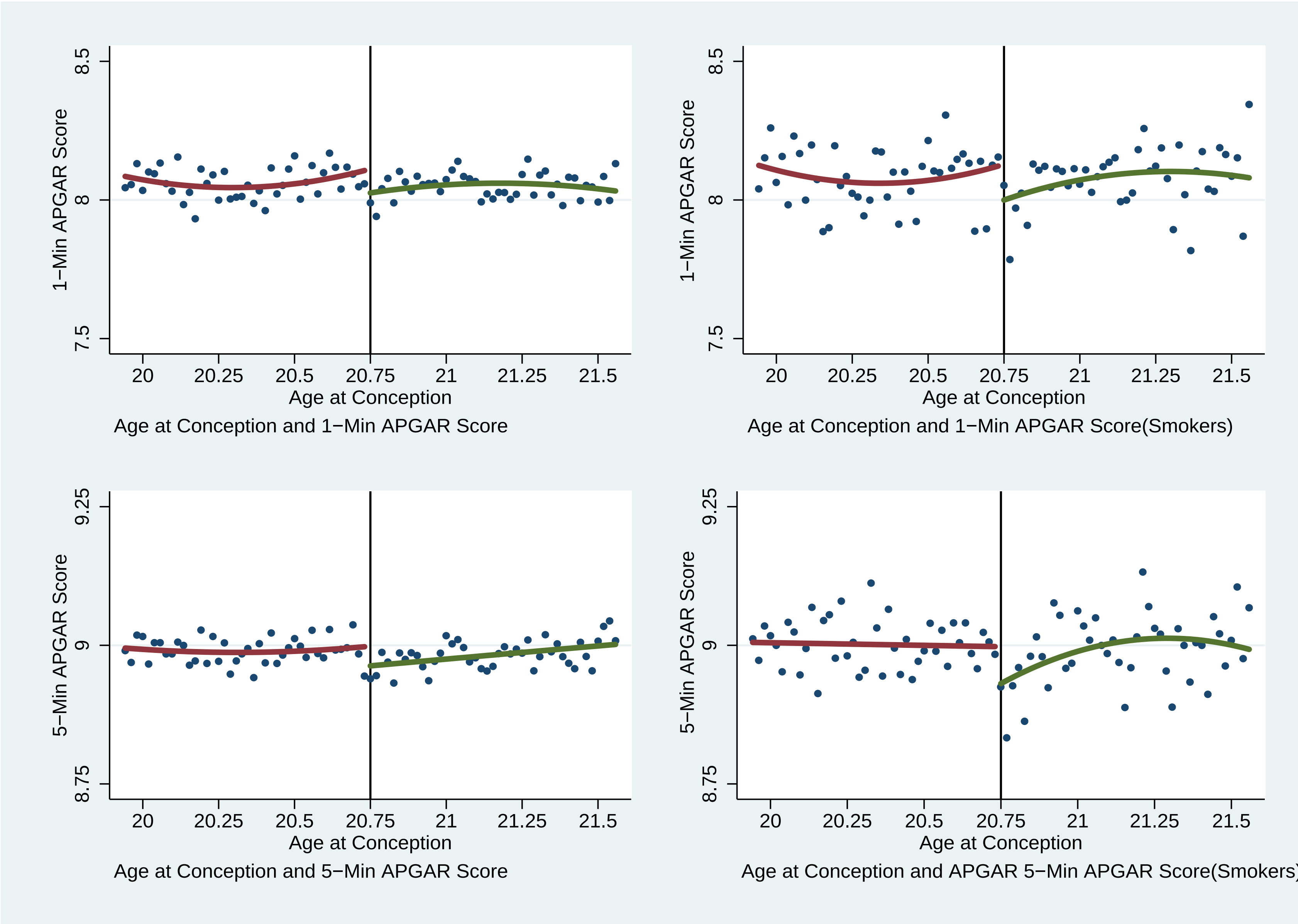

Figure 4: Mother's Age at Conception and Infant Health (3)

Appendix

Table AI: State Minimum Cigarette Purchase Age (1989-2007)

Year	Number of States by State Minimum Cigarette Purchase Age					
	16	17	18	19	21	None
1988	5	4	31	3	0	8
1989	2	4	35	3	0	6
1990	2	4	36	3	0	5
1991	1	3	40	3	0	3
1992	0	2	42	3	1	2
1993	0	0	46	3	1	0
1994	0	0	46	3	1	0
1995	0	0	46	3	1	0
1996	0	0	46	3	1	0
1997	0	0	46	3	1	0
1998	0	0	46	3	1	0
1999	0	0	46	3	1	0
2000	0	0	46	3	1	0
2001	0	0	46	3	1	0
2002	0	0	46	3	1	0
2003	0	0	47	3	0	0
2004	0	0	47	3	0	0
2005	0	0	47	3	0	0
2006	0	0	46	4	0	0
2007	0	0	46	4	0	0

Source: State Legislated Actions on Tobacco Issues.