The Intergenerational Impact of Terror: Does the 9/11 Tragedy Reverberate into the Outcomes of the Next Generation?

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Abstract

A medical literature that provides biological pathways from maternal stress to adverse birth outcomes, coupled with a growing consensus that birth characteristics are predictive of later life wellbeing, suggest that events that cause psychological trauma during pregnancy may have dire consequences for the next generation. Due to the unexpected nature of the terrorist attacks of September 11th, 2001 a random cohort of in utero children where exogenously insulted by increased maternal psychological distress. The goal of this study is to rigorously examine the casual effect of acute maternal stress on birth outcomes. To explore this question, it is imperative to avoid two identification pitfalls common in natural experiment studies of this topic: non-stress related negative externalities and post-event endogenous fertility selection. With these issues in mind, this analysis excludes those individuals most at risk of health and resource shocks unrelated to stress, New York City and Washington D.C. residents, and does not rely on the endogenously selected post-event birth cohorts. Results suggest that the children exposed while in utero were born significantly smaller and early than previous cohorts. Additionally, intrauterine growth is specifically restricted by first trimester exposure to stress, while gestational age is most reduced by increased maternal psychological distress in mid pregnancy. Intriguingly, the magnitudes of the effects are quite small, suggesting that the human gestational process is mostly resilient to acute insults of psychological anxiety.

I Introduction

The September 11, 2001 tragedies in New York City, Arlington, VA and Shanksville, PA extinguished nearly 3,000 lives and shook the United States sense of national security to its core. The unanticipated nature of the attacks along with the devastating imagery of the event produced high levels of psychological distress throughout the nation (Schuster et al. 2001 and Knudsen et al. 2005). This wave of stress was persistent, with many experiencing elevated levels for several weeks to months after the attacks, and weighed particularly heavily on women (Silver et al. 2002 and Stein et al. 2004). In addition, as suggested in Becker and Rubinstein's theory of responses to terrorism (2011), the fear generated by the event was not limited to those in assaulted areas. In a nationally representative survey Schuster et al. found over 40% of adults reported stress related symptoms after the September 11th attacks. (2001). One particularly troubling aspect of this widespread "terror" shock, is that it may cause the impact of the 9/11 event to spread into the next generation.

Using theoretical models, animal experiments, and small sample human research the medical literature has biologically mechanized and repeatedly correlated maternal stress with, among other birth outcomes, restricted intrauterine growth and shortened gestational length (de Catanzaro and Macniven 1992, Wadhwa et al. 1993, 2001, and 2004, Mulder et al. 2002 provides a review). Further, recent and consistent findings have connected birth outcomes to later life human capital accumulation (Behrman and Rosenzweig 2004, Case et al. 2005, and Black et al. 2007). These two lines of research have motivated social scientists to reassess the full negative effect on society of psychologically distressing events such as, discrimination, violence, and natural disasters, by evaluating their impact on the birth outcomes of the exposed pregnant women. This paper will add to this emerging literature by using the September 11th, 2001 tragedy as an exogenous stress shock to estimate the response in birth outcomes from the psychological fallout caused by terrorism.

The factors that set this work apart from previous studies of stress and birth outcomes is that it relies on an event with unique attributes that facilitate the precision of the analysis, as well as, utilizes a large and demographically robust dataset. The first element which makes this event particularly suitable to this study is its unanticipated nature. Due to the fact that the stress shock was unexpected, fear of omitted variable bias, a problem faced by many quasi-experimental analyses that struggle to control unobserved factors correlated with maternal stress and maternal qualities that effect birth outcomes, can be greatly reduced. The strategy of minimizing the potential for endogenous non-random maternal characteristic differences in cohorts through the use of an unanticipated event, though, is not a methodology without further complications.

When using an event catastrophic enough to cause significantly elevated stress levels as an experiment, there is significant potential that the tragedy also caused other negative externalities which the exposed will have to endure and may impact the outcome under study. In the case of the September 11, 2001 attacks there are a number of potential non-stress related shocks which may also effect an in utero child's birth outcomes. While most studies of this event focus on the areas directly effected by the attack New York City (NYC) and the Washington D.C. primary metropolitan statistical area (DC), these are the regions particularly vulnerable to misallocation of stress as the sole contributor to poor birth outcomes. Specifically it is those cohorts from NYC and DC that, post-attack, are much more likely to have mothers that also faced a pollution related adverse health shock and a negative resource shock due to loss of economic activity (Bram, Orr and Rapaport 2002 and Landrigan et al. 2004).

Furthermore, when using a tragic event as a natural experiment, it is possible that the assumption of a random treatment group may lose reliability if there is potential for selective migration out of the study area. If a study of the impact of terror on birth outcomes restricts their sample to only those individuals residing in and giving birth in the city that experienced the attack, it must be able to properly control for the group of mothers whose preference for safety and health lead them to move out of the city after the event and thus leave the sample. To date, no large sample study of the September 11th event using NYC and/ or DC residents has addressed this problem.

To mitigate concern over these two sets of identification issues this analysis will exclude cohorts born in NYC and DC. This choice is made because those living in the rest of the country will have had fewer potential negative aftereffects beyond increased maternal stress and, by using the entire country as the sample area, migration concerns are limited.

Finally, an issue that must be carefully considered in all natural experiment studies of an event's impact on in utero health is that of selective fertility. When using the 9/11 attacks as the event of interest it is fairly straightforward to argue that all cohorts conceived before September 11th, 2001 are randomly assigned to the treatment or control group. Many studies of this event, though, also use cohorts conceived after the event as controls. It is quite plausible that family planning decisions made after the catastrophe could be endogenously related to parental characteristics correlated with birth outcomes. Specifically this study suggests that cohorts conceived post event have mothers that were significantly more educated and less likely to be African American. This indicates that part of the reference group, in a study that includes post-event cohorts, is non-randomly and positively selected and thus severely hinders the identification strategy. As such, in this paper, specific attention is paid to attempting to only analyze cohorts conceived before September 11th 2001.

To this end, using the Vital Statistics Natality Birth Data, which includes all U.S. live births that received a birth certificate, enables analysis to be restricted to births of residents outside NYC and DC and conceived before September 11, 2001, while maintaining very large sample sizes. In addition to the robust sample size, the Vital Statistics data provides this analysis with information imperative to the study such as: demographic characteristics of the mother, birth timing down to the month, and several birth outcomes.

Using this natural experiment framework and detailed data, results indicate that infants in utero during the 9/11 attacks are significantly smaller (5-15 grams) and more likely to be born preterm (1% to .4% more likely to be <37 gestational weeks). Further, intrauterine growth is found to be most sensitive to stress exposure in the first trimester and gestational age is most reactive to exposure in mid pregnancy. While these findings are consistent with the current medical literature in that they suggest maternal anxiety has statistically significant negative impacts on birth outcomes, the small magnitudes of the effects indicate that despite the biological pathways, the developing fetus seems to be protected or resilient to acute insults of maternal psychological distress.

This paper is organized as follows. Section II.1 will offer a brief review of the mechanisms linking maternal stress and birth outcomes. Section II.2 will discuss the prominent work estimating the relationship between birth outcomes and later life health and human capital. Section II.3 will present recent studies that specifically attempt to identify the effect of maternal stress on birth outcomes. Section II.4 will highlight the previous literature on the effect of September 11th on birth outcomes. Section III will describe the data and methodology used in this research. Section IV will contain the results from the regression analysis. Sections V.1-V.2 will provide a discussion of the inherent assumptions and potential confounds of this analysis, and lastly Section VI will provide conclusions.

II Literature Review

II.1 Stress and Birth Outcomes: Biological Mechanisms

While the physiological level of response each individual has to a stressful event varies, there are certain biological feedbacks which all humans use to regulate psychological distress. In particular the body unleashes cortisol, norepinephrine, and epinephrine in elevated levels in reaction to acute stress as well as "worry, anxiety, and cognitive preparation for a threat" (McEwen 1998). These chemicals than stimulate the supply of corticotropin-releasing hormone (CRH). Linking maternal stress to birth outcomes, various studies have indicated that the level of CRH is strongly related to intrauterine growth and parturition timing (Wadhwa et al. 1993, 2004, Mancuso et al.

2004 and others). Additionally, Mulder et al. suggest that arousal of the sympathetic nervous system, a symptom of increased stress, can cause restricted blood flow to the fetus and result in decreased intrauterine growth (2002). Some research has also indicated that the timing of the stress exposure has first order implications on the magnitude of the negative effect.

Multiple medical studies have shown that the release of the hormones associated with a reaction to stress is attenuated during pregnancy and this chemical insulation increases throughout pregnancy (Schulte et al. 1990 and de Weerth and Buitelaar 2005). While this suggests that the adverse effects of maternal psychological distress on birth outcomes should be most prevalent in early gestation, not all studies have supported this claim, and some have even come to the opposite conclusion (Hedegaard et al. 1993, Schneider et al. 1999). As it stands, the medical literature advocates that the timing of in utero stress exposure is important to the biological path of birth outcome damage, but the specific pattern is still without strong empirical support.

II.2 Birth Outcomes' Impact on Later Life Health and Human Capital

While generating a clear causal link has been difficult, a growing literature has been building a consensus that health as early as birth can have significant consequences for later life economic, educational, and health outcomes (Strauss and Thomas 2007 provide an overview of the current literature). Moreover, a set of studies has linked a specific birth outcome, birthweight, to longrun health and human capital accumulation. Of these studies, the work utilizing birthweight differences in twins to control for unobserved parental heterogeneity has generated the most robust findings.

Behrman and Rosenzweig (BR) used data from the Minnesota Twin Registry to conduct an analysis that examined the impact of birthweight differences between monozygotic female twins on their later life health and human capital attainment (2004). They find that more birthweight portends increased height and educational progress. Furthermore, for those at the bottom of the distribution, birthweight differences between twins was predictive of economic wellbeing.

In a more recent study, Black et al. attempt to improve the BR analysis by using a larger set of twins, including both males and females in the analysis, and relying on administrative birth outcome information (2007). With this improved data Black et al. found results consistent with BR. They report that birthweight has a significant impact on long-term height, IQ, earnings, and education outcomes. While these twin studies are unable to control for parental behavioral changes over time, within families, related to birthweight (e.g. compensating low birthweight with extra parental inputs or investing more heavily in the larger twin) the results are highly suggestive of an important link between birth outcomes and later life wellbeing.

II.3 Stress and Birth Outcomes: Prior Evidence

Interest in evaluating the impact of maternal stress on birth outcomes is not a new research area. Over the last few decades there have been many non-experimental studies striving to identify the connection (Newton and Hunt 1984, Hedegaard et al. 1996, Dole et al. 2003, among others). As with many research areas though, the specter of uncontrolled factors correlated with both the explanatory variables and the outcome of interest have hindered these estimates' validity. Specific to this field, most non-experimental methods are unable to control for all the maternal attributes thought to be correlated both with the maternal stress measurement and adverse birth outcomes (e.g. genetics, health, risk, time discounting preferences, and variance and level of own stress assessment). In an effort to clean analysis of these concerns, many studies have turned to the methodological framework of the natural experiment.

One type of stress inducing event that has been used in several of these works is an earthquake. Glynn et al. used the 1994 Northridge, California earthquake as its stress shock (2001). This work suggested that individuals in utero during mother's exposure to the earthquake early in gestation had lower gestational ages. While this work was innovative in its approach, it suffers from very small sample size (40 women), no control of seasonality or preexisting trends between exposure and non-exposure mothers, and a lack of control for factors other than stress contributing to birth outcome differences (other health, income, or environment shocks associated with the earthquake). A more robust extension of this methodological concept is Torche's recent analysis using the 2005 Tarapaca earthquake in Chile (2011).

The 2005 Tarapaca earthquake provided Torche with a very unique event to study the psychological effects of an earthquake. Two helpful features of this event in terms of this analysis are Chile's strict building codes and that the earthquake's epicenter was located in low density areas. These factors provide some evidence that negative health externalities beyond stress were limited. Further, by using the robust data of Chilean birth certificates the author is afforded a demographically rich and large data source. The results from this study support those found in Glynn et al., in that they suggest that acute maternal stress, specifically early in pregnancy, has significant and non-trivial negative consequences for birth outcomes (51 gram reduction in birthweight and 2.6% increase in preterm births). While migration post-earthquake and the inclusion of the after earthquake birth cohort, both of which may be highly selective, can not be completely ruled out as potential confounds, this analysis is a strong piece of evidence linking acute maternal anxiety and birth outcomes. Another important study in this area is Adriana Camacho's work linking an alternative stress event to poor birth outcomes (2008).

By using random landmine explosions in Colombia as exogenous stress shocks, Camacho is able to utilize a novel source of variation in psychological distress to address this research question. Moreover, in addition to using a model which controls for municipality (similar to a U.S. county) level time invariant heterogeneity, she is also able to conduct alternative analysis using mother-fixed effects. Both models offer qualitatively and quantitatively consistent findings; maternal exposure to a landmine explosion in their municipality significantly decreases birthweight by approximately 8 grams.

One drawback to this study is that due to the reliance on quarterly landmine data, proper analysis of the importance of exposure timing is limited. The results suggest that the effect is strongest two quarters before the birth quarter, but without being able to use birth month specifically, this date range falls in between the first and second trimester. As for identification, this paper is very strong and the concerns are confined to possible non-random geographic sorting related to recent landmine explosions and/or selective migration related to landmine and pregnancy timing (the mother fixed effects model is limited to non-migrant mothers).

In summary, this study along with Torche's findings, make a strong case that acute maternal stress exposure has statistically significant repercussions for birth outcomes, but the pronounced difference in the magnitudes of the effect in the two studies, the lack of temporal precision in the analysis, and the various confounding factors leaves room for additional advancements in this field.

II.4 Sept. 11th, 2001 and Birth Outcomes: Prior Evidence

In the years following the tragic events of 9/11 many researchers have expressed concern over the possible negative effects the event may have had on in utero children. These studies have focused in three areas; environmental fallout, discrimination, and stress.

Studies have suggested that the destruction of the World Trade Center (WTC) was the most severe environmental catastrophe in the history of NYC (Landrigan 2001). After the events on September 11th a gigantic plume containing a mixture of numerous hazardous materials hovered and traveled across NYC (Landrigan et al. 2004). Medical research using samples of pregnant women living or working in NYC have found that exposure to pollutants damaged intrauterine growth and triggered an increase in significantly smaller for gestational age children (Landrigan et al. 2004 and Perera et al. 2005). These findings indicate that focusing attention on births outside NYC may be a more accurate way to assess avenues in which the attack effected in utero children beyond direct health shocks from pollution. One interesting line of research to that end has looked at how differential treatment and psychological distress of Arab-named women may have lead to poorer birth outcomes.

Diane Lauderdale and El Sayed et al. hypothesized that, post 9/11, Arabic named women would suffer from significant increases in discrimination and that this would negatively effect their birth outcomes (2006 and 2008). While these studies had very similar data resources and methodologies, the results were quite different. In California, Lauderdale found that children born to Arabic-named women pregnant during 9/11 had a significantly higher likelihood of being low birth weight (LBW, <2,500 grams) and preterm (PTB, <37 weeks of gestation) than comparison children from the previous year and that this did not hold for any other ethnicities. On the other hand, El Sayed et al. found in Michigan that women with Arab American ethnicity who were pregnant during 9/11 were *less* likely to give birth to a LBW or PTB child.

It is difficult to reconcile these conflicting findings other than to speculate that each state had varying levels of discrimination as well as different magnitudes and/or selectivity of in/out-migration (not captured by either analysis). Furthermore, while these studies ask a very intriguing question, they are not able to nail down the mechanism through which discrimination would be effecting birth outcomes. While increased stress is one channel, another major pathway could be financial. For instance, Kaushal et al. found that wages for Arab-Americans declined after the September 11th attacks (2007). Further, family incomes could be negatively impacted through changed preferences for transactions with Arab-American businesses. Thus, unfortunately the discrimination studies have not formed a consensus and are not aimed at identifying the effects of psychological distress specifically.

A host of studies in the medical literature have attempted to make a more clear statement about the effect of September 11th induced maternal stress on birth outcomes. Several studies used small selected samples of New Yorkers who lived close to the WTC (Berkowitz et al. 2003 and Lederman et al. 2004). While these results supported a connection between maternal stress and poor birth outcomes, their geographic proximity to the attack confounds the identification strategy with previously mentioned pollution effects. Since these earlier works, there have been a number of papers which have attempted to clean some of these concerns through the use of much larger samples which excluded some or all of the environmentally effected areas or allow them to conduct sensitivity tests of this issue.

Melissa Eccleston, whose paper was written concurrent to this study, explores the impact of the Sept. 11 attacks using birth certificate data. She focuses most of her analysis on New York City residents born between 1995 and 2004. She finds that cohorts in their first or second trimester of gestation weighed significantly less and were born significantly earlier than controls. In order to address the issue of the confounding environmental pollution she also runs regressions separating out the "less" effected boroughs (Staten Island, Queens, and the Bronx), finding that while the magnitudes are reduced (between a 2 - 24%) maternal stress continues to display a significant effect on birth outcomes.

This study, though, and any other focusing on residents of the attacked areas, are not without important limitations. By using residents from any part of NYC, the analysis faces the prospect of the exposed cohorts experiencing not just aggravated maternal stress but also a negative resource shock. Multiple studies have shown that NYC employees lost a significant number of labor hours and wages over the next few months following the attacks (Bram, Orr and Rapaport 2002 and Dolfman and Wasser 2004). Intuitively, loss in income for expecting families can lead to reduced health inputs, causing poorer birth outcomes and thus creating an overstatement of the effect of maternal stress.[1] Moreover, in addition to the income shock

[1] Eccleston attempts to address this issue by looking at birth outcomes for the cohort born between August and December 2002. By analyzing this group, which was conceived at least 6 weeks after the event, she suggests that she can assess the effect of the economic downturn on birth outcomes independent of maternal stress. Eccleston finds that this cohort does not have significantly worse birth outcomes and concludes that the economic downturn could not be driving her results. This reasoning though, misses the fact that family planning after a major terrorist event in one's city and while facing an economic downturn will be highly selective. Analysis of maternal characteristics of post-event conceiving families in NYC indicate that they were significantly less likely to be African American and marginally significantly more likely to complete more years of education. Given the endogenous and seemingly positive selection in post-event conception, Eccleston's robustness check no longer provides any alleviation of the concern over bias caused by the resource shock that was concurrent to the maternal stress shock, because the negative effect of the earning loss will be counterbalanced by the positive sample se-

faced by the NYC "treatment" group, this cohort may also be contaminated by selective migration.

Following a major health threatening event there may be migration out of the effected city by pregnant women trying to insulate themselves from further stressors or other health insults. More generally after an attack on a major city, there may be a reaction by financially able individuals to move out of metropolitan areas as they now seem more dangerous. In fact, in Eccleston's study, she presents evidence that mothers of the exposure cohort in NYC are significantly less likely to be white. Additionally, Eccleston points out that migration statistics based on NYC and NY state income tax filings indicate that from 2001 to 2002 NYC experienced more and higher income emigration than the rest of NY state. Taken together, these findings strongly suggest that there are likely to be additional characteristics, unobserved in the birth certificate data, which are also significantly correlated with being a NYC treatment group mother and negatively correlated with birth outcomes.

A final concern, relevant for the Eccleston study, is that including cohorts conceived after the September 11th attack can lead to misidentification. As mentioned in footnote 1, post-event cohorts from attacked cities tend to be from families with positively selected characteristics, and thus using them as controls biases the results toward making the treatment cohort look like the event had a larger negative effect on birth outcomes than it truly did. Thus, while Eccleston is more rigorous than any previous work using NYC residents, it still struggles to generate clean estimates of the effect of maternal stress because NYC residents were both exposed to several negative birth outcome triggers, and reacted in non-random ways to the event.

The work most in line with the approach found in this paper was conducted by Eskenazi et al. They used birth certificate data for upstate NY residents in the 40 weeks after the event and compared them to those born during the same period in the preceding two years to shield its analysis from

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lection. Analysis of the maternal characteristics of NYC post-event conceiving families is conducted using the same method as in Section V.2, equation (3) and can be found in Table D1.

some of the concerns raised previously. The results from this analysis indicated that very low birthweight births (VLBW, <1,500 grams) increased in upstate NY around the New Year (2nd trimester exposure) and 8 months after 9/11, but moderately low birthweight births (1500-<1999 grams) *decreased* for those born in early December. Results for PTB were also mixed as the authors found that late December births were more likely to be moderate PTB (32-<37 weeks), while those exposed late in pregnancy living in upstate NY were significantly *less* likely to have a moderate PTB. One issue still faced by this study, due to its focus on upstate NY residents, is the contamination of the "treatment" group by composition change brought on by endogenously selected NYC residents moving out of the city following Sept. 11th. Furthermore, upstate NY residents include many daily commuters into NYC, creating the potential for pollution exposure and experience of the economic fallout in NYC to be impacting the sample.

To avoid the difficulty of identifying maternal stress's relation to birth outcomes using residents from cities that were attacked, a few studies have looked elsewhere for confirmation of the link. Smits et al. looked at over 3,000 Dutch infants in utero during and one year after September 11th, 2001 and found that those exposed while in there 2nd and 3rd trimester had significantly smaller birthweight (2006). Further, a study by Endara et al. using a large dataset of infants born to active-duty military families found *no* effect from being in utero during the attacks (2009). Both of these studies though, rely on the use of the post 9/11 conception cohort as the control group and thus lose part of their identification accuracy as fertility rates and characteristics have been found to change after catastrophic events (Evans et al. 2010). Further, Rich-Edwards et al. using 1,184 Boston area women estimated that those pregnant during 9/11 were *less* likely to have a PTB, but a failure to control for time trends may be driving this counter-intuitive result (2005).

Building off of the lessons of the current literature this study hopes to avoid the various challenges of analyzing this subject in order to bring clarity to the question of whether exacerbated maternal mental stress can significantly hinder birth outcomes and thus potentially reverberate into the future of the next generation.

III Data and Methodology

The data used for this study are the 35,809,694 birth certificates for children born between January 1, 1995 and December 31, 2003 collected by the National Center for Health Statistics available in the Vital Statistics Natality Birth Data (VSNB). In addition to providing a large sample, the data contains several birth outcome variables as well as, demographic and medical data on the mother and the birth.

When determining timing of a birth's exposure to the September 11th attacks two methods are employed. The first approach estimates conception date as nine months prior to birth date, mirroring what is typically found in the literature when using only birth timing information. In the VSNB birth date data is available down to the month. As such, for births in September of 2001 it can not be determined whether they were exposed or not and thus, as an attempt to err on the side of a non-result, they will be considered part of the control group. Each of the first 8 birth months post-September 2001 are considered exposed and will be analyzed independently to try and pin down how the timing of the stress event impacts birth outcomes. This approach uses all infants delivered before June 1, 2002 in an effort to limit, as much as possible, to children conceived prior to the event.[2]

As is common in the literature this paper will use a linear reduced form model. Specifically the model being estimated using this approach is as follows:

$$b_{imjt} = \alpha_0 + Treat_i^{'}\beta + X_{im}^{'}\delta + \gamma_{yrproxy} + \gamma_{month} + \gamma_j + \gamma_{yrproxy,j} + \epsilon_i \quad (1)$$

where b_{imjt} is the birth outcome of interest for individual i, born at date t, to mother m, that resides in state j.

To evaluate the impact of maternal stress on early life health, the birth

[2]As will be seen in section V.2, cohorts conceived after the event are endogenously and possibly positively selected families and thus their inclusion would jeopardize the randomness of the treatment/control designation.

outcomes tested include overall birthweight, birthweight for gestational age z-score, as well as indicators for LBW, VLBW, and PTB.[3] Additionally, there is a medical literature that suggests that maternal stress may impact the sex ratio by reducing male births (reviewed in Catalano et al. 2006). As such, an indicator for being a male infant is also examined.

In this equation the matrix $Treat_i'$ is 8 indicators of being born in one of the 8 months from October 2001 to May 2002, representing the exposure period. Additionally, the matrix X_{im}' contains controls suggested by the medical literature including mother characteristics (education, race, marital status, age, plurality, and an indicator for diabetes) and birth information (plurality and sex of infant). Due to VSNB's large dataset, controlling for many of these variables can be done with great flexibility, rather than linearly or quadratically, which is the general practice in the literature. Thus, indicator variables are used for mother's education (18 levels), mother's age (36 levels including a level for less than 16 years of age and a level for 50 and over), and parity (8 levels including a level for live birth order of 8 and above).

Additionally, since the method of identification is temporal in nature, controlling for time trends non-parametrically is imperative to proper analysis of this event's impact on birth outcomes. This is made a bit more complicated by the fact that the coefficients of interest include month by month indicators for all births in 2002. In order to include time fixed effects without damaging interpretation of the treatment point estimates, the data from 1995 to 2002 was broken up into 6 equal segments of 16 months. Thus, while true birth year fixed effects are not included, these six, 16 month interval fixed effects, $\gamma_{yrproxy}$, will serve as controls for time trends. In addition it is critical in this type of study to control for seasonality in birth outcomes, and thus, month of birth fixed effects, γ_{month} are also included. Further, to account for any unobserved heterogeneity that is time invariant within the mother's residence state, dummies for mother's state of residence are added

[3]Birthweight for gestational age z-score is calculated as an infant's birthweight minus the mean birthweight from 1995 to 2000 for that infant's gestational age, all divided by the standard deviation of birthweight from 1995 to 2000 for that infant's gestational age.

to the model, γ_j. Finally, to soak up any location specific time trends, fixed effects for the interaction of an observation's 16 month birth interval and mother's state of residence are incorporated into the specification,$\gamma_{yrproxy,j}$.

A second approach used in the analysis will utilize the more informative but less accurate gestational age data. The VSNB contains data on the weeks a child was in gestation. Researchers have argued that gestational age is incomplete and imprecise (Reichman and Hade 2001) and the concerns stem from the fact that the statistic is predominately based on the mother's report, is in a small number of cases adjusted by a clinical estimate, or may be missing all together. In this paper gestational age is used with caution and considerable analysis is conducted only using the birth date information, but given the fact that, to be a first order problem, the bias would have to take a specific pattern related to the timing of September 11th, much of the concern is attenuated.

When using gestational age (in weeks) together with birth month information, a rough approximation for conception week can be estimated. In this study conception week is calculated as the gestational age minus 2 weeks, as conception usually occurs 2 weeks after the last normal menstrual period, divided by 4, subtracted from the birth month, then increased by 12 if the difference is less than 1. Conception year is then either the birth year or the birth year less one if the conception month is larger than the birth month. Since weekly data must be subtracted from monthly data to generate conception week, each conception week covers a range of conception dates. For example, if an infant is born in the first week of a month the conception week generated in the data is correct. If an infant is born in the last week of a month, though, the conception week generated in the data is early by 3 weeks. As such, to make sure to exclude all births conceived after the event, only infants with a calculated conception date of August 14, 2001 or earlier are included.[4]

When using this second approach the model estimated is as follows:

$$b_{imjt} = \alpha_0 + Treat_i'\beta + X_{im}'\delta + \gamma_{yrproxy} + \gamma_{week} + \gamma_j + \gamma_{yrproxy,j} + \epsilon_i \quad (2)$$

[4]See footnote 3.

where b_{imjt}, X'_{im}, and γ_j are the same as in equation (1). In (2), $Treat'_i$ is a matrix of 8 indicators for each month of conception from January 1, 2001 to August 14, 2001. Further, as in (1) a complete set of year fixed effects can not be used, so the data is placed into six equal 16 month groups based on conception date, $\gamma_{yrproxy}$. Finally, since the data contains gestational date by week, the seasonality fixed effects, γ_{week}, are indicators for week of conception. The rest of the controls found in equation (1) remain the same.

IV Results

Each row of Table 1 represents a separate regression and provides the estimates of the β coefficients when using the first approach in which only birth month information is utilized and NYC and DC residents are excluded.[5] The results show that the majority of the significant birthweight effects from maternal distress are grouped in the first trimester of exposure, as cohorts born between March and May 2002 are born significantly smaller and are more likely to be LBW or VLBW. The timing of stress's effect on gestational age, though, does not exhibit a clear relationship as it is cohorts exposed in the 3rd and 6th months of gestation that are significantly more likely to be born as a PTB infant. On the other hand, while intrauterine growth and gestational age appear to be impacted by acute maternal stress insults, the sex ratio seem to be unaffected.

Similarly, Table 2 contains the results of analysis using conception date information, which allows the sample to be stripped more thoroughly of post-exposure conceived infants and gives a more precise estimation of gestational timing of the event. As in Table 1, Table 2 excludes all NYC and DC residents. As expected, these results are larger and stronger in terms

[5]In all tables using the individual level data, robust standard errors are reported and results that are significant using the Schwarz criteria are boxed. The Schwarz criteria is a Bayesian approach to hypothesis testing and is included because it provides a stricter interpretation of statistical significance. In particular, it requires the significance level to be inversely related to sample size: critical t is calculated as the square root of the natural log of n (Schwarz 1978).

of magnitude and significance. The estimates indicate that almost the entire cohort of children in utero during the attacks had significantly reduced birthweight, by as much as 15 grams. Furthermore, as in the previous tables, this reduction in birthweight exists for those at the bottom end of the distribution as well; the exposure group children were significantly more likely to be a LBW or VLBW infant.

The estimates in Table 2, in regards to exposure timing's effect on intrauterine growth, reinforce the findings from the first approach, in that, once gestational age is controlled for using the z-score, it is clear that intrauterine growth is only significantly restricted by stress exposure in early gestation. Furthermore, when using the more informative conception date data, it it apparent that parturition timing is most sensitive to maternal stress in the middle of pregnancy as those cohorts were significantly more likely to be born preterm.[6] Interestingly, the findings indicate that a child's risk of being born LBW or VLBW is related much more strongly to maternal stress's impact on gestational age then through intrauterine growth restriction. The sex ratio, as before, appears to be unaffected by acute maternal psychological distress.

V Discussion

V.1 Alternative Specifications

In order to assess the sensitivity of the main results from Table 2 several alternative specifications were examined [7]. Table A1 contains results from running the same regression as in equation (2) on a slightly more selected sample. There may be reason to believe that the resource shock faced by

[6]One counter-intuitive result is the finding that those exposed in the first month of gestation were *less* likely to be born preterm. Results from section V.2 provide some evidence that this finding may be driven by positive behavioral changes or composition changes of the mothers in this cohort. This will be addressed again in Section V.2.

[7]Similar alternative specifications following equation (1) have also been conducted. The results from these regressions mirror those presented in this section, in that they are evidence of the robustness of the estimates in Section IV. Tables B1-B4 contain the alternative specification results when using equation (1).

NYC residents also extended out into the surrounding counties around NYC, as many of the residents of the NY metropolitan statistical area work in NYC. Thus, the results from Table A1 exclude not only residents of NYC and DC but the NYC primary metropolitan statistical area as well. The findings using this smaller sample are almost indecipherably different than the baseline results, indicating the group of residents outside NYC are not driving the results.

In the next two sensitivity tests many additional variables are added to the original specification. Given the large number of independent variables and massive sample size being used, the computation burden for these alternative specifications can be quite substantial. In an effort to speed analysis for these two tests, the data was transformed from individual level data to combined cell data. Specifically, the data was collapsed such that each cell contains all the individuals from the same county of residence, week of gestation, year of conception, and sex. Each of the variables of interest are calculated as the mean value for each cell group and the regressions are weighted by the number of individuals that make up each cell. Table A2 is a replication of Table 2 using this new cell data. The coefficient estimates in Table A2 are only negligibly different than those found in Table 2 and the interpretation of the impact of maternal stress is unchanged. As such, the results from sensitivity tests using the cell level data will not be driven by the change in the form of the database.

While there are studies that have shown there is a loss in job hours and earnings in NYC after 9/11, it is also quite possible that resource shocks from 9/11 may have differentially and significantly impacted areas all over the country. In order to address this concern, 15 variables, calculated from the Bureau of Labor Statistics, Local Area Unemployment Statistics, where added to equation (2) that indicate the unemployment level in the child's county of residence during the 15 months following the estimated conception date. These added controls can proxy for possible economic fluctuations faced by each child's parents during and following the gestation period.[8]

[8]The economic activity from approximately six months after birth is included in case the parents are able to reasonably predict coming economic hardship/prosperity and made

Results from this analysis can be found in Table A3. While many of the point estimates from this analysis are slightly larger in magnitude than in the baseline, overall, the results are qualitatively equivalent to those found in Table A2, suggesting that differential economic fluctuations related to the September 11th tragedy are not driving the results.

Finally, since the computational burden is reduced when using the cell level data, an analysis was able to be conducted where the state-level, γ_j, and state-time, $\gamma_{yrproxy,j}$, fixed effects are replaced with county-level and county-time fixed effects. By using this finer level of geographic information any unobserved heterogeneity at the county or county and year proxy level can be swept out of the coefficient estimates of interest. The results from this specification are displayed in Table A4, and, as in the rest of this section, the results are only marginally different from the baseline. In all, the alternative specifications provided additional support for the baseline results in terms of magnitudes and the temporal variation of the effect.

V.2 Test of Assumptions and Possible Confounds

By using the framework of a natural experiment, this analysis requires several strong assumptions and important sample selection choices. The first selection decision that was made for this study was the choice to exclude NYC and DC residents from the analysis. As mentioned previously this decision was made by relying on previous studies that indicate that, along with being exposed to the events of Sept. 11th, these individuals also have a higher likelihood of having been exposed to a pollution and/or resource shock, either of which would be negatively related to birth outcomes and confound the estimation of the effect of psychological distress (Landrigan et al. 2004, Perera et al. 2005, and Bram, Orr and Rapaport 2002).

A second sample selection decision made for this analysis is to exclude individuals conceived after the events of September 11th. This choice was made as there is concern that family planning choices may have been significantly altered in the months following the tragic events of 9/11. To take

earlier adjustments to their consumption that would effect the in utero child.

a closer look at this issue, maternal characteristics of non-NYC and DC infants conceived in the first seven months following the terrorist attack are compared to the composition of maternal attributes in the rest of the sample period. The regression used in this analysis is as follows:

$$b_{imjt} = \alpha_0 + \beta \cdot POST + \gamma_{1994} - \gamma_{2000} + \gamma_{week} + \gamma_j + \epsilon_i \qquad (3)$$

where POST is an indicator for being conceived in the first seven months after Sept. 11, 2001, $\gamma_{1994} - \gamma_{2000}$ are 7 indicators for being conceived in the years from 1994 to 2000, and γ_{week} and γ_j are the same as in equation (2). For this test, b_{imjt} will be three maternal characteristics: an indicator for whether the mother is African American, an indicator of whether the mother attended any college, and a measure of the number of years of school the mother completed As such, β is the coefficient of interest and will indicate whether the mothers of the post-event conceived children are significantly different from those conceived in the first 8 months of 2001.[9]. The results of this analysis, found in Table 3, make a strong statement that the post-event conceiving parents are significantly different than the parents from the previous cohort[10]. Specifically, the mothers have a statistically significantly different racial composition (they are less likely to be African American) and are statistically significantly more educated (both in overall years of school as well as the likelihood of having attended college). Given the potential bias that can be caused by including infants from mothers that are endogenously and, most likely, positively self-selected, the choice to cut the sample at those conceived before the event will help preserve the randomness needed for identification using a natural experiment.

With these sample selection choices made, the final assumption that needs verification is that the treatment and control groups being used are randomly assigned and compositionally equivalent. To test the validity of this assumption an analysis of the maternal characteristics of the treatment

[9]The seasonality controls are of utmost importance in this analysis since the children are born over different sets of months.

[10]A similar analysis using only the birth month information is found in Table C1. The results are qualitatively similar.

group was conducted. The specification used to examine the composition of the treatment mothers compared to the control mothers is as follows:

$$b_{imjt} = \alpha_0 + Treat_i^{'}\beta + \gamma_{yrproxy} + \gamma_{week} + \gamma_j + \gamma_{yrproxy,j} + \epsilon_i \qquad (4)$$

where $Treat_i^{'}\beta$, $\gamma_{yrproxy}$, γ_{week}, γ_j, and $\gamma_{yrproxy,j}$ are the same as in equation (2), but the dependent variables being tested are the 3 variables of maternal characteristics from the previous analysis.[11] Additionally, there may be concern that due to the stress caused by Sept. 11th a disproportionate and non-random number of fetal deaths or abortions may have occurred, changing the representativeness of the sample. To test this concern, using the cell level data mentioned in Section V.1, a similar regression to (4) was conducted where the dependent variable was the number of live births in each cell.

As can be seen in Table 4 there appears to be no racial composition difference between treatment mothers and control mothers. Additionally, in terms of college attendance and years of education, while there are a few significant differences, the positive direction of the differences make it clear that this change is not driving the results.[12] Furthermore, the analysis suggests that the exposure group was not different, in terms of size, than previous cohorts.

Finally, in order to attribute the poor birth outcomes found in Section IV to the biological mechanisms connecting stress to retarded intrauterine growth and restricted gestational age, it is important to establish that the events of 9/11 did not change the health behaviors of mothers. If, for example, mothers pregnant during the event, began to take on unhealthy behaviors such as increased tobacco consumption or decreased use of prenatal care, this would necessarily alter the interpretation of the results found in Section IV. To conduct this analysis equation (2) is calculated with maternal behaviors (maternal weight gain, as well as, indicators for whether prenatal

[11] A similar analysis using only the birth month information is found in Table C2. The results are qualitatively similar.

[12] This composition change may be responsible for the counterintuitive positive impact of stress on PTB found for the August 2001 conception cohort.

care started late or never was used, smoking during pregnancy, and alcohol use during pregnancy) as the dependent variables.[13] As seen in Table 5, there does not seem to be any systematic negative behavioral reaction by mothers to being exposed to the Sept. 11th events.

VI Conclusion

Using an unfortunate and unanticipated national tragedy and a robust source of data, this study estimates the impact that elevated maternal stress has on birth outcomes. In order to develop a clean identification strategy, residents of the attacked areas, who were exposed to other important health and resource shocks in addition to psychological distress, were excluded from the sample, and analysis was limited to those that had made their fertility decision before the event. The findings of this study suggest that, as predicted by the medical literature, infants exposed in utero to increased maternal stress were born significantly smaller and earlier than previous cohorts. Further, month by month analysis indicates that the timing of the stress insult does lead to important differences in the health outcome of the child as intrauterine growth is most sensitive to stress shocks in the first trimester, while gestational age is most susceptible in mid pregnancy.

Taking these results, along with the supportive estimates from multiple alternative specifications, together, the evidence repeatedly points to a statistically significant relationship between maternal stress and poor birth outcomes, but the small magnitudes of the coefficients suggest that the long-term health and economic impact may be negligible. Using BR as a guide, this analysis would estimate that children exposed to an acute maternal stressor like the Sept. 11th attack in the first trimester are, at worst, likely to achieve .01 less years of education, have .02 inches less height, and obtain .2% less earnings.

In summary, it appears that while biological pathways connecting maternal stress and birth outcomes exist and can be identified in the data, the

[13] A similar analysis using only the birth month information is found in Table C3. The results are qualitatively similar.

size of the impact is quite small. These results strongly suggest that the womb and/or the fetus have evolved such that they can reliably protect the next generation from acute maternal psychological distress.

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VIII Tables and Figures

Table 1
Departure of Birth Outcomes for Children In Utero During 9/11 Attack
Using Natality Data on Births from January 1, 1995 to May 31, 2002
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Birth							
Birth Outcome	Observations	Mean	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002
Birthweight	27,830,257	3,320	-0.05	0.33	-4.19 ***	2.57	-0.37	-7.91 ***	-3.32 **	-8.31 ***
			(1.49)	(1.52)	(1.51)	(1.50)	(1.53)	(1.50)	(1.51)	(1.50)
BW for GA Z-Score	27,549,946	0.00	0.00	0.00	0.00	0.00	0.00	-0.01 ***	-0.01 **	-0.01 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	27,830,257	7.5%	0.00%	0.00%	0.08%	-0.04%	0.02%	0.21% ***	0.05%	0.19% ***
			(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
VLBW (<1,500 g)	27,830,257	1.4%	0.01%	0.04%	0.05%	0.05%	0.01%	0.09% ***	0.05%	0.07% **
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Preterm (<37 wks)	27,566,306	11.5%	-0.02%	0.11%	0.38% ***	0.06%	0.04%	0.20% **	0.07%	0.11%
			(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Male	27,861,010	51.2%	-0.02%	-0.04%	-0.25%	0.06%	-0.08%	-0.13%	-0.11%	-0.10%
			(0.13)	(0.14)	(0.14)	(0.13)	(0.14)	(0.13)	(0.14)	(0.13)

Notes:
Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.
Robust standard errors are in parenthesis with, **, meaning significant at 5 percent, ***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.
Each regression controls for 16 month birth cohort fixed effects, birth month fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the birth cohort and mother's state of residence fixed effects.
[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

Table 2
Departure of Birth Outcomes for Children In Utero During 9/11 Attack
Using Natality Data on Births Conceived before August 14th, 2001
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Conception							
Birth Outcome	Observations	Mean	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001[2]
Birthweight	27,552,002	3,323	-1.48	-5.60 ***	-9.70 ***	-7.66 ***	-10.07 ***	-6.61 ***	-8.40 ***	-15.29 ***
			(1.21)	(1.21)	(1.21)	(1.23)	(1.21)	(1.19)	(1.19)	(1.72)
BW for GA Z-Score	27,552,002	0.00	0.00 **	0.00	0.00	0.00	-0.01 ***	-0.01 ***	-0.01 ***	-0.02 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	27,552,002	7.4%	0.09%	0.13% **	0.26% ***	0.38% ***	0.27% ***	0.16% ***	0.19% ***	0.22% ***
			(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.08)
VLBW (<1,500 g)	27,552,002	1.3%	0.04%	0.00%	0.08% ***	0.16% ***	0.19% ***	0.09% ***	0.07% ***	-0.02%
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.04)
Preterm (<37 wks)	27,568,056	11.3%	-0.08%	0.51% ***	0.98% ***	0.67% ***	0.35% ***	0.03%	0.15% **	-0.49% ***
			(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)
Male	27,568,056	51.2%	0.09%	-0.10%	0.16%	0.05%	0.03%	-0.05%	-0.04%	0.08%
			(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.15)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent, ***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.

Each regression controls for 16 month conception cohort fixed effects, conception week fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the conception cohort and mother's state of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

[2]Concieved week between August 1, 2001 and August 14, 2001.

Table 3
Change in Maternal Characteristics for Infants Conceived After 9/11 Attack[1]

Maternal Characteristic	Observations	Mean	Post-Event Cohort[1]	
Mother is African American	29,821,033	14.2%	-0.19%	***
			(0.03)	
Mother's Years of Education	29,417,747	12.79	0.019	***
			(0.003)	
Mother, Some College	29,417,747	45.6%	0.37%	***
			(0.05)	

Notes:
Data obtained from NCHS. Excludes NYC and Washington D.C. PMSA residents.
Includes all births from January 1, 1995 to December 31, 2003 conceived before March 14th, 2002.
Robust standard errors are in parenthesis with, **, meaning significant at 5 percent,
***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.
Each regression controls for conception year fixed effects, conception week fixed effects, and mother's state of residence fixed effects.
[1]Considered conceived after event if conception week is after August 14th, 2001.

Table 4
Departure of Maternal Attributes of Children In Utero During 9/11 Attack
Using Natality Data on Births Conceived before August 14th, 2001
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Conception							
Maternal Characteristic	Observations	Mean	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001[2]
Mother is African American	27,568,056	14.2%	0.02%	-0.04%	0.12%	-0.04%	0.04%	-0.16% **	-0.06%	-0.04%
			(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.10)
Mother's Years of Educatior	27,196,339	12.8	0.01	0.00	0.01	0.01	0.01	0.04 ***	0.03 ***	0.04 ***
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Mother, Some College	27,196,339	45.5%	0.04%	0.05%	0.12%	0.02%	0.16%	0.62% ***	0.46% ***	0.61% ***
			(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.15)
Number of Live Births[3]	781,490	35.3	0.21	1.39	1.14	0.08	0.34	1.01	1.16	1.37
			(1.14)	(1.14)	(1.14)	(1.12)	(1.14)	(1.15)	(1.17)	(1.43)

Notes:
Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.
Robust standard errors are in parenthesis with, **, meaning significant at 5 percent, ***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.
Each regression controls for 16 month conception cohort fixed effects, conception week fixed effects, mother's state of residence fixed effects, and an interaction of the conception cohort and mother's state of residence fixed effects.
[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)
[2]Concieved week between August 1, 2001 and August 14, 2001.
[3]This analysis uses the cell level data described in Section V.1.

Table 5
Departure of Maternal Behaviors of Children In Utero During 9/11 Attack
Using Natality Data on Births Conceived before August 14th, 2001
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Conception							
Maternal Behavior	Observations	Mean	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001[2]
Late/No Prenatal Care[3]	27,033,176	3.7%	-0.02%	0.02%	-0.06%	-0.03%	-0.04%	-0.07%	-0.10% **	-0.15% ***
			(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)
Maternal Weight Gain	22,013,433	30.8	0.02	0.03	0.06	0.08 **	0.15 ***	0.17 ***	0.10 ***	0.01
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.05)
Smoke While Preg.	22,691,092	13.3%	-0.06%	-0.01%	0.05%	-0.03%	-0.12%	-0.19% ***	-0.16% **	-0.18%
			(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.10)
Alch. Use While Preg.	23,483,669	1.1%	0.00%	0.02%	0.01%	0.02%	0.03%	-0.02%	0.01%	0.02%
			(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.03)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent, ***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.

Each regression controls for 16 month conception cohort fixed effects, conception week fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the conception cohort and mother's state of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

[2]Concieved week between August 1, 2001 and August 14, 2001.

[3]Late/No prenatal care defined as either starting prenatal care in the 3rd trimester or never receiving prenatal care.

Table A1

Departure of Birth Outcomes for Children In Utero During 9/11 Attack Using Natality Data on Births Conceived before August 14th, 2001 Excluding Residents of the New York City and Washington D.C. Metropolitan Areas[1]

			Month of Conception							
Birth Outcome	Observations	Mean	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001[2]
Birthweight	27,415,768	3,323	-1.49	-5.61 ***	-9.87 ***	-7.64 ***	-10.11 ***	-6.70 ***	-8.51 ***	-15.29 ***
			(1.22)	(1.21)	(1.21)	(1.23)	(1.21)	(1.20)	(1.19)	(1.73)
BW for GA Z-Score	27,415,768	0.00	0.00 **	0.00	0.00	0.00	-0.01 ***	-0.01 ***	-0.01 ***	-0.02 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	27,415,768	7.4%	0.09%	0.13% **	0.26% ***	0.38% ***	0.28% ***	0.16% ***	0.19% ***	0.22% ***
			(0.05)	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.05)	(0.08)
VLBW (<1,500 g)	27,415,768	1.3%	0.04%	0.00%	0.09% ***	0.16% ***	0.19% ***	0.09% ***	0.07% ***	-0.02%
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.02)	(0.02)	(0.04)
Preterm (<37 wks)	27,431,784	11.3%	-0.08%	0.51% ***	0.98% ***	0.66% ***	0.35% ***	0.03%	0.16% **	-0.49% ***
			(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.08)
Male	27,431,784	51.2%	0.10%	-0.11%	0.15%	0.05%	0.04%	-0.05%	-0.03%	0.07%
			(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.11)	(0.15)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.

Robust standard errors are in parenthesis.

Each regression controls for 16 month conception cohort fixed effects, conception week fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the conception cohort and mother's state of residence fixed effects.

** Significant at 5 percent, *** Significant at 1 percent, **BOX** Significant using the Schwarz Criteria

[1]The New York City and Washington D.C. metropolitan areas are defined as the New York, NY Primary Metropolitan Statistical Area and the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA), respectively.

[2]Concieved week between August 1, 2001 and August 14, 2001.

Table A2

Departure of Birth Outcomes for Children In Utero During 9/11 Attack
Using Collapsed Natality Data on Births Conceived before August 14th, 2001
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Conception							
Birth Outcome	Observations	Mean	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001[2]
Birthweight	780,888	3,259	-1.09	-5.24 ***	-9.23 ***	-7.13 ***	-9.41 ***	-6.36 ***	-7.99 ***	-14.73 ***
			(1.39)	(1.38)	(1.43)	(1.44)	(1.43)	(1.42)	(1.36)	(2.06)
BW for GA Z-Score	780,888	-0.04	0.00	0.00	0.00	0.00	-0.01 ***	-0.01 ***	-0.01 ***	-0.01 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	780,888	9.9%	0.07%	0.11% **	0.25% ***	0.37% ***	0.25% ***	0.15% ***	0.18% ***	0.21% **
			(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.09)
VLBW (<1,500 g)	780,888	2.6%	0.03%	-0.01%	0.08% ***	0.15% ***	0.18% ***	0.09% ***	0.06% **	-0.03%
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Preterm (<37 wks)	781,490	13.5%	-0.09%	0.50% ***	0.97% ***	0.65% ***	0.33% ***	0.03%	0.15%	-0.49% ***
			(0.08)	(0.08)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.09)
Male	781,490	50.4%	0.14%	-0.04%	0.19%	0.09%	0.03%	-0.05%	-0.03%	0.13%
			(1.71)	(1.71)	(1.70)	(1.69)	(1.68)	(1.67)	(1.67)	(2.22)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates. Data was collapsed such that each cell contains all the individuals from the same county of residence, week of gestation, year of conception, and sex. The regressions are weighted by the number of individuals that are contained in each cell.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent and, ***, meaning significant at 1 percent

Each regression controls for 16 month conception cohort fixed effects, conception week fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the conception cohort and mother's state of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

[2]Concieved week between August 1, 2001 and August 14, 2001.

Table A3

Departure of Birth Outcomes for Children In Utero During 9/11 Attack Using Collapsed Natality Data on Births Conceived before August 14th, 2001 Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1] and Controlling for County Level Economic Conditions

			Month of Conception							
Birth Outcome	Observations	Mean	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001[2]
Birthweight	780,888	3,259	-0.18	-5.86 ***	-10.21 ***	-7.69 ***	-10.82 ***	-7.71 ***	-11.21 ***	-17.23 ***
			(1.41)	(1.39)	(1.45)	(1.45)	(1.45)	(1.46)	(1.40)	(2.09)
BW for GA Z-Score	780,888	-0.04	0.00 **	0.00	0.00	0.00	-0.01 ***	-0.01 ***	-0.01 ***	-0.02 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	780,888	9.9%	0.04%	0.12% **	0.26% ***	0.36% ***	0.27% ***	0.18% ***	0.26% ***	0.27% ***
			(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.09)
VLBW (<1,500 g)	780,888	2.6%	0.02%	-0.01%	0.07% **	0.15% ***	0.18% ***	0.09% ***	0.08% ***	-0.02%
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Preterm (<37 wks)	781,490	13.5%	-0.16%	0.50% ***	0.99% ***	0.61% ***	0.35% ***	0.06%	0.27% ***	-0.42% ***
			(0.08)	(0.08)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.10)
Male	781,490	50.4%	0.12%	-0.05%	0.17%	0.09%	0.00%	-0.06%	-0.06%	0.11%
			(1.73)	(1.73)	(1.72)	(1.70)	(1.70)	(1.70)	(1.70)	(2.25)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates. Data was collapsed such that each cell contains all the individuals from the same county of residence, week of gestation, year of conception, and sex. The regressions are weighted by the number of individuals that are contained in each cell.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent and, ***, meaning significant at 1 percent

Each regression controls for 16 month conception cohort fixed effects, conception week fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the conception cohort and mother's state of residence fixed effects. Additionally, these regressions contain controls for the unemployment level in the child's county of residence during the 15 months following the estimated conception month, calculated from the Bureau of Labor Statistics, Local Area Unemployment Statistics.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

[2]Concieved week between August 1, 2001 and August 14, 2001.

Table A4

Departure of Birth Outcomes for Children In Utero During 9/11 Attack Using Natality Data on Births Conceived before August 14th, 2001 Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Conception							
Birth Outcome	Observations	Mean	Jan 2001	Feb 2001	Mar 2001	Apr 2001	May 2001	June 2001	July 2001	Aug 2001[2]
Birthweight	780,888	3,259	-1.18	-5.29 ***	-9.22 ***	-7.17 ***	-9.37 ***	-6.30 ***	-7.84 ***	-14.53 ***
			(1.33)	(1.30)	(1.36)	(1.36)	(1.36)	(1.35)	(1.31)	(1.98)
BW for GA Z-Score	780,888	-0.04	0.00 **	0.00	0.00	0.00	-0.01 ***	-0.01 ***	-0.01 ***	-0.01 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	780,888	9.9%	0.07%	0.11% **	0.24% ***	0.36% ***	0.24% ***	0.15% ***	0.17% ***	0.20% **
			(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.06)	(0.09)
VLBW (<1,500 g)	780,888	2.6%	0.03%	-0.01%	0.07% ***	0.15% ***	0.18% ***	0.09% ***	0.06% **	-0.03%
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Preterm (<37 wks)	781,490	13.5%	-0.09%	0.50% ***	0.97% ***	0.65% ***	0.31% ***	0.02%	0.13%	-0.51% ***
			(0.08)	(0.08)	(0.09)	(0.09)	(0.08)	(0.08)	(0.08)	(0.10)
Male	781,490	50.4%	0.15%	-0.04%	0.22%	0.09%	0.07%	-0.04%	0.00%	0.18%
			(1.71)	(1.72)	(1.70)	(1.69)	(1.68)	(1.68)	(1.67)	(2.22)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates. Data was collapsed such that each cell contains all the individuals from the same county of residence, week of gestation, year of conception, and sex. The regressions are weighted by the number of individuals that are contained in each cell.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent and, ***, meaning significant at 1 percent

Each regression controls for 16 month conception cohort fixed effects, conception week fixed effects, mother's county of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the conception cohort and mother's county of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

[2]Concieved week between August 1, 2001 and August 14, 2001.

Table B1

Departure of Birth Outcomes for Children In Utero During 9/11 Attack
Using Natality Data on Births from January 1, 1995 to May 31, 2002
Excluding Residents of the New York City and Washington D.C. Metropolitan Areas[1]

			Month of Birth							
Birth Outcome	Observations	Mean	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002
Birthweight	27,693,676	3,320	0.15	0.41	-4.17 ***	2.54	-0.33	-7.85 ***	-3.18 **	-8.22 ***
			(1.50)	(1.52)	(1.51)	(1.51)	(1.53)	(1.50)	(1.52)	(1.50)
BW for GA Z-Score	27,413,705	0.00	0.00	0.00	0.00	0.00	0.00	-0.01 ***	-0.01 **	-0.01 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	27,693,676	7.5%	-0.01%	-0.01%	0.07%	-0.05%	0.02%	0.20% ***	0.04%	0.18% ***
			(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
VLBW (<1,500 g)	27,693,676	1.4%	0.01%	0.03%	0.05%	0.05%	0.00%	0.08% ***	0.04%	0.06% **
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Preterm (<37 wks)	27,430,025	11.5%	-0.02%	0.10%	0.38% ***	0.05%	0.04%	0.20% **	0.06%	0.10% ***
			(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)	(0.08)
Male	27,724,382	51.2%	0.00%	-0.02%	-0.24%	0.06%	-0.07%	-0.11%	-0.10%	-0.09% ***
			(0.13)	(0.14)	(0.14)	(0.13)	(0.14)	(0.13)	(0.14)	(0.13)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.

Robust standard errors are in parenthesis.

Each regression controls for 16 month birth cohort fixed effects, birth month fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the birth cohort and mother's state of residence fixed effects.

** Significant at 5 percent, *** Significant at 1 percent, **BOX** Significant using the Schwarz Criteria

[1]The New York City and Washington D.C. metropolitan areas are defined as the New York, NY Primary Metropolitan Statistical Area and the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA), respectively.

Table B2
Departure of Birth Outcomes for Children In Utero During 9/11 Attack
Using Collapsed Natality Data on Births from January 1, 1995 to May 31, 2002
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Birth							
Birth Outcome	Observations	Mean	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002
Birthweight	329,011	3,218	-0.03	0.76	-3.72	2.89	0.05	-7.31 ***	-2.68	-7.97 ***
			(2.03)	(1.93)	(1.94)	(1.92)	(1.94)	(1.92)	(1.96)	(1.89)
BW for GA Z-Score	280,177	-0.06	0.00	0.00	0.00	0.01	0.00	-0.01 ***	0.00	-0.01 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	329,011	11.5%	0.00%	-0.01%	0.06%	-0.05%	0.01%	0.18% ***	0.03%	0.18% **
			(0.08)	(0.07)	(0.07)	(0.07)	(0.08)	(0.07)	(0.07)	(0.07)
VLBW (<1,500 g)	329,011	3.5%	0.01%	0.03%	0.04%	0.05%	0.00%	0.07% **	0.04%	0.06%
			(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
Preterm (<37 wks)	280,509	15.4%	-0.03%	0.09%	0.35% ***	0.05%	0.03%	0.17%	0.05%	0.10%
			(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Male	336,317	50.5%	0.05%	-0.01%	-0.13%	0.03%	-0.04%	-0.17%	-0.10%	-0.12%
			(4.24)	(4.24)	(4.24)	(4.20)	(4.19)	(4.18)	(4.18)	(4.17)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates. Data was collapsed such that each cell contains all the individuals from the same county of residence, month of birth, year of birth, and sex. The regressions are weighted by the number of individuals that are contained in each cell.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent and, ***, meaning significant at 1 percent

Each regression controls for 16 month birth cohort fixed effects, birth month fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the birth cohort and mother's state of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

Table B3

**Departure of Birth Outcomes for Children In Utero During 9/11 Attack
Using Collapsed Natality Data on Births from January 1, 1995 to May 31, 2002
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]
and Controlling for County Level Economic Conditions**

			Month of Birth							
Birth Outcome	Observations	Mean	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002
Birthweight	329,011	3,218	-0.13	0.46	-4.83 **	1.56	-1.85	-9.02 ***	-5.31 ***	-10.36 ***
			(2.06)	(1.95)	(1.97)	(1.94)	(1.97)	(1.95)	(2.00)	(1.91)
BW for GA Z-Score	280,177	-0.06	0.00	0.00	0.00	0.00	-0.01	-0.01 ***	-0.01 ***	-0.02 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	329,011	11.5%	0.01%	-0.02%	0.08%	-0.02%	0.05%	0.21% ***	0.08%	0.23% ***
			(0.08)	(0.08)	(0.08)	(0.07)	(0.08)	(0.07)	(0.07)	(0.07)
VLBW (<1,500 g)	329,011	3.5%	0.01%	0.03%	0.05%	0.06%	0.01%	0.07% **	0.04%	0.07%
			(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.04)	(0.04)	(0.03)
Preterm (<37 wks)	280,509	15.4%	-0.04%	0.06%	0.38% ***	0.06%	0.06%	0.20% **	0.09%	0.14%
			(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)	(0.10)
Male	336,317	50.5%	0.01%	-0.05%	-0.15%	-0.02%	-0.05%	-0.25%	-0.15%	-0.19%
			(4.28)	(4.27)	(4.28)	(4.23)	(4.23)	(4.23)	(4.24)	(4.21)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates. Data was collapsed such that each cell contains all the individuals from the same county of residence, month of birth, year of birth, and sex. The regressions are weighted by the number of individuals that are contained in each cell.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent and, ***, meaning significant at 1 percent

Each regression controls for 16 month birth cohort fixed effects, birth month fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the birth cohort and mother's state of residence fixed effects. Additionally, these regressions contain controls for the unemployment level in the child's county of residence during the 15 months following the estimated conception month, calculated from the Bureau of Labor Statistics, Local Area Unemployment Statistics.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

Table B4
Departure of Birth Outcomes for Children In Utero During 9/11 Attack
Using Collapsed Natality Data on Births from January 1, 1995 to May 31, 2002
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Birth							
Birth Outcome	Observations	Mean	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002
Birthweight	329,011	3,218	-0.27	0.45	-3.79 **	2.47	-0.28	-7.47 ***	-3.01	-8.13 ***
			(1.68)	(1.60)	(1.60)	(1.63)	(1.67)	(1.62)	(1.67)	(1.65)
BW for GA Z-Score	280,177	-0.06	0.00	0.00	0.00	0.01	0.00	-0.01 ***	0.00	-0.01 ***
			(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
LBW (<2,500 g)	329,011	11.5%	0.01%	-0.01%	0.06%	-0.04%	0.02%	0.19% ***	0.04%	0.18% ***
			(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)	(0.07)
VLBW (<1,500 g)	329,011	3.5%	0.01%	0.03%	0.04%	0.05%	0.00%	0.07% **	0.04%	0.06%
			(0.03)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)	(0.03)
Preterm (<37 wks)	280,509	15.4%	-0.01%	0.10%	0.36% ***	0.06%	0.04%	0.17%	0.05%	0.09%
			(0.09)	(0.09)	(0.09)	(0.09)	(0.10)	(0.09)	(0.09)	(0.09)
Male	336,317	50.5%	-0.01%	-0.04%	-0.11%	-0.03%	-0.09%	-0.21%	-0.17%	-0.13%
			(4.25)	(4.25)	(4.25)	(4.21)	(4.20)	(4.19)	(4.19)	(4.18)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates. Data was collapsed such that each cell contains all the individuals from the same county of residence, month of birth, year of birth, and sex. The regressions are weighted by the number of individuals that are contained in each cell.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent and, ***, meaning significant at 1 percent

Each regression controls for 16 month birth cohort fixed effects, birth month fixed effects, mother's county of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the birth cohort and mother's county of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

Table C1
Change in Maternal Characteristics for Infants Conceived After 9/11 Attack[1]

Maternal Characteristic	Observations	Mean	Post-Event Cohort[1]	
Mother is African American	30,137,299	14.2%	-0.18%	***
			(0.03)	
Mother's Years of Education	29,707,280	12.78	0.028	***
			(0.002)	
Mother, Some College	29,707,280	45.5%	0.52%	***
			(0.04)	

Notes:
Data obtained from NCHS. Excludes NYC and Washington D.C. PMSA residents.
Includes all births from January 1, 1995 to December 31, 2002.
Robust standard errors are in parenthesis with, **, meaning significant at 5 percent,
***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.
Each regression controls for birth year fixed effects, birth month fixed effects,
and mother's state of residence fixed effects.
[1]Considered conceived after event if born after May 31, 2002.

Table C2

Departure of Maternal Attributes of Children In Utero During 9/11 Attack
Using Natality Data on Births from January 1, 1995 to May 31, 2002
Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

			Month of Birth							
Maternal Characteristic	Observations	Mean	Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002
Mother is African American	27,861,010	14.2%	-0.19% **	-0.11%	0.02%	-0.28% ***	-0.20% **	-0.21% **	-0.22% **	-0.29% ***
			(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Mother's Years of Education	27,461,455	12.8	0.00	0.00	-0.01	0.02 ***	0.02 **	0.02 **	0.03 ***	**[0.04]** ***
			(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	**[(0.01)]**
Mother, Some College	27,461,455	45.4%	-0.17%	-0.04%	-0.24%	0.21%	0.11%	0.28% **	0.32% **	**[0.59%]** ***
			(0.13)	(0.13)	(0.13)	(0.13)	(0.14)	(0.13)	(0.13)	**[(0.13)]**
Number of Live Births[2]	291,590	95.5	0.19	0.91	0.87	1.52	2.92	1.81	4.30	5.04
			(8.30)	(8.12)	(8.18)	(8.16)	(7.96)	(8.21)	(8.15)	(8.30)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent, ***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.

Each regression controls for 16 month birth cohort fixed effects, birth month fixed effects, mother's state of residence fixed effects, and an interaction of the birth cohort and mother's state of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

[2]This analysis uses the cell level data described in Tables B2-B4.

Table C3
Departure of Maternal Behaviors of Children In Utero During 9/11 Attack Using Natality Data on Births from January 1, 1995 to May 31, 2002 Excluding Residents of New York City and the Washington D.C. Metropolitan Area[1]

Maternal Behavior	Observations	Mean	Month of Birth							
			Oct 2001	Nov 2001	Dec 2001	Jan 2002	Feb 2002	Mar 2002	Apr 2002	May 2002
Late/No Prenatal Care[2]	27,248,623	3.8%	0.01%	-0.02%	0.03%	-0.14% ***	-0.11% **	-0.03%	-0.06%	-0.14% ***
			(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
Maternal Weight Gain	22,048,841	30.8	0.007	0.008	0.055	0.117 ***	0.099 **	0.216 *** [BOX]	0.063	0.000
			(0.040)	(0.041)	(0.041)	(0.040)	(0.041)	(0.040) [BOX]	(0.040)	(0.040)
Smoke While Preg.	22,754,458	13.3%	0.04%	-0.02%	0.19% **	-0.02%	0.01%	-0.17%	-0.07%	-0.20% **
			(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)	(0.09)
Alch. Use While Preg.	23,547,147	1.2%	-0.01%	0.02%	0.04%	-0.03%	0.01%	0.02%	0.02%	0.00%
			(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)

Notes:

Data obtained from National Center of Health Statistics 1995 to 2002 birth certificates.

Robust standard errors are in parenthesis with, **, meaning significant at 5 percent, ***, meaning significant at 1 percent, and **BOX** meaning significant using the Schwarz Criteria.

Each regression controls for 16 month birth cohort fixed effects, birth month fixed effects, mother's state of residence fixed effects, fixed effects for live birth order (8-levels), fixed effects for mother's age (36-levels), fixed effects for mother's education level (18-levels), parity, mother's diabetes, mother's race (white, black, Hispanic, and other), child's gender, and an interaction of the birth cohort and mother's state of residence fixed effects.

[1]The Washington D.C. metropolitan area is defined as the Washington, DC-MD-VA-WV Primary Metropolitan Statistical Area (PMSA)

[2]Late/No prenatal care defined as either starting prenatal care in the 3rd trimester or never receiving prenatal care.

Table D1
Change in Maternal Characteristics for New York City Infants Conceived After 9/11 Attack[1]

Maternal Characteristic	Observations	Mean	Post-Event Cohort[1]	
Mother is African American	963,731	28.0%	-0.55%	***
			(0.24)	
Mother's Years of Education	945,583	12.55	0.028	*
			(0.016)	
Mother, Some College	945,583	40.3%	0.10%	
			(0.27)	

Notes:
Data obtained from NCHS. NYC residents only.
Includes all births from January 1, 1995 to December 31, 2003 conceived before March 14th, 2002.
Robust standard errors are in parenthesis with, *, meaning significant at 10 percent,
, meaning significant at 5 percent, and ,*, meaning significant at 1 percent
Each regression controls for conception year fixed effects, conception week fixed effects, and mother's state of residence fixed effects.
[1]Considered conceived after event if conception week is after August 14th, 2001.