Maternal Stress and Pregnancy Outcomes

Evidence from the 2004 Madrid Bombing

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Introduction

At 7.40 am on **March 11th, 2004**, in a coordinated attack by Al-Qaeda, **ten bombs** simultaneously exploded on four commuter trains in **Madrid**.


EL PAIS

DIARIO INDEPENDIENTE DE LA MAÑANA

Infierno terrorista en Madrid: 192 muertos y 1.400 heridos

Interior investiga la pista de Al Qaeda sin descartar a ETA

The attack was sudden and unpredictable; the bomb explosions in commuter trains meant that almost everybody was at risk of being affected themselves or may have known someone potentially affected. In the aftermath of the attack, an **increase of mental disorders** among the citizens of Madrid has been identified (Miguel-Tobal et al., 2006).

We exploit the Madrid Bombing as **a natural experiment to investigate**:

- **the effect of prenatal maternal stress** on birth weight and gestational age
- whether prenatal maternal stress affects pregnancy outcomes according to **mothers' socioeconomic status** (SES)

Theory

Maternal stress & Placental Clock:

- Prenatal maternal stress triggers the release of corticotropin-releasing hormone (CRH), which in turn may set the placenta for a preterm delivery (McLean et al., 1995)
- **High levels of CRH** during the 1st and 2nd trimester of gestation are associated with **a higher risk of premature delivery** (Holzman, Jetton, Siler-Khodr, Fisher, & Rip, 2001)

Prenatal investments & heterogeneity in the shock:

- The exposure to an acute stressor may activate adaptive behaviors in mothers, which in turn may engage in prenatal investments to shelter the pregnancy (Dancause et al., 2011; Torche & Villareal, 2014)
- However, **prenatal investments are likely to be socially stratified**. High-SES parents may be more likely to compensate for an early shock compared to low-SES parents (Bernardi, 2014; Conley, 2008)

Data

In this work, we include the **entire population of births from mothers resident in Madrid** for the years **2002, 2003, and 2004**, which is composed of **65,400 singleton births**. The data are provided by Spanish statistical institute.

Methods

We use the **month of birth** to identify the trimesters in which the **treatment** (maternal stress *in utero*) is assigned, estimating its effect on birth weight and gestational age.

We identify four groups. With the exception of the placebo group, each group consists of children who are *in utero* in the same trimester before (control) and after the attack (treatment):

	Placebo	3rd Trim.	2nd Trim.	1st Trim.
Control	12/2002 to 2/2003	3/2003 to 5/2003	6/2003 to 8/2003	9/2003 to 11/2003
Treatment	12/2003 to 2/2004	3/2004 to 5/2004	6/2004 to 8/2004	9/2004 to 11/2004

We apply a **Difference-in-Difference (DID) estimator**, comparing children born in different trimesters (T)

$$\text{DiD} = (\text{T}_{\text{post-treat}} - \text{T}_{\text{pre-treat}}) - (\text{T}_{\text{before post-treat}} - \text{T}_{\text{before pre-treat}})$$

Conclusions

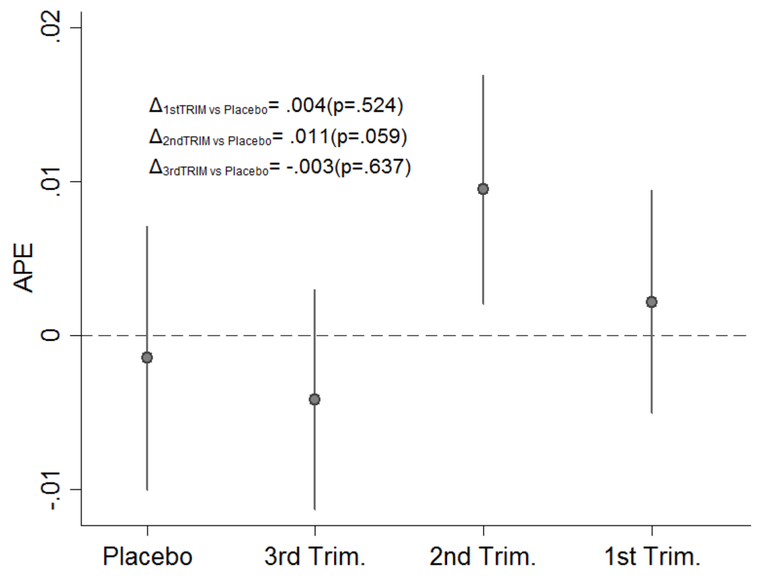
- Maternal stress generated by the Madrid terrorist attack has a noxious effect on pregnancy outcomes, increasing the chances of a premature delivery; the effect of the shock is homogeneous across mothers' SES
- We find a homogeneous effect of the shock, whereas Torche & Villarreal (2014) found that low-SES mothers were compensating for a shock during the pregnancy
- A sudden shock may thus not lead to a behavioral response by the mothers

→ No major differences in prenatal investments among different mothers?

- However, it remains an open question whether children born from different mothers will experience the same detrimental consequences of being born premature later in life, especially considering the differences between high-SES parents and low-SES parents in compensating for early-life disadvantages

Results

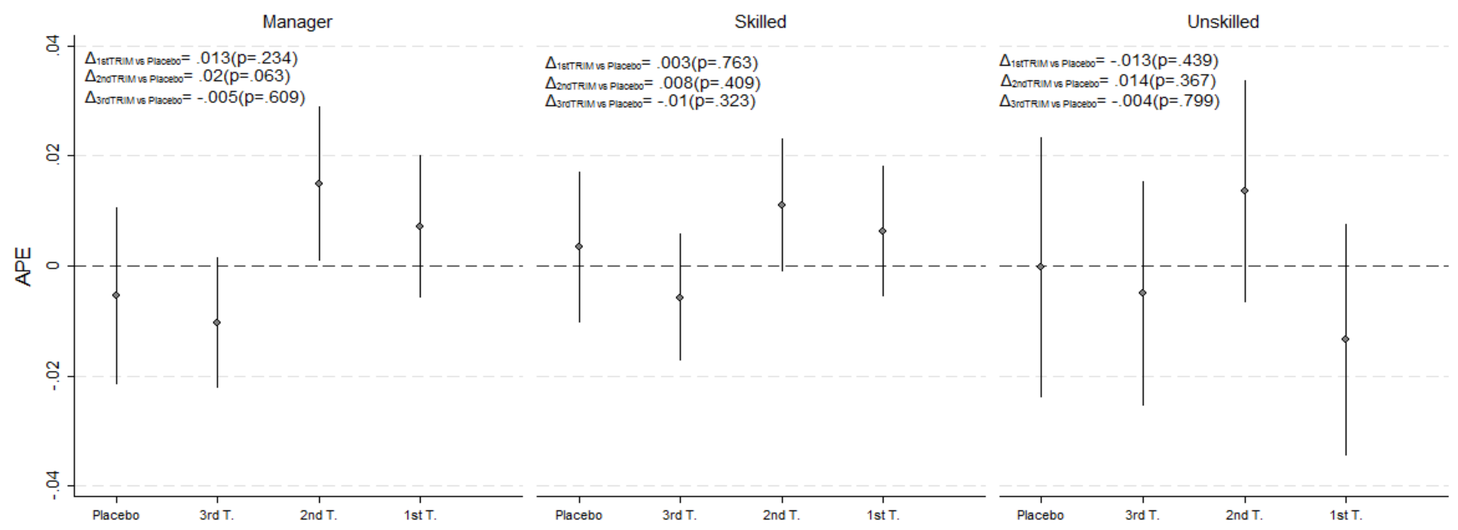
GRAPH 1. Effect of terrorist attack on the probability of premature delivery by groups



- **NO effect of the exposure to the stress resulting from the terrorist attack on birthweight.**
- However, the terrorist attack increased (+1%) the probability of pre-term birth for children exposed during the 2nd trimester of gestation (**GRAPH 1**)
- **The shock has a homogeneous effect across mothers' SES**. During the 2nd trimester of gestation all the pregnant women experienced an increase in the probability of delivering a preterm child. High-SES women showed the highest increase, of about 2% (**GRAPH 2**)

→ similar findings: Chilean earthquake (Torche, 2011), and 9/11 terrorist attack (Currie & Schwandt, 2015)

GRAPH 2. Probability of premature delivery by groups and mothers' SES



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