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# The Effect of Prenatal Stress on Cooperation: Evidence from Violent Conflict in Uganda

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**Abstract**

Are preferences endogenously determined in the womb? We play a public goods game with Ugandan children born during a conflict characterised by high civilian victimisation. Children whose caregivers suffer from post-traumatic stress disorder are more likely to free-ride in the game. Genetic and environmental factors alone do not explain the relationship, but children's 2D:4D digit ratio – a marker of fetal hormone exposure associated with epigenetic effects of maternal distress – does. Our findings extend the fetal origins literature to the domain of preferences. By reducing next generation's taste for cooperation, conflict may have father-reaching economic consequences than previously thought.

*Keywords:* Prenatal Stress, Cooperation, Digit Ratio, Fetal Origins, Conflict
*JEL codes:* D03, C93

## 1. Introduction

The nine months in utero may well be the most critical time in a person's life (Almond and Currie, 2011). Later-life characteristics are increasingly associated with "fetal origins". Suffering from severe trauma and stress during pregnancy alters the hormone exposure of the child, triggering epigenetic processes that may shape brain evolution and behaviour (Dörner et al., 2001; Keverne and Curley, 2008). Among others, this was shown to affect future abilities, personality, and health trajectories. Do these in utero changes extend to the domain of social preferences?

We play a public goods game with 442 children born in Pader district in Northern Uganda during the 1998-2006 period of intense fighting between government forces and the Lord's Resistance Army (LRA). The game requires a one-shot dichotomous choice on whether to cooperate or not—free-riding being the only dominant strategy. Simultaneously we conduct an extensive socio-economic questionnaire including violent conflict exposure (victimisation), post-traumatic stress disorder (PTSD) symptoms, and a closely related public goods game with the child's main caregiver.

We find that children who's caregivers suffer from PTSD symptoms are significantly more likely to free-ride in the game. We speculate that this results from a combination of genetic and environmental intergenerational transmission mechanisms, but also epigenetic ones—through changes in hormone exposure during early fetal development. While it is impossible to measure the exact hormonal profile of fetuses later in life, we can proxy for it using a one of the many biometric markers of in utero hormone exposure, which develop mostly during early gestational stages and remain relatively stable throughout life. We opt for the 2D:4D digit ratio, which measures the relative length of the index finger with respect to the ring finger, and is therefore non-intrusive and relatively easy to measure (Manning et al., 2003; Lutchmaya et al., 2004; Zheng and Cohn, 2011). Like other biometric markers of prenatal hormonal

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