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## Comment      Ronald Lee

In this excellent chapter, important issues are at stake. How do fetal conditions such as maternal nutrition affect later life health, productivity, and general success? Are childhood conditions a mechanism through which low socioeconomic status is transmitted across generations? Does the Trivers-Willard hypothesis from evolutionary theory apply to human populations? The chapter also addresses an important policy issue about the importance of public assistance for pregnant women or women of reproductive age, which may impact the later development and socioeconomic outcomes for their in utero children.

The identification strategy is to analyze the consequences of a huge exogenous shock: the nutritional deprivation caused by the famine in China during the period of the Great Leap Forward. This shock was limited in time

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and to some degree in space. Because it was exogenous, and not the result of choices made by the individuals affected, it provides a quasi-experimental setup for the study of later life outcomes for births that were in utero at the time of the famine.

This chapter contributes to a growing literature on the effects of early life or prenatal circumstances on later life outcomes, including in old age. Some of the authors have already made important contributions to this literature. My role as discussant is to chip away at the analysis, which I will now try to do. I have several points, as follows.

### **External Validity**

Suppose we accept all aspects of the study design and the findings that result. Can we generalize from these findings to reach broader conclusions about the effects of caloric deprivation of pregnant women on the fetuses they carry? The biological response to a sudden and severe shock, as well as to the accompanying stress and anxiety, may be very different than the response to chronic malnutrition. Can we really draw useful lessons about nutritional deprivation as a mechanism for the intergenerational transmission of poverty?

### **Selectivity of Births**

According to some estimates, the Great Leap Forward (GLF) period had around 30 million extra deaths, but also around 30 million fewer births, relative to the numbers that would have been expected based on levels and trends before and after. This leads me to wonder which women gave birth during and right after the GLF and which did not. If births were reduced most strongly in those areas that were most strongly affected by GLF, then the geographic location of those births that did occur would have been atypical. If it was the women who were best able and willing to control their fertility who chose to avoid births during this period, then there may have been negative selection on the mothers of those births that did occur. On the other hand, if the poorest and most disadvantaged females avoided giving birth during GLF then those births that did occur would have been positively selected.

### **Dynamics of Births during and After Demographic Crises**

From many studies of historical and Third World demographic crises, it is well-established that there is a distinct pattern to the response of births to a crisis such as a price shock or health shock (Lee 1997). Births begin to decline around six months after a grain price shock, with this early timing perhaps reflecting abortion, miscarriage, or possibly anticipation of the shock by farmers who may have had better knowledge than was reflected in grain prices. The trough in births comes around twelve months after the shock,

and then births rebound, reaching a peak two or three years later that is well above normal levels. Then they decline back toward normal. This pattern reflects biometric aspects of the reproductive cycle and occurs for mechanical rather than behavioral reasons. Ordinarily, some women are pregnant, some have just given birth and are breastfeeding, and some others are ready to become pregnant again. Ordinarily women are distributed across these states. In a reproductive trough, however, women who would normally give birth do not. Rebound occurs because these women who would normally have given birth during the trough are now ready to give birth soon after, because they are not in postpartum amenorrhea induced by breastfeeding. The point is that those born after the shock are also selected, in an opposite way to the selection on births during the trough. For this reason, those born a couple of years after the shock may not be a good control group.

### **Family Effects**

The death of a child in a family would increase the resources available for surviving offspring and to those born next, who would then have better adult outcomes than otherwise. A particular application of this general point is that the death of a child during the GLF would have created a longer interval separating the younger and older sibling, and we know from many studies that longer birth intervals benefit the children at either end of the interval in terms of health, survival, height, weight, and so on.

### **Heritability of Sex Tilt and the Trivers-Willard Hypothesis**

In our evolutionary past, male reproductive success was contingent on competitive success relative to other males, whereas female reproduction was automatic. For this reason, there would have been an evolutionary advantage to females who could tilt the probability of sex of birth toward males when they gave birth in favorable circumstances and toward females when they were in poor circumstances. This study identifies migrant children who came to Hong Kong from the mainland during a brief window of a few months in 1962. These immigrants to Hong Kong gave birth about twenty to twenty-five years later. Using microdata on births, the study examined differences in the characteristics of their births, finding that those affected by the famine had lower birth weight births and a higher proportion of female births, compared to other Chinese immigrants in Hong Kong. This appears to support the Trivers-Willard hypothesis as applied to humans.

This is important new evidence on this point. However, a few points suggest caution. First, it seems likely that the selectivity of migration to Hong Kong would have been different for women and children impacted by the famine. Other women were pulled to Hong Kong by economic advantages, while the Great Leap Forward migrants would have been pushed from their homelands. They would have come from different regions of China. At the

period when they gave birth, sex selection by ultrasound became common. Could the famine refugees have resorted to sex selection less readily than economic migrants? Then the sex ratio effect would be behavioral and not biological.

Although I have raised a number of questions about the internal and external validity of this study, I doubt that any of these possible distortions would matter enough to affect the outcome. The evidence in figure 9.5 is quite strong, and overall I actually find the evidence in this excellent study persuasive.

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## Comment Naohiro Ogawa

Almond, Edlund, Li, and Zhang have written an intellectually stimulating chapter, estimating the long-term effects of the 1959 to 1961 Chinese famine on those born during that time. By heavily drawing upon a micro-level data set derived from the 2000 China Census (1 percent sample), the authors have successfully shown a major impact of maternal malnutrition upon these cohorts: reduced sex ratio (males to females) at birth in two generations. In addition, they have found that famine survivors, compared with other intact birth cohorts, showed a higher probability of (a) suffering from an impaired literacy; (b) staying out of the workforce; (c) relying upon their family members as dependents; and (d) living in a smaller house.

In their quantitative analysis, Almond and his associates have utilized the following two measures of famine intensity: death rates and average month of birth. In the case of the former, data on the all-age death rate in twenty-nine out of thirty-one provinces was used as a base. The weighted average of the death rate in the province of birth for the duration of the fetal period was calculated for each individual, and this variable was labeled as  $wdr_{jt}$ . Then, by collapsing this weighted death rate by month of birth, the authors created another predictor, namely,  $awdr_{jt}$ , which represents a population-weighted national average for each month and year.

Because of the lack of relevant information representing the level of famine intensity facing each person's household or his or her community, the