

Title: Mortality and Fertility Interactions:  
New Insights from Recent Population Dynamics in Cambodia

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While the question of how human populations are regulated lies at the core of demography as a scientific discipline, there is relatively little research on the topic. In part, this state of the field reflects the trend that, following the gradual disenchantment with the grand paradigm of the demographic transition theory, demographers have increasingly specialize themselves in either one of the components of population change (fertility, mortality, and migration). The question of population regulation, on the contrary, lies in understanding the internal and external linkages between these components.

Sporadic attempts to precisely document mortality influences on fertility have generated more doubts than evidence about any such direct relationships (e.g., Preston 1978; Montgomery & Cohen 1998; Palloni & Rafalimanana 1999). A few of the recent reviews on the state of the fertility transitions, however, have emphasized the role of mortality declines in fertility change (e.g., Hirschman 1994; Mason 1997; Cleland 2000), and brought back Davis' (1963) theory of multiphasic demographic response.

In this paper, I study the fertility trends in the years following the fall of the Khmers Rouges' regime in Cambodia, a regime characterized by a mortality crisis of an unmatched intensity in the second half of the 20<sup>th</sup> century. While there was clearly a post-war "baby-boom" in Cambodia, post-crisis fertility rebounds do not necessarily indicate an impact on reproductive *behavior*. Reviews of demographic responses to exogenous shocks in historical populations (e.g., Lee 1997) suggest that such rebounds are driven by marital fertility surges that result from the increase in the number of susceptible women following the conception dearth during a crisis. The data analyzed in this paper were

hence collected specifically to allow for more detailed analyses of the components of the Cambodian baby boom.

### Conceptual background

Formulated most notably by Notestein (1945) and Davis (1948), the demographic transition theory (DTT) was arguably the founding paradigm of international demography. Largely an offspring of the modernization theory then dominant in the social sciences, the DTT suggested that the fertility transition would result from structural changes linked to a general “modernization” process that included economic development, industrialization, and urbanization. Half a century later, the DTT has been “dramatically shattered” by analyses of past European fertility transitions (Alter 1992:13), as well as by findings from more recent fertility declines. The once “iconoclast” view that structural transformations only played a minor role in most fertility transitions has gradually gained acceptance (Cleland & Wilson 1987). Evidence from 18<sup>th</sup>-century France (Coale 1986) and 19<sup>th</sup>-century United States (Haines 2000) showed that mortality declines, in particular, did not necessarily precede fertility change. More recent fertility transitions have also occurred in very different demographic and economic contexts (Bongaarts & Watkins 1996), but an impressive mortality decline constitutes an almost universal aspect of the changing environments in which these modern transitions have taken place (Heuveline 1999). Yet, periodical re-investigations of a potential mortality-fertility link (summarized in Montgomery & Cohen 1998 and in Preston 1978) failed to provide compelling evidence that mortality decline played a substantial role in initiating or sustaining fertility transitions.

A growing consensus holds, however, that the search for the mechanisms that may link fertility to mortality might have been too narrow. Preston's (1978) analytical framework consists of compensatory fertility responses to mortality changes at the family level and at the aggregate (population) level. Most empirical investigations of the mortality-fertility links have focused on the former level: biological birth interval effects, and parental replacement and hoarding strategies. Preston's conclusion that the "continued pursuit of the aggregate relations is probably the most important business left unfinished" (1978:16) remains valid today. Critical of the distinction between "natural" and "controlled" fertility, Mason (1997) similarly argues that all societies regulate their reproduction, and that parity-specific control within marriage is only one of its modern forms. Building on Davis' (1963) framework of "strains" on existing family systems, Mason holds that changing mortality conditions represent one of the principal strains on traditional regulatory mechanisms. Hirschman (1994:228) even suggests that we study fertility declines more generally in terms of how "demographic equilibria" are "reestablished after mortality declines." Contributions to this new research agenda have been hampered by the near absence of "control" populations, however, because mortality has been declining, and quickly, in most modern populations. The study of the social-level impact is also complicated by the fact that mortality declines have spanned several decades now, and many other potential "confounding" social factors have greatly changed as well.

In order to move from couples' calculus to collective responses, one possible research direction is to study the fertility response to past mortality crises, in particular in populations in which fertility has not yet been "controlled." The available record

indicates that when living conditions improve after a period of extreme hardship -- war, famine or epidemic, for example -- fertility often, but not always, increases temporarily (Agadjanian and Prata 2002; Lindstrom & Berhanu 1999; Lee 1997; Palloni, Hill & Aguirre 1996; Galloway 1988; Watkins & Menken 1985; Eversley 1957). Contrary to a common perception, post-crisis baby booms are largely produced by couples married before the crisis, and the timing of the birth increase is consistent with the predictions of biometric models of marital fertility (Sheps & Menken 1973). Because of fewer births during crises, an unusually high number of women are “susceptible” to the risk of conception at the end of a crisis, which leads to record numbers of births one to two years later, given the typical waiting period for conception and duration of the pregnancy itself. Such “mechanical” fertility responses are not evidence that the existing social mechanisms of children regulation were amended in any way as a result of the mortality experience. But this typical response can hardly explain the fertility rebound in Cambodia.

### The data

In the 1970s, Cambodia experienced sudden and extensive political upheavals. About a third of the Cambodian population may well have died during this decade as a direct or indirect result of the Cambodian civil war, the American-Vietnamese war, the Khmers Rouges’ violent regime, the famine, or the Vietnamese invasion (Heuveline 1998; Kiernan 1996; Sliwinski 1995). The Cambodian population has since undertaken its demographic “reconstruction.” As the 1998 census age distribution suggests (National Institute of Statistics 1999), the annual number of births increased by nearly 50% after the fall of the Khmer Rouge regime and increased by another 50% during the following

decade. This timing differs from the above-described typical post-crisis baby booms. Moreover, the usual preponderance of marital fertility appears unlikely because many existing marriages ended tragically in the 1970s, while other families were disseminated nationally and abroad and were only reunited years later. Union formation must have played a significant role in the fertility rebound even though the sex ratio at the time (70 male per 100 female) clearly placed unusual constraints on the marriage “market.” Finally, the extended duration of the fertility surge seems to indicate that the decade-long crisis had lasting effects on the reproductive behavior of surviving and then-formed couples.

A specific survey was undertaken to study the effect the dramatic increase in mortality might have had on reproductive behavior. A population of 10,000 people was selected, and birth and marriage histories collected from all women aged 15 to 75. The extension of the typical upper age limit in fertility studies reduces the age selectivity in the years before the war. Data were also collected on parental survivorship from all residents. These quantitative data were completed by focus group discussions with different cohorts of women on marriage formation and fertility preferences. The population surveyed consists of all the resident of the study site and is not intended to be a representative sample of Cambodia. The population is rural, but geographically close to the capital city. It was thus expected to demographic behavior in the population would be intermediate between those of the capital city and of the more remote rural areas, and that demographic variables would hence be relatively close to the national averages.

## Preliminary results

Mortality under the Khmers Rouges. The island population is rural and its inhabitants are not expected to have been particularly targeted by the Khmers Rouges. The proportion of residents who lost a parent during the less than four years of the Khmer Rouge rule (April 1975 – January 1979) is thus surprisingly high. Among the residents alive at the time of the survey who had a father alive in April 1975, 27% lost him under the Khmers Rouges. The same proportion is 17% for mothers. These figures come close to national estimates of 32% loss for males over age 20 and 21% loss for females over age 20 (adapted from Heuveline 1998).

It is possible that in retrospect residents are more likely to report a parental death during the highly salient period of the Khmers Rouges. But it is very likely that the children whose parents died then were less likely to survive themselves, especially if they were young at the time. In the absence of reporting errors, the proportion collected from a sample of survivors should hence be an underestimate of the actual proportion of deaths among people aged 20 and over. The results confirm that mortality under the Khmers Rouges spread far beyond the urban upper classes that constituted the initial target of the regime.

In terms of the reproductive system, altogether a third of all existing unions in 1975 were ended by death by January 1979. In 16% of these unions, both spouses died between 1975 and 1979, for 13% more the husband died, and for another 4% the wife died during that period. Adding to these figures the voluntary and involuntary separations that might have occurred during those years yields the image of a shattered reproductive system when the Khmers Rouges leave in early 1979.

Total fertility before, during, and after the Khmers Rouges. The age structure of this population resembles that of Cambodia, with people in five-year age groups under 20 two to three times more numerous than in older five-year age groups. This reflects, however, the higher mortality experienced by the older cohorts as much as the higher post-war fertility rates producing the younger cohorts.

The analyses of birth histories yield slightly more than five lifetime births per woman at the early 1970s rates (1971-75 period TFR of 5.10). The figure is lower than expected since the national average in the 1960s was close to 7. However, there was a large difference between the rest of the country and the capital city, Phnom Penh, where fertility was already estimated at 5.3 births per woman in the 1962 census. It is also possible that the civil war that ended with the Khmers Rouges take over of Phnom Penh had already begun to depress fertility, as young men were drafted to fight and civil populations were displaced.

Conception rates clearly fell after the Khmers Rouges took command in April 1975, and the period TFR for 1976, 1977, and 1978 averages only 4.25. It is difficult to compare this number with any other estimate, since to my knowledge, this is the first estimate of fertility under the Khmers Rouges. The decline is perhaps not as sharp as one might have feared based on the scale of the mortality crisis. At least half of all deaths are believed to have resulted from a general exhaustion and health deterioration of the population that should have also impacted fecundability, while the displacement of populations, although mostly those of urban origin, should have resulted in extended periods of spousal separation.

The expected baby boom is found in the fertility rates of 1979 and 1980, which yield more than seven lifetime births per woman (period TFR of 7.35) and a 73% increase over the previous three-year average. Even though fertility peaks during the two years immediately following the fall of the Khmers Rouges, the decline is rather gradual. Average fertility only declines by 10% in the following five years, to 6.55 lifetime births per woman, and remains at or above pre-war levels --depending on how depressed the early 1970s fertility was—throughout the 1980s (1986-90 period TFR of 5.6). The total fertility trend already casts a doubt on the validity of the biometric explanation of baby boom that seems to apply to historical mortality crises and subsequent fertility surges (Lee 1997). First, the fertility increase is too prolonged to fit this explanation because the number of susceptible women should return to normal after a few years only. Second, the sheer volume of births produced in excess of normal pre-war levels far exceeds the volume of “missed” births during the war.

Marital fertility trends. The analyses of marital fertility explain some of these trends. First, there is almost no change in marital fertility during the Khmers Rouges years over the five years before, the TMFR declining only from 6.92 to 6.77 births per woman from one period to the next. This suggests that the wartime reduction in fertility was almost entirely due to fewer new marriages, and more importantly, to a much higher incidence of marriages ending in the death of one of the spouses. The temporary separation of spouses and reduced fecundability may not have played a significant role in this population. As total fertility, marital fertility increases sharply after the war (the TMFR peaks at 10.38 in 1979-80) and declines gradually. In the late 1980s (1986-90), the TMFR is still one full birth per woman higher than before the war (1971-75).

Even more than the total fertility estimates, these figures suggest that the couples that survived the Khmer Rouge regime and those formed in subsequent years exhibited a higher fertility than before the war. The analyses of marital fertility continue to investigate whether this proceptive behavior was more marked among women who had lost a parent, a spouse, or a child under the Khmers Rouges.

Nuptiality trends. The role of marriage in the baby boom can be analyzed first in term of the first proximate determinant of fertility in Bongaarts' decompositional model, i.e., the index or marriage TFR/TMFR. Declining from .74 in 1971-75 to .63 in 1976-78, the index promptly rebounds to .71 in 1979-80 and remains nearly unchanged up to the early 1990s (.70 in 1991-95). At first sight, it may seem that not much happened on the marriage market and that things simply returned to normal after the Khmers Rouges.

Returning the marriage index to its previous level was no mechanical occurrence, however. The marriage market was quite different in 1979 than it had been in earlier time. The unmarried populations included a much higher proportion of widows than before, and the sex ratio of the unmarried population was quite unbalanced with a scarcity of males. Current analyses continue to document this and will measure first- and higher-order marriage rates respectively among the never married and the widowed/separated populations.

Subsequent analyses will focus on the conditions that allowed for marriages to occur after the Khmers Rouges in spite of an unfavorable marriage market. These analyses will compare data on marriage preferences collected during focus group interviews conducted in the same population and actual characteristics of newly-weds in 1979 and subsequent years. Preliminary analyses focusing on the age of the partners

already suggest much more diversity in the marriage formed in the 1980s than in previous decades (since we interview all women up to age 75 and marriage typically occurs before age 30, marriage trends can be traced back to the mid-1950s).

### Discussion

To summarize, population dynamics in this Cambodian commune provides evidence of a modest decline in fertility during the Khmers Rouges years (1975-78), followed by an increase after the fall of their regime. Fertility peaks in the two years immediately after the Khmers Rouges (1979-80), but fertility rates remained higher than in the early 1970s throughout the 1980s. While post war baby booms appear to be quite common occurrences throughout demographic history, the case of Cambodia in the 1980s does not fit the standard biometric explanation in which lower conception rates during the war yield temporarily to a higher number of susceptible women and a short fertility surge, even in the absence of behavioral change. First, fertility decline during the late 1970s was too limited to increase the number of susceptible women so to explain entirely the fertility surge in 1979-80. Second, the increase in the number of susceptible women among intact couples was counterbalanced by a decrease in the number of such couples, and in particular, an increase in the number of widows. Third, biometric explanations cannot account for the relatively high fertility that prevailed in the entire following decade.

In contrast, the results presented in this paper reveal that married couples after 1979 had higher fertility rates than before 1975, and that marriage patterns after 1979 were also more diverse than before 1975. Hence, these results support the claim that the survivors of the Khmer Rouge regime engaged in “proceptive” behaviors at two levels at

least: that of the marital unit and that of the extended family typically involved in marriage arrangements. This claim obviously contrasts with the classical perception of a pre-transitional population. “Natural” fertility levels in pre-transitional European populations did exhibit cross-sectional variations to an extent similar to the variations found here (period TFRs ranging from 5 to 7.5 between 1970 and 1990, with even lower fertility under the Khmers Rouges). But it is generally thought that these pre-transitional variations across regions do not reveal conscious behavior to increase or decrease childbearing, and when fertility fluctuated over time, changes in marriage patterns (age at marriage, and proportion never marrying) are believed to account for most of the fertility variations (Schofield 1989). In contrast, the index of marriage in the population studied here remained nearly unchanged, with the exception of the temporary decline during the Khmers Rouges years, during the two decades of fertility change, and marital fertility fluctuated from just fewer than 7 to more than 10 lifetime births per woman.

While the extant literature might not provide as strong evidence of a pre-transitional “behavioral” fertility increase in any other population, the case presented here is consistent with the fertility changes observed among migrants moving from denser to more sparsely populated land (Charbonneau et al. 2000; Easterlin 1976; VanLandingham & Hirschman 2001). The higher marital fertility of those migrants is believed to result from the different lesser economic constraints that they face at destination. In the present case, the lack of data on the economic environment prevailing in the early 1970s and 1980s does not allow for a test of such effects. While the association between a mortality increase and a subsequent fertility increase is quite strong, the evidence does not discriminate between an association mediated by external factors also associated with the

mortality increase, such as the resulting decrease in population density, and a more direct effect, such as a psychological response of individual actors and structural response of institutions both threatened by the Khmers Rouges regime. One must note, however, that there is little else than low population density in common between the New World frontiers and post-Khmer-Rouge Cambodia, which experienced famine in 1979 and remained dependent on international food donations during the early 1980s.

To return in closing to the initial question of the mortality-fertility links, does the case presented here tell us something about the role mortality declines might have played on fertility declines? A few of exceptions appear in order. First, the Cambodian experience was, fortunately, quite unique in its intensity. There might be a “dose” effect such that reproductive behavior is affected by mortality experience only when the latter changes dramatically. Two studies on recent post-war mortality in pre-transitional Ethiopia (Lindstrom & Berhanu 1999) and Angola (Agadjanian and Prata 2002) show some fertility response but not quite as strong as here, which may be due to a less intense mortality shock. Similarly, smoother mortality transitions might not have had a significant impact subsequent fertility. A second plausible argument is that the mortality-fertility relationship needs not be symmetrical. Mortality increases lead to a higher frequency of deaths --noticeable, dramatic events that may elicit a response-- while as argued by Montgomery (1998) for instance, mortality decreases reduce that frequency, hence resulting in “non-events” that might be less easily perceived.

If on the other hand, mortality does operate on fertility, why did so many studies yielded inconclusive or negative results? The first reason is the complexity of the web of interactions. In the case presented here, the mortality increase and decrease can be dated

very precisely, and their fluctuations are so sudden and dramatic that it is difficult to argue for a spurious relationship with fertility. In most populations, however, mortality declines are driven by a number of other contextual changes that may affect fertility as well. Moreover, if the relationship between mortality and fertility is indirect, one must also account for factors other than mortality affecting the mediating factors between mortality and fertility. Fertility transition occurred during a period of economic growth, for instance, as well as mortality decline. A study that attempts to tease out the independent effect of mortality change net of economic growth does find some evidence of a positive net effect at the national level (Heuveline 2001), but it is impossible at that level to measure and account for all the potential factors that could influence both mortality and fertility, even net of economic ones. Individual-level surveys provide superior data in the sense that the most relevant individual factors can be measured and added to the analysis. The focus on the individual level might be their weakness for the study of mortality-fertility links, however, as it is doubtful that only the mortality experienced in the family influences reproductive behavior. The framework laid out by Preston two and a half decades ago includes four mechanisms. The first three, operating at the individual level (biological, replacement, and hoarding), have been extensively investigated. The fourth one, operating at the community-level, has not, in part because individual-based survey data do not lend themselves easily to analyses that include larger effects. In the case of the population under investigation here, changes in marital fertility appear to have been too important to be limited to the families that experienced a loss --an impression to be confirmed by the ongoing analyses.

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