Mortality Influences on Fertility: Cambodia During and After the Khmers Rouges*

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Abstract

The study of mortality crises provides an unusual and valuable perspective on the relationship between mortality and fertility changes, a relationship that has puzzled demographers for decades. We present here the first evidence taken from a large population that attests to a one-third decline in fertility during the Khmer Rouge regime, followed by a baby-boom produced by a two-year marriage burst and a decade of marital fertility above its pre-Khmer-Rouge levels. Our results illustrate the potential influence of mortality on fertility, which may be more difficult to identify for more gradual mortality declines. Our findings also reinforce recent qualifications about the meaning of the core concept of natural fertility.

The study of mortality crises provides an unusual and valuable perspective on the relationship between mortality and fertility*, a relationship* that has puzzled demographers for decades. While several recent reviews on the state of the fertility transition emphasize the role of mortality decline in fertility change (e.g., Cleland 2001; Hirschman 1994; Mason 1997), the empirical record is rather disappointing. The second National Academy of Sciences' review of the issue (Montgomery and Cohen 1998) provides little more evidence than the first, largely skeptical review two decades earlier (Preston 1978). The prolonged and gradual pattern of mortality decline enjoyed by most populations introduce several thorny analytical difficulties, however, such as a long list of potential confounding factors, feed-back mechanisms, and an uncertain lag structure (LeGrand and Sandberg 2004).

Rapid mortality swings that are well-defined in time and space are less vulnerable to these analytical challenges, but researchers must often make ingenious use of data collected for other purposes than the specific study of the mortality and fertility links. If, however, mortality decline does indeed contribute to fertility decline, we would expect to find that mortality crises induce some subsequent fertility increase. Historical time series provide evidence of crisis-induced fertility declines and post-crisis fertility rebounds, but those are not necessarily indicative of any change in reproductive *behavior* (Lee 1997). The record from more recent mortality crises in China (Ashton, et al. 1984), Ethiopia (Lindstrom and Berhanu 1999), or Angola (Agadjanian and Prata 2002) is also inconclusive in terms of changes in reproductive behavior.

In this paper, we analyze what we believe are the first data collected for the purpose of documenting fertility trends before, during, and after a mortality crisis—

arguably the most intense such crisis of the second half of the twentieth century. During the "three years, eight months, and twenty days" of the Khmer Rouge (KR) regime, the population of Cambodia lost an estimated 1.5 to 2.0 million people to excess mortality (Heuveline 1998; Kiernan 1996; Sliwinski 1995). This would amount to a quarter of the country's population size at the time of the KR takeover. While the distinctively small size today of the cohorts born during those tragic years suggests that the population decline was also accentuated by a reduction in fertility, ancillary data are required to separate excess deaths from any birth dearth. Post-KR fertility surveys were not undertaken until the late 1990s, when fertility was found to be relatively high for the region, but lower than before the onset of the civil war that led to the KR takeover. Due to their focus on current fertility and contraceptive use, the above surveys collected data on the birth histories of women only up to age 50 at the time of the survey, which hinders the retrospective study of fertility more than a couple of decades before the survey (Rindfuss, Palmore, and Bumpass 1982).

The data analyzed here include close to 3,000 birth histories of women aged 15 to 74 in 2001-02, when such histories were collected as part of an ongoing demographic surveillance system. Fertility levels appear lower in this population than in the country for the periods and age groups available in the most recent nationally-representative fertility survey, but fertility changes appear remarkably consistent with national trends in the past 20 years. The upper age limit of 75 years allows us to provide a quantitative assessment of the fertility reduction and rebound induced by the extreme hardships endured by this population under the KR. In this population, we find evidence of a sustained fertility increase subsequent to the mortality crisis, which we interpret as the

reproductive response of threatened families and communities. In particular, we see evidence of an increase in marital fertility, occurring within a "natural fertility" regime at the time, which also leads us to revisit the meaning of this core concept of demographic theory (Henry 1961).

Background

Demographic Theory and Mortality-Fertility Interactions

While the question of how human populations are regulated lies at the core of demography as a scientific discipline, there is today relatively little research on the topic (Cleland 2001). This in part reflects the fact that most demographers have distanced themselves from grand theory, specializing instead in either one of the components of population change (i.e., fertility, mortality, or migration). The question of population regulation, however, requires understanding the internal and external links between those components. Early demographic theories addressed both mortality and fertility changes. A case in point is the Malthusian paradigm, which, interestingly enough, suggests that *fertility* may indirectly influence mortality, inasmuch as unchecked fertility invariably leads to excessive population growth, and brings with it a concomitant negative impact on wealth, health, and survival (see Figure 1).

Often described as neo-Malthusian for its concern over population growth, the demographic transition paradigm asserts that fertility and mortality declines can independently result from "modernization," a general process characterized first and foremost by economic development and urbanization. Although mortality decline was at times included among the list of factors that would eventually lower fertility, fears of a population explosion nevertheless grew when mortality declines proved to be fast

outpacing economic development, raising doubts that that mortality change alone enough could induce a fertility response:

> In short, the programmes of agricultural development administered by outsiders have enhanced production and improved health, but they have also left relatively untouched the details of social organization, and the customs, attitudes, and beliefs of the population which throughout the centuries have served to maintain high birth-rates. (Notestein 1953:20)

In a late reformulation of the demographic transition perspective, Davis (1963) articulates a framework in which mortality influences fertility through the "strains" that mortality and other social changes place on existing family systems, as well as the possible responses of those families—including, but not limited to, fertility decline—to ease those "strains" (Figure 1). The subsequent empirical analyses of past European fertility transitions and more recent fertility declines have "dramatically shattered," in Alter's (1992:13) words, the demographic transition paradigm, in both formulations. The once "iconoclast" view that structural transformations only play a minor role in most fertility transitions has gradually gained acceptance (Cleland and Wilson 1987). Evidence from 18th-century France (Coale 1986) and 19th-century America (Haines 2000) shows that mortality declines did not necessarily precede fertility change.

The disenchantment experienced by demographers in respect to the efficacy of predictions drawn from the grand paradigm of the demographic transition theory likely contributed to the relative neglect of theories of population change as a whole process and a gradual focus on its components and their proximate determinants. In a demography that has become, in Kirk's (1996:361) words, "a science short on theory, but rich in quantification," the relationship between mortality and fertility has not entirely disappeared from the demographic agenda but has instead shifted to more specific sub-

areas. In the context of population explosion fears, the facet of the relationship that has received the most attention is arguably whether declines in infant mortality would induce fertility declines. Coordinating a National Academy of Sciences panel on the issue, Preston (1978) has laid out a framework of four direct mechanisms through which a decline in infant mortality can depress fertility (Figure 1): (1) a physiological factor (early interruption of maternal breast-feeding), (2) a hoarding or insurance effect (which should decline with infant mortality), (3) a replacement effect (attempts to replace a deceased child), and (4) a social effect (community-level changes induced by mortality decline). The empirical findings have again been disappointing, and when physiological, hoarding, and replacement effects were found, they were too small to account for much decline in fertility. A second National Academy of Sciences panel reached essentially the same conclusion two decades later (Montgomery and Cohen 1998, also see Palloni and Rafalimanana 1999).

Contrary to these findings, several leading demographers have over the last decade pointed out that mortality change must have played a central role in recent fertility declines, and have subsequently argued that the search for the mechanisms that may link fertility to mortality might have been too narrow. Hirschman (1994:228), for instance, suggests that we study fertility declines more generally in terms of how "demographic equilibria" are "reestablished after mortality declines." These declines indeed generated tremendous population growth and increased relative size of the youngest age groups in the less developed regions of the world until fertility also declined substantially in the second half of the twentieth century (Heuveline 1999). Building on Davis (1963), Mason (1997) contends that such growth among the young had to constitute a major strain on the

traditional post-natal mechanisms through which societies regulated their reproduction. Cleland (2001:80) more directly calls for "a reinstatement of mortality decline at the center of fertility transition theory," arguing that mortality decline is the only common feature of these fertility changes that have otherwise occurred under vastly different conditions (Bongaarts and Watkins 1996).

The disconnect between empirical findings and theoretical expectations may originate in part in a near-exclusive use of individual-level survey data to investigate these population-level arguments. Preston already noted that most empirical investigations of the mortality-fertility links focused on the three individual-level factors of his framework (biometric, replacement, and hoarding effects, respectively), and his conclusion that the "continued pursuit of the aggregate relations is probably the most important business left unfinished" (1978:16) remains valid today. The few analyses of the aggregate-level changes in child survival and in fertility have typically been more successful at documenting the expected relationship (e.g., Galloway, Lee and Hammel 1998; LeGrand and Barbieri 2002). It is also true that a focus on infant mortality may not fully account for strains on families and child-rearing institutions that may manifest themselves in a more pronounced manner once children are about to establish independent living. Mason (1997) adds that much empirical research has focused too narrowly on explaining the exact timing of the onset of fertility decline. Examining cross-national changes in life expectancy at birth over a thirty-year period (1960-1990) suggests, for instance, that mortality change may have accounted for one-fourth of fertility change (Heuveline 2001). Such empirical analyses are greatly complicated, however, by the gradual decline of mortality over several decades, which raises thorny, if

not inextricable statistical issues, including but not limited to omitted variables with respect to the many other potential factors that have greatly changed during the period as well, the uncertain lag structures between dependent variables and their influence on fertility, the possibility of feed-back mechanisms, and the appropriate level of aggregation for these "social-level" effects.

One way to alleviate some of these concerns is to pursue research that investigates communities affected by rapid mortality swings that are well-defined in time and place. Historical demography unfortunately provides abundant examples of unusual hardship (war, famine or epidemic), and the extant record suggests that such crises may induce a fertility decline, a decline that is often, if not always, followed by a rebound that returns fertility rates to pre-crisis level, or even, though temporarily, above the pre-crisis levels (Eversley 1957; Festy 1984; Galloway 1988; Lee 1997; Watkins and Menken 1985). Contrary to a common perception, when post-crisis baby booms occur, they 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 and Menken 1973). Owing to the decline in 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. These "biometric" fertility responses are not, it should be noted, evidence that the existing social mechanisms of children regulation were amended in any way as a result of the mortality experience. More data than typically available from historical populations would be necessary to study this issue more directly.

Precious few demographic studies of recent mortality swings exist, and the conclusions of such studies are contradictory. After falling during the 1958-61 famine in China, fertility rates rose sharply in 1962-63, above their pre-famine levels (Ashton, et al. 1984). Wartime drop and postwar rebound were also found in Angola (Agadjanian and Prata 2002). In contrast, war and famine in Ethiopia seem to have induced both short-term and long-term fertility declines (Lindstrom and Berhanu 1999). Even though richer data are available on the contemporary populations cited above than on historical populations, the data were ostensibly collected for purposes other than those intended by the studies noted, and, therefore, they have their own limitations. Overall, however, a general consensus has emerged that physical separation of spouses during wartime, physiological impairments during a famine, and the psychological stress associated with short-term uncertainty induced by war or famine depress fertility. While the effects on fertility of physical separation and the physiological impairments are believed to end rapidly after the crisis concludes, less is known about the long-term psychological effects of such an experience on fertility.

Cambodia, 1960 to the Present

Independent since 1953, Cambodia has a small population relative to neighboring Thailand and Vietnam, enumerated at 5.7 million in 1962, when its first modern census was undertaken (Migozzi 1973). Cambodia entered a civil war in 1970, when a military coup overthrew Prince Norodom Sihanouk, who then called for armed resistance. In addition to the civil war, Cambodia also suffered under the 1972-1973 "strategic" bombing by U.S. B-52s of its Eastern provinces bordering Vietnam. The civil war ended on April 17, 1975, when the KR entered Cambodia's capital city, Phnom Penh.

During the next three years, eight months, and twenty days, the KR undertook what has been described as the most radical social transformation ever attempted (Kiernan 1996; Weitz 2003). It certainly stands as among the deadliest of the 20th century. The KR leaders systematically arrested and killed suspected political opponents; all urban centers were also emptied, forcing residents into rural areas. Rural residents in areas controlled by the former regime, together with urban residents, were labeled "new people" under the KR, and many were also forced to relocate to new rural areas where local KR cadres often resented them and could arbitrarily kill anyone who disobeyed even the most minor orders. Exhaustion from long days of hard work, which included clearing malaria-endemic forested areas, as well as an insufficient diet and the absence of modern medicines also killed many. While extant estimates of deaths range anywhere from 500,000 to 3 million, the figures most compatible with subsequent demographic data are in the range of 1.5 to 2.0 million excess deaths, that is, nearly one quarter of the entire population of Cambodia in 1975 (Heuveline 1998; Kiernan 1996; Sliwinski 1995).

The KR's attempt to radically transform Cambodian society included a frontal attack on the family, perceived as the core institution of social reproduction, and family members were often separated into age and sex work groups. Whereas nearly all marriages were previously arranged by families, local KR cadres now had to approve of all marriages, contracted in a brief mass ceremony. Some appear to have been forced (Ponchaud 1998 [1977]: 160-1, 294-5; Ngor 1987: 292), and Heuveline and Poch (2003) estimate from a sub-sample of the 2000 Cambodian Demographic and Health Survey (described below) that 32.4 percent of the women who married during the 1975-1978

period had their husband chosen by a non-relative and/or did not give their consent to the marriage, compared to 6.9 percent of those married in other years.

In December 1978, conflict with Vietnam escalated, and within a few weeks the KR lost control of most of the country and took refuge in the forest-clad hills at the Thai and Laotian borders. While a government composed of Cambodians was promptly established, Vietnamese troops remained in the country for ten years, during which time the KR continued to fight the central government and control a few outlying districts. If peace had been restored to most provinces, mines continued to kill farmers, among others, returning to claim land. Living conditions nevertheless improved overall, with the establishment of administrative structures and infrastructures, health and education in particular, along the Vietnamese model. The U.S. opposition to legitimize any expansion of communist Vietnam, and the increasingly clear record of the KR atrocities, which made their restoration an unpalatable alternative to the Vietnamese occupation, led to a political impasse that lasted until the 1991 Paris agreements. During that entire period, Cambodia's international economic and cultural ties remained largely limited to Soviet-bloc countries on whose aid it depended.

The perspective of United-Nations sponsored elections in 1993 brought dramatic changes to the country in the form of foreign investments and aid as well as international visitors and cultural representations from the West. Among the many projects subsequently supported by international aid, two are particularly important for social sciences researchers: (1) the 1998 General Population Census (1998 GPC), the first since 1962, and (2) the 2000 Cambodia Demographic and Health Survey (CDHS 2000). The 1998 GPC shows that in spite of foreign investments, the country remains one of the

poorest in Asia—the gross domestic product only reached $238 per capita in 2000 (National Institute of Statistics 2001), while its population has remained 84 percent rural (National Institute of Statistics 1999). The population clearly bears the marks of the KR reign, and also of the demographic reconstruction that followed. The greater toll of excess mortality among males is reflected in a sex ratio for the population aged 15 and over, which has slowly recovered from a low of about 75 males per 100 females in 1980 (Huguet 1992), suggesting unusual constraints on the marriage "market" in the post-KR years. Nonetheless, a post-Kr "baby boom" is likely even though its magnitude can hardly be estimated from census data. While the census shows numbers of annual cohorts members for the 1980s that are about 50 percent greater than for the years 1975-1978, this may reflect not only their larger numbers at the time of birth but also their higher survival rates.

CDHS 2000 sheds some light on current fertility levels, however. With a Total Fertility Rate (TFR) of 4.0 live births per woman (National Institute of Statistics 2001), Cambodia remains, along with Laos, an exception to the region's rapid fertility transition. Fertility appears to be declining, however, and is already substantially lower than at the time of the 1962 census, when the TFR was estimated between 6.7 and 7.1 live births per woman (Heuveline 1998; Migozzi 1973; Siampos 1970). The transition underway can be read in the strong provincial differentials in TFR: from 2.1 in Phnom Penh province, in which 44 percent of the households are located in rural areas surrounding the capital city, to 4.2 in Kandal, the 95 percent rural province surrounding Phnom Penh province, and 6.3 in Mondulkiri and Ratanakiri, more remote rural provinces (National Institute of Statistics 2001). With a sample upper age limit of 50 years, however, it is difficult to

assess fertility trends around the time of the KR from these data. Moreover, CDHS 2000 did not collect the complete marital histories that would have made possible the analysis of the specific contribution of marriage to fertility decline in the context of a marriage market severely constrained by the sex ratio of the adult population.

Data and Methods

The data

We analyze data from the Mekong Island Population Laboratory (MIPopLab), a demographic surveillance system launched in December 2000 in a rural district adjacent to Phnom Penh province and itself located in Kandal province. The basic demographics of the entire district population of 10,000 residents are updated twice a year. A specific survey module was designed to study the effect the dramatic mortality increase under the KR might have had on reproductive behavior. The module includes the birth and marriage histories of all women aged 15 to 74—a higher upper age limit than in most fertility studies, which was selected to reduce age selectivity concerns in the years before the civil 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.

This module was administered in one village in December 2001 and in three more villages in June and July 2002, and a total of 2,843 marriage and birth histories were collected. This population may not be representative of Cambodia, foremost because of its geographical location. Because of the above-mentioned strong fertility gradient, we expect this rural population at the border of Phnom Penh and Kandal provinces to exhibit fertility levels below the national average but above those of the mostly urban Phnom

Penh province. The 1998 GPC suggests that in respect to marriage patterns (e.g., singulate mean age at marriage for women), however, MIPopLab (24.7 years) might be closer to Phnom Penh province (24.7 years) than the national average (22.5 years) or even Kandal province (23.0 years). The experience in the district under the KR cannot be held as either representative or extreme. A population constituted almost entirely of farmers was likely less targeted by the KR regime than urban dwellers or more educated people. Residents of areas close to the capital city and not under the control of KR during the civil war were *de facto* suspected of supporting the previous regime. Some residents of the district were forced to move as part of the KR redistribution of population from the Eastern to the Northwestern region of the country (Kiernan 1996). As described below, we will thus compare the results from this population with those from nationally-representative data in any effort to isolate features that might be uncharacteristic of the rest of the country. For the pre-KR period, we will use extant estimates from the 1962 Census (Heuveline 1998; Migozzi 1973; Siampos 1970). For the most recent period, we will analyze data from CDHS 2000.

Methods

From MIPopLab data we estimate period and cohort trends in age-specific rates of fertility, marriage, and marital fertility. Respecting fertility and marital fertility rates, we consider five-year periods, beginning with 1961-65 to 1996-2000, though for the years 1976-80 we decompose in two: 1976-78 (the main KR years) and 1979-80 (around and after the KR fall). Periods for marriage rates are shifted by one year, that is, from 1960-64 to 1970-74, 1975-77, 1978-79, and from 1980-84 to 1995-99. This is so that we may

compare marriage rates across birth cohorts grouped on the basis of their age at the time of the KR takeover.

As for fertility rates, at the end of the first period (1965), MIPopLab respondents were under age 40. We thus compute age-specific fertility rates up to age 39 in 1961-65, up to age 44 in 1966-70, and up to age 49 in all subsequent periods. We then estimate the 1966-70 TFR from age 15 to 49 by prorating the 1971-75 TFR on the ratio of the partial TFR truncated at age 44 in 1966-70 and in 1971-75. The 1961-65 TFR is then similarly estimated by prorating this TFR estimate for 1966-70 on the ratio of the 1961-65 and 1966-70 partial TFRs truncated at age 39. We compare these early-period age-specific fertility rates with extant analyses of the 1962 census. Census adjustments are presented in detail in Siampos (1970), which also provide indirect estimates of the TFR for Phnom Penh (5.3) and the entire country (7.0). In a re-analysis of the national data, Heuveline (1998) uses Brass' (1975) technique and estimates a five percent lower estimate for the country (6.7), which we will use, together with a similarly scaled-down TFR for Phnom Penh (5.1).

For the most recent period, we estimate rates for the 1981-85 to 1996-2000 periods from CDHS 2000 for the entire country and for the two provinces bordering the district in which MIPopLab is located (Phnom Penh and Kandal). Because the upper age limit is 50 years, TFRs can only be estimated for the 1996-2000 period. For 1981-85, 1986-90, and 1991-95, we estimate partial TFRs (truncated at age 34, 39, and 44 respectively) and obtain TFR estimates by prorating these partial TFRs on the TFR and similarly-truncated partial TFR estimates for the same period in MIPopLab.

To estimate marriage rates back to 1960 in MIPopLab, we use the same proration technique as for fertility rates, but only as it relates to ages at which marriage rates are already quite low: after age 39 (1960-64) or even age 44 (1965-69). We also estimate cohort probability of ever-marrying by certain ages. The 1962 census only provides proportion married by age, from which Migozzi (1973) estimated an ever-married life table that we can compare to the cohort estimates of the proportion ever-married in MIPopLab. For the most recent periods, CDHS 2000 only provides the date women "started to live with" their first husband and their marital status at the time of the survey. We can thus only estimate first-marriage rates and proportion ever-married up to age 34 beginning with the 1981-85 period. Since it is acceptable for the future groom to start living with his future wife and her parents once the two families have exchanged gifts to seal the marriage agreement, the timing might differ from that which could otherwise be obtained from the marriage date. In addition, about 16 percent of those dates were inferred from the respondent's birth date and her answer to the question, "How many years passed since your birth when you started living with him?" (National Institute of Statistics 2001).

We can estimate age-specific marital fertility rates in MIPopLab exactly as we do age-specific fertility rates, replacing estimates of person-years by estimates of person-years lived as married. Ongoing birth registration in MIPopLab suggests that extra-marital births continue to be extremely rare (on the order of one percent). Birth dates retrospectively reported outside of a marital period are more likely to result from a misreport of birth or marriage dates, or to correspond to the rather long engagement period that may precede the actual marriage ceremony but during which future spouses

may already live together (Heuveline and Poch 2003; Migozzi 1973:72-3). In his analysis of the 1962 census, Migozzi (1973:161) treats all births as marital births (i.e., kept in the rates' numerators), an approach that we follow in our analyses of data from both MIPopLab and CDHS 2000. While it entails a slight over-estimation in all periods, this approach is preferable to treating all dates as correct, thus excluding mis-reported births, which would likely result in a greater downward bias for earlier rather than for later periods. Comparing MIPopLab marital fertility estimates to nationally-representative estimates proves quite difficult. Migozzi (1973:163) estimates marital fertility rates by dividing the indirectly-estimated age-specific fertility rates (from Siampos 1970) by the proportion married in the corresponding age group as reported at the time of the census. The results, however, are surprisingly high in the youngest age groups: .79 births per married person-year in the 14-19 age group, for instance (Migozzi 1973:256). Siampos' (1970) indirect estimates were obtained after shifting a sizable fraction of an age-group to the next younger age group to reflect the fact that age is often counted starting as age one at the time of birth. If the age-specific proportions reported as married in the census are not similarly adjusted, a strong bias will occur in the age-group during which the proportion married increases rapidly with age. As the proportion of married women reaches a plateau after age 30, we obtain age-specific marital fertility rates from ages 30 to 49 for the entire country and from Phnom Penh, dividing the age-specific fertility rates estimated as described above by the proportion of married women reported in the census (Migozzi 1973:247). We then obtain Total Marital Fertility Rate (TMFR) estimates by prorating the sum of these rates on the ratio of the sum to the TMFR estimated in

MIPopLab in the 1961-65 period. Shifting the age structure as in Siampos (1970) to correct the proportion married from age 15 to 50 provided nearly identical results.

CDHS 2000 does not provide marriage histories to estimate marriage rates in more recent periods. As mentioned above, the date of starting cohabitation with a first husband is reported or inferred, and Heuveline and Poch (2003) argue that for women divorced or widowed at the time of the survey, the date of the last marital disruption can be approximated from data on their last sexual partner. Using this approach, the 1996-2000 TMFR and partial TMFRs for 1981-85, 1986-90, and 1991-95 can be estimated for women married only once, up to ages 34, 39, and 44, respectively. TMFRs for these four periods are then estimated by prorating the partial estimates on the TMFR and partial TMFR for the same period from women married only once in MIPopLab. However, to infer dates required to analyze data from CDHS 2000 may not make the timing of marital events around the KR period as precise as in MIPopLab, where marital dates were asked specifically and with reference to a calendar showing the date of the KR takeover and fall. Moreover, using the onset of cohabitation with the first husband may yield more married person-years than would the actual marriage date, and thus lower the marital fertility estimates compared to the two other sources of data.

Demographic trends reconstructed retrospectively (from the data of either MIPopLab or CDHS 2000) might be biased by selective survival to the present. The extent of such a bias cannot be tested from contemporary data, and the direction of a potential bias is not easy to anticipate. As single young adults were drafted for the toughest work assignments, they might have experienced higher mortality rates than married people of the same age, which would tend to increase age-specific fertility rates

among survivors compared to the entire population at the time. On the other hand, it is possible that parents with many children endured even greater sacrifices in order to improve slightly the lot of their children, which would induce the opposite selection bias.

Results

Mortality During the Khmer Rouge Regime and Subsequent Sex Ratio

While we cannot claim that the experience of the population in MIPopLab is typical of that of the entire country during the KR, we expected to find mortality rates close to national averages during the KR years, because this rural population should have fared slightly better than urban populations, yet worse than those referred to as "old people" by the KR regime. Questions on the survival of parents provide for a very rough test of the above proposition. We found that 20 percent of the respondents with a mother alive at the time of the KR takeover reported her death during the KR regime. The corresponding proportion for fathers is 35 percent. At the same time, with excess deaths estimated at about 25 percent of the 1975 population, and a sex ratio of about 1.5 male deaths per female death (Heuveline 1998), we estimate that excess mortality claimed about 30 percent of the 1975 male population and 20 percent of the 1975 female population nationwide. Add to these estimates another five percent for each sex to account for normal mortality during those four years and this very crude comparison (e.g., multiple reporting on same parents by siblings, unknown age structure of the parents' population) suggests that the MIPopLab figures are fairly close to the national average for males, and perhaps slightly lower for females.

Another finding from questions about parents' survival is the dramatic impact the KR years had on extant marriages. Among respondents whose parents were both alive at

the time of the KR takeover, 8 percent more lost only their mother, 21 percent lost only their father, and 16 percent lost both parents during the KR. Taken together, then, 45 percent of intact parental unions in 1975 were disrupted by the death of at least one spouse during the four years that followed.

Another implication of the KR-period mortality is the resulting shortage of men in the adult population, estimated to be on the order of 75 males per 100 females aged 15 and over in 1980 (Huguet 1992), and hence probably about one single adult male for every two single adult women. The latter ratio can be arrived at by assuming the pre-KR proportion of women aged 14 and over married at around 62 percent, as estimated before the civil war (Migozzi 1973:137), ignoring potential survival differences between married and single women, and applying our above estimate of 21 percent of pre-KR union resulting in husband-only death. This admittedly rough calculation yields about one half of the women over age 15 as still married in 1978-79, and, subtracting 50 married males and females from the sex ratio, suggests that only 25 single males remained per 50 single females.

Period Fertility

Period TFRs from MIPopLab, CDHS 2000, and the 1962 census are compared on Figure 2. MIPopLab estimates exhibit three clear fertility trends: (1) a sharp decline after 1975, (2) a dramatic surge in 1979-80, and (3) a sustained decline thereafter. The most recent trend is in close agreement with the national trend found in CDHS 2000, as well as the trends in Phnom Penh and Kandal provinces. The fertility level is also, as expected, intermediate between that cited for the above two provinces and consistently remains

between 21.7 and 22.9 percent lower than the national estimate throughout the two decades.

The 1961-65 and 1966-70 TFRs estimates from MIPopLab might be a bit low, as they appear to be near the 1962 census figures for Phnom Penh province, although, as in the 1980s and 1990s, they remain between 20 and 25 percent lower than the national indirect estimate from the 1962 census (24.9 percent and 22.4 percent lower, respectively). Inasmuch as little reason exists to expect fertility decline during the 1960s, a slight underestimation due to the omission of early births by the oldest women in the MIPopLab sample is plausible. At the same time, the decline from 5.2 to 4.9 live births per woman between 1965-69 and 1970-74 could well be attributable to the civil war.

To the best of our knowledge, these data provide the first direct evidence of a fertility decline in a large population during the KR regime. According to our estimates, the TFR declined sharply during the KR regime, down to 3.7 live births per woman in 1976-78, that is, 29 percent lower than its level before the civil war. Taking into account the above-mentioned possibility that the pre-war births were slightly under reported, we conclude that in this population fertility rates between 1976 and 1978 fell to two-third of their pre-war level.

The fertility rebound in the two years after the KR regime is quite striking. We estimate that the TFR increased slightly from over seven live births per woman for the 1979-80 period, which was 91 percent larger than in the preceding 1976-78 period and still 36 percent larger than the 1966-70 level. After this two-year boom, fertility begins a rather rapid decline, but more than likely remains above the pre-war levels during the first subsequent five-year period. According to MIPopLab data, the 1981-85 TFR is

seven percent higher than the 1966-70 TFR (5.5 versus 5.2), whereas the national estimate that can be extrapolated from CDHS 2000 is 7.1 for the same period, which is also above the 1962 census estimate of 6.7 live births per woman. Both in the MIPopLab and the national populations, the 1981-85 fertility level appears seven percent higher than *ante bellum*. Given the above-noted high proportion of unions terminated by death during the period, the standard explanation for post-crisis fertility rebound in historical populations—which attributes the trend mostly to the high rate of conception among existing unions (Lee 1987)—appears inapplicable to the Cambodian baby boom. We hence turn to the analysis of marriage trends to further consider the plausibility of this explanation in post-KR Cambodia.

Period and Cohort Nuptiality

Figure 3 shows the period Crude Marriage Rate (CMR) between ages 15 and 34 from 1960-64 to 1995-99 based on MIPopLab data, and from 1980-84 on, it compares MIPopLab- and CDHS-2000-based estimates of period crude rates of first marriage between the same ages. There are no equivalent estimates for the earlier periods but the average 1960-74 first marriage rates from MIPopLab suggest that 87.8 percent of a birth cohort married at least once by age 30, which compares to the 90.5 percent nationwide yielded by the 1962 census estimates (Migozzi 1973:248).

We find that the CMR between ages 15 and 34 fell to only 35 percent of its pre-war level during the KR regime, but rebounded 86 percent higher than this pre-war level, and that occurred as early as 1978-79. The 1978-79 period is the only period in which a difference between the first and all marriage rates is visible (Figure 3), suggesting a non-negligible contribution of re-marriages in that period only. The increase in marriage can

also be seen in part as a catching-up for cohorts that have delayed entry into marriage during the KR period. Figure 4 shows the proportion ever-married at different ages for four sets of three-year birth cohorts: birth cohorts that reached the corresponding age (1) just before the KR (around 1972), (2) around the time of the KR takeover (1975), (3) toward the end of the KR regime (around 1978), and (4) after the KR fall (around 1981). The proportions ever-married are shown at ages 18, 21, 24, 27, and 30, respectively, according to MIPopLab estimates; and at age 21, according CDHS 2000 estimates. Cohorts of women who entered the prime ages for first marriage at the time of the KR were all able to compensate quite rapidly after the fall of the KR. For some cohorts, the post-KR marriage boom even resulted in a slightly higher proportion being married at a given age than had been the case before the KR. Consistent with the later pattern of marriage in MIPopLab than in the rest of the country, as documented by the 1997 GPC, national estimates from CDHS 2000 exhibit a higher proportion ever married by age 21, but the same pattern of decreases and increases around the time of the KR (Figure 4).

The 1978-79 CMR between ages 15 and 34 is all the more impressive (.26 marriages per person-year) when a prevailing sex ratio on the order of one single male for every two single females aged 15 and over is taken into account. At this rate, 41 percent of single women aged 15 to 34 would marry within two years, suggesting that a substantial majority of unmarried men over the age of 15 were married during this short period. Therefore, such high rates could not last very long. MIPopLab estimates show that in the early 1980s, the marriage rates had already fallen below their pre-KR levels and would not recover their typical pre-KR value until the early 1990s, when the sex ratio in the cohorts of marriageable age returned near parity. (The latest decline in marital rates

likely has less to do with KR-related events than with the restoration of schooling in the 1990s and the gradual transition to a market economy in the early 1990s that kept girls in school longer and provided young women with more wage-employment opportunities.) From 1980-84 on, the national estimates derived from CDHS 2000 data display the same ups and downs, but not as marked as in MIPopLab, arguably because of the more precise timing of events in the latter data (Figure 3).

In order to shed further light on these patterns, Figure 5 shows age-specific marriage rates before the KR (1960-74), during the KR (1975-77), around the fall of the KR (1978-79), and after their fall (1980-84). The 1980-84 pattern is quite similar to that of 1960-74 up to age 25, when age-specific marriage rates become significantly lower than they had been previously. This probably reflects the imbalance of the sex ratio, and the fact that in Cambodia a never-married woman is considered an "old maid" by age 25. Whereas before a spinster could marry an old bachelor in a more casual ceremony than the traditional marriage, after 1980, the shortage of marriageable men age 15 and over seems to have reduced women's odds of marrying past age 25. As for the 1978-79 marriage boom, although rates are higher than before the KR regime at all ages, the rebound is particularly pronounced between ages 15 and 25, with marriage rates that are more than twice their pre-KR level. Further evidence that the marriage boom was more than just a catch-up for delayed marriages can be seen in marriage rates themselves, which more than doubled between 1960-74 and 1978-79 among women aged 15 to 19, who were too young in 1975 to have had to postpone much their entry into marriage yet.

Period and Cohort Marital Fertility

Period TMFRs from MIPopLab, CDHS2000, and the 1962 census are compared in Figure 6. MIPopLab estimates exhibit the three same trends that were visible in Figure 2. First, the TMFR declines in 1975-78 compared to the 1965-69 levels before the onset of the civil war, but its relative decline (-15 percent) is only one half of the TFR decline over the same periods (-29 percent) because the latter is also accounted for in part by two above-mentioned marital trends: (1) nearly one half of pre-KR unions ends in the death of the husband or wife before the KR fall, and (2) the rate of marriage formation declines during the KR reign. Second, the TMFR dramatically increases in 1979-80, but this time its relative increase (+46 percent compared to 1965-69) even exceeds the TFR increase over the same period (+36 percent). In spite of the 1978-79 marriage boom that gradually restored the proportion married to its earlier level, the contribution of marriage to total fertility (i.e., the TFR/TMFR ratio) was still lower, on average, during the 1979-80 period than it had been before the civil war. Third, the TMFR declines by 15 percent from the 1979-80 peak to the next five-year period. This relative decline is more moderate than the decline in total fertility over the same period (+21 percent), suggesting that this decline in total fertility was due in part to the constraints on the marriage market that effectively lowered marriage rates after 1980. According to these data, marital fertility remained high throughout the 1980s and early 1990s, and the TMFR was still 18 percent higher in 1991-95 that it had been in 1966-70.

The most recent trends closely parallel national trends derived from CDHS 2000, and from 1980 to 1999, the TMFR estimates for the country and the Kandal province are extremely close to those derived from MIPopLab. The TFR estimates from MIPopLab were instead intermediate between the Phnom Penh and Kandal estimates from CDHS

2000, which might be explained in part by a marriage pattern in MIPopLab comparable to that of Phnom Penh and substantially later (2.2-year difference in SMAM) than the pattern observed in the country. This difference appears insufficient to explain fully the 20-25 percent difference in total fertility observed earlier between MIPopLab and national figures, however, and the underestimation of marital fertility rates from CDHS 2000, due to the above-mentioned potential overestimation of marital duration, is another likely factor. This is further suggested by the 1960s TMFRs estimates from MIPopLab, which are significantly lower than the national estimates derived from the 1962 census, and again closer to that of Phnom Penh. While a slight omission of early births by the oldest women in the MIPopLab sample is quite plausible, to align the 1965-69 MIPopLab figures with the national estimates would require adjusting MIPopLab estimates upward by as much as one third (assuming the omission of one in every four births). As discussed above, both the 1962 census and the CDHS 2000 data require too many adjustments to yield marital fertility estimates reliable enough to back such a strong claim. Considering the ratio of the TFRs in MIPopLab and in the country, combined with the difference in the marriage pattern, we estimate that the pre-war TMFR would be 10 to 15 percent lower in MIPopLab than in the country, which would suggest a TMFR around eight live births per married woman among the MIPopLab population at the time, and a 15-percent underestimation in the retrospective birth-history data. From this assessment, we conclude that marital fertility in the MIPopLab population most likely did not return to the pre-war levels until the second half of the 1980s.

The high marital fertility of the post-KR years is also illustrated on Figure 7, which compares the marital fertility of three sets of cohorts. Clearly, each set has the

highest marital fertility at the age the respondents were just after the KR: around age 40 for the cohorts born in 1936-45, age 30 for the cohorts born in 1946-55, and age 20 for the cohorts born in 1956-65. The marital fertility boom is thus truly a period effect rather than a cohort effect, since it affected all cohorts regardless of their age at the time. In particular, as similarly observed for first-marriage rate, even women who were around age 15 at the time of the KR takeover contributed to the post-KR marital fertility surge even though they had not had their reproductive career interrupted by the KR.

Summary and Discussion

The KR's unprecedented attempt to entirely overhaul the economic, social and cultural fabric of Cambodia resulted in the excess deaths of about one fourth of its population in less than four years. The following few years witnessed a baby boom as fertility, after a drop during the KR reign, rebounded rapidly. In this paper, we present what we believe are the first estimates of the extent of fertility fluctuations that can be inferred, but not precisely measured from previous demographic data (Huguet 1992). Using data collected specifically for these purposes, we estimate that fertility under the KR fell about one-third below its level before the onset of the civil war. After nearly doubling in the subsequent two years (1979-80), fertility began to decline again but was still about seven percent higher, on average, in the early 1980s than it had been in the late 1960s.

A baby boom following a crisis-induced baby dearth is not unusual, but some of the features of the Cambodian fertility surge are. Reviews of the historical record (e.g., Lee 1997) suggest that the fertility rebound is typically commensurate with the short surge in marital fertility induced by the preceding drop in conceptions. In Cambodia, first of all, the proportion of women who were married but neither pregnant nor breastfeeding

is unlikely to have increased substantially during the KR. There was certainly a decline in conception among married women (nearly 20 percent), but a decline in the proportion of married women also contributed to the overall fertility decline. About 20 percent of the married women who survived to the end of the KR regime were widowed, and under the KR the new marriage rate had dropped to about one third of its pre-war level. Second, a marriage boom undoubtedly accompanied the post-KR marital fertility increase. The CMR between the ages of 15 and 34 around the time of the KR fall (1978-79) reached nearly twice its pre-war levels. Third, the period of high fertility outlasted the marriage boom, which quickly leveled off due to another demographic legacy of the KR regime: a severe imbalance in the sex ratio of the adult population resulting from the excess of male over female mortality during the KR. The approximately seven-year period during which post-KR fertility exceeded its pre-war level thus derives from an at least equally-long, perhaps even longer, period during which marital fertility exceeded its pre-war level. Such a prolonged period/stage of high fertility cannot be explained away by a preceding conception dearth. Last, all reproductive-age women participated in the post-KR marriage and marital fertility surge, even women at the outset of their reproductive career who were too young to have experienced reduced fertility during the KR regime.

In the case of the post-KR fertility increase, the typical explanation of decreases and increases in conception rates among married women must thus be complemented by at least two additional *behavioral* explanations: a dramatic, albeit brief, marriage boom and high marital fertility even after the first post-KR birth. While our data do not document changes in all the factors that could have contributed to these two trends, the magnitude and the timing of the different changes leave us with no doubt that mortality

change was the principal factor. The fall of the KR regime was abrupt, but for the Cambodian people the war only ended some ten years or more later. If combat became more sporadic, food production, for instance, continued to be hampered by land mines and shortage of men in their most productive ages. The return to normal conditions was a protracted process in all respects except mortality, which dropped instantly, as soon as the KR lost control over a given area.

Two factors in particular make us hesitate to use the Cambodian experience to assert a more general influence of mortality declines on fertility declines, however. First, the exceptional magnitude of the Cambodian mortality crisis may make the fertility response more conspicuous in our data than in those used to analyze similar cases in Angola (Agadjanian and Prata 2002) and in Ethiopia (Lindstrom and Berhanu 1999), but it may also induce a response when none would have taken place in less dramatic conditions (i.e., *dose response*). Second, the mortality-fertility relationship might not be symmetrical inasmuch as a mortality increase could yield a fertility increase without mortality decrease necessarily leading to fertility decrease. Montgomery (1998) argues that mortality declines may not be as readily perceived as generally assumed because mortality declines do not generate events but rather non-events, that is, the absence of a death that would have occurred had the mortality conditions of the past prevailed into the present. A mortality increase and the increased frequency with which one experiences a death in one's surroundings might be more easily perceived and hence more likely to have an impact on subsequent fertility.

Our findings may not therefore be interpreted as a demonstration of a direct, symmetrical relationship between mortality and fertility, but at the very least they do

indicate a relationship between fertility levels and past mortality levels. Gradual mortality decline may not have an immediate, easily- identifiable impact on fertility, but the Cambodian tragedy shows that a rapid, unequivocally perceptible mortality decline will disrupt the relationship that had gradually been established between mortality and fertility. As pointed out by LeGrand and Sandberg (2004), proponents of the demographic transition theory have long argued the existence of such a relationship, cast in the functionalist framework dominant at the time**:**

> "Any society having to face the heavy mortality characteristic of the pre-modern era must have high fertility to survive. All such societies are therefore ingeniously arranged to obtain the required births. Their religious doctrines, moral codes, laws, education, community customs, marriage habits, and family organizations are all focused toward maintaining high fertility"(Notestein 1945:39)

Based on our findings, two qualifications are, however, in order: (1) before the KR these "doctrines, codes, customs, and habits" did not lead to very high fertility, and (2) they proved flexible enough to allow for a higher fertility after the KR.

The fact that pre-transitional fertility rates were substantially lower than their potential maximum has now been well documented (Bongaarts and Potter 1983). The reduction of the social and economic barriers to marriage is also a well-documented mechanism through which marriage patterns can change relatively rapidly (e.g., Eversley 1957). In Cambodia, high rates of marriage were produced in part by the catch-up of cohorts that had delayed marriage during the KR, and by the marriage of women at earlier ages than what had been typical. In our focus group discussions, several women married during this period narrated the intense pressure from their parents to marry right away. One of them, for instance, recalls:

> "After the downfall of the Pol Pot regime in 1979, my parents and my siblings insisted that I marry. I disagreed and disagreed. However, I could not resist my

> parents who kept pushing me to marry. So, I married him and have had him as my husband ever since. I must marry…. I must marry… What was that for? I just survived Pol Pot and I had not yet understood what life was."
>
> Focus group discussion, MIPopLab, 12/16/2000

While marriages arranged by the family were customary in Cambodia, marriage was preceded by a rather lengthy spousal selection process by which families "feel each other out," as a Khmer expression goes (Steinberg 1959:84). Approached by the potential groom's parents, the potential bride's parents regularly turned down proposals coming from families deemed too modest. These considerations appear to have become secondary at the time, as mentioned by another participant married in the early 1980s:

> "I never thought about whether or not to marry a husband who had no job or who was illiterate… I never did. When I was told to marry, I just married. I did not know that a jobless and illiterate husband was of no use, and that consequently I shouldn't marry him. Today, girls from the younger generation understand that very well."
>
> Focus group discussion, MIPopLab, 12/16/2000

As the Cambodian marriage system is matrilocal, the pressure on single women to marry may reflect competition among families for scarce male manpower, due to the excess of male over female mortality during the KR period.

The increase in marital fertility presents a much greater challenge in attempting to account for within the natural fertility paradigm—in the sense of an absence of parity-specific fertility behavior (Henry 1961)—that with the possible exception of the capital city, suited Cambodia society before and just after the KR. Neither can focus group discussions twenty years later shed much light on the issue, for all that focus group participants attest to is that contraceptives were not available until the late 1980s and that babies kept coming:

> "Oh, at that time we did not have any means to prevent births. The conception occurred on its own will and we had to live with that. […] If I got pregnant, it

> meant I had a child… No matter how many. I was speechless. Sometimes, there were two births in one year. One child was just five-month old and I got pregnant again."
>
> Focus group discussion, MIPopLab, 12/16/2000

While this description does fit the natural fertility paradigm, it probably would not differ much from accounts of reproductive "decisions" before the KR. Van Bavel (2003) argues that the well-documented decline of marital fertility with marriage duration likely originates in changes in coital frequency rather than in any of the measurable alternatives. The proportion of very recent marriages, and the shorter interval from marriage to first birth than between subsequent births, must have at first contributed to the increase in marital fertility, but could not have sustained it for as long as high fertility is observed in this population. For lack of a better alternative, we speculate that couples at all durations maintain a higher coital frequency than was the case in previous periods.

Regardless of the exact mechanisms, our findings in respect to the adjustment of one or several of the determinants of natural fertility may add to the unease expressed by several demographers toward the concept of natural fertility when opposed to controlled fertility. Leridon (1989), for instance, introduces the term of "pseudo-natural" fertility, and Santow (1995) even more bluntly advances the oxymoronic "control of natural fertility" (also see Mason 1997). Our findings are indeed consistent with those documenting the experience of migrants to lower-density areas, which showed that they have higher fertility in such areas than had been the case in their areas of origin. This "frontier" effect is best known from Easterlin's (1976) work on the U.S. in the nineteenth century (also see Anderton and Bean 1985), and the fertility of French migrants in the Saint-Lawrence valley in the 17th century (Charbonneau, et al. 2000). As the sex ratio is typically high in frontier settlements, a lower age at marriage for women can contribute

to this high total fertility. More recently, however, VanLandingham and Hirschman (2001) also document a frontier effect in pre-transitional Thailand, in which they show that marital fertility accounts for at least one half of the fertility differentials across regions. But while these "frontier" effects result from a personal experience—moving to another part of the country or to another country—which opens the possibility of self-selection biases, in Cambodia fertility increased as a result of a collective experience of extraordinary mortality beyond individual control. Our results therefore reinforce a stream of findings that suggests that some or all members of a pre-transitional population, unlikely to be *deliberately* spacing their births to reduce their total fertility, can nevertheless adjust their fertility, and even their marital fertility, to take into account the different conditions of their new environment.

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Figure 1: Conceptual Models of Mortality-Fertility Links

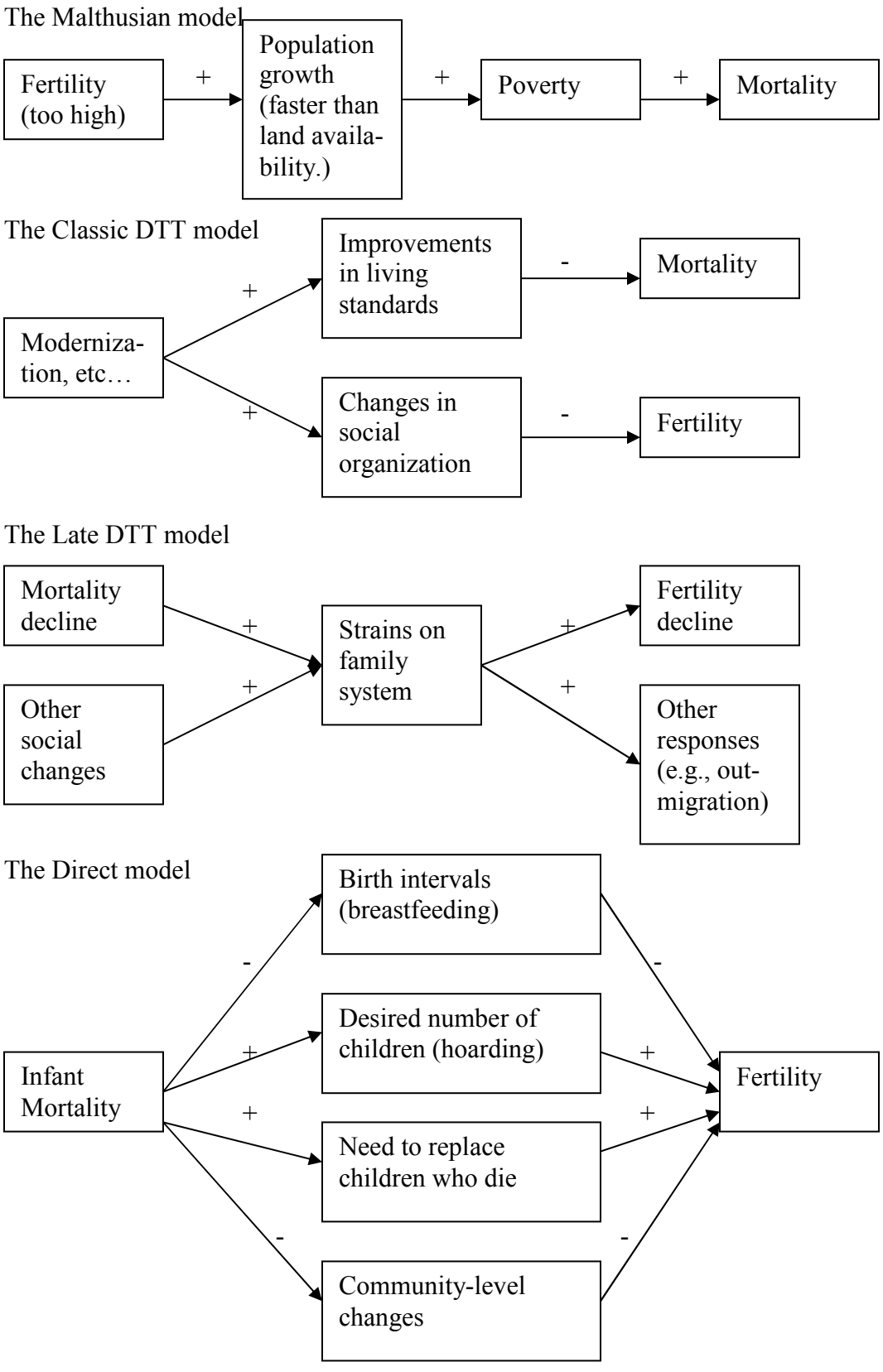
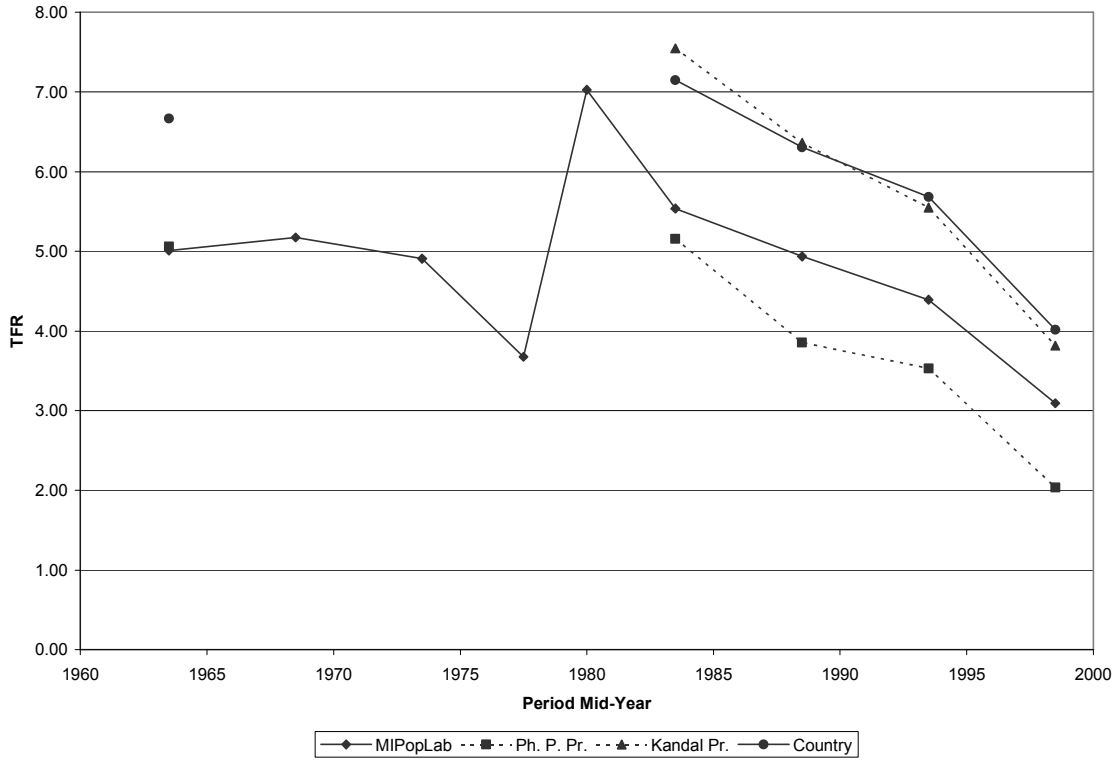


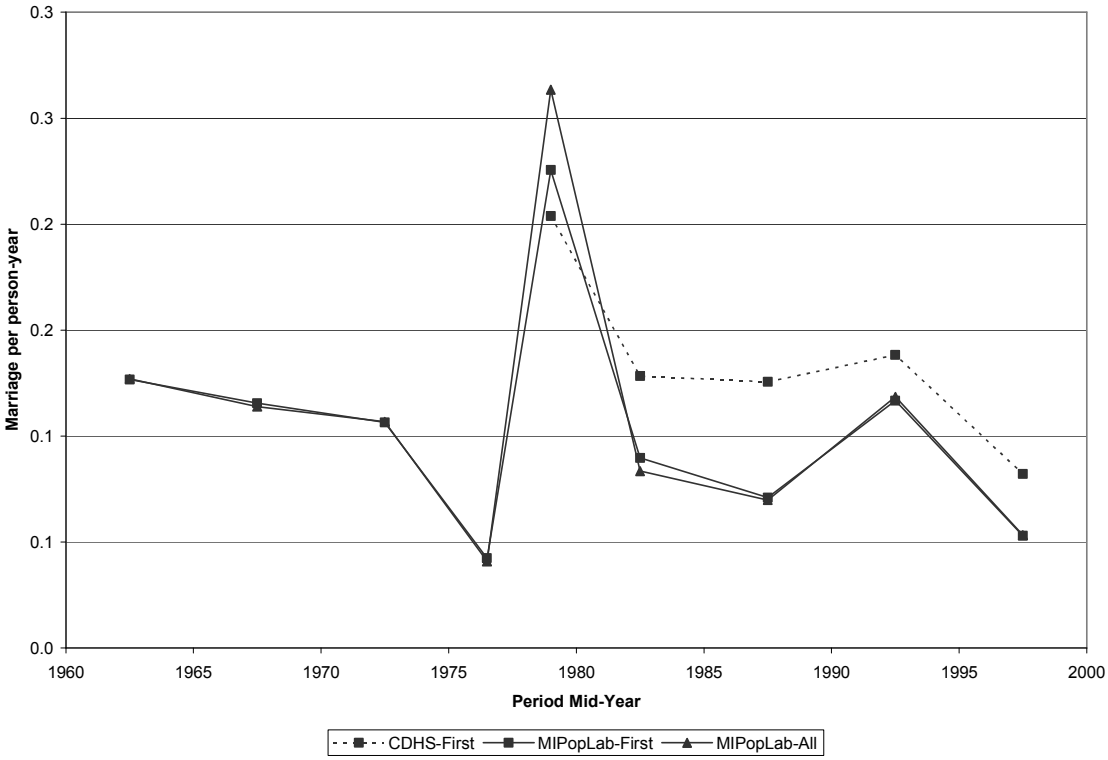
Figure 2: Total Fertility Rates by Period, 1961-65 to 1996-2000



Note: From 1961-65 to 1996-2000, total fertility rates correspond to a five-year period, with the exception of the 1976-80 period, which is divided into 1976-78 and 1979-80, respectively.

Sources: Estimates from MIPopLab are the authors' calculations. Estimates for the country, and for Phnom Penh and Kandal provinces, are also the authors' calculations based on the age groups available in the CDHS 2000 data in each period, and prorated to age 15 to 49, assuming the same age structure of fertility as in MIPopLab during the same period. The 1961-65 estimates for the country and for Phnom Penh province are Migozzi's (1973:254) indirect estimates from the 1962 census, adjusted as in Heuveline (1998:61-2).

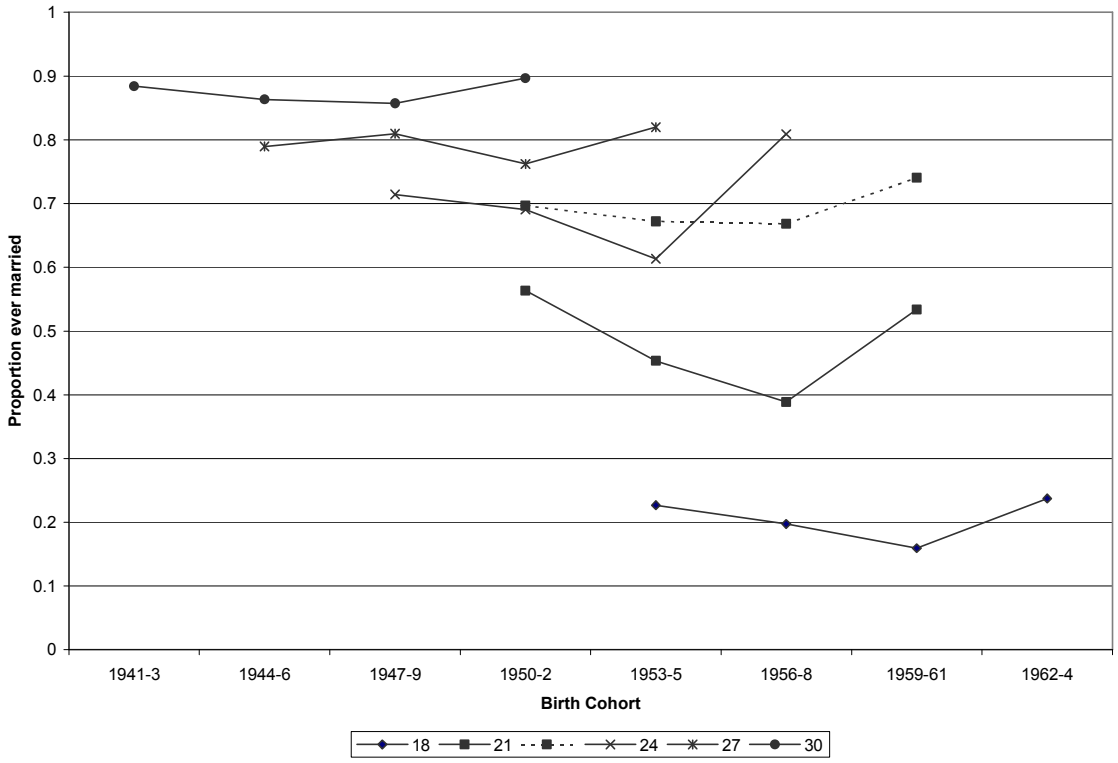
Figure 3: Crude First and All Marriage Rates, Ages 15 to 34, by Period, 1960-64 to 1995-99



Note: From 1960-64 to 1995-99, marriage rates correspond to a five-year period, with the exception of the 1975-79 period, which is divided into 1975-77 and 1978-79, respectively.

Sources: Author's calculations from MIPopLab and CDHS 2000 data.

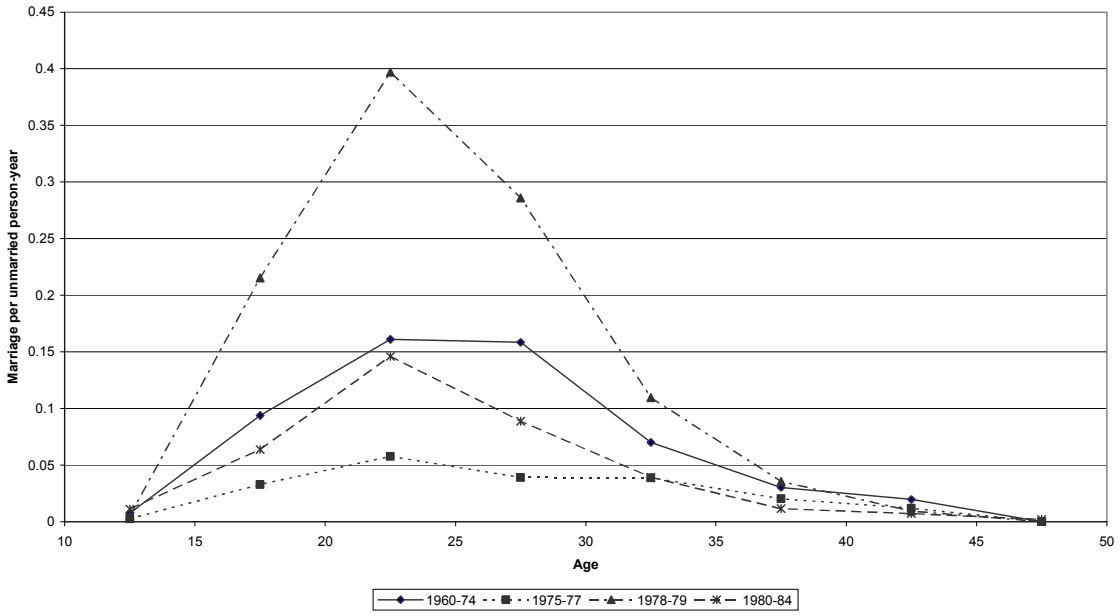
Figure 4: Proportion Ever-Married by Ages 18, 21, 24, 27, and 30, by Birth Cohort



Note: The broken line represents the proportion ever-married by age 21 from CDHS 2000. Solid lines represent the proportion at different ages from MIPoPLab.

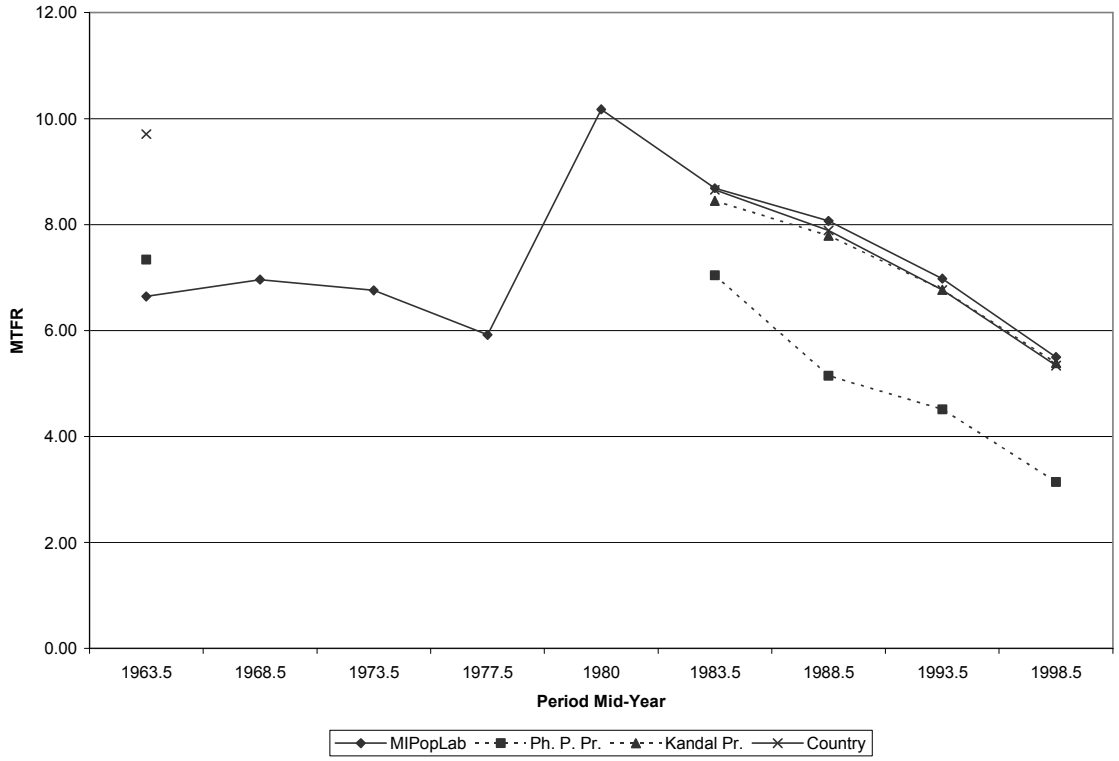
Sources: Author's calculations from MIPopLab and CDHS 2000 data.

Figure 5: Age-Specific Marriage Rates by Period, 1960-74, 1975-77, 1978-79, and 1980-84



Sources: Author's calculations from MIPopLab data.

Figure 6: Total Marital Fertility Rates by Period, 1961-65 to 1996-2000

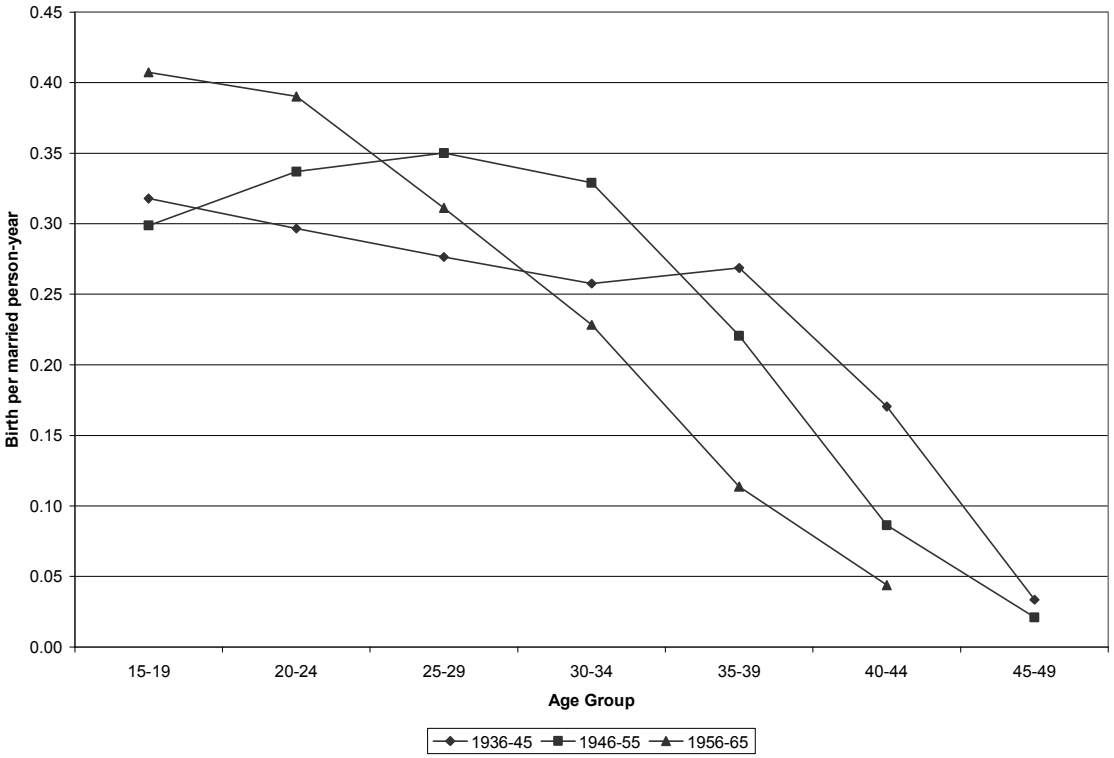


Note: From 1961-65 to 1996-2000, total marital fertility rates correspond to a five-year period, with the exception of the 1976-80 period, which is divided into 1976-78 and 1979-80, respectively.

Sources: Estimates from MIPopLab are the authors' calculations. Estimates for the country, and for Phnom Penh and Kandal provinces, are also the authors' calculations based on women married only once in the age groups available in the CDHS 2000 data in each period, and prorated to age 15 to 49**,** assuming the same age structure of marital fertility as in MIPopLab during the same period. The 1961-65 estimates for the country and for Phnom Penh province are Migozzi's (1973:165) estimates from the 1962 census from age 30 to 50, adjusted as in Heuveline (1998:61-2), and prorated to age 15 to 49**,**

[add comma] assuming the same age structure of marital fertility as in MIPopLab during the 1961-65 period.

Figure 7: Age-Specific Marital Fertility Rates, by Cohorts



Sources: Authors's calculations from MIPopLab data.