Famines and Fertility: Evidence from the Recent Intercensal Period and Beyond in Rural Malawi

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ABSTRACT:

I examine how the likelihood of giving birth changes around a famine in Malawi. Malawi experienced famines in 2002 and 2005/2006, which affected between one-fifth and one-third of its predominantly rural inhabitants. While previous research suggests that major economic shocks impact fertility, less is known about the effects of famines especially at the micro-level. Using retrospective birth histories from the Malawi Longitudinal Studies of Families and Health, and discrete-time hazard models, it appears that the famines of 2002 and 2005/2006 had residual, lingering effects on fertility—as seen in declines two to three years after the onset of the famines. Understanding the impacts of famines on vulnerable populations, like rural Malawians, is a worthwhile endeavor in efforts to improve population projections and devise interventions after such events in the future.

Key Words: famine, fertility, Malawi, sub-Saharan Africa

INTRODUCTION

In the "developed" world, fertility decisions are now driven by the "lifestyle" choices of individuals which may go against the values of increasingly archaic institutions' (like the church), and family members' (parents and grandparents) desires. Further, unusual seasonal changes—like ones without much rain or perhaps too much snow—are unlikely to affect men's and women's fertility decisions in the "developed" world because of almost universally accessible modern housing (to keep the rain out and its occupants warm), reliable health care services, and state welfare programs should even the poorest of individuals fall upon "hard times". Fertility decisions in the "developing" world are unlike those of the "developed" world though, and are often based more-so on the perceived economic value of children, urbanization, and the diffusion of new ideas regarding fertility coming from the "developed" world (see Bongaarts and Watkins 1996; Caldwell 1976; Caldwell 2005; Cleland and Wilson 1987; and Watkins 1987). In many "developing" countries, many families are also more susceptible to Mother Nature based on the limited availability of electricity and/or gas heating, and certainly because of inadequately built houses; one walk through a village in sub-Saharan Africa (SSA) makes this evident.

In this paper, I will examine how the likelihood of giving birth changes around a famine. I use the case of Malawi—a small SSA nation of approximately 16 million people (Malawi National Statistical Office 2011)—which is ranked 171st out of 187 countries based on the United Nations Human Development Index (United Nations Development Programme 2011). Since over 80% of Malawians live in rural areas (Malawi National Statistical Office 2011), it is no surprise that the country relies heavily on its agricultural exports to trade in the world market—such as tea, tobacco, and sugar cane. Malawians also extensively use the maize and potatoes they grow for their own sustenance (World Bank 2010). Thus, if a famine were to occur, it would seemingly have a great impact on the economy of Malawi and more importantly, the vast majority of its people. Such famines occurred in 2002 and 2005/2006 and recent birth histories of Malawian women are compared in relation to these years.

SHOCKS AND FERTILITY

Fertility is intimately related to individual, household, and extended family economic decisions (Becker, Duesenberry, and Okun 1960; Becker 1992; Caldwell 1976; Easterlin 1975; Levy 1985; Schultz 1973; Willis 1974). It is well known that economic recessions and depressions in "developed" nations are associated with higher chances of childlessness (Morgan 1991) and delays in childbearing (Ryder 1982; Sobotka, Skirbekk, and Philipov 2011) which are even deemed to be a normative response to financial adversity (Rindfuss, Morgan, and Swicegood 1988). But, not all women and households are as likely to respond to such economic shocks in this manner. It has been shown that across a range of European nations since the 1970s, difficult economic circumstances lower the chance of 20 to 29 year old women having a child, but not for those 30 and above (Neels, Theunynck, and Wood 2013). Also, downward fertility responses to major economic shocks are not immediate, but rather usually take place a year or more afterward, with an uptick in fertility once the effects of the shock dissipates (Sobotka, Skirbekk, and Philipov 2011). Even further, as in the case of Russia in the mid-1990s, fertility is not always associated with economic crises and uncertainty and may even increase during these periods (Kohler and Kohler 2002).

Demographers know comparatively less about how major shocks like famines impact fertility. Unlike recessions, famines occur exclusively in "developing" countries where food security is a much more likely reality. We have seen evidence that malnutrition (which may be caused by a famine) and fecundity are closely linked (Bongaarts 1980). More specifically, the combination of poor nutrition, poor living conditions, and hard labor create conditions of subfecundity and thus, lower total fertility (Frisch 1978). Malnutrition does not have to be severe to affect fertility either (Frisch and Bongaarts 1982). Famines in Eastern Europe and Asia have been unsurprisingly associated with an increased in stillbirths and miscarriages (Cai and Feng 2005; Kane 1987), as well as calculated decisions not to bear children during food shortages and/or when grain prices inflate (Galloway 1988; Menken and Phillips 1990) alongside other household economic considerations; such decisions have even been witnessed to be exacerbated by civil wars, which amplify reductions in fertility (Clifford, Falkingham, Hinde 2010) as well as increase the rate of female infanticide which further skews fertility estimates (Xin 1989). But there is competing evidence that suggests there is no relationship between food intake and childbearing even "in conditions of chronic or endemic malnutrition" (Menken, Trussell, and Watkins 1981, 425). And thus, it is unclear of the extent to which biological factors limit fertility during famines in comparison to economic and social factors.

The timing of fertility changes in response to famines and their impact on fertility largely depends on the length and severity of the famine (Bongaarts and Cain 1982) and may even be "directly proportionate" to these factors (Kane 1987). As in the case of pre-industrial Europe, an estimated 40% to 60% of the variation in fertility from year-to-year is deemed to be determined by changes in grain prices (Galloway 1988); longer, more dramatic increases in grain prices are therefore correlated with lower fertility and steeper declines. More-severe famines, like the one Ireland faced in the 1840s, also sharply increase mortality rates and significantly diminish the number of births that were expected to have taken place (Boyle and Ó Gráda 1986). For the most part though, fertility rates recover after famines—even if it is a brief period (Das Gupta and Shuzhuo 1999)—and might reach levels higher than the pre-famine period as a response (Bongaarts and Cain 1982). And, of course, not all socioeconomic gradients or even age-groups of women are equally affected by famines (Razzaque 1988).

In SSA specifically, famines and economic downturns have been linked to temporarily lower levels of marital fertility in Ethiopia (Lindstrom and Berhanu 1999) alongside brief drops in fertility rates by over a quarter among famine victims (Kidane 1989). Yet, Cameroon's economic crisis spurred at least a 10 year fertility decline (Eloundou-Enyegu, Stokes, and Cornwell 2000). However, in SSA on the whole, there is little evidence to suggest that temporary declines in fertility due to economic shocks turn into long-term trends in fertility decline (Coussy and Vallin 1996; Lesthaeghe 1989; Lindstrom and Berhanu 1999; Mason 1993; Peng 1987; Watkins and Menken 1985). It would seem that the fertility responses in the wake of such shocks SSA are similar to those found elsewhere.

There is not one set fertility path that populations throughout the world take during economic downturns and other events, like famines (see Figure 1 below). But we still typically see the postponement of childbearing which begins at least one year after the onset of the shock, and is eventually followed by either the stabilization of fertility rates or even a brief rise in fertility after the negative economic effects have subsided. One must expect that women a country like Malawi, which is highly vulnerable to agricultural shocks, would display similar fertility behaviors during a famine.

-Insert Figure 1 about here-

OTHER CONSIDERATIONS IN THE SUB-SAHARAN AFRICAN AND MALAWIAN CONTEXTS

It is well documented that Malawian women have recently changed their fertility behaviors to account for HIV/AIDS infection or HIV/AIDS-related risks for themselves and their potential children (Hoffman et al. 2008; Noël-Miller 2003; Taulo et al. 2009; Yeatman and Trinatopoli 2009). Living in an area with high HIV/AIDS prevalence and believing that oneself has a high chance of becoming infected, may even hasten the timing of fertility for women (Trinitapoli and Yeatman 2011). These changes are, at least in part, likely due to the changing social understanding of sexual activity which stems from the diffusion of ideas from the "developed" world into these rural areas (Watkins 2004).

Yet, while HIV/AIDS is an important determinant of fertility in many sub-Saharan African nations—and may slow or speed-up fertility and fertility intentions—it is crucial to realize that HIV/AIDS is not solely responsible for recent changes in African fertility rates (Lewis et al. 2004; Rutenberg and Watkins 1997). The introduction of family planning programs and contraceptive technology have been well documented as exogenous factors contributing to fertility declines in sub-Saharan Africa (Garenne and Joseph 2002), although the impact of contraception on fertility rates has been far less effective than predicted and seen in other developing regions of the world (Cleland et al. 2006). Leadership problems, economic stagnation, and slow declines in child mortality (Caldwell and Caldwell 2002) have also hindered fertility declines in sub-Saharan Africa. Cultural practices and values—such as young ages at first marriage or religious and familial pressures to produce numerous children (Caldwell and Caldwell 1987)—and partner separation due to employment also can impact fertility rates (Bongaarts, Frank, and Lesthaege 1984). While these dynamics may not always lead to fertility declines, the evidence clearly shows that sub-Saharan African fertility decisions are nonetheless affected by a variety of reasons other than just the high prevalence of HIV/AIDS.

THE 2002 AND 2005/2006 FAMINES

Malawi's two famines between the 1998 and 2008 censuses, greatly affected the health and well-being of its residents. In both instances, the Malawian government was relatively unprepared for these crises, and their appeals for emergency foreign aid took place after the onset of each famine. Grain prices were low between 1998 and 2001, but in 2001, the government sold most of its grain reserves and was without effective policies and programs to mitigate the effects of poor crop yields and the ensuing famine (Mkoka 2002; Phillips 2007). The country also experienced heavy flooding in the first few months of 2001, which hurt farmer's private reserves of crops and diminished grain supplies throughout the country. The government's delayed public response to an impending food shortage also contributed to a severe famine (Stevens, Devereux, and Kennan 2002) that began in January and peaked in May of 2002. The international media did not begin frequently reporting on this issue until March of 2002 (Rowan 2002), and the famine had certainly gotten worse by May, as it was labelled as the country's "worst-ever" famine (Tenthani 2002). Roughly 3 million people were predicted to have been affected by the famine by September of 2002 (Mkoka 2002).

Just a few years later, about one-third of Malawians—or nearly 5 million people—were reported to be *severely* affected by the 2005 famine. The famine occurred in part due to untimely drought and rains, in addition to the subsequent steep increases in food prices (Menon 2007; Phiri 2006) and was first noticed in August of 2005, with a considerable increase in its severity by October which continued through early 2006 until food relief arrived (Menon 2007).

Although Malawi was unable to effectively develop a food shortage program after the 2002 famine, Malawi adopted a type of national drought "insurance" program following the 2005 famine (Syroka and Nucifora 2010). As Philipose (2007) implies, Malawi is an extremely vulnerable nation to such disastrous events due to widespread absolute poverty and reliance on donors in such crises. Nevertheless, the 2005/2006 famine received little international media attention but undoubtedly posed seriously difficult problems for Malawians to overcome in the following year (Phiri 2006).

In years since, the Malawian government, with the help of foreign donors, implemented a fertilizer subsidy program to alleviate some of the losses that rural Malawians experienced during the famine with the thought that this would provide a type of safety net from drought in future years. Despite a glowing New York Times report of Malawi's fertilizer subsidy program as the catalyst in ending the effects of the famine (Dugger 2007), the livelihood impacts of this subsidy program have been equivocal (see Dorward and Chirwa 2011; Holden and Ludunka 2010).

Examining the relationship between fertility and famine is an important consideration in SSA since roughly 70% of this region's population resides in rural areas (World Bank 2012) where most African rural inhabitants are likely to be vulnerable to drought, heavy rains which may destroy crops and homes, or other environmental shocks depending on the season or distance from the equator. But, many other world regions like Asia, the Middle-East, North Africa, and Latin America all contain highly impoverished and densely occupied rural areas whose populations are also susceptible to environmental shocks that may affect a variety of household decisions, such as fertility. Since this study is limited to rural Malawi, this paper will inevitably be unable to provide a framework of what demographers can expect to happen to fertility rates after a drought for all "developing" nations, let alone African ones. But by using this case and examining fertility around the time of these famines, I seek to provide insight into this natural demographic experiment.

MALAWIAN FERTILITY TRENDS AND INFANT AND CHILD MORTALITY

Since the 1960s and 1970s, total fertility rates (TFRs) have been slowly declining in sub-Saharan Africa (Garenne and Joseph 2002) and Malawi is no exception. Malawian census data show a slow decline in total fertility from 7.6 to 6 children per woman between 1977 and 2008. However, this decline describes a transition from extremely high fertility to very high fertility and compared to other developing nations during this time period, fertility has declined little (United Nations 2011). The 2010 Demographic and Health Surveys confirm this trend and estimate that the TFR is at 5.7 for the entire nation, although slightly higher at 6.1 in rural areas. But, since census data are only collected every 10 years (at best) in Malawi, it is difficult to determine intercensal nuances in fertility trends and the effects of famines on fertility. Regardless, Malawi's fertility rates are slowly declining, but it does not appear that drastic reductions lie in the near future as Malawian women are clearly expected to produce many children. This is not surprising given the fact that from the 1960s to the late 1980s the Malawian government banned family planning in efforts to keep with cultural traditions. It was not until the early 1990s that Malawi "adopted a cautious policy of offering modern methods for child-spacing" (Chimbwete, Watkins, and Zulu 2005, 86). The effect of this policy, on total fertility, remains to be seen.

-Insert Figure 2 about here-

Age-specific fertility rates have remained remarkably consistent since the early 1990s (DHS 2010). The median age at first birth in Malawi is 18.9 years while the rural median is slightly lower and the urban median is slightly higher than this overall median. This means that half of Malawian women have a child before they turn 19 years old (DHS 2010).Women have the highest fertility rates have remained between 20 and 24 years, and secondly, between 25 and 29 years. This consistent pattern suggests that Malawian women are not delaying births—as a vast proportion of the world had begun to do in the 1990s—but rather sticking with cultural norms of early first births and slow drop offs in, but continued fertility as individuals age.

Malawian fertility declines have coincided with declines in infant and child mortality, but since the pace of fertility decline has not matched that of increased infant and child mortality survival rates, its population continues to grow, as seen in many "developing" settings (Cleland 2001; Van de Walle and Knodel 1980). Using a combination of data, the recent Malawian census indicates that infant mortality is estimated to have dropped from 134 deaths per 1000 live births in 1992 to 72 in 2006 and risen up to 87 in 2008. Similarly, under five mortality declined from 234 deaths per 1000 live births in 1992 to a low of 122 in 2006 with a slight increase to 140 in 2008 (Malawi National Statistical Office 2011). Also, both infant and child mortality dropped considerably between 2000 and 2004—encompassing the period around the 2002 famine—yet it declined only marginally between 2004 and 2006—around the second famine. Thus, while it is clear that infants and children are surviving at a much higher rate than in the past, which is contributing to total population growth in Malawi, we cannot be certain that these declines were at all hindered by the two famines

MALAWI LONGITUDINAL STUDY OF FAMILIES AND HEALTH DATA

The data for this study come from the 2010 wave of the Malawi Longitudinal Study of Families and Health (MLSFH). These data are retrospectively able to capture a portion of the picture that neither censuses nor the DHS can—extensive data in years between 1998 and 2009. The study initially used a type of stratified random sampling method to select districts within each of the three Malawian regions in 1998, and this continued at the village level. The villages selected in 1998 were used in the 2001, 2004, 2006, 2008, and 2010 waves of data. The three districts that have been surveyed are Rumphi in the Northern Region, Mchinji in the Central Region, and Balaka in the Southern Region. Roughly 1500 respondents were sampled in each district in each of the three waves of data I use here. There has been a turn-over rate between waves of about 20% to 30% depending on the region of the country (Anglewicz et al. 2009).

Respondents were asked a series of questions pertaining to their household rosters, demographic traits, earnings and property, intergenerational financial and non-financial transfers, mortality in the community, sexual activity, attitudes towards HIV/AIDS, and their levels of community engagement. In each of the three waves of MLSFH data used in this study, respondents provided their fertility histories as part of their household rosters. Respondents were allowed to list up to 25 people comprising their family and household members who may be living or dead.

METHODS AND OUTCOME VARIABLE

I use data from the 2010 wave of the MLSFH to examine the likelihood of giving birth before, during, and after the famine years of 2002 and 2005/2006, among two samples: one that took part in the 2010 survey, and a supplementary sample that took part in both the 2008 and

2010 surveys (see Appendix—results not yet shown at the time of writing), in efforts to evaluate the robustness of the impacts of famine on fertility between 1998 and 2009. Since the survey was conducted between May and August in 2010, not all births in 2010 were recorded and are thus not included in the analyses.

I estimate discrete-time event history logistic regression models to predict the likelihood of giving birth in a given year, using the standard approach to event history analysis (see Allison 1984). With this data structure each spell encompasses the person-periods (person-years in this case) from the first interval (1998) to the next birth given a certain parity, or onward from the year after a birth to the year of the next birth (if there is one) of a certain parity for these women. Since I define twelve intervals in this analysis, and time is a key predictor, the discrete-time approach is more appropriate than a continuous time approach such as a Cox proportional hazards model. Further, with relatively little and some competing evidence on the hazard rates of fertility surrounding a famine year, a non-parametric approach is warranted. Out of a possible 3798 respondents who participated in the 2010 survey (2234 women and 1564 men), 658 ever-married women comprise one sample; of the 3020 individuals who participated in 2008 *and* 2010 (1806 women and 1214 men), 576 ever-married women comprise the comparative sample (see Appendix—results not yet shown). Therefore, 87% of the women in these samples are the same, and therefore the remaining 13% could add variation into estimates of the likelihood of giving birth. The analyses are limited to women 25 to 45 years old at the time of the survey in 2008, or 15 to 35 years in 1998, and already had one child. Therefore, the childless of 15 to 35 year olds in 1998 (a small portion of the sample), and individuals who were older than 45 in 2010 were censored from the analyses. These individuals were separated into five-year (inclusive) cohorts of respondents (born between 1963-1967, 1968-1972, 1973-1977, and 1978-1983) who had given birth to at least 1 child by 1998. Based on the household rosters from 2008, I constructed retrospective birth histories from 1998 to the end of 2009. The 12 year observation window was chosen in order to effectively evaluate fertility trends before and after both famines and capture information within and beyond the recent intercensal period. Since these data are retrospective, I do not lose respondents due to migration as is common in panel data and consequently, individuals who have migrated at some point between 1998 and 2009 are not unnecessarily censored from these analyses.

There are limitations to using retrospective birth histories, however. Potter (1977) warns that the intervals between births may be too narrow for what is physically likely given the design of questionnaires. More specifically, it is the date of the first birth that is the most crucial to the entire birth history for if it is not listed correctly initially, the respondent may compensate for this error by listing births that are impossibly spaced (Hobcraft and Murphy 1986). For instance, the dates of birth reporting are not necessarily independent of one another because of error introduced into recalling births based on questionnaires requiring respondents to list their children's birth dates/years in rapid succession. While this is not always the case with the way in which the MLSFH questionnaire is structured, it almost certainly occurs.

INDEPENDENT AND CONTROL VARIABLES

The MLSFH survey is limited in the amount of retrospective time-varying information that would be conducive to this analysis, such as HIV/AIDS status and specific years of children's deaths (which may impact fertility). Therefore, time-invariant controls and predictors include region, cohort (noted above), and educational attainment[1]. Year, a two-year fertility lagged variable, age, and the number of children per respondent, and are used as time-varying predictors of the likelihood of giving birth. Age is an error-prone variable, and cases where age and birth cohort match are used in efforts to mitigate age-related discrepancies.

Controlling for age and any lagged fertility effects is important in efforts to mitigate the effects of the life course, and subsequent timing of births. The region dummy variable is included to account for the varying agricultural capacities of farmers throughout Malawi since the northern region tends to be the most prosperous and fertile while the southern region is the least prosperous and fertile (Kalipeni 1996), and region also essentially captures the major discrepancies in ethnic composition by region (ie. Tumbukas in the northern region, Chewas in the central region, and Yaos in the southern region). Birth cohorts are controlled for since the older cohort likely has a lower risk of childbirth in a given year, than the younger cohort.

The time dummy variables consist of one year intervals from 1998 to 2009. The 2002 and 2005 year dummies serve only as a proxies for the effects of a famine, but are unable to provide further detail on the most severe months of the famine, or whether a family was affected by the famine. By considering parity at the end of each interval, birth order is factored into this analysis—including the interaction with parity and specific years in the full model. Then, educational attainment is used as an additional predictor of the likelihood of giving birth in a given year. Education is measured as having received no schooling, attended primary school

[1] Although educational attainment could be time-varying for rural Malawian women who were between 15 and 35 at the start of the observation window, an already small minority had attended secondary school or higher by the end of the observation window. Further, most 15 year olds would have completed their primary schooling and therefore be unlikely to have attained secondary education in subsequent years. Thus, given the way that I categorize educational attainment (see below), there are unlikely to be any consequences in treating educational attainment as a time-invariant variable for these analyses.

(roughly first grade to eighth grade), and attended secondary school or higher (ninth grade onward). Since educational attainment roughly equates to women's empowerment and ensuing delays in childbearing in rural Malawi, and fewer births per woman, this is an important variable that needs to be included and thus, its interaction with parity is also accounted for in the full model. In the end, the event history data constructed from the 658 and 576 respondents consists of 51324 and 44928 person-period records, respectively.

GRAIN PRICES IN MLSFH SITES (BALAKA, MCHINJI, RUMPHI)

Supplementary data on various grain prices were collected in Balaka, Mchinji, and Rumphi by local informants and other MLSFH researchers for each month between 1999 and 2007. In Figure 2, I present the regional monthly and yearly prices of maize—the staple crop and source of daily nourishment for Malawians—in order to provide a better indication of the timing and implied effects of the 2002 and 2005/2006 famines for this particular rural Malawian sample. As is common in famines, maize prices (and other grain prices not shown) shot up during the most severe months of the 2002 and 2005 (which lingered into 2006) famines.

-Insert Figure 3 about here-

RESULTS-DESCRIPTIVE STATISTICS

Table 1 depicts respondents' characteristics as of 2010. The mean age of the sample is just under 37 years. Each region accounts for about one-third of the sample in this paper, which is a consequence of the study design. Respondents are relatively evenly spread across the five-year (inclusive) birth cohorts which indicates that there is a substantial portion of younger women who have not completed their fertility (which the discrete-time hazard model effectively accounts for), while a smaller portion—those born 1963 and 1967—are likely to have completed their fertility.

Perhaps more importantly, respondents averaged 6.3 children by the end of 2009, which is slightly higher than Malawi's TFR. With a standard deviation of 2.3 only a small portion of women have only one or two children (about 2%), but if many did, then this would be alarming. This is not the case though.

-Insert Table 1 about here-

Finally, about two-thirds of women attended primary school, while slightly more than a quarter report having no education, and a small minority (7.1%) have some secondary level education or higher. Nationally, between 66% and 78% of women aged 25 and 44 have not finished their primary school certificate; 10% to 12% of these women have completed primary; and the small remaining proportion has some secondary school credits (Malawi National Statistical Office 2011). While the national estimates do not map directly onto the MLSFH measures, the fact that most of the sample did not attend secondary school implies that these women are similar to other women in Malawi.

In sum, it appears that this small sample of rural Malawians is not exceptional compared to the national average, and, therefore, seems appropriate for this analysis.

RESULTS-MULTIVARIATE ANALYSIS

The discrete-time hazard logistic regression models in Table 2, and the predicted likelihood of having another birth in a given year in Figure 3, reveal that the risk of having a birth—at least among this sample—did not have a uniform pattern, even when controlling for fertility lags, age, region, cohort, parity, education, a cohort-parity interaction, and an education-parity interaction. Fertility lags, cohort, education, parity and year, are significantly associated with the likelihood of giving birth throughout the models, while other controls and predictors are not consistently or not at all significant. Although age predictors are not associated with the chance of having a child in a given year there is evidence that in each year, the likelihood of giving birth is higher for younger cohorts than older cohorts. Many of these women in the three younger cohorts entered the observation window in their peak fertility years, which may account for this difference. The most-educated women also have significantly lower chances of giving birth in a given year (except in the full model). As expected, having more children lowers the chances of having a child in any year.

-Insert Table 2 about here-

The most revealing effects on the risk of having a child are found in the year dummy variables even when controlling for fertility lags, age, ethnicity, cohort, parity, education, and the cohort-parity interaction. From 1998 to 1999, the likelihood of having a child significantly decreased and substantially increased in 2000, before dramatically dropping in 2001. The risk of giving birth in 2002—the first famine year—was significantly higher than 2001, but 2003, 2004, and 2005—immediately after the famine—were not different from 2002 in the full-model (although graphically Figure 2 suggests otherwise). In 2006—the year that continued to experience the famine that began in late 2005—women were significantly more likely to give birth than in 2005. Relative to 2006, the chances of giving birth are significantly lower in 2008 and 2009.

-Insert Figure 4 about here-

ARE CHANGES IN FERTILITY DUE TO FAMINE?

At first glance, it would appear that there are changes in fertility around the famine years of 2002 and 2005/2006. But the differential chances of having a child during and after famine years do not necessarily directly correspond with changes in fertility due to various economic shocks, including famine, as seen in other contexts. For instance, these major events are not followed by extended declines in fertility (Eloundou-Enyegu, Stokes, and Cornwell 2000; Neels, Theunynck, and Wood 2013), or at least delays in fertility (Lindstrom and Berhanu 1999; Ryder 1982; Sobotka, Skirbekk, and Philipov 2011). Yet there is some evidence of the chances of childbearing remaining the same or perhaps slightly increasing immediately after the Malawian famines, which is similar to what Kohler and Kohler (2002) find during economic crises in Russia. The likelihood of giving birth in 2002—or even the two years after the famine—does not seem to be negatively influenced by the famine. But the lower chances of giving birth in 2005—relative to 2002—and in 2008 and 2009 relative to 2006 (when most births in response to the late 2005/early 2006 famine would have taken place) suggest that, if anything, declines in the likelihood of giving birth are delayed and seemingly short-lived. Even though the MLSFH does not provide yearly data on health clinic attendance and/or contraceptive use, there is a distinct possibility that during famine years, higher order needs such as food, water, and shelter took economic precedence over lower order needs such as purchasing contraception and therefore, the chance of having a child would not diminish and could rise. Of course, one must consider that the distinction between these results and most others lies in the fact that micro-level fertility trends are examined in this piece as opposed to national-level total fertility rates. By 2009, it is clear that the chances of childbearing are lower than 1998—even after controlling for the obvious predictors pertaining to the aging process, which aligns with the drop in total fertility among Malawian women in this time period. And although ideal results depicting drop-offs in fertility after the famine years at the micro-level would show that declines in total fertility were accelerated by famines, we are left with the possibility that the small upticks or lack of changes in fertility after these famines indicate that behavioral responses to famines slowed the macro-level decline in total fertility.

There are several other considerations about changes in the likelihood of giving birth between 1998 and 2001 though that warrant attention. If one were to work backward from 2001, it is plausible that the untimely rains, rise in food prices, and the government's sale of most of its grain reserves in the first part of 2001 served as a warning of an ensuing famine, and as a precursor to the famine may have been responsible for at least some delays in childbearing. But given that an unknown (and presumably substantial) portion of births in 2001 would have begun prior to 2001, experiencing heavy rains and changes in food prices in 2001 would not have deterred women from giving birth. Thus, the spike in fertility in 2000 becomes more interesting since its height is only matched by the drop in 2001. However, there is no easy explanation for this phenomenon or whether it occurred by chance. In 1999—when (again) a presumably substantial portion of births in 2000 began—the Malawian government announced the development of its Employment Act, which at least nominally guaranteed many favorable workers' rights and working conditions. Also, in June of 1999, Malawians partook in their nation's the second democratic election. While it is purely speculative, these events and the spike in fertility are not likely a coincidence. The prospect of better earnings and rights for workers in 2000 may have encouraged families to have children with the prospect of better employment in the near and distant future. Elections producing secular and/or progressive leaders and politicians have been shown to diminish fertility rates (Lesthaeghe and Wilson 1982) and since Malawi's president at the time, Bakili Mulizi, was the opposite, perhaps fertility spiked. Nonetheless, regardless of the explanation for fluctuations in the likelihood of giving birth near the beginning of the observation window in these analyses, it is clear that the most dramatic changes occurred prior to the onset of Malawi's two famines. Malawi's famines were less devastating than Ethiopia's in the mid-1980s, and these findings might support Kane's (1987) propositions about the correlation between the strength of a famine and the effect on fertility. One must then ask how severe a famine must be in order to drastically impact the likelihood of giving birth during and after the famine.

The limitations of the MLSFH data and retrospective birth histories hinder the extent to which one could explicitly pinpoint the effects of the 2002 and 2005/2006 famines. The data cannot depict the timing of fertility, or motivations, more clearly in these years. To begin, this study is limited to a small sample of rural Malawians whose birth histories are constructed retrospectively and without regard to birth month, and are undoubtedly prone to errors (Potter 1977). Further, I only examine live births since the data do not contain information on miscarriages or stillbirths since these are possible consequences of famines and subsequent malnutrition, which biases my ability to fully assess how the household *decision* to have a child is affected by famine. Although the MLSFH collects information on deaths within the household, predicting the effects of famines on infant and child mortality is outside the scope of this paper. Next, the HIV statuses—or even perceived HIV statuses—of these women or their partners are also unable to be included in these discrete-time hazard models, even though the association between HIV and fertility and fertility preferences exists (Hoffman et al. 2008; Noël-Miller 2003; Taulo et al. 2009; Watkins 2004; Yeatman and Trinatopoli 2009); it is unclear how HIV impacted these individuals' decisions to have children in a given year. Household decisions and the rationale behind having another child are also left unknown, except for assumptions about age and the life course, cohort, birth order, and education, included in the models. Further, the reductions in the likelihood of giving birth between any two years is a maximum of about 12% and, more typically, a change in 3% to 5%.

DISCUSSION

The results presented and absence of other major events between 2001 and 2009 implies that the famines of 2002 and 2005 had some residual, lingering effects on women's fertility, even if the mechanisms are not clear. These findings are substantively important, nonetheless. The relative dearth of micro-level research on the relationship between famines and fertility is likely due to the difficulties in acquiring comprehensive birth histories in many countries that have experienced famines, or other major economic or environmental shocks for that matter. Although this study is largely exploratory and descriptive, it aims to spur future research on this important relationship. For instance, if economic and environmental shocks are likely to lead to short term fertility declines in subsequent years, and the demographic jury is still out as to whether these shocks lead to *sustained* fertility declines, or any declines at all, this may signal a need for further revisions current population estimates that predict Malawi will triple in size by 2060 (United Nations 2010). Estimates including the likelihood of environmental and economic shocks could improve future population projections and, in turn, the various policies, such as the availability of schooling or acquisition of grain reserves that are designed to address these projections. More practically, children born in famine years may have been malnourished during gestation and afterward, which could have long-term effects on various outcomes such as lower chances of completing high school and worse health (Shi 2011).

This piece is another part of a growing body of literature that is concerned with these implications but ultimately, larger studies of this nature must be conducted across more countries. More importantly, understanding the impacts of a shock like a famine on economically vulnerable populations, such as rural Malawians, is a worthwhile endeavor. The opportunity to comprehend the impacts that a major shock has at the national and household levels is important so that governments, non-governmental organizations, and citizens can identify suitable interventions to support families and direct resources into appropriate places during times of higher or lower fertility.

FIGURES AND TABLES

Figure 1: Pathways Linking Famines and Subsequent Changes in Fertility

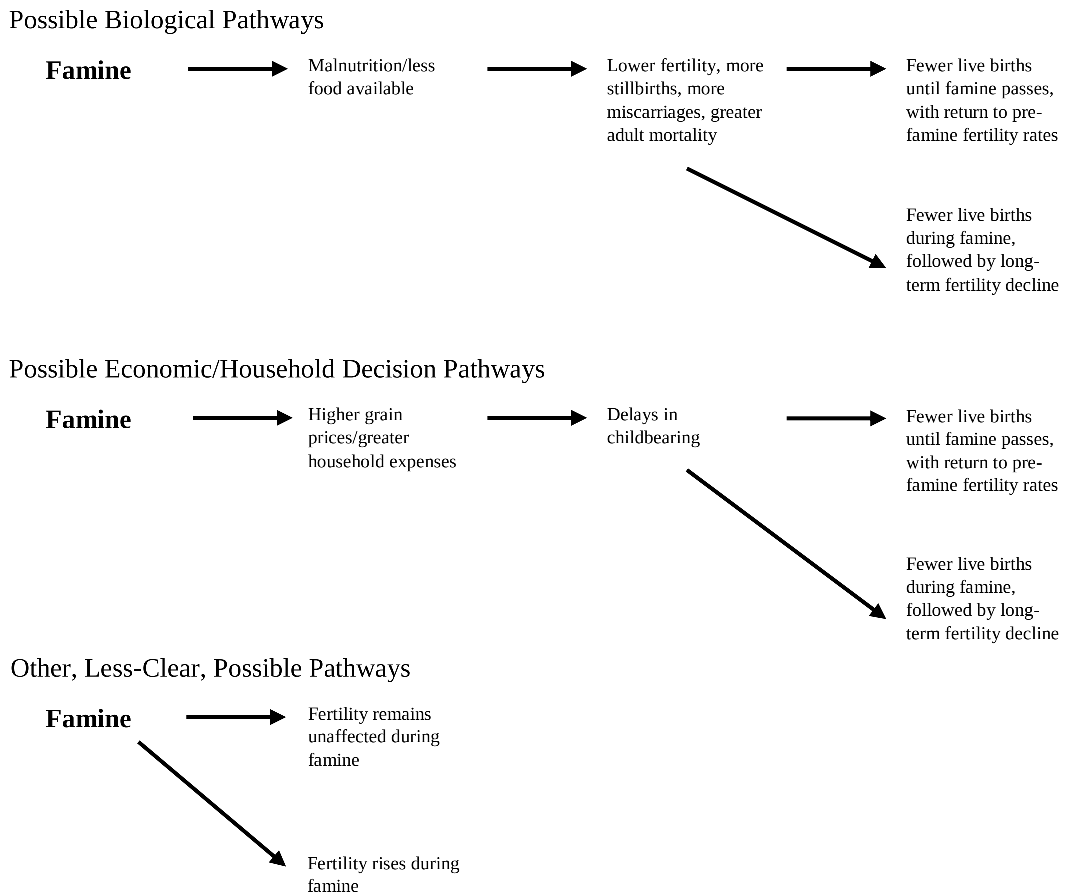


Figure 2: Malawian Total Fertility Rates

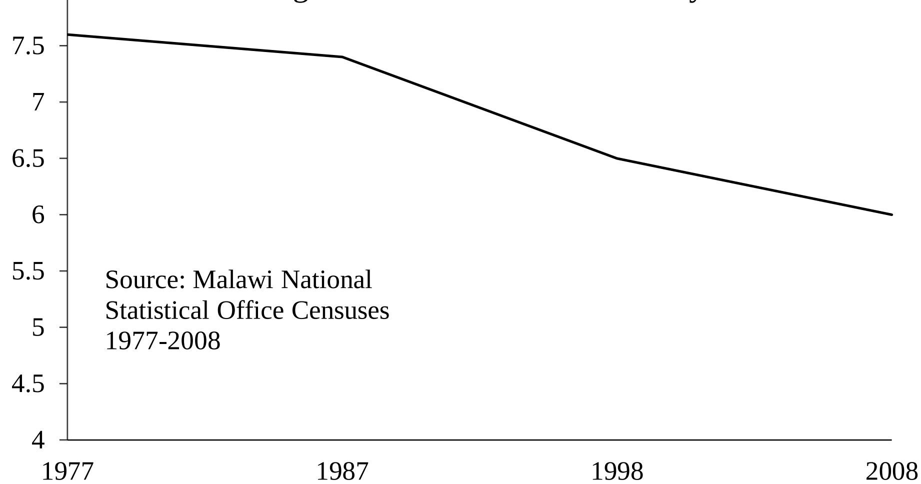


Figure 3: Monthly Changes in Maize Grain Prices at MLSFH Sites

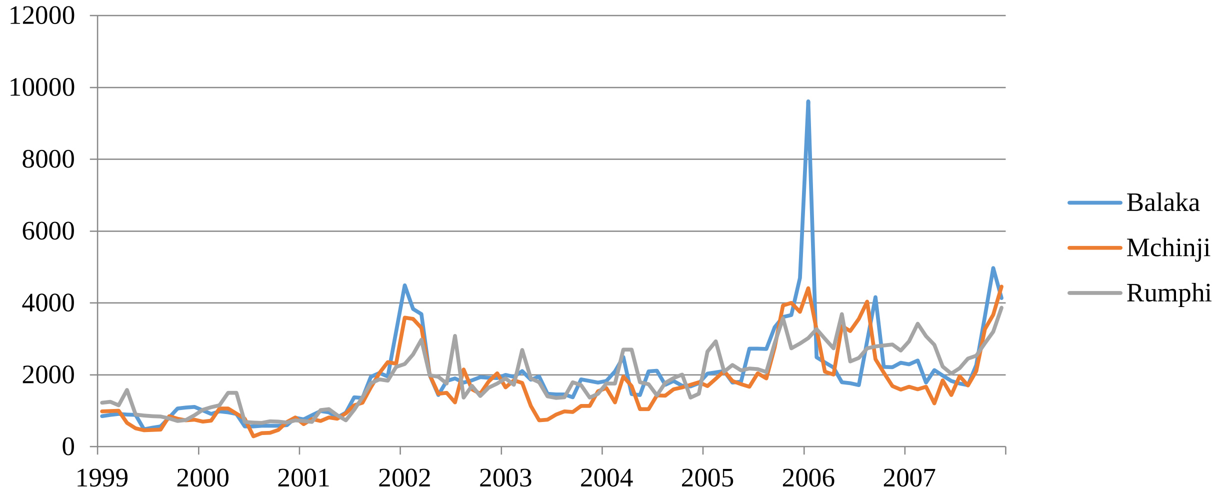


Table 1: Descriptive Statistics at Time of Survey, 2010

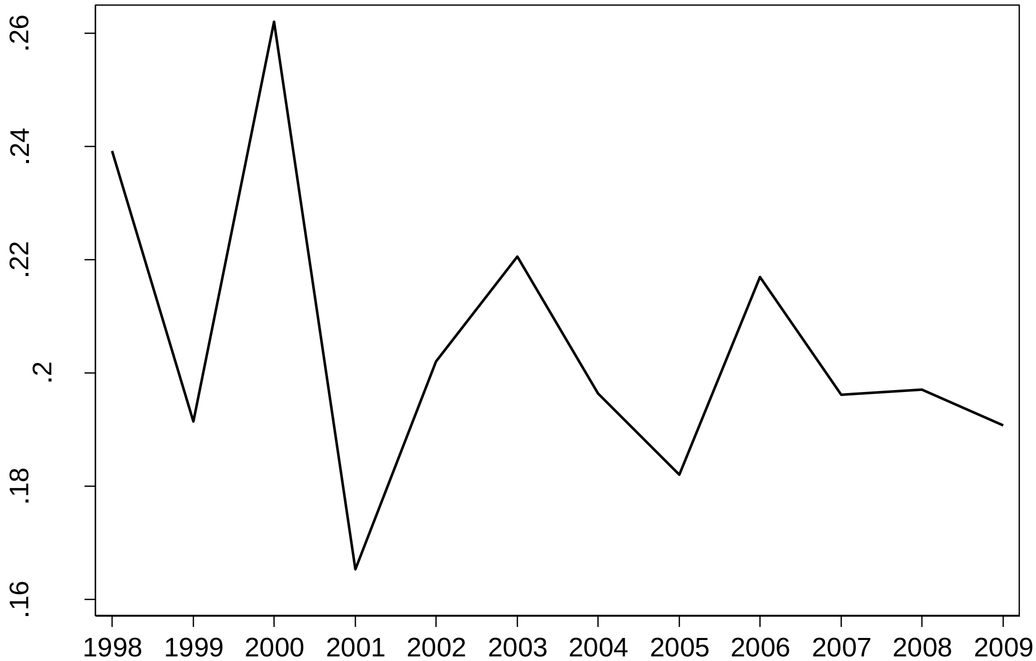
Categorical Variables	*Percent Distributions*
Region	
Central	36.2
South	32.4
North	31.5
Cohort	
Born 1963-1967	14.4
Born 1968-1972	29.0
Born 1973-1977	30.1
Born 1978-1983	31.5
Education	
None	26.1
Attended Primary	66.7
Attended Secondary or Higher	7.1
Continuous Variables	*Means (Standard Deviations)*
Number of Children (end of 2009)	6.3 (2.3)
Age	36.7 (5.1)
N	658

Table 2: Likelihood of Having a Birth by Time Interval, Considering Cohort-Parity Interaction

	1	2	3	4	5
Fertility Lag 1	2.747***	2.773***	2.746***	2.772***	2.772***
	(0.03)	(0.03)	(0.03)	(0.03)	(0.03)
Fertility Lag 2	1.187***	1.213***	1.186***	1.212***	1.213***
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Age	0.014	0.045	0.010	0.040	0.055
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Age^2	-0.001	-0.001	-0.000	-0.001	-0.001
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Region (Central)					
South	0.025	-0.005	0.006	-0.037	-0.035
	(0.04)	(0.05)	(0.05)	(0.06)	(0.06)
North	-0.044	-0.136*	-0.017	-0.091#	-0.089
	(0.04)	(0.05)	(0.04)	(0.05)	(0.06)
Cohort (Born 1963-1967)					
Born 1968-1972	0.241**	0.205*	0.232**	0.187#	0.423**
	(0.08)	(0.10)	(0.09)	(0.10)	(0.15)
Born 1973-1977	0.302**	0.235*	0.291**	0.214#	0.646**
	(0.10)	(0.11)	(0.10)	(0.11)	(0.24)
Born 1978-1983	0.247*	0.129	0.232*	0.099	0.673*
	(0.11)	(0.12)	(0.11)	(0.12)	(0.32)
Year (2002)					
1998	0.423*	0.383*	0.416*	0.369*	0.381*
	(0.18)	(0.18)	(0.18)	(0.18)	(0.18)
1999	-0.095	-0.117	-0.101	-0.127	-0.121
	(0.21)	(0.21)	(0.21)	(0.21)	(0.21)
2000	0.617***	0.596***	0.613***	0.588***	0.594***
	(0.17)	(0.17)	(0.17)	(0.17)	(0.17)
2001	-0.427#	-0.434*	-0.428*	-0.436*	-0.433*
	(0.22)	(0.22)	(0.22)	(0.22)	(0.22)
2003	0.191	0.197	0.194	0.202	0.197
	(0.19)	(0.19)	(0.19)	(0.19)	(0.19)
2004	-0.078	-0.064	-0.074	-0.057	-0.062
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
2005	-0.260#	-0.226	-0.257#	-0.219	-0.227
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
2006	0.120	0.156	0.127	0.170	0.161
	(0.15)	(0.14)	(0.14)	(0.14)	(0.14)
2007	-0.138	-0.075	-0.130	-0.058	-0.065
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
2008	-0.122	-0.064	-0.112	-0.046	-0.053
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
2009	-0.236	-0.145	-0.224	-0.121	-0.126
	(0.15)	(0.15)	(0.15)	(0.15)	(0.15)
Parity		-0.139***		-0.144***	-0.085**
		(0.02)		(0.02)	(0.03)
Education (None)					
Attended Primary			-0.063	-0.102#	-0.033
			(0.05)	(0.06)	(0.16)
Attended Secondary or Higher			-0.178*	-0.332***	-0.220
			(0.08)	(0.09)	(0.26)
Cohort x Parity	No	No	No	No	Yes
Education x Parity	No	No	No	No	Yes
Constant	-2.726***	-2.742***	-2.585***	-2.503***	-3.202***
	(0.57)	(0.58)	(0.56)	(0.57)	(0.80)
Observations	51010	51010	51010	51010	51010
BIC	32422.4	32139.3	32437.2	32138.1	32141.2

# $p < 0.10$, * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Figure 4: Fitted Hazard Probabilities of Giving Birth, by Year



Fitted values control for fertility lags,age, ethnicity, cohort, number of children,
education, cohort-parity interaction, and education-parity interaction.

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