Income Shocks, Contraceptive Use, and Timing of Fertility*

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PRELIMINARY

*THE RESULTS PRESENTED ARE PRELIMINARY. PLEASE DO NOT QUOTE WITHOUT PERMISSION.

Abstract

This paper examines the relationship between household income shocks and fertility decisions. Using panel data from Tanzania, we estimate the impact of agricultural shocks on contraception use, pregnancy, and the likelihood of childbirth. To account for unobservable household characteristics that potentially affect both shocks and fertility decisions we employ a fixed effects model. Households significantly increase their contraception use in response to income shocks from crop loss. This comes from an increased use of both traditional contraceptive methods and modern contraceptives. The poorer the household the stronger the effect of income shock on contraceptive use is. Furthermore, pregnancies and childbirth are significantly delayed for households experiencing a crop shock. For both pregnancy and childbirth the likelihood of delay as a result of shocks increases the poorer the household. We argue that these changes in behavior are the result of deliberate decisions of the households rather than income shocks' effects on other factors that influence fertility, such as women's health status, the absence or migration of spouse, and dissolution of partnerships.

Keywords: Tanzania, family planning, shocks, timing of fertility

JEL codes:

1 Introduction

Analyzing how households cope with income shocks has been an active research area for many years. One area that has not received much attention is to what extent household decisions on fertility are affected by shocks. Furthermore, standard economic models of fertility focus mainly on the effect of household and individual characteristics on fertility outcomes. Although these models have been useful for understanding the broad outlines of fertility decisions they tend to ignore the dynamic aspect of fertility decisions. There is evidence that shocks affect short term fertility, but it is not clear whether changes in fertility are the result of intentional planning or an unintended consequence of the effect of income shocks on other outcomes (Lindstrom and Berhanu 1999; Pörtner 2008; Evans, Hu, and Zhao 2010).

Understanding the relation between shocks and fertility decisions is important for three reasons. First, children are expensive both in terms of direct and opportunity cost. A child birth diverts resources from other uses and investments because of the direct cost of maintaining the child and because less of the mother's time is available for productive work. This potentially hampers the household's recovery after a shock. Because many developing countries experience a large number of income shocks, understanding the factors that help or hinder households' recovery after a shock is important. Second, children born immediately after a shock fare worse than other children. In the short- and medium-term they have worse health as measured by height-for-age (Pörtner 2010). Long-term effects include worse self-reported health, lower schooling, and less wealth (Maccini and Yang 2009). Finally, it will improve our understanding of how households' regulate their fertility. Couples may try to control fertility through increased use of traditional contraceptive methods if modern contraceptives are not available. Traditional contraceptive methods are less effective than modern contraceptives, and if parents show intent to control fertility this has policy implication for the availability and targeting of family planning services.

This paper examines the direct effect of income shocks on family planning. It shows that an exogenous income shock, measured here by accidental crop loss, leads to a greater use of contraception. Income shock significantly increases the likelihood of using both traditional and

modern contraceptives. We also find that the likelihood of pregnancies and child births decreases in households facing income shocks, resulting from the contraception use.

The paper makes three contributions to the literature. It contributes to the income smoothing literature as households affected by income shock use family planning as a mechanism to smooth their consumption. In the short run bearing a child means removing scarce resources away from other useful purposes to the birth and maintenance of the child. Farmers can therefore smoothen their consumption by delaying child birth during times of income shock.

Secondly, this paper also contributes to the family planning and fertility literature. This is the first paper to show that households respond to income shocks through family planning, which, in turn, affects fertility. Earlier studies have shown that fertility rate decreases in response to major economic shocks (Pörtner 2008; Lindstrom and Berhanu 1999; Evans, Hu, and Zhao 2010). Our study provides evidence that the reduced fertility occurs through a planned decision process rather than as an unplanned consequence.

Thirdly, the paper contributes to the buffer stock literature (Deaton 1992) by examining the role of asset holdings as a coping mechanism to shocks. We find that households with greater assets are able to offset the shock, with no increase in their contraception use in response to shocks. Hence, greater assets act as a buffer for households and does not necessitate change in family planning for those households.

2 Prior Literature

Most of the prior literature on the impact of economic and other shocks on fertility have used historic data on what are now developed countries. Data from Rouen, France, over the period 1681-1787, show that increases in wheat price led to a dramatic fertility decline for the urban poor, while fertility of urban wealthy was unaffected in response to those shocks (Galloway 1987). Similarly, English data from 1542 to 1800 show that mortality shocks led to short-term fertility declines, with the largest decline typically the year following the shock (Bailey and Chambers

1998). This data also indicated that an increase in real wage leads to an increase in short-term fertility. Eckstein, Mira and Wolpin (1999) found that increases in wage rate and decline in child mortality explains a significant part of the long term fertility decline in Sweden during the period 1736 to 1946. In another study on Sweden, Schultz (1985) uses aggregate county level data to show that an increase in the value of women's time relative to men's time led to a decrease in fertility in Sweden during the period 1860-1910. He finds that an increase in prices of butter increased women's relative wage compared to men, thus leading to a decline in fertility. Eckstein, Schultz and Wolpin (1985) also uses Swedish data to find that a positive crop shock, positive weather shock and positive wage shock increases fertility through higher population growth for the following five to ten years period. However, the increase in birth rate is found to be only a change in the timing of birth and has no cumulative effect on long term fertility rate. They also find that an increase infant death rate is followed by a short term increase in birth rate. They also find that an increase in non-infant death rate first reduces fertility (child bearing population in marriage are reduced), but is followed by a rise in fertility with the peak occurring in about five years. In a developing country setting,

[More recent evidence - need German/Russian studies here] Lindstrom and Berhanu (1999) also provides evidence that famine and domestic/regional military attacks in Ethiopia leads to a short-term decrease in the likelihood of conception.

Although there are many studies that show the impact on contraception use, such as, contraception use increases in response to schooling (Ainsworth et al., 1996; Chen and Guilkey, 2003; Feyisetan and Ainsworth, 1996), focused information campaigns (Chen and Guilkey, 2003), participation in savings or credit group (Steele et al., 2001), etc., there has only been one study (Hernandez-Correa, 2010) that attempts to show the impact of shocks on contraception use. He uses a cross-sectional data to find that households suffering from adverse events are more likely to use contraception compared to ones not suffering from that event.[1] However, the paper does

[1] Adverse events include economic and environmental aspect, such as: rise in input cost, rise in cost of goods, difficulty finding buyers, difficulty finding inputs, floods, late rains, early rains, droughts, pest problems, etc. Households may be able to anticipate many of these problems and therefore they can adjust their behavior accordingly which can lead to endogeneity. However, the author does not claim that these adverse events are actually exogenous or transitory

not claims or provide evidence that the adverse events are exogenous or transitory in nature. The effect of the adverse event is not clearly identified and there is potential endogeneity bias as the paper only compares these two groups without any household or individual level fixed effects, and therefore the difference in contraception use can result from some other endogenous characteristics present within the group. The cross-sectional data, rather than a panel also limits his study as they cannot find the before and after effects of shocks on contraception use.

3 Methodological Framework

[THIS WILL BE EXPANDED WITH A MORE FORMAL MODEL]

The basic question in this paper is: do income shocks affect timing of fertility? There are at least three reasons why a household may want to delay fertility in the event of a shock. First, children are costly in the short run. Having more children may eventually contribute to the household's production in the long run and help it overcome shocks (Pörtner 2008), but the short term impact on availability of resources for other household members is almost certainly negative. Secondly, at least some of the mother's time will be diverted from other activities towards care of the new child. If households respond to a shock by increasing hours worked as suggested by Kochar (1999), then diverting time away from work will be even more costly. It is, however, also possible that the shock will temporarily lower the cost of time for women, which would make it more attractive to have a birth now. Finally, the household may realise that children born following a shock have worse health outcomes and are more likely to malnourished and therefore decide to postpone having the next child.

Observing a decline in fertility following a shock is, however, not direct evidence of a conscience decision to limit fertility. One possible response to a shock is to have one or more households members migrate in search of better economic opportunities. If either the husband or wife are gone for extended periods of time this will have a negative effect on the probability of conception.

in nature, so the author may possibly recognize this as an endogenous variable.

Furthermore, reduction in the likelihood of intercourse may result from psychological depression caused by the shock. We would also observe a decline in fertility if people delay marriage or if there is an increase in the dissolution of marriage. Finally, severe income shock can lead to health problems and starvation for household members. This could increase the incidence of secondary sterility through a reduction in age of menopause or famine induced amenorrhea. Shocks could also lead to malnutrition of mothers, which may lead to more stillborn births and fewer infants surviving after birth.

4 Data description

The data comes from the Kagera Health and Development Survey (KHDS) conducted by the World Bank and the University of Dar es Salaam in the Kagera region of Tanzania. The survey was conducted in four rounds from 1991 through 1994 and surveyed over 800 households, drawn from 51 communities (49 villages) in the six districts of Kagera. The Kagera region is on the western shore of Lake Victoria and borders Uganda, Rwanda and Burundi as shown in Figure 1. The population (1.3 million in 1988, about 2 million in 2004) is overwhelmingly rural and primarily engaged in producing bananas and coffee in the north and rain-fed annual crops (maize, sorghum, cotton) in the south (Beegle et al. 2006). Tree-crops and cassava, a commonly grown crop, have fairly continuous cultivation over the year.

The average interval between each of the survey rounds was between six and seven months. The sample selection was based on a variable probability sampling procedure (a two-stage, randomized stratified procedure) based on expected mortality. In the first stage, based on the 1988 Tanzanian census, the census clusters were randomly selected after stratifying them based on mortality rates and agro-climatic zones. Households were then stratified into "high-risk" and "low-risk" groups in the second stage, based on illness and death of households in the 12 months before the enumeration process. Finally, households were randomly sampled from the groups.[2]

[2]For further details on the sample selection, please refer to World Bank (2004).

Figure 1: Map of Kagera region

The data contain detailed information on individual and household level demographic and socioeconomic characteristics, which makes it suitable for this study. The survey asked detailed questions about fertility and birth control of all married women regardless of age and women 14 years and older. Specific questions include total number of prior births; whether the respondent is currently pregnant; whether she has given birth since the last survey round; whether she is currently using contraception; and the type of contraception, traditional or modern, used if she is currently using contraception. Traditional contraceptives include abstinence and rhythm method. Modern contraception include: condom, diaphragm, pill, IUD, injection, female and male sterilization.[3] For our sample we use all married or partnered women 18-45 years of age.

The survey also asked about any accidental crop loss experienced since the last survey. The survey specifically asks whether the households lost any crop due to insects, rodents, fire, rotting,

[3]As female and male sterilizations are typically permanent procedures stopping pregnancy, once an individual is sterilized we remove them from our sample because their fertility decision can no longer be a choice variable.

Table 1: Frequence of Shocks

Frequency	Number	Percent
0	269	64
1	135	32
2	15	4
Total	419	100

Note. Number of observations is 831.

or other calamities. Crop loss is measured in Tanzanian Shilling (TZS). We use this accidental crop loss variable as our measure of income shock.

[Descriptive statistics and discussion here]

Table 2 show the percentages of women in the sample who used contraceptives, who were pregnant at the time of the survey, and who had given birth between the two survey rounds by whether their household had experienced a shock. For contraceptives, the shocks are for the period 1-6 months before the survey, whereas for pregnancy and childbirth the shocks are for the period 7-14 months before the survey. The contraceptive prevalence rate is low. The average is only 15 percent, distributed with 9 percent using traditional methods and 6 percent using modern contraceptives. Independent of type used, the prevalence rate is higher if the household has experienced a shock. Corresponding to the higher contraceptive use for women who has experienced a shock, fewer women were pregnant or had recently given birth if the household was exposed to a shock. These descriptive statistics provide a first indication that shocks are associated with the delay of fertility but do not tell show whether the relationship is causal.

5 Estimation Strategy

The main concern with estimating the effects of shocks on contraceptive use and fertility is that there may be unobserved factors that affect both shocks and outcomes. One possibility is that households with fewer resources are more likely to experience a shock but are less likely to be able to afford or have knowledge about contraceptives. This would bias the OLS downwards relatively

Table 2: Contraceptive Use, Pregnancy, and Childbirth by Shock

	Percentages		
	All	With shock	Without shock
Any contraception	15	17	14
Traditional	9	10	8
Modern	6	7	6
Pregnant	14.3	10.3	14.4
Childbirth	14.0	13.8	14.5

Note. For contraception, shocks are for the period 1-6 months before survey date. For pregnancy and childbirth shock are measured 7-14 months before survey date.

to the true effect. To address the problem of unobserved heterogeneity and endogeneity we use an individual fixed effects model. This allows us to control for all time-invariant mother characteristics when estimating the impact of crop loss on contraceptive use and fertility outcomes. The KHDS is a rich survey that allows us to control for many time varying individual and household characteristics including women's age, number of prior births, and individual fixed effects. The survey also provides detailed measure of household assets holdings: value of business equipment, durable goods, land, livestock and personal savings. We control for all these above variables.

We estimate the fixed effects version of the following equation:

$$\begin{aligned} Y_{i,t} &= \beta_1 Croploss_{i,t} + \beta_2 Croploss_{i,t} \times Asset_{i,t-2} \\ &+ \beta_3 Croploss_{i,t-1} + \beta_4 Croploss_{i,t-1} \times Asset_{i,t-2} \\ &+ X_{i,t}\alpha + \mu_i + \varepsilon_{i,t}, \end{aligned} \tag{1}$$

where $Y_{i,t}$ is contraception, pregnancy, or child birth, $X_{i,t}$ include number of births, age, total household assets per capita at $t-2$, and μ_i is time-invariant individual specific characteristics. We use dichotomous outcomes for contraception use, pregnancy and child birth in all the following estimations. In other words, the estimated equations are fixed effects linear probability models. Because shocks may have longer term effects on fertility decisions, we estimate the effect of crop lost in the last 14 months, i.e. previous two rounds of the survey, on current contraceptive use and pregnancy

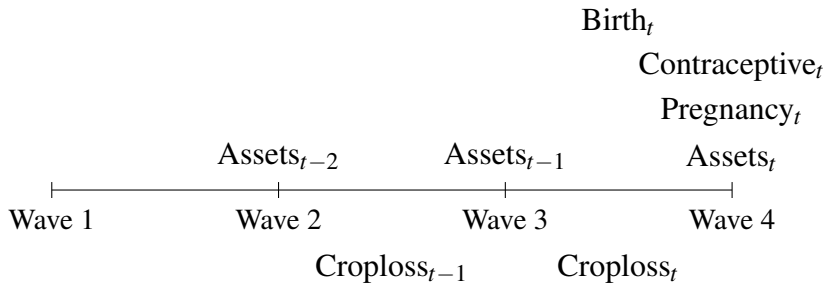

Figure 2: Example of timing for wave 4

status.

6 Results and Discussion

Table 3 presents the effects of crop loss on the probability that a woman uses any type of contraceptives. Crop loss is measured per capita and is interacted with household assets per capita two survey rounds ago to capture the household's ability to withstand shocks. We examine the effects for crop loss during the last 7 months before the survey date and for the period 7-14 months before the survey date. The first column shows OLS results and the second column fixed effects results.

For the OLS results only the amount of crop lost 7-14 months before the survey has a statistically significant effect. Using fixed effects, we find that all crop loss variables and their interaction with lagged assets have statistically significant effects on current contraceptive use. For both shocks in the last 7 months and shocks 7 to 14 months there is a statistically significant increase in contraceptive use. These increases are smaller the more assets per capita households have. Hence, the fixed effects results are in line with the descriptive statistics above. Household that experience shocks are more likely to postpone births, but this effect is moderated by higher wealth.

Table 4 shows the effects of shocks on traditional and modern contraceptive use, with OLS results in columns 1 and 3 and fixed effects results in columns 2 and 4. We focus on the fixed effects results here. Shocks in the last 7 months significantly increase modern contraceptive use with the interaction effect of shocks and assets again negative and statistically significant, indicating

Table 3: The Effects of Crop Loss on Any Contraceptive Use

	Any contraception use	
	OLS	FE
Crop loss - last 7 months	−0.028	0.183***
	(0.027)	(0.052)
Crop loss - last 7 months x Lagged assets	−0.000	−0.006***
	(0.001)	(0.002)
Crop loss - 7-14 months	0.039**	0.079***
	(0.018)	(0.020)
Crop loss - 7-14 months x Lagged assets	−0.000	−0.001***
	(0.000)	(0.000)

Note. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All values of crop lost and assets are per capita and measure in 1,000 TZS. Variables not shown: age of mother, number of births, and 2 period lagged per-capita assets.

that households with greater asset holdings offset the effects of shocks. There are, however, no statistically significant effects for shocks 7-14 months before the contraceptive use decision. The effect on the use traditional contraceptives is essentially identical to the effect in Table **??**. Shocks in the last 14 months leads to a significant increase in traditional contraceptive use, and households with greater asset holdings are able to compensate for the effect of these shocks.

Do changes in contraceptive behavior translate into changes in pregnancy and fertility outcome? Tabel 5 show the effects of shocks on whether the respondent is currently pregnant and whether she has given birth in the 7 months period before the survey. A woman who is currently pregnant may have conceived up to 9 months before. If a shocks occurred over the last 7 months before the survey date there might not be an effect because the woman was already pregnant when the shock occurred. In addition to the standard specification above, we also estimate a specification with on the effect of shocks occurring 7-14 months prior to the survey. The effect on pregnancy is consistent with our previous results on contraceptives. Shocks 7 to 14 months before the survey lead to a statistically significant decline in the likelihood of pregnancy. The interaction term between shocks and assets also indicate that wealthier farmers are able to use household assets to cope with the shock and hence their pregnancy is not delayed, although the effect here is not

Table 4: The Effects of Crop Loss on Traditional and Modern Contraceptive Use

	Contraceptive Type			
	Modern		Traditional	
	OLS	FE	OLS	FE
Crop loss - last 7 months	−0.015	0.159***	−0.012	0.204***
	(0.014)	(0.051)	(0.023)	(0.053)
Crop loss - last 7 months x Lagged assets	−0.000	−0.006***	−0.000	−0.007***
	(0.000)	(0.002)	(0.001)	(0.002)
Crop loss - 7-14 months	0.013	0.017	0.043**	0.079***
	(0.018)	(0.019)	(0.017)	(0.017)
Crop loss - 7-14 months x Lagged assets	−0.000	−0.000	−0.000	−0.001***
	(0.000)	(0.000)	(0.000)	(0.000)

Note. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All values of crop lost and assets are per capita and measure in 1,000 TZS. Variables not shown: age of mother, number of births, and 2 period lagged per-capita assets.

statistically significant.

Column (3) of Table 5 shows that shocks 7-14 months prior to the survey has a negative but insignificant effect on childbirth in the last 7 months. The total length of the four rounds of the KHDS survey is only a little over two years, which is the likely reason for the insignificant effect. There is simply not enough time to observe both the shocks and the birth. A woman who has given birth in the 7 months period prior to a survey would have conceived about nine months before that. With the short time between surveys there is no enough variation to identify the effect of shocks on childbirth.

7 Robustness Checks

Table 6, we examine to what extent shocks cause a delay in pregnancy through the increased use of contraceptive. The interaction effect of crop loss 7-14 months ago and traditional contraceptive used following those crop loss has a negative and significant effect on pregnancy. Despite being an endogenous specification, this estimation provides evidence that the shock indeed delays pregnancy through increased use of traditional contraceptive. Similarly, the interaction effect of

Table 5: The Effects of Crop Loss on Pregnancy and Births

	Currently Pregnant	Currently Pregnant	Childbirth since last survey
Crop loss - last 7 months	−0.013		
	(0.036)		
Crop loss in last 7 months x lagged assets	0.000		
	(0.001)		
Crop loss - 7-14 months	−0.032*	−0.033*	−0.011
	(0.020)	(0.019)	(0.013)
Crop loss - 7-14 months x lagged assets	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)

Note. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All values of crop lost and assets are per capita and measure in 1,000 TZS. Variables not shown: age of mother, number of births, and 2 period lagged per-capita assets.

crop loss and the use of modern contraceptive has a negative and significant effect. It shows that pregnancy is delayed because of increased use of modern contraceptives during economic shocks. Interestingly, there is no independent effect of using either traditional or modern contraceptives on the likelihood of being pregnant. Only women with a strong enough incentive because of shocks are successful in preventing a pregnancy. Furthermore, there is essentially no difference in the effectiveness of the two types of contraceptives.

Table 6: Contraceptive Use and Pregnancy

	Currently Pregnant	
	Traditional	Modern
Contraceptives (7 months)	0.043	0.029
	(0.052)	(0.061)
Crop loss - 7-14 months	−0.099***	−0.092***
× Contraceptives (7 months)	(0.019)	(0.019)
Crop loss - 7-14 months	−0.018	−0.021
	(0.013)	(0.014)

Note. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All values of crop lost and assets are per capita and measure in 1,000 TZS. Variables not shown: age of mother, number of births, and 2 period lagged per-capita assets.

Shocks may cause households to delay pregnancy not only through increased contraceptive use, but also through its effect on other factors such as, starvation or illness of mothers, migration of partners, or dissolution of marriage. As robustness check we examine if shocks affects these other factors, which may then affect pregnancies. Table 7, we examine if shocks cause a decline in mother's health. Shocks have no significantly effect on woman's body-mass index (BMI) (column 1) or the likelihood of illness (column 2). Hence, there is no evidence that crop loss causes illness or starvation which could, in turn, have reduced fertility through increased secondary sterility or greater stillborn births.

Table 7: The Effects of Crop Loss on Women's BMI and Illness

	Respondent	
	BMI	Illness
Crop loss - last 7 months	−0.046	−0.164
	(0.248)	(0.181)
Crop loss - 7 months x lagged assets	−0.002	0.002
	(0.006)	(0.003)
Crop loss - 7-14 months	−0.002	0.016
	(0.041)	(0.016)
Crop loss - 7-14 months x lagged assets	−0.001**	−0.000
	(0.000)	(0.000)

Note. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%. All values of crop lost and assets are per capita and measure in 1,000 TZS. Variables not shown: Age of mother and number of births.

Similarly, in Table 8, our estimates show that shocks do not lead to a significant increase in migration (column 1) or a significant increase in dissolution of marriages (column 2). Therefore, our estimates provide evidence that pregnancies are not delayed as a result of these factors.

8 Conclusion

This paper examines the relationship between household income shocks and fertility decisions. We show that households consciously plan the decision of delaying child births through adjustment in

Table 8: The Effects of Crop Loss on Absence of Partner and Marriage Dissolution

	Absence/migration of partner	Dissolution of of marriage
Crop loss - last 7 months	0.002	0.005
	(0.004)	(0.011)
Crop loss - last 7 months x lagged assets	−0.000	−0.000
	(0.000)	(0.000)
Crop loss - 7-14 months	−0.000	0.002
	(0.001)	(0.002)
Crop loss - 7-14 months × lagged assets	0.000	−0.000
	(0.000)	(0.000)

Note. Standard errors in parentheses; * significant at 10%; ** significant at 5%; *** significant at 1%

household's contraceptive use when coping with income shocks. Our estimates demonstrate that contraceptive use, both traditional and modern, significantly increases and pregnancy decreases following a household income shock. We further find that wealthier households use their asset to offset the shock, and hence the impact on fertility is significant larger for the poorer households. To account for unobservable household characteristics that potentially affect both shocks and fertility decisions we employ a fixed effects model. Our results imply that providing better access to contraceptives during times of economic shocks could improve the ability of households to postpone births and lead to better mother and child health.

[To be expanded]

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