Natural disasters and fertility in African countries: Evidence on the role of contraception and wealth *

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Abstract

We study the role of floods as a determinant of fertility among 17 African countries from 2004 to 2019. We exploit different measures of floods occurrences and impacts derived from the Emergency Events Database, and match this to micro-level data from the Data Health Survey. This allows us to document how access to modern contraception interact with the random occurrence of natural disasters to affect births among women, and how this relationship varies across wealth levels. Our results confirm existing evidence that floods increase the probability of having a new child, but we show that this relation is reversed for women who use of contraception. In addition, we find that this effect is the strongest for women in the highest quartile of the wealth distribution. These results have important implications for how climate change, economic growth, and access to modern contraception may affect fertility in the coming decades.

Keywords: fertility; natural disasters; flood; contraception; wealth; economic growth.

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1 Introduction

The evolution of the climate change is widely acknowledged to be responsible for an increased frequencies of natural disasters, including heat waves and floods, and this trend is expected to continue in the coming decades (IPCC, 2018). Understanding the impact of natural disasterf on societal and economic outcomes is an important asset to inform adaptation strategies. Evidence suggests that natural disasters are detrimental to economic growth (Strobl, 2011, 2012; Felbermayr and Gröschl, 2014; Klomp and Valckx, 2014; Klomp, 2016), and can therefore indirectly impact demographic trends (Brueckner and Schwandt, 2015; Casey et al., 2019). Evidence further suggests that wealth inequalities increases vulnerability to natural disasters both within countries (Cappelli et al., 2021) and across countries (Noy, 2009; Casey et al., 2019). Moreover, because inequalities also hamper access and use of contraceptive methods, a dynamic that increases with natural disasters (Creanga et al., 2011; Leyser-Whalen et al., 2011; Behrman and Weitzman, 2016). Because contraceptive methods reduce fertility (Bongaarts, 2017; Kissinger et al., 2007), both wealth inequalities and contraceptive use can be key factors in analysis of natural disasters impacts on fertility.

In this paper, we focus on the evolution of births after a period of flood, and we provide novel evidence on how contraception and wealth play a role in the possibility to adapt (Kissinger et al., 2007; Leyser-Whalen et al., 2011; Behrman and Weitzman, 2016; Bongaarts, 2017). We exploit data for 17 African countries over the period 2004 to 2019. In order to quantify the impact of floods on fertility and the linkage with contraception and wealth, we apply a 2-step approach. We use the Data Health Survey (DHS) to have micro-level evidence on new births. These data also provides information on wealth quartile national classification and contraception use at the respondent level. We merge these data with the Emergency Events Database (EM-DAT) in order to quantify the occurrence of floods.

More specifically, we define birth as a dummy variable being equal to 1 when a childbirth occur during the year prior to the survey.[1] Our analysis considers three alternative measures capturing the severity of flooding events in a region and year: (i) numbers of floods, (ii) the

[1] We define birth as a dummy variable to avoid any variations induced by twins of more children at the term of a pregnancy.

number of individuals affected by floods and (iii) the number of deaths due to floods in the 5 years preceding surveys. Based on these data, we exploit the recurrence of DHS surveys in order to build a pseudo-panel model to quantify the impact of flooding events on births.[2] We use time fixed effects in order to factor our any temporal fertility trends, such as potential declining fertility rate in developing countries (Lerch, 2019). We control the robustness of our analysis with the inclusion of socio-economic control variables.

In a second step, we consider the role of modern contraceptive methods in interaction with our measures of floods. Here, our measure of contraceptive use is defined by the utilization of modern contraceptive methods at the respondent level. We add this interaction to our main specification in order to have a better perception on how does floods in relation to contraception use can modify birth decisions (Behrman and Weitzman, 2016; Bongaarts, 2017; Kissinger et al., 2007). Next, in order to consider the role of wealth inequalities and contraception use in the relationship between natural disasters and births, we exploit our national categorization of respondent wealth. This categorization is measured on a quartile national distribution of wealth. Based on this distribution of wealth, we split our estimation across wealth quartiles. In particular, we run four separate regressions that allow us to identify the relationship between natural disasters and birth in perspective of contraception in the context of the wealth of women. This two-step approach allows us to identify the impact of floods on new birth and then to analyze the means of adaptations through wealth inequalities.

With these specifications, we estimate a positive increase of new birth due to an increase of the occurrence of floods, an increase in people affected by floods or an increase of deaths due to floods. More specifically, and increase of one flood in the 5 years prior to surveys induce a statistically significant increase of 0.004 in the probability of births on average. Similarly, an increase of 1'000 deaths by floods and an increase of 1'000'000 people affected by floods induce statistically significant increases of 0.029 and 0.014 the probability of births on average. Besides, our interaction term between floods and contraception shows that contraception use

[2] As our data are repetitions of anonymized surveys, we have cross-sectional data repeated approximately every 5 years. We define our pseudo-panel approach is by cells of 20 years regional cohorts of women that are between 15 and 49 years old. We create an interaction term of our cohorts cells with our survey regions in order to observe a stable group of women over time. We conduct robustness check analysis to show that the time frame of our cells does not impact our results.

invert floods impact on birth probabilities. For women using modern contraceptive methods, a one unit increase in people affected and in deaths by floods decrease probabilities to have a child by 0.024 and 0.007. Finally, by constructing a distinction between wealth classes, we find that wealthy women have more means to control their reproductive health after floods shocks, while poorer women do not seem to use contraception as an adaptation variable in the aftermath of floods. Our estimations show a statistically significant interaction term between floods and contraception use for the richest share of respondent, while the poorest share of respondent estimates show a constant statistically significant effect of contraception use.

Our research contributes to a novel, while growing, literature on the linkages between climate change and fertility. Nevertheless, this linkage direction remains controversial and seems to be highly dependent on the context (Simon, 2017). In particular, Casey et al. (2019) develop a quantitative model combining economic-demographic theories and existing estimation of the consequence of climate change. With this model they show that climate change may increase worldwide fertility differences, as fertility rates under the impact of climate change tend to decrease in richer northern countries while increasing in poorer tropical countries. Conversely, Cho (2020) estimates that an increase in day of high temperature reduces the birth rate in South Korea, as Barreca et al. (2015) found for the United States. In addition, Barreca et al. (2015) estimate potential rebound effects, but not large enough to compensate for the decrease in fertility rates.

We also contribute to a second strand of literature that shows how natural disasters have an impact on fertility. This strand of literature is showing significant results, but more research is needed in order to have a better understanding of demographic dynamics (Frankenberg and Thomas, 2014). On the one hand, Davis (2017) analyzes the impact of Hurricane Mitch in Nicaragua and finds that the downfall of this hurricane on the fertility induced an increase in the birth rate that lasted from 4 to 6 years. Similarly, Nobles et al. (2015) also find an increase in the demand of the child after the deaths induced by the 2004 Indian Ocean tsunami in Indonesia. On the other hand, Sellers and Gray (2019) analyze an Indonesian community fertility behaviors during the years 1993 to 2015, find that climate shocks might constrain the fertility rate. Hamamatsu et al. (2014) and Pörtner (2008) estimate similar trend in the birth rate. As a middle point, Evans et al. (2010) estimate that, in the USA, hurricanes of low severity

induce an increase in the birth rate, while hurricanes of high severity induce a decrease in birth rates, thus showing the importance of the magnitude of natural disasters while considering their impact on fertility.

Finally, we also contribute to the research field addressing the linkage of fertility preferences, contraception and inequalities with natural disasters and fertility. Access to contraception can be hampered by natural disasters, thus has negative consequences on women's reproductive health (Behrman and Weitzman, 2016), impact that is reinforced by racial inequalities (Seltzer and Nobles, 2017; Leyser-Whalen et al., 2011) and socioeconomic status (Nandi et al., 2018). On fertility preferences, Haq (2018), by his research in a rural community in Bangladesh, shows that floods increase the demand of male children.

The remaining of this paper is structured as follows. Section 2 describes the databases the procedure we use to construct the unique database of this research. Section 3 describes empirical strategy, including our pseudo-panel approach. Section 4 shows a summary of our data and reports estimation results. Finally, Section 5 briefly discusses the results and concludes.

2 Data

In this section, we discuss how we use our unique database in order to construct a fine-grained analysis of the impact of floods on births. We use survey microdata from the Individual Recode DHS database to measure women characteristics such as children, wealth and contraceptive usage. We use EM-DAT database to measure floods occurrence and magnitude. This section describes both database and introduce additional database we use in extensions.

Our database is a survey sample and 17 countries over the years 2004 to 2019.[3] We use these 17 countries database in order to identify survey regions, defined by the DHS, without change in borders in which more than one survey have been conducted during our period of observation (see figure A1 and table A1)[4]. We identify one dependent variable to represent births, a binary variable taking the value of 1 if the respondent has given birth in the 12 months

[3] The 17 countries in the survey database are: Benin, Burkina Faso, Cameroon, Congo, Congo Democratic Republic, Ethiopia, Ghana, Kenya, Liberia, Malawi, Mali, Mozambique, Namibia, Senegal, Sierra Leone, Tanzania,Togo

[4] Survey regions are at the sub-national level and defined by the DHS for each country. These regions are states or state aggregations within a country. For additional details see ICF (2018)

prior to taking the survey. As our analysis is focus on the control and adaptation of fertility, we use a dummy variable in order to reduce potential noise produced by multiple birth at the term of a pregnancy.

We define 3 treatment variables in order to measure floods occurrence and magnitudes during the 5 years prior to each DHS survey. Specifically, our variables are composed of the count of floods, the count of deaths directly induced by floods and the count of people affected by floods (Noy, 2009; Klomp, 2016).[5] These three treatment variables are reported for each DHS region. To ease interpretation, we divide the count of people affected by 1'000'000 and the count of deaths by 1'000.

Additionnally, we use the birth date of each respondent to construct 20 years cohorts for our pseudo-panel estimation. The DHS provides individual weights in order to improve the representativity of the survey sample. Our cohorts variable, together with the DHS sampling weights allows to have a temporal continuity in the representativity of the sample of the population. We use DHS contraceptive usage information to measure if the respondent is using modern contraception for a time frame long enough to prevent birth during our measurement of birth, namely two years. We use this lag in the usage of contraception in order not to control for women using contraception right after having a child, which would generate a downward bias on our contraception estimates. We use the DHS wealth index variable to classify women in four wealth category - from poor to rich -, based on a national wealth distribution. In addition, we use respondent information on education, iliteracy and rural-urban types of living area in our vector of control.

We complement our information with data at the country level from the Uppsala Conflict Data Program database and from the World Bank, in order to control for national differences, such as national socio-economic varaibles and civil unrest. From these databases, we obtain national and yearly measurements of conflict fatalities, women labor forces, GDP growth, national health expenses, prevalence of undernutrition, death rates, age dependency and life expectancy.

Finally, our novel database allows to identify birth behaviors at respondent level for each

[5] Our deaths and people affected counts are based on the EM-DAT numbers reported, which report deaths as people that dies because the natural disasters happened and affected people as people that needed direct assistance during an emergency situation. For additional details see Guha-Sapir (2021)

year of survey, while measuring floods events in the living DHS region of each respondent over the 5 years preceding surveys. Our additional database allows to test the robustness of our estimations to the inculsion of individual and national variables.

3 Methods: Empirical strategy

This section discusses our empirical strategy. We first focus on our main specification to identify the impact of floods on births. Then, we discuss a second set of specifications where we assess the role of contraception and wealth of survey respondents. Finally, we discuss robustness checks.

3.1 Estimation of the main effects

The objective of our empirical strategy is to quantify how floods that occurred in the five years prior to a survey in year t, within a given region r, impacts fertility in year t by a women i in that region r. Formally, we denote the occurrence of floods as $\textit{Floods}_{r,t}$ which can be measured in three ways: (i) the number of floods that occurred, (ii) the total number of deaths directly attributed to floods, and (iii) the total number of people affected by floods. While we run separate regressions for each measure, we can write main specifications in general terms as follow:

$$\textit{newbirth}_{i,t} = \alpha + \rho \textit{Floods}_{r,t} + \gamma_1 C_{i,t} + \gamma_2 X_{c,t} + \delta_t + \theta_i \times \eta_r + \epsilon_{i,t}\,. \tag{1}$$

where $\textit{newbirth}_{i,t}$ is a dummy variable that takes the value 1 if at least one birth occurred during the year leading to the survey and $\textit{Floods}_{r,t}$ is one of the three measures of flood occurrences. Next, we consider a set of control variables, where $C_{i,t}$ is a vector measured at the micro level namely contraception, education, illiterate status and wealth index and urban or rural living place. We use these control variables in order to control for factors that play a role in individual fertility decisions. For instance, these variable would control for the fact that women with higher education and income tends to have less children (Seltzer and Nobles, 2017; Leyser-Whalen et al., 2011). $X_{c,t}$ is a set of control variables at the macro (country) level, which accounts for the number of conflicts fatalities, age dependency, death rate, life expectancy, GDP growth, female labour force ratio, expenditure in health per capita and prevalence of under nutrition.These

control variables allow to control for common factors that influence fertility, such economic development, political instability and women empowerment (Brueckner and Schwandt, 2015; Casey et al., 2019; Kissinger et al., 2007). Additionally, we control for year fixed effects (δ_t), fixed effects for the 20-year cohort of each woman (θ_i), fixed effects for the survey region (η_r), and the interaction between the cohort categorization and the region fixed effects which allows us to build a pseudo-panel identification ($\theta_i \times \eta_r$). This pseudo-panel specification, together with the weights provided by the DHS used to compute our estimations, allow us to use this interaction between cohorts and survey regions as a substitute to individuals fixed effects. As surveys are anonymized, comparing respondent of the same generation living in the same survey region allow to compare respondent with similar characteristics. Lastly, $\epsilon_{i,t}$ is an error term.

Next, we document how the impact of floods can interact with the use of contraception, and then split our data across quartiles for the wealth index of women in our data. Thus with these specifications, we look at means of women to control and adapt their fertility in relation to foods shocks. This gives one regression for each quartile. This is shown in the following specification:

$$\begin{aligned} \textit{newbirth}_{i,t} = \alpha + \rho_2 \textit{Floods}_{r,t} + \rho_3 \textit{Floods}_{r,t} \times \textit{ModernContraception}_{i,t} \\ + \gamma_1 C_{i,t} + \gamma_2 X_{c,t} + \delta_t + \theta_i \times \eta_r + \epsilon_{i,t} \,. \end{aligned} \tag{2}$$

were $\textit{Floods}_{r,t} \times \textit{ModernContraception}_{i,t}$ is the centered interaction between the three distinct measurements of floods impact and a binary variable that defines if survey respondents are using contraceptive methods in a sufficient long time to prevent any new birth during the 12 months prior to surveys.

3.2 Robustness checks

We document the robustness of our results along 3 key dimensions: (i) how we define the scale of a flooding event (ii) how we measure access to contraception, and (iii) for a panel database based on history of births variations in our database construction. We provide some detail about each in turn.

In order to control for the definition of the treatment, namely floods, we consider variation in treatment specifications, by lagging by one and two years the floods. The addition of lags allows us to control if the specification of a 5-year count is significant and see how direct are the effects

of our treatments. We also divide affected people and death by the total population to have relative treatments. This robustness check allows us to control for the relative magnitude of the floods impact in relation to the population of the country (Cavallo et al., 2013; Panwar and Sen, 2019). For the definition of contraception, we use an alternative definition taking into account modern and traditional contraception. We use this alternative definition of contraception use, following the DHS categorization of contraception types (ICF, 2012). Finally, we build a novel database that reconstruct the history of birth per women, provided by the DHS surveys, in order to have a panel database. With this robustness check, we widely increase the size of our sample, as the birth history of each respondent goes up to 20 years. In addition, this speciation allows us to test a different identification then our pseudo-panel specification, as we directly track birth for a specific respondent. Nevertheless, due to the survey nature of our data, this panel format cannot allow us to track evolution in other individual characteristics of the respondent.

4 Data and results

This section reports our empirical results. First, we provide summary statistics of our data. Second, we present the results from our main specification, documenting the impact of floods on new births. Third, we discuss the role of contraception and wealth. Lastly, we present robustness checks.

4.1 Descriptive statistics

Table 1 summarizes the DHS survey data at the women's level. Our outcome variable, the average of the binary variable of having children in the 12 months prior to the survey is of 0.6, with a minimum and maximum of respectively 0 and 1. The average of birth shows our data are slightly skewed on the right. Considering individual contraceptive behaviors, the average of modern contraception (0.087) shows that most of the observed population does not use modern contraception. This value indicates a low modern contraception usage and access in our database. Finally, the wealth index average (1.783) shows that the wealth distribution of women observed in our data is slightly skewed on the poor side of the wealth distribution. This implies a small over representation of relatively poor respondents in our database.

Table 1: Summary stats: individual level

	Mean	Std. Dev.	Min	Max
New birth	0.60	0.49	0	1
Modern contraception	0.09	0.28	0	1
Education	0.73	0.77	0	3
Illiteracy	0.57	0.50	0	1
Wealth index	1.78	1.48	0	4
Urban	2.21	0.41	2	3

Notes: *New birth* is a binary variable equal to 1 if the woman taking the survey had a child in the past 12 months before the survey. *Modern contraception* is a binary variable equal to 1 if respondent of the survey started taking modern contraception at least 24 months prior to taking the survey. *Education* is the level of education reached by the survey respondent, from no education (equal to 0) to higher education than secondary (equal to 3). *Iliteracy* is a dummy variable equal to 1 if the survey respondent is illiterate. *Wealth index* is a categorical variable giving the wealth level of the respondent in the context of her own country, the category are from poor to rich. *Urban* is a dummy variable equal to 1 if the survey respondent lives in an urban area. These data are provided by DHS surveys and are at the women's level.

Table 2: Summary stats: survey region level

	Mean	Std. Dev.	Min	Max
Sum of floods past 5 years	1.22	1.93	0	9
Sum of death by floods past 5 years	0.03	0.14	0	1.67
Sum of affected by floods past 5 years	0.09	0.35	0	3.83
Conflict fatalities	110.36	322.33	0	1841
Young age dependency	83.11	7.83	62.68	96.99
Death rate	10.24	2.58	5.85	16.72
Life expectancy	57.92	4.58	46.82	67.38
GDP growth	5.50	3.54	-4.39	20.72
Women Labor force	47	3.83	35.03	54.88
Health expenses	0.60	0.90	0.12	4.89
Prevalence undernutrition	20.04	10.51	4.70	41.50
20 years cohorts size	527.43	612.73	100	6974

Notes: *Sum of floods over 5 years preceding surveys* is the sum of floods that happened in a survey region in the 5 years prior to the survey. *Sum of death by floods over 5 years preceding surveys* is the sum of deaths directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Sum of affected by floods over 5 years preceding surveys* is the sum of affected people directly induced by floods that happened in a survey region in the 5 years prior to the survey. *conflict fatalities* is the number of fatalities induced by conflict at the country level. *Young age dependency* is the number of young people under working age (below 15 years) compared to the number of people in working age (15 to 64 years). *Death rate* is the mortality rate of per 1'000 people. *Life expectancy* is the national life exepectency in years. *GDP growth* is the yearly growth of the national GDP. *Women labor force* is the share of women in the national working forces. *Health expense* are the health expenditure per capita. *Prevalence undernutrition* is the prevalence of undernutrition in percentage of the national population. *20 years cohorts size* is the size of each cohorts cells in our data, showing how many respondent we have in each cohort of 20 years per survey regions. These data are at the survey region level.

Table 2 summarizes data at the regional and country level. The average of floods over 5 years is of 1.22, but we can see a large range, as the minimum of flood is 0 and the maximum

9.These numbers show large differences in flood occurrence between regions and time. The sum of deaths due to floods has an average of 32 deaths over 5 years, with a minimum of 0 and maximum of 1'668 deaths directly attributed to floods. Similarly, floods have large differences in terms of death magnitudes between regions and time. Finally, over 5 years, floods affect on average 95'000 people and range from 0 to around 3'832'000. These values show that floods have a large range of magnitude also in terms of affected people. These statistics on our three treatments variable show that we have large variations in our treatments, in terms of occurrence as in terms of magnitude. Thus we observe the impacts of large and smaller floods, as multiples successive flood events.

4.2 Main results

Table 3 reports our baseline empirical results. Each sets of 3 columns has use a different treatment. Columns 1 to 3 use the sum of floods over the 5 years preceding survey. Columns 4 to 6 use the sum of death induced by floods over the 5 years preceding survey. Columns 7 to 9 use the sum of people affected by floods over the 5 years preceding survey. Columns 1, 4 and 7 are pseudo-panel regressions and individual control variables. In columns 2, 5 and 8 we add a vector of socio-economic control variables at the country level. In columns 3, 6 and 9 we add the impacts of the centered interaction of our treatments with the use of modern contraception. In all columns, we report sample weighted estimations and standard errors in parenthesis.

Results in column 1 indicate that one additional flood during the past five years significantly increases the probability of women to have a child by 0.004 on average. This indicates that floods have a positive impact on the fertility of the overall population. However, with this individual control specification, columns 4 and 7 show that the magnitude of floods does not have a statistically significant effect. Introducing the country level control variables (column 2, 5 and 8) increase the magnitude and the significance of the floods impacts through death and affected people (with estimates of respectively 0.029 and 0.014). Finally, the introduction of an interaction term between flood measurements and the usage of modern contraception shows that the use of modern contraception counteracts the increasing effect of floods on new birth. For the flood impact through death and affected, we even estimate a statistically significant negative

Table 3: Baseline results from panel data estimation

	New birth								
	(1) FE	(2) FE +control	(3) FE +control	(4) FE	(5) FE +control	(6) FE +control	(7) FE	(8) FE +control	(9) FE +control
Sum of floods past 5 years	0.004***	0.004***	0.005***	–	–	–	–	–	–
	(0.001)	(0.001)	(0.001)						
Sum of death by floods past 5 years	–	–	–	0.010	0.029**	0.044***	–	–	–
				(0.007)	(0.009)	(0.010)			
Sum of affected by floods past 5 years	–	–	–	–	–	–	0.005	0.014***	0.019***
							(0.003)	(0.004)	(0.004)
Modern contraception	-0.024***	-0.022***	-0.021***	-0.024***	-0.022***	-0.010*	-0.024***	-0.022***	-0.011*
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Sum of floods × Modern contraception	–	–	-0.005*	–	–	–	–	–	–
			(0.002)						
Sum of death by floods × Modern contraception	–	–	–	–	–	-0.068***	–	–	–
						(0.010)			
Sum of affected by floods × Modern contraception	–	–	–	–	–	–	–	–	-0.026***
									(0.004)
Education	-0.053***	-0.052***	-0.052***	-0.053***	-0.052***	-0.052***	-0.053***	-0.052***	-0.053***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Iliteracy	0.062***	0.063***	0.063***	0.063***	0.064***	0.064***	0.063***	0.063***	0.063***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Wealth Index	-0.018***	-0.018***	-0.018***	-0.017***	-0.018***	-0.018***	-0.017***	-0.018***	-0.018***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Urban	-0.030***	-0.029***	-0.030***	-0.030***	-0.029***	-0.030***	-0.030***	-0.029***	-0.030***
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Conflict fatalities	–	0.000*	0.000	–	0.000**	0.000**	–	0.000**	0.000*
		(0.000)	(0.000)		(0.000)	(0.000)		(0.000)	(0.000)
Young age dependency	–	0.000	0.000	–	0.002	0.001	–	0.002	0.002
		(0.001)	(0.001)		(0.002)	(0.002)		(0.002)	(0.002)
Death rate	–	-0.001	-0.002	–	0.009	0.008	–	0.007	0.005
		(0.009)	(0.009)		(0.010)	(0.010)		(0.009)	(0.009)
Life expectancy	–	-0.011*	-0.012*	–	-0.007	-0.007	–	-0.009	-0.010
		(0.006)	(0.006)		(0.006)	(0.006)		(0.006)	(0.006)
GDP growth	–	0.001	0.001	–	0.002*	0.002*	–	0.002*	0.002*
		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)
Women labor force	–	0.015***	0.015***	–	0.014***	0.014***	–	0.014***	0.014***
		(0.004)	(0.004)		(0.004)	(0.004)		(0.004)	(0.004)
Health expenses	–	-0.066*	-0.067*	–	-0.071*	-0.073*	–	-0.064*	-0.065*
		(0.030)	(0.030)		(0.030)	(0.030)		(0.030)	(0.030)
Prevalence undernutrition	–	0.002	0.002	–	0.001	0.001	–	0.002	0.001
		(0.001)	(0.001)		(0.001)	(0.001)		(0.001)	(0.001)
Constant	0.348***	0.151	0.237	0.353***	-0.267	-0.209	0.353***	-0.240	-0.134
	(0.029)	(0.405)	(0.407)	(0.029)	(0.442)	(0.443)	(0.029)	(0.428)	(0.429)
Observations	329,537	329,517	329,517	329,537	329,517	329,517	329,537	329,517	329,517
Cohort fixed effects	465	465	465	465	465	465	465	465	465
R-squared	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122

Notes: In all columns, the dependent variable - *New birth* - is a binary variable equal to 1 if the woman taking the survey had a child in the past 12 months before the interview. *Sum of floods over 5 years preceding surveys* is the sum of floods that happened in a survey region in the 5 years prior to the survey. *Sum of death by floods over 5 years preceding surveys* is the sum of deaths directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Sum of affected by floods over 5 years preceding surveys* is the sum of affected people directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Modern contraception* is a binary variable equal to 1 if respondent of the survey started taking modern contraception at least 24 months prior to taking the survey. *Sum of floods × Modern contraception*, *Sum of death by floods × Modern contraception* and *Sum of affected by floods × Modern contraception* are centered interaction term between floods measurements and contraception use. *Education* is the level of education reached by the survey respondent. *Iliteracy* is a dummy variable equal to 1 if the survey respondent is illiterate. *Wealth index* is a categorical variable giving the wealth level of the respondent in the context of her own country. *Urban* is a dummy variable equal to 1 if the survey respondent lives in an urban area. *conflict fatalities* is the number of fatalities induced by conflict at the country level. *Young age dependency*, *Death rate*, *Life expectancy*, *GDP growth*, *Women labor force*, *Health expense* and *Prevalence undernutrition* are socio-economic country level control variables. The period of observation is from 2004 to 2019. Standard errors in parentheses. *,** and *** respectively denote significance at 5%, 1% and 0.1% levels.

effect of floods on birth for the share of the population that uses modern contraception. These last results indicate that floods have a differentiated effects on the share of the population, depending on the use of modern contraception.

Table 4: Baseline results: wealth distinction

	New birth											
	Rich	Middle	Poor	Poorest	Rich	Middle	Poor	Poorest	Rich	Middle	Poor	Poorest
	(1) FE +control	(2) FE +control	(3) FE +control	(4) FE +control	(5) FE +control	(6) FE +control	(7) FE +control	(8) FE +control	(9) FE +control	(10) FE +control	(11) FE +control	(12) FE +control
Sum of floods past 5 years	0.005*	0.001	0.005*	0.008***	–	–	–	–	–	–	–	–
	(0.002)	(0.002)	(0.002)	(0.002)								
Sum of death by floods past 5 years	–	–	–	–	0.049**	0.018	0.050**	0.039*	–	–	–	–
					(0.017)	(0.018)	(0.017)	(0.017)				
Sum of affected by floods past 5 years	–	–	–	–	–	–	–	–	0.019**	0.010	0.017**	0.021**
									(0.007)	(0.007)	(0.007)	(0.007)
Modern contraception	-0.012	-0.017*	-0.016	-0.041***	-0.001	-0.004	-0.008	-0.033**	-0.002	-0.004	-0.008	-0.033**
	(0.008)	(0.008)	(0.008)	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)	(0.009)	(0.009)	(0.009)	(0.010)
Sum of floods × Modern contraception	-0.005	-0.005	-0.006	-0.001	–	–	–	–	–	–	–	–
	(0.003)	(0.004)	(0.004)	(0.004)								
Sum of death by floods × Modern contraception	–	–	–	–	-0.082***	-0.079***	-0.055**	-0.037	–	–	–	–
					(0.017)	(0.019)	(0.019)	(0.021)				
Sum of affected by floods × Modern contraception	–	–	–	–	–	–	–	–	-0.030***	-0.032***	-0.020*	-0.015
									(0.007)	(0.008)	(0.008)	(0.009)
Education	-0.056***	-0.047***	-0.043***	-0.057***	-0.056***	-0.047***	-0.043***	-0.056***	-0.056***	-0.047***	-0.043***	-0.056***
	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)	(0.005)
Iliteracy	0.063***	0.064***	0.067***	0.058***	0.063***	0.065***	0.067***	0.059***	0.063***	0.064***	0.067***	0.058***
	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.006)
Urban	-0.029***	-0.023***	-0.029***	-0.036***	-0.029***	-0.024***	-0.028***	-0.035***	-0.029***	-0.023***	-0.028***	-0.035***
	(0.005)	(0.006)	(0.008)	(0.009)	(0.005)	(0.006)	(0.008)	(0.009)	(0.005)	(0.006)	(0.008)	(0.009)
Conflict fatalities	0.000	0.000*	0.000	-0.000	0.000	0.000*	0.000*	0.000	0.000	0.000*	0.000*	0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Young age dependency	-0.008**	-0.001	0.003	0.007*	-0.007*	-0.001	0.005	0.007*	-0.006	-0.000	0.005	0.009**
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Death rate	-0.030	0.007	0.009	0.019	-0.019	0.007	0.024	0.025	-0.023	0.009	0.017	0.026
	(0.016)	(0.016)	(0.016)	(0.016)	(0.017)	(0.017)	(0.018)	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)
Life expectancy	-0.034***	-0.010	-0.007	0.011	-0.029**	-0.010	0.000	0.013	-0.031**	-0.009	-0.004	0.012
	(0.010)	(0.010)	(0.010)	(0.009)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)	(0.010)
GDP growth	0.001	0.005*	0.001	-0.001	0.001	0.005*	0.002	0.000	0.001	0.005*	0.002	0.000
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Women labor force	0.023***	0.012	0.015*	0.005	0.021**	0.011	0.014*	0.007	0.022***	0.011	0.015*	0.006
	(0.006)	(0.006)	(0.006)	(0.006)	(0.007)	(0.007)	(0.006)	(0.007)	(0.007)	(0.007)	(0.006)	(0.007)
Health expenses	-0.108*	-0.134**	-0.054	0.023	-0.109*	-0.139**	-0.059	0.002	-0.104	-0.133**	-0.054	0.016
	(0.054)	(0.051)	(0.054)	(0.053)	(0.054)	(0.051)	(0.054)	(0.053)	(0.054)	(0.051)	(0.054)	(0.053)
Prevalence undernutrition	0.001	0.003	0.002	-0.001	0.001	0.003	0.002	-0.001	0.001	0.003	0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Constant	2.046**	0.326	-0.572	-1.285	1.576*	0.365	-1.262	-1.539*	1.698*	0.246	-0.979	-1.640*
	(0.715)	(0.717)	(0.743)	(0.702)	(0.804)	(0.789)	(0.805)	(0.748)	(0.772)	(0.759)	(0.780)	(0.735)
Observations	79,914	83,579	80,921	85,103	79,914	83,579	80,921	85,103	79,914	83,579	80,921	85,103
Cohort fixed effects	465	465	465	465	465	465	465	465	465	457	457	457
R-squared	0.124	0.122	0.115	0.118	0.125	0.122	0.115	0.118	0.125	0.122	0.115	0.118

Notes: In all columns, the dependent variable - *New birth* - is a binary variable equal to 1 if the woman taking the survey had a child in the past 12 months before the interview. *Sum of floods over 5 years preceding surveys* is the sum of floods that happened in a survey region in the 5 years prior to the survey. *Sum of death by floods over 5 years preceding surveys* is the sum of deaths directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Sum of affected by floods over 5 years preceding surveys* is the sum of affected people directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Modern contraception* is a binary variable equal to 1 if respondent of the survey started taking modern contraception at least 24 months prior to taking the survey. *Sum of floods × Modern contraception*, *Sum of death by floods × Modern contraception* and *Sum of affected by floods × Modern contraception* are centered interaction term between floods measurements and contraception use. *Education* is the level of education reached by the survey respondent. *Iliteracy* is a dummy variable equal to 1 if the survey respondent is illiterate. *Wealth index* is a categorical variable giving the wealth level of the respondent in the context of her own country. *Urban* is a dummy variable equal to 1 if the survey respondent lives in an urban area. *conflict fatalities* is the number of fatalities induced by conflict at the country level. *Young age dependency*, *Death rate*, *Life expectancy*, *GDP growth*, *Women labor force*, *Health expense* and *Prevalence undernutrition* are socio-economic country level control variables. The period of observation is from 2004 to 2018. Standard errors in parentheses. *,** and *** respectively denote significance at 5%, 1% and 0.1% levels.

4.3 Wealth differential analysis

Table 4, we report our results taking into account the wealth differentiation. Columns 1 to 4 reports the impact of the occurrence of floods during the 5 years preceding surveys from the richest to the poorest population. Columns 5 to 8 reports the impact of the sum of death due to floods during the 5 years preceding surveys from the richest to the poorest population. Columns 9 to 12 reports the impact of the sum of affected people due to floods during the 5 years preceding surveys from the richest to the poorest population. All of these specifications are based on our baseline results, taking into account individual and country level control variables and interaction between modern contraception and floods.

Starting with the impact of floods all of our estimations in table 4 show fairly similar results in terms of magnitude to our main estimates. Nevertheless, the impact of floods on middle wealth women is never statistically significant. By taking into account contraception and contraception interaction, we estimate clear differences in behaviors between the richest and the poorest share of the population. The direct impact of contraception is never statistically significant for the richest share of the population (columns 1, 5 and 9) where it is always statistically significant for the poorest share of the population (columns 4, 8 and 12). Contrastingly, the interaction term between flood measurements and modern contraception is never statistically significant for the poorest share of the population, while being highly statistically significant for the richest share of the population. Taken together, these results indicate differentiation based on wealth in terms of the impact of floods on the population birth rate and thus might be a sign of inequalities in terms of adaptation to natural disasters and means of adaptation at the reach of women in accordance to their own wealth.

4.4 Robustness check

In columns 1 to 6 of table 5, we report our robustness check for the temporality of flood measurements. In columns 1 to 3 of table 5, we introduce a lag of 1 year on flood measurements and in columns 4 to 6 of table 5, we introduce a lag of 2 years on flood measurements. In columns 7 and 8 of table 5, we report estimates with relative terms in magnitude of the floods, we divide the number of deaths or people affected by the country total population. In columns

Table 5: Baseline results: lagged treatment, relative treatment and all contraceptives

	New birth										
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
		Treatment lagged by 1 year			Treatment lagged by 2 year			Relative treatment		All contraception	
Sum of floods	0.004***	–	–	0.004***	–	–	–	–	0.005***	–	–
past 5 years	(0.001)			(0.001)					(0.001)		
Sum of death by floods	–	0.001**	–	–	0.001**	–	403,481.143**	–	–	0.042***	–
past 5 years		(0.000)			(0.000)		(154,887.302)			(0.010)	
Sum of affected by floods	–	–	0.001***	–	–	0.001***	–	212,678.693***	–	–	0.018***
past 5 years			(0.000)			(0.000)		(60,728.051)			(0.004)
Modern contraception	-0.017***	-0.011*	-0.012*	-0.017***	-0.011*	-0.012*	-0.020***	-0.021***	–	–	–
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)			
Sum of floods ×	-0.004	–	–	-0.007**	–	–	–	–	–	–	–
Modern contraception	(0.002)			(0.002)							
Sum of death by floods ×	–	-0.001***	–	–	-0.001***	–	-1289309.691***	–	–	–	–
Modern contraception		(0.000)			(0.000)		(171,481.926)				
Sum of affected by floods ×	–	–	-0.001***	–	–	-0.001***	–	-567,433.481***	–	–	–
Modern contraception			(0.000)			(0.000)		(74,718.310)			
All contraception	–	–	–	–	–	–	–	–	-0.028***	-0.020***	-0.021***
									(0.004)	(0.005)	(0.005)
Sum of floods ×	–	–	–	–	–	–	–	–	-0.004	–	–
All contraception									(0.002)		
Sum of death by floods ×	–	–	–	–	–	–	–	–	–	-0.061***	–
All contraception										(0.010)	
Sum of affected by floods ×	–	–	–	–	–	–	–	–	–	–	-0.023***
All contraception											(0.004)
Constant	0.167	-0.201	-0.171	0.234	-0.222	-0.188	-0.117	-0.126	0.199	-0.247	-0.177
	(0.401)	(0.441)	(0.427)	(0.401)	(0.441)	(0.426)	(0.453)	(0.441)	(0.407)	(0.443)	(0.428)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	324,223	324,223	324,223	324,223	324,223	324,223	324,098	324,098	329,517	329,517	329,517
Cohort fixed effects	465	465	465	465	465	465	465	465	465	465	465
R-squared	0.118	0.119	0.119	0.119	0.119	0.119	0.124	0.124	0.122	0.122	0.122

Notes: In all columns, the dependent variable - *New birth* - is a binary variable equal to 1 if the woman taking the survey had a child in the past 12 months before the interview. *Sum of floods over 5 years preceding surveys* is the sum of floods that happened in a survey region in the 5 years prior to the survey. *Sum of death by floods over 5 years preceding surveys* is the sum of deaths directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Sum of affected by floods over 5 years preceding surveys* is the sum of affected people directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Modern contraception* is a binary variable equal to 1 if respondent of the survey started taking modern contraception at least 24 months prior to taking the survey. *All contraception* is a binary variable equal to 1 if respondent of the survey started taking any type of contraception at least 24 months prior to taking the survey. *Sum of floods × Modern contraception*, *Sum of death by floods × Modern contraception*, *Sum of affected by floods × Modern contraception*, *Sum of floods × All contraception*, *Sum of death by floods × All contraception* and *Sum of affected by floods × All contraception* are centered interaction term between floods measurements and contraception use. Individual controles are: *Education*, *Iliteracy* , *Wealth index* and *Urban*. Contry controls are: *conflict fatalities*, *Young age dependency*, *Death rate*, *Life expectancy*, *GDP growth*, *Women labor force*, *Health expense* and *Prevalence undernutrition*. The period of observation is from 2004 to 2019. Standard errors in parentheses. *,** and *** respectively denote significance at 5%, 1% and 0.1% levels.

9 to 11 of table 5, we report estimates using an alternative definition of contraception, taking into account modern and traditional contraception. In columns 1 to 6 in table 6, we replace our linear specification with logit (in columns 1 to 3) and probit (in columns 4 to 6). In columns 7 to 12 of table 6, we report our estimates with variations in our pseudo-panel specification, considering cohorts of 10 years and 5 years. Finally, in table 7, we change the dataset structure in order to have a panel based on birth history of women passing the DHS survey.

Columns 1 to 6 in table 5 estimates shows fairly similar pattern than our main estimations. Nevertheless, the magnitude of the floods measurements in terms of death and affected people is smaller than our main estimates, in the case of both lags (column 2, 3 and 5, 6). This might shows that floods magnitude has mainly an impact on the probability of births when they happen at a point in time very close to the contraception. Columns 7 and 8 show that using relative magnitude of flood measurements does not change the relationship that we find in our baseline estimates, as an increase in death or people affected also increase the probability to have children and using modern contraception inverses this relationship. Columns 9 to 11 show that in our case using modern or traditional contraception does not seem to hamper our estimates, as the modern contraception estimates and interactions between contraception and floods measurements are similar then the ones of our baseline estimations.

Columns 1 to 6 in table 6 estimates show that our baseline estimation might have a downwards bias due to the choice of the specification. By using logit and probit estimators, all of our estimates of interest increase in magnitude. This does not change the underlying findings of our baseline estimations, but shows that the impact of floods on the probability of having a child is larger. For instance, in column 2, an increase of a thousand deaths due to floods increases the probability of having a child by 14.8%, while our baseline estimation reports an increase of 2.9% (column 2 of table 3) in the probability of having a child due to a similar death shocks. Columns 7 to 12 in table 6 show that variations in the size of our pseudo-panel cohorts do not have a significant effect on our results. We find some variations in the magnitude of the effects, but these variations remain in the confidence interval of our baseline estimations.

Finally, table 7 we report estimations of our panel database. These estimations cannot be directly compared to our baseline estimations, as, due to the survey form of our main database, we cannot have variations in the individual controls. Thus, because of this panel form, we

Table 6: Robustness check: Logit, probit and cohorts size variations

	New birth											
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
		Logit			Probit			10 years cohorts			5 years cohorts	
Sum of floods past 5 years	0.024***	–	–	0.015***	–	–	0.005***	–	–	0.004**	–	–
	(0.006)			(0.003)			(0.001)			(0.001)		
Sum of death by floods past 5 years	–	0.148**	–	–	0.094***	–	–	0.034***	–	–	0.035***	–
		(0.045)			(0.027)			(0.009)			(0.009)	
Sum of affected by floods past 5 years	–	–	0.078***	–	–	0.049***	–	–	0.018***	–	–	0.018***
			(0.018)			(0.011)			(0.004)			(0.004)
Modern contraception	-0.078***	-0.028	-0.030	-0.052***	-0.022	-0.023	-0.023***	-0.012*	-0.012**	-0.042***	-0.029***	-0.029***
	(0.022)	(0.023)	(0.023)	(0.013)	(0.014)	(0.014)	(0.005)	(0.005)	(0.005)	(0.004)	(0.005)	(0.005)
Sum of floods × Modern contraception	-0.015	–	–	-0.010	–	–	-0.003	–	–	-0.002	–	–
	(0.010)			(0.006)			(0.002)			(0.002)		
Sum of death by floods × Modern contraception	–	-0.330***	–	–	-0.196***	–	–	-0.070***	–	–	-0.080***	–
		(0.048)			(0.028)			(0.010)			(0.010)	
Sum of affected by floods × Modern contraception	–	–	-0.126***	–	–	-0.075***	–	–	-0.027***	–	–	-0.031***
			(0.021)			(0.012)			(0.004)			(0.004)
Constant	-2.004	-3.532	-3.827	-1.284	-2.291	-2.448*	-0.407	-0.815	-0.887*	-0.132	-0.594	-0.669
	(1.951)	(2.127)	(2.072)	(1.174)	(1.281)	(1.245)	(0.426)	(0.464)	(0.451)	(0.433)	(0.468)	(0.456)
Individual controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Country controls	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	
Observations	324,223	324,223	324,223	324,223	324,223	324,223	324,223	324,223	324,223	324,223	324,223	324,223
Cohort fixed effects	483	483	483	483	483	483	966	966	966	1771	1771	1771
R-squared							0.149	0.150	0.150	0.187	0.187	0.187

Notes: Columns 1 to 3 are logit specifications, columns 4 to 6 are probit specifications, columns 7 to 9 use 10 year cohorts, columns 10 to 12 use 5 years cohorts. In all columns, the dependent variable - *New birth* - is a binary variable equal to 1 if the woman taking the survey had a child in the past 12 months before the interview. *Sum of floods over 5 years preceding surveys* is the sum of floods that happened in a survey region in the 5 years prior to the survey. *Sum of death by floods over 5 years preceding surveys* is the sum of deaths directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Sum of affected by floods over 5 years preceding surveys* is the sum of affected people directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Modern contraception* is a binary variable equal to 1 if respondent of the survey started taking modern contraception at least 24 months prior to taking the survey. *Sum of floods × Modern contraception*, *Sum of death by floods × Modern contraception* and *Sum of affected by floods × Modern contraception* are centered interaction term between floods measurements and contraception use. Individual controles are: *Education*, *Iliteracy* , *Wealth index* and *Urban*. Contry controls are: *conflict fatalities*, *Young age dependency*, *Death rate*, *Life expectancy*, *GDP growth*, *Women labor force*, *Health expense* and *Prevalence undernutrition*. The period of observation is from 2004 to 2019. Standard errors in parentheses. *,** and *** respectively denote significance at 5%, 1% and 0.1% levels.

Table 7: Robustness results: panels data

	New birth		
	(1) FE + control	(2) FE + control	(3) FE + control
Sum of floods past 5 years	0.001***	–	–
	(0.000)		
Sum of death by floods past 5 years	–	0.001	–
		(0.001)	
Sum of affected by floods past 5 years	–	–	0.001***
			(0.000)
Education	0.003***	0.003***	0.003***
	(0.000)	(0.000)	(0.000)
Iliteracy	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Wealth Index	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Urban	-0.001**	-0.001**	-0.001**
	(0.000)	(0.000)	(0.000)
Conflict fatalities	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)
Young age dependency	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Death rate	-0.008***	-0.008***	-0.008***
	(0.000)	(0.000)	(0.000)
Life expectancy	-0.006***	-0.006***	-0.006***
	(0.000)	(0.000)	(0.000)
GDP growth	-0.001***	-0.001***	-0.001***
	(0.000)	(0.000)	(0.000)
Women labor force	-0.000*	-0.000*	-0.000*
	(0.000)	(0.000)	(0.000)
Health expenses	0.044***	0.044***	0.044***
	(0.002)	(0.002)	(0.002)
Prevalence undernutrition	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)
Constant	0.398***	0.392***	0.393***
	(0.025)	(0.025)	(0.025)
Observations	12,079,436	12,079,436	12,079,436
Year fixed effects	Yes	Yes	Yes
R-squared	0.013	0.013	0.013

Notes: In all columns, the dependent variable - *New birth* - is a binary variable equal to 1 on years where the survey respondant had a child. *Sum of floods over 5 years preceding surveys* is the sum of floods that happened in a survey region in the 5 years prior to the survey. *Sum of death by floods over 5 years preceding surveys* is the sum of deaths directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Sum of affected by floods over 5 years preceding surveys* is the sum of affected people directly induced by floods that happened in a survey region in the 5 years prior to the survey. *Education* is the level of education reached by the survey respondent. *Iliteracy* is a dummy variable equal to 1 if the survey respondent is illiterate. *Wealth index* is a categorical variable giving the wealth level of the respondent in the context of her own country. *Urban* is a dummy variable equal to 1 if the survey respondent lives in an urban area. *conflict fatalities* is the number of fatalities induced by conflict at the country level. *Young age dependency*, *Death rate*, *Life expectancy*, *GDP growth*, *Women labor force*, *Health expense* and *Prevalence undernutrition* are socio-economic country level control variables. Standard errors in parentheses. *,** and *** respectively denote significance at 5%, 1% and 0.1% levels.

cannot observe the dynamic among floods, contraception and new birth. Nevertheless, these estimations show that floods have an impact on the probability of having a new child, at least for treatments measured in terms of flood occurrence and people affected by floods.

5 Discussion and conclusion

In this study, we have quantified the relationship between floods and births in 18 African countries, providing novel empirical evidence that natural disasters, and especially floods, have an impact on birth decisions, and thus on demographic trends. In addition, we document the role of contraception in this decision, and how wealth plays a role in the accessibility and usage of the contraception as a response to an increase in floods. Our results might suggest that improving the access and information about contraception could empower women, especially for reproductive health, and that the development of such policies could help to hamper fertility shocks induced by natural disasters.

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Appendix A Surveys

Figure A1: DHS survey regions observed

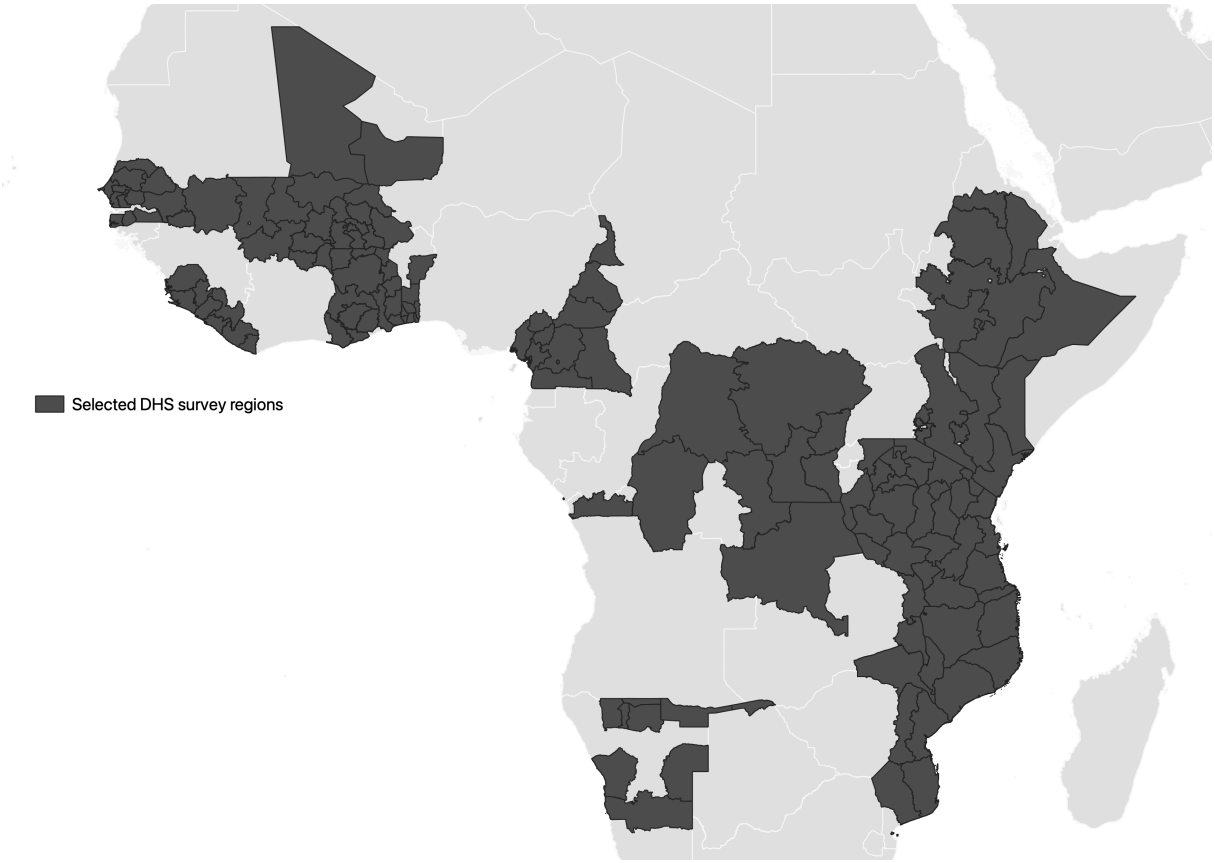

Table A1: List of surveys

Country	Survey
Benin	2006 DHS 2011-12 DHS 2017-18 DHS
Burkina Faso	2003 DHS 2010 DHS 2014 MIS 2017-18 MIS
Cameroon	2004 DHS 2011 DHS 2018 DHS
Congo	2005 DHS 2011-12 DHS
Congo, Democratic Republic	2007 DHS 2013-14 DHS
Ethiopia	2011 DHS 2016 DHS
Ghana	2003 DHS 2008 DHS 2014 DHS 2016 MIS
Kenya	2003 DHS 2008-09 DHS 2014 DHS
Liberia	2007 DHS 2013 DHS 2016 MIS
Malawi	2004 DHS 2010 DHS 2014 MIS 2015-16 DHS
Mali	2006 DHS 2012-13 DHS 2015 MIS 2018 DHS
Mozambique	2003 DHS 2011 DHS 2015 AIS
Namibia	2006-07 DHS 2013 DHS
Senegal	2005 DHS 2010-11 DHS 2017 DHS
Sierra Leone	2008 DHS 2013 DHS
Tanzania	2004-05 DHS 2010 DHS 2015-16 DHS
Togo	2013-14 DHS 2017 MIS