The Hidden Social Costs of Climate Change: Evidence on Climate Shocks and Child Abandonment in Uganda.

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Abstract. Child abandonment is a relevant phenomenon all over the world, and it is more so in developing countries, where it is made worse by income conditions in rural households. At the same time shocks related to climate change are increasingly hitting several countries, generating a reduction in agricultural output and, as a result, increasing difficulties in feeding and growing children in rural areas. The aim of this paper is to move a first step in the investigation of the role played by climate change in driving rural households' critical decisions, with a specific attention to child abandonment. To this end, we first investigate the determinants of child abandonment and then its impact on households' welfare. Following the Wooldridge (2002) approach, we estimate pooled selection model and pooled OLS using the Mundlak (1978) device. By adopting Uganda as a relevant case study, the analysis is developed using longitudinal data on Ugandan rural households for the waves 2009-10, 2010-11, and 2011-12 collected in World Bank Living Standards Measurement Study-Integrated Surveys on Agriculture. Preliminary results confirm the relevance of climate shocks, as measured by the SPI, as drivers of children household abandonment. We can therefore expect that policies encouraging rural households' resilience to climatic shocks may have a virtuous indirect impact, reducing the number of children who are forced to leave their households.

JEL Classification: Q12, Q54, O15

Key-words: Climate change, agriculture, child abandonment, panel data switching endogenous regression model, Uganda.

1. Introduction

Poverty in developing countries is a widespread phenomenon, and is particularly harmful for children, who represent the most vulnerable part of the population. Parents living below the international poverty line fight to provide basic sustenance for themselves and their children. Many people, both young and adults, experience malnutrition and deprivation of clean water, sanitation, electricity, medical care, housing, and education. The international community is reacting to these shortages in the context of the Millennium Development Goals, which are, among other things, aimed at intensifying the efforts to "eradicate extreme poverty and hunger." (UN, 2015)

A lot of children in developing nations are also exposed to other harms, such as child labour, slavery, prostitution, and children trafficking. Child abandonment is another relevant phenomenon taking place all over the world, but particularly in developing countries where it is made worse by income conditions in rural households[1].

Poverty has been recognized as the main motivation for relinquishment (Smolin, 2007). Literature indicates that legitimate children are more likely to be abandoned by poor families during periods of economic crisis (Fuchs, 1984; Hunecke, 1987) or in response to food shortage (Food and Agriculture Organization, 1996; Fuchs, 1987; Guemple, 1979). This phenomenon has been studied especially from an historical point of view. Conversely, some theoretical and empirical studies investigate the

[1] In principle, it is important to distinguish between abandonment per se and relinquishment. In fact, abandonment refers to situations where the child is left by the parents or usually a single mother without a guarantee of immediate provision of care (e.g. a child is left on the street or the doorstep of an orphanage, etc.) and they are aware that the child will be immediately assisted at the time of leaving him (usually this situation leads to the child's adoption). Unfortunately, our data sources do not allow us to make this distinction in our empirical analysis, so that the related assessment is left for future research.

determinants of one of the desirable outcomes of abandonment and/or relinquishment, i.e. national or inter-country children's adoption, possibly for the higher availability and comparability of data[2].

Kuhn and Lahiri (2016) empirically test the predictions of their theoretical model showing that household income negatively influences child relinquishment whereas household size has a positive effect on the "supply" of children for adoption.

Medoff (1993) estimates the supply of adoptable infants applying the rational choice economic model of fertility arguing that women that relinquish a child have higher opportunity costs of motherhood with respect to women that decide to parent. In the empirical model he shows that the decision to leave a child in order to be adopted is positively influenced by women's education, marital status, religious affiliation and negatively affected by women's labour force participation, unemployment rate and the amount of the state's Aid to Families with Dependent Children.

Gennetian (1999) and Medoff (2008) study the impact of abortion access on the supply of infants relinquished in order to be adopted showing that a more restrictive abortion law and higher abortion prices may reduce the number of undesirable childbirths and consequently relinquishments.

In this paper, we move a step towards the understanding of the drivers of child abandonment phenomenon in developing countries, choosing Uganda as a relevant case study. Our focus is on the drivers that are expected to be relevant according to the (very few) existing contributions, but our research effort also aims at enriching the set of potential determinants by accounting for climate change shocks. To this end, our analysis is articulated in two main steps: first, we investigate the determinants of child abandonment including climate related variables, and then we assess the impact of child abandonment decisions on rural households' welfare. In this way, we try to identify an indirect channel through which climate related problems may affect households' welfare (as measured by income), namely by increasing the likelihood of child abandonment to take place.

[2]Also data on the number of children in foster care or in other institutions for children who are orphaned or whose parents cannot care of them are scarce.

The paper is organized as follows: the next section presents the empirical strategy, section 3 describes data, while section 4 comments on current (preliminary) results. Finally, section 5 concludes and provides information on the upcoming research steps.

2. Empirical Framework

When the selection process is based on time constant unobserved heterogeneity, a panel estimator solves the problem without an instrumental variable (Wooldridge, 2002). However, the selection process might be generated by time-varying unobserved heterogeneity that affects the outcomes. To circumvent this problem, we follow a recent multi-step procedure as in Murtazashvili and Wooldridge (2016) that combines the control function approach (Bourguignon et al., 2007) with an endogenous switching.

Since the fixed effects estimator does not provide consistent estimates in the presence of unbalanced data, we followed Wooldridge (2002) approach which consist of estimating pooled OLS and pooled selection models using the Mundlak (1978) device. The Mundlak device combines the fixed-effects and the random effects estimation approaches. Thus, by including Mundlak device we control for time-constant unobserved heterogeneity, as with fixed effects, while avoiding the problem of incidental parameters in nonlinear models such as the probit model.

In the first step, a probit model accounting for unobserved household heterogeneity is estimated to generate generalized residuals (selection correction terms):

$$d_{it} = 1[\alpha' z_{it} + w_{it} > 0], \;\; w_{it} \sim N[0,1] \qquad (1)$$

where $[1]$ is the indicator function, which is unity whenever the statement in brackets is true, and zero otherwise[3], z_{it} includes covariates and instrumental variables and w_{it} is the idiosyncratic error term normally distributed.

[3]Remember that Probit model does not depend on the assumption of Independence of Irrelevant Alternatives (IIA).

In the second step, the outcome equations are estimated using OLS and including the generalized residuals as an additional regressor to capture selection bias due to time varying unobserved heterogeneity:

$$y_{it} = \beta' x_{it} + \epsilon_{it}, \quad \epsilon_{it} \sim N[0, \sigma_\epsilon^2] \qquad (2)$$

where y_{it} is the welfare variable, x_{it} is a matrix including covariates, Mundlak device, generalized residuals and the specific constant term; ε_{it} is the idiosyncratic error term normally distributed.

One of the main advantages of these models is the possibility to build counterfactual outcomes which assess the average treatment effects (ATE) of the child abandonment compared to the case in which the child stays in the household. It is given by the structural difference of welfare between the actual abandonment choice and a counterfactual scenario of no abandonment. The ATE is thus the welfare outcome that households who abandon would experience if they decided to not send their children elsewhere. Another advantage of this approach is its computational simplicity, aided by using of control function method.

2.1 Model specification

The model specification for our panel endogenous switching model is as follows:

$$d_{it} = 1[\alpha' z_{it} + \gamma' H_i + w_{it} > 0], w_{it} \sim N[0,1] \qquad (3)$$

where d_{it} is the selection variable (child abandonment), z_{it} is a matrix of observable household characteristics including year and region dummies and the exclusion restrictions. H_i denotes time constant unobserved heterogeneity term and α and γ are unknown parameters to be estimated.

In the second stage of the endogenous switching regression model, net crop income (y_{it}) is estimated for households who abandon and those who do not abandon separately, controlling for the endogenous nature of abandonment decisions:

$$y_{it_j} = \beta_j' x_{itj} + \Omega_j' \hat{\lambda}_{itj} + \delta_j' \hat{\lambda}_{itj} T + \gamma_j' H_{ij} + \epsilon_{itj} \quad j = 0,1. \qquad (4)$$

where j denotes the two regimes, x_{it} is a set of observable household characteristics, including time (T) and region dummies. λ_{it} are generalized residuals derived from equation (3) to capture time-varying household effects. As discussed above, the unobserved heterogeneity H_i will be replaced by the average values of time-varying explanatory variables.

Then in order to calculate the ATE, we can compare an actual expected outcome where abandonment has taken place, given by the following expected value:

$$\mathrm{E}\left[y_{i,t}^1 | j = 1\right] = \beta_1' x_{it1} + \Omega_1' \hat{\lambda}_{it} + \delta_1' \hat{\lambda}_{it} \mathrm{T} + \gamma_1' H_{i1}, \qquad (5)$$

With a counterfactual outcome taking place in the absence of abandonment.

$$\mathrm{E}\left[y_{i,t}^0 | j = 0\right] = \beta_0' x_{it0} + \Omega_0' \hat{\lambda}_{it0} + \delta_0' \hat{\lambda}_{it0} \mathrm{T} + \gamma_0' H_{i0} \qquad (6)$$

As a result, we can conclude that the average treatment effect is given by:

$$\mathrm{E}\left[y_{i,t}^1 | j = 1\right] - \mathrm{E}\left[y_{i,t}^0 | j = 0\right] \qquad (7)$$

3. Data and Descriptive Statistics

Two datasets were used in the analysis. Household longitudinal data are based on Uganda National Panel Survey (UNPS) program implemented by Uganda Bureau of Statistics, with financial and technical support of the Government of Netherlands, and the World Bank Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) project. The UNPS is a multi-topic panel household survey that commenced in 2009/10 and continued for the years 2010-11, 2011-12, and 2013-14.

Individuals grouped in 4373 households were included in the unbalanced panel built for the investigation. These nationally representative household surveys include detailed information on household demographic characteristics such as education, household size, sex and age of the household head and other data on household shocks and assets.

Specifically, we select the dependent variable for the first step of our analysis as “child abandonment”, which is a dummy variable built up on the basis of general household data from the UNPS survey.

The data on crop and total income, nonfarm income and other sources of income come from Smallholders Data Portrait provided by FAO (2018). The smallholder farmers' Data Portrait is a comprehensive, systematic and standardized data set on the profile of smallholder farmers across the world. At present it provides information for nineteen countries.

The LSMS-ISA survey data record geo-referenced household and enumeration area level Latitude and Longitude coordinates using handheld global positioning system (GPS) devices. This creates the possibility of linking household level data with geo-referenced climatic information to identify how weather variables affect the farmers’ diversification strategies and their impact on food security measures.

Climatic data are collected by the Global Land Data Assimilation System (GLDAS) v2.1. GLDAS is a global gridded reanalysis dataset (Rodell et al., 2004a) with a spatial resolution of 0.25°*0.25° and 3-hourly temporal resolution. Climatic indicators considered are the following: mean temperature, total precipitation, the Standard Precipitation Index (SPI) and the Consecutive Dry Days (CDD). The SPI is an indicator of seasonal trends in precipitation; it is calculated on long-term precipitation and it is based on the probability of precipitation for any time scale (Edwards and McKee 1997). The present study includes two precipitation variables (and their square values), which count the number of months in which the SPI is greater (less) than 1 (-1), in order to compute the effects of droughts (floods). CDD is the annual count of days during which dryness at local level is present; while the former indicators are rainfall-related variables, the latter regards the state of temperature. In order to assess the impact of climate on the variable of interest, it is important to include both kinds of indicators (and their squared values) in the analysis. Table 1 shows summary statistics of selected variables.

Table 1. Summary statistics

Variable	Mean	p50	sd	min	max	N
Age head of hh	45.380	44	15.994	0	100	5586
Square of age head of hh	2315.139	1936	1517.850	0	10000	5586
Single and female head of hh (Yes=1)	0.127	0	0.333	0	1	5645
Average years of education in hh	3.806	3.5	2.249	0	16	5635
Number of people in the hh	7.074	7	3.026	2	29	5645
Rain-fed land owned, hectares	1.925	0.809	9.129	0	330.264	5589
Adoption of improved seeds (Yes=1)	0.252	0	0.434	0	1	5645
HH Distance in (KMs) to Nearest Land Border Crossing	92.924	86.464	54.819	0.03	207.741	5643
Received a vaccination (Yes=1)	0.250	0	0.433	0	1	5645
Annual Mean Temperature (0C * 10)	219.285	222	17.912	148	265	5643
Nr of months in which SPI<-1 in the last 5 years	0.938	1	1.069	0	5	5645
Year=2010	0.322	0	0.467	0	1	5645
Year=2011	0.324	0	0.468	0	1	5645
Region=Central	0.209	0	0.407	0	1	5645
Region=Eastern	0.261	0	0.439	0	1	5645
Region=Northern	0.286	0	0.452	0	1	5645

4. Empirical results

Table 2 reports results from the first step of our empirical approach, where we estimate the drivers of child abandonment in Uganda. Results show the relevance of the presence of a single and female head of the household and the number of people in the household, (driving abandonment up as expected, due to a larger likelihood of experiencing economic problems). Interestingly, also the presence of rain-fed land increases the share of abandonment; this may be explained by the possibility that rain-fed land is more exposed, *ceteris paribus*, to climate and weather shocks. On the other hand, the adoption of improved seeds drives down child abandonment, this impact being possibly explained by the larger productivity of this kind of seeds. Moving to our climatic variables, a larger mean temperature implies a larger share of child abandonment, and the same holds for our SPI-related indicator of extreme weather-related events: weather shocks and climate change trend are therefore a relevant variable in explaining child abandonment. This suggest a possible route through which climate change may affect social welfare. Notice that our results are robust when we include Mundlak device in our analysis (column 2 of Table 2).

Table 2. First step –Pooled Probit

	(1)	(2)
Variables	Probit	Probit
Age head of hh	-0.003	0.004
	(0.617)	(0.731)
Square of age head of hh	0.000	-0.000
	(0.256)	(0.800)
Single and female head of hh (Yes=1)	0.233**	0.229**
	(0.017)	(0.021)
Average years of education in hh	0.022	0.020
	(0.143)	(0.588)
Number of people in the hh	0.065***	0.066***
	(0.000)	(0.000)
Rain-fed land owned, hectares	0.004**	0.005**
	(0.017)	(0.015)
Adoption of improved seeds (Yes=1)	-0.170**	-0.166**
	(0.035)	(0.039)

HH Distance in (KMs) to Nearest Land Border Crossing	0.001	-0.007
	(0.129)	(0.565)
Received a vaccination (Yes=1)	0.049	0.106
	(0.513)	(0.281)
Annual Mean Temperature (^{0}C * 10)	0.005*	0.005*
	(0.087)	(0.085)
Nr of months in which SPI<-1 in the last 5 years	0.136***	0.136***
	(0.002)	(0.002)
Year=2010	-0.193*	-0.191*
	(0.080)	(0.086)
Year=2011	-0.532***	-0.529***
	(0.000)	(0.000)
Region=Central	-0.073	-0.077
	(0.463)	(0.437)
Region==Eastern	-0.116	-0.115
	(0.285)	(0.291)
Region==Northern	-0.515***	-0.516***
	(0.000)	(0.000)
Constant	-3.317***	-3.240***
	(0.000)	(0.000)
Mundlak		Yes
Observations	5,574	5,574

*Note: Robust p-value in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Table 3 shows the second step of our analysis, namely the impact of socio-demographic variables, together with geographic and health status proxies and the generalized residuals from the analysis in the first stage, to assess the welfare impacts (if any) for child abandonment. We measure welfare using net crop income at household level. Notice that age is only significant and concave if the Mundlak device is not used in step 1 (with a standard concave relationship), as it can be assessed by looking at columns 1 and 2 in Table 3. The same is true for the average level of education. This seems to suggest a "time-invariant" feature for these variables. Other relevant explanatory variables suggest that number of people in the household and improved seeds increase income, partly confirming the explanation of the impact of these variables in the first step of our analysis.

Table 3. Second step – Pooled OLS

	(1)	(2)
Variables	OLS	OLS
Age head of hh	0.003**	-0.001
	(0.022)	(0.585)
Square of age head of hh	-0.000*	0.000
	(0.053)	(0.514)
Single and female head of hh (Yes=1)	-0.047**	-0.045**
	(0.015)	(0.020)
Average years of education in hh	0.010***	-0.004
	(0.000)	(0.580)
Number of people in the hh	0.021***	0.020***
	(0.000)	(0.000)
Rain-fed land owned, hectares	0.002**	0.002**
	(0.011)	(0.017)
Adoption of improved seeds (Yes=1)	0.056***	0.055***
	(0.000)	(0.000)
HH Distance in (KMs) to Nearest Land Border Crossing	-0.000	0.003
	(0.104)	(0.440)
Received a vaccination (Yes=1)	-0.013	-0.025
	(0.346)	(0.193)
Generalized Residuals	-0.020	-0.019
	(0.161)	(0.163)
Year=2010	0.052***	0.059***
	(0.001)	(0.000)
Year=2011	0.259***	0.263***
	(0.000)	(0.000)
Region=Central	-0.235***	-0.234***
	(0.000)	(0.000)
Region==Eastern	-0.352***	-0.354***
	(0.000)	(0.000)
Region==Northern	-0.453***	-0.451***
	(0.000)	(0.000)
Constant	13.637***	13.554***
	(0.000)	(0.000)
Observations	5,560	5,560
R-squared	0.205	0.206

*Note: Robust p-value in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

Table 4 – Average Treatment Effects on Treated (ATET)

	Actual outcome	Counterfactual outcome (crop income of households If we assume no child abandonment)	ATET	Percentage
Overall	944742.8	2700429	-1755686.2 ***	-65.02%
Single and female head of hh (Yes=1)	943242.4	2448034	-1504791.6 ***	-61.47%
Single and female head of hh (No=0)	945028.2	2748439	-1803410.8 ***	-65.62%
Climate shock (Yes=1)	896799.4	2581689	-1684889.6 ***	-65.26%
Climate shock (No=0)	980796.3	2789722	-1808925.7 ***	-64.84%

Table 4 shows the Average Treatment Effects on Treated (ATET). Overall, child abandonment appears to worsen households' income significantly. Comparing actual income (under child abandonment) with a counterfactual under the hypothesis that the same households did not abandon, we conclude that child abandonment is not a fruitful strategy to improve farmers' welfare. Also, and more specifically, single and female heads households seem to be less affected by abandonment; at the same time, child abandonment does not appear as a solution to (self-declared) climate shock.

5. Concluding remarks and further steps

As it emerges from our preliminary analysis, climate related shocks may be relevant in driving the decision of household in relation to child abandonment. Other variables affecting this decision are of a (direct or indirect) economic relevance: in other words, we may expect child abandonment to be, at least partly, related to the economic conditions of the household, which also affect crop income. Preliminary results from Average Treatment Effects analysis, along the lines sketched in section 2, suggest that abandonment does not appear a fruitful strategy to improve farmers' welfare.

The coming steps of our work will concentrate on completing our analysis (among other things, by bootstrapping standard errors), on improvements in the robustness of our results as well as on the development of the Average Treatment effects analysis, in order to be able to better assess the impact of child abandonment (and therefore of its drivers) on households' income and welfare.

References

Bourguignon, F., Fournier, M. and Gurgand, M. 'Selection bias corrections based on the multinomial logit model: Monte-Carlo comparisons', Journal of Economic Surveys, Vol. 21, (2007) pp. 174–205.

Food and Agriculture Organization of the United Nations (FAO). 'Study on the Impact of Armed Conflicts on the Nutritional Situation of Children' (Rome, 1996).

Fuchs, R.G. Abandoned Children: Foundlings and Child Welfare in 19th Century France, (Albany, State University of New York Press, 1984).

Fuchs R.G. 'Legislation, poverty, and child-abandonment in nineteenth-century Paris'. The Journal of interdisciplinary history, Vol. 18, No. 1 (1987), pp. 55-80.

Gennetian, L. 'The supply of infants relinquished for adoption: Did access toabortion make a difference?' Economic Inquiry, 37-3 (1999), pp. 412–431

Guemple, L. 'Inuit adoption'. Ottawa: Canadian Museum of Civilization, Canadian Ethnology Service. Mercury Series 47 (1979).

Hunecke V. I trovatelli di Milano: Bambini esposti e famiglie espositrici dal XVII al XIX secolo. (Bologna: Il Mulino, 1989).

Khun C., Lahiri S. 'The economics of international child adoption: An analysis of adoptions by U.S. parents, The Quarterly Review of Economics and Finance, Vol. 64 (2017), pp 22-31.

McFadden, D. 'Qualitative response models', in: W. Hildenbrand (ed.), Advances in Econometrics (Cambridge, UK: Cambridge University Press, 1980).

Medoff, M. H. 'An empirical analysis of adoption', Economic Inquiry, 31 (1993), pp. 59–70.

Medoff, M. H. 'The effect of abortion costs on adoption in the USA', International Journal of Social Economics, Vol. 35- 3 (2008), pp.188-201.

Mundlak, Y. 'On the pooling of time series and cross section data', Econometrica, Vol. 46, (1978) pp. 69–85.

Murtazashvili, I., & Wooldridge, J. M. A control function approach to estimating switching regression models with endogenous explanatory variables and endogenous switching. *Journal of Econometrics*, 190(2), (2016) pp. 252-266.

Smolin, D. M. 'Intercountry adoption and poverty: A human rights analysis'. *Capital University Law Review, 36*, (2007) pp. 413–453. Retrieved from

Wooldridge, J. M. Econometric Analysis of Cross Section and Panel Data (Cambridge, MA: MIT Press, 2002).

United Nations. The Millennium Development Goals Report 2015, United Nations. (New York, United Nations Publications, 2015).