Households’ Consumption Vulnerability to Natural Shocks in Niger: Insights from Livestock mortality and Insect Damage

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ABSTRACT

This study seeks to assess the households' consumption vulnerability to livestock mortality and insect damage in Niger. Ordinary Least Square regression, Unconditional Quartiles regressions and a set of poverty simulations are performed on the panel data of the National Household Living Conditions and Agriculture Survey of Niger. The results indicate that livestock morality and insect damage are heterogeneously impeding households' consumption growth. In fact, households which experienced a higher consumption growth have most felt the effect of livestock mortality; while insect damage has only a significant negative effect on households that observed a lower consumption growth. Furthermore, the simulations results reveal that these shocks are poverty drivers in Niger which calls for insurance and social protection setting up. The study reveals also that income control by women, education, livelihood diversification, fecundity reduction, access to microcredit and access to mobile phone seem to be resilience factors to natural shocks that should be strengthened.
Keywords: Natural shocks, Resilience, Poverty, Niger.
JEL classification codes: O12, D12.

1 INTRODUCTION

In Niger, a landlocked poor country of Africa South of the Sahara, the economy depends strongly on agriculture which occupies more than 80 percent of the workforce and contributes to more than 40 percent of the Gross Domestic Product (GDP). This activity is not only the main source of revenue but also the main source of food (HCI 3N, 2012; World Bank, 2013a). For example, Livestock, only, generates about 10% of the income for rural households and up to 43% of households income in pastoral zones (Zezza, 2012) while nearly 25% of the food needs are meet by the Livestock (Republic of Niger, 2011). For the World Bank (2013b), in Niger, over 60% of households rely in part on their own agricultural production to meet their consumption needs. Moreover, in this country most of the chronic poor are crop farmers of which almost 8 in 10 live in households where the principal activity is crop farming. Livestock, on the other hand, fares slightly better with only 2 percent of the chronic poor engaged primarily in livestock rearing (World Bank, 2013b).

A sustainable agricultural growth is necessary for poverty reduction acceleration in Niger. However, agriculture in Niger is handicapped by its low productivity and its exposition to a number of risks due to natural shocks. Among these latter, insect damage and livestock mortality constitute a threat to agriculture and accordingly, exacerbates the food insecurity in the country. For example, Locust outbreak is high frequency high severity risk in Niger and almost one-third of losses during 2004–05 food crises is attributed to it, with adverse impact on both crop and livestock sector (World Bank, 2013a). In addition, considering livestock significance for Niger's economy, livestock mortality is another principle risk for the country development (World Bank, 2013a). During the 2009-2010 pastoral crisis about 24% of the livestock of Niger are loosed due to fodder deficit (38%) and diseases (35%) (Republic of Niger, 2011). In this context, the living conditions of the population are particularly precarious in Niger, as no insurance company is currently active in the agricultural sector. In other words, protecting households from insect damage and cattle mortality is necessary for poverty reduction.

The importance of risk reduction to ending poverty and fostering sustainable development is well recognized by the international community (United Nation, 2016). Available empirical studies found a negative impact of natural shocks on households' welfare (Arouri et al. 2015; Rodriguez-Oreggia et al. 2012) by increasing poverty and inequality (Benson, 1997). In addition, studies at micro level have also shown that poor households are likely to suffer not only from low levels of welfare on average but also from fluctuations in their welfare due to their limited coping ability (Fafchamps, 2003; Dercon, 2005; De Haen and Hemrich, 2007). Furthermore, for many households, the possibility of loss resulting from a shock also leads to excessive risk avoidance and preference for low-risk, low-return activities (Oviedo and Moroz, 2013). Dercon and Christiaensen (2011) found that the risk of reduced consumption affects the adoption of agricultural technology by farmers in rural Ethiopia.

The literature also found that Livestock mortality and insect damage could transmit poverty between generations and keep people in long-run poverty. Indeed, these vulnerability factors may have a lasting impact. For example, after a shock of livestock mortality, the reconstruction of a herd takes several years and may even become impossible in some cases (Grain de Sel. 2013). In addition, selling livestock in order to obtain food is one example of what has been described as a poverty trap syndrome related to asset depletion (Carter et al. 2008). With respect to insect damage, De Vreyer et al. (2015), found that the 1987–89 locust plague in Mali has a strong impact on the educational outcomes of children living in rural. Banerjee et al. (2007) showed that by the time they were 20 years old, the children of wine-growing families born during the grapevine roots Phylloxera attacks destroying 40% of French vineyards between 1863 and 1890 were 0.6–0.9 centimeters shorter than others. The study of Akresh et al. (2011) in Rwanda reached a similar negative impact on height. Takashi et al. (2005) found that community-level crop damage in Ethiopia leads to growth loss in children aged 6 to 24 months.

Furthermore, it is important to note that despite the growing interest for the effect of natural shocks at micro level in recent years, the number of empirical studies exploring their impacts on households' welfare is very low (Arouri et al. 2015). In addition, there is no enough focus in the literature on the natural shocks effects according to their type. For Kurosaki (2015), the available evidences emphasized more the idiosyncratic shocks welfare impacts despite that aggregate risks are much more important than idiosyncratic sources of risk (Ligon and Schechter, 2003). In reality, households are normally nested in various communities such that any shock at the community level will affect households within the community (Azeem et al., 2016) and this can render ineffective households coping strategies. For example, Porter (2012) found that covariate shocks affects significantly households' consumption but idiosyncratic shocks not in rural Ethiopia because with idiosyncratic shocks households can use village risk sharing strategies but these mechanisms become inefficient with covariate shocks. However, there has been less effort in micro-econometric studies to explain the sources and impacts of aggregate shocks than idiosyncratic shocks and this calls for research on the microeconomic impacts of covariate shocks (Kurosaki, 2015).

The present study seeks to add to the literature on the impacts of natural shocks on households' welfare by assessing the vulnerability of households' consumption to covariate chocks of livestock mortality and insect damage in Niger and simulate their impacts on poverty. Specifically, this study attempts to investigate the following questions: Do livestock mortality or insect damage increase households' consumption vulnerability? What are the distributive effects of livestock mortality and insect damage on households' consumption growth? And what are the impacts of livestock mortality and insect damage severity on poverty? These evidences are important for efficient policy formulation in Niger to mitigate the effects of natural shocks that will hit with increasing frequency as the world prepares for a changing climate (IPCC, 2014).

The rest of the paper is structured as follows. Section 2 describes the empirical strategy for the assessment of the vulnerability of household consumption to livestock mortality and insect damage. Section 3 presents the data used and a descriptive analysis. Section 4 presents the results of the econometric estimations and poverty simulations. Finally, section 5 is devoted to the conclusion.

2 EMPIRICAL STRATEGY

To analyze the households' consumption vulnerability to natural shocks in this study, a reduced form of household welfare model is estimated econometrically (Arouri et al., 2015). The outcome variable is defined as function of household characteristics and variables that indicate shocks. Two types of econometric model are estimated in this study. The first estimation is the ordinary least square regression in order to highlight the average effects of livestock mortality and insect damage on household consumption growth. The second estimation is quantiles regression for the distributive effect analysis. Finally, an equation is generated to simulate these shocks effects on poverty.

It is important to note that the primary problem is estimating the effect of livestock mortality and insect damage is their probable endogeneity as unobserved variables including both village-level and household-level variables may be correlated with these natural shocks variables. Since livestock mortality and insect damage are village-level variables, they are more likely to be correlated with unobserved village-level variables which can be decomposed into time-variant and time invariant village-level variables.

To deal with this endogeneity issues Arouri et al. (2015) used the commune fixed-effect regression to eliminate unobserved time-invariant commune-level variables by assuming that the remaining endogeneity bias will be negligible after the elimination of the unobserved time invariant variables and the control of observed variables if shocks variables are weakly correlated with unobserved time-variant variables. In this study, as we have only two surveys for the panel data we follow a similar approach to overcome the endogeneity of livestock mortality and insect damage following Kurosaki (2015). In fact, we assume that the dependent variable in the econometric model is the first difference of the logarithm of the nominal consumption expenditure per adult equivalent converted into real term by dividing this value by the national poverty line ($\Delta ln\ C_i = ln\ C_{i,2} - ln\ C_{i,1} = \ln\left(\frac{C_{i,2}}{C_{i,1}}\right) = \ln\left(\frac{C_{i,2}-C_{i,1}}{C_{i,1}} + 1\right) \approx \frac{C_{i,2}-C_{i,1}}{C_{i,1}}$). $C_{i,t}$ is known as the "welfare ratio" where subscript i refers to individual i and t to the survey year. So, unobservable time-invariant variables at household-level and village-level that affect consumption are controlled cleanly. Furthermore, an idiosyncratic health shock variable is added in the model to minimize this bias.

2.1 Average effects estimation

The average effect is estimated using ordinary least square regression approach. The econometric model for household i is define as follows:

$$\Delta ln\ C_i = X_i b_0 + b_1 S_{1v} + b_1 S_{2v} + b_3 S_{3i} + \varepsilon_i \quad (1)$$

where X_i is a vector of household head characteristics in the first wave of the panel data comprising the household head gender, age and its square, education level, socioeconomic group, marital status, ethnicity, household size, the share of different members age groups, possession of mobile phone, distance from household to nearest market and presence of bank or microcredit center in the village where the household lives; S_{1v} is a measure of village-level livestock mortality shocks that occurred between the two survey in village v where household i lives; S_{2v} is a similar measure of village-level insect damage; S_{3v} is the idiosyncratic health shock; b_0 is a vector of parameters to be estimated; b_1, b_2 and b_3 are parameters to be estimated which show the average impact of village-level and idiosyncratic shocks on consumption growth; and ε_i is a zero mean errors term.

2.2 Distributive effects estimation

The objective of the second estimation is to assess the effect of livestock mortality and insect damage along the distribution of household consumption growth. Estimation methods that go beyond the mean have to be used. A convenient way of characterizing the distribution of consumption growth is to compute its quantiles. For that purpose, we resort to unconditional quartiles regression following Firpo et al. (2009) which characterizes the heterogeneous impact of the shocks on various points of the outcome distribution. The unconditional quantile regression is based on the Re-centered Influence Function (RIF). This latter is a widely used tool in robust estimation that can easily be computed for each quantile of interest. The method consists of regressing the RIF for the quantile to evaluate the impact of changes in the distribution of covariates on the conditional quantiles of the marginal distribution of the dependent variable. This approach provides the opportunity to assess the effects in terms of marginal effect comparing to unconditional quantile regression of Koenker and Bassett (1978). In fact, conditional quantiles do not average up to their unconditional population counterparts. As a result, the estimates obtained by running conditional quantile regression cannot be used to estimate the impact of shocks on the corresponding unconditional quantile.

2.3 Poverty impact simulations

We use the results from average effects estimation of livestock mortality and insect damage to generate an equation to simulate the impact of these natural shocks severity increase or mitigation on poverty. More precisely, as variable S_{1v} and S_{2v} are binary and the outcome variable is logarithmic, the marginal effects of livestock mortality and insect damage on household consumption growth ($\Delta ln\ C_i = \ln\left(\frac{C_{i,2}}{C_{i,1}}\right)$) are respectively, $e^{b_1} - 1$ and $e^{b_2} - 1$. This means that living in a village hit by livestock mortality or insect damage induces a change in the ratio $\frac{C_{i,2}}{C_{i,1}}$ by $e^{b_1} - 1$ or $e^{b_2} - 1$ percent. Therefore a relation between shocks and household welfare can be define as follows:

$$C_{i,2}^{s} = (e^{b_1(1_{(S_{1v}=1)}S_{1v}) + b_2 1_{(S_{2v}=1)}S_{2v})})C_{i,2} \quad (2)$$

Where $C_{i,2}^{s}$ is the simulated household welfare ratio and $1_{(S_{1v}=1)}S_{1v}$ and $1_{(S_{2v}=1)}S_{2v}$ are binary indicator variables taking the value 1 if shocks occurred in the village and 0 otherwise. The idea of the simulation is to vary the values of b_1 and b_2 which generate new $C_{i,2}^{s}$ values. Accordingly, The Foster–Greer–Thorbecke indices FGT(0), FGT(1) and FGT(2) are calculated from $C_{i,2}^{s}$.

3 DATA AND DESCRIPTIVE ANALYSIS

3.1 Data sets

The data used come from, *Enquête Nationale sur les Conditions de Vie des Ménages et l'Agriculture* (ECVMA), also known as the National Household Living Conditions and Agriculture Survey in Niger. It is a panel survey. The first wave was done in 2011 and the second wave in 2014. As part of this survey, the number of sampled households is around 4000. Each wave took place in two passages, that is to say that each household is visited twice. During the first passage, household and agriculture/livestock questionnaires were filled as well as the community questionnaire/prices. In the second passage, the household questionnaires and agriculture/livestock are filled in.

The sample for the ECVMA 2011 includes approximately 4,000 households in 270 Enumeration Areas (EA). The sample is nationally representative, as well as representative of Niamey, other Urban and Rural. Within the rural EAs, the sample is also representative of three ecological zones - agricultural zones, agro-pastoral zones, and pastoral zones. Households visited in 2011 were revisited in 2014. Households and individuals who moved after the 2011 survey were tracked. When the entire household moved within Niger, the household was found and re-interviewed in 2014. When individuals from the household moved, one individual per household was selected to follow.

It is important to note that it is the community questionnaire that has been exploited to determine livestock mortality and insect damage shocks. The livestock mortality is that due to epizootics, forage deficit, and flood of Cattle, Sheep, Goats, Camelins or Asins while the insects' damage is about serious insect attack against the harvests in the village. These shocks are precisely derived from answers to a shock module incorporated in community questionnaire asking respondents whether in their village they experienced different types of shocks during the past five years. As the first wave started in July 2011 and the second wave ended in March 2015, we can assume that the shock reported in the different villages have taken place within the two surveys. However, despite these are subjective measures of shocks, this approach of measuring event is popular and largely applied in the literature (eg. Ligon and Schechter, 2003; Dercon, 2005; Dutta et al. 2010; Kurosaki, 2015; Urouri et al., 2015).

3.2 Descriptive analysis

After matching and cleaning the two data waves the final size of the sample is 3018. Table 1 displays the summary statistics of the variables retained for the analysis from the sample. The dependent variable denoted $\Delta ln\ C_i$, mean is 0.667 and it ranges from -10.191 to 30.294 which indicates that there are households whose consumption growth is negative during the period. The proportion of households headed by women is 0.131. In average households' heads are 45.5 years old and most of them have no formal education level. Indeed, only 12% of them have accomplished the primary school and 7.7% the secondary school.

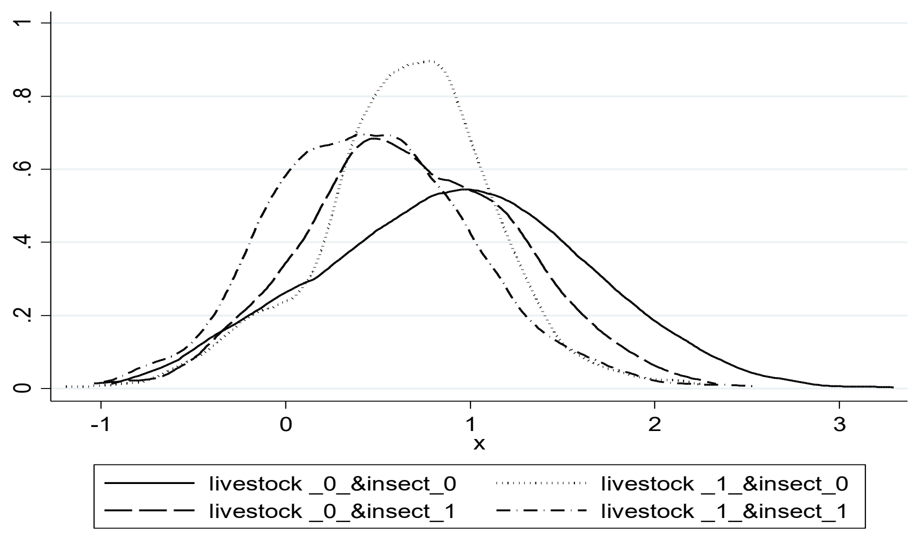
Table 1: Summary Statistics of the sample

Variables	Obs	Mean	Std-Dev	Min	Max
$\Delta ln\ C_i$	3018	0.667	0.626	-10.191	30.294
Sex (Ref. Male)	3018	0.131	0.337	0	1
Age(/100)	3018	0.455	0.144	0.170	0.950
Age(/100) square	3018	0.228	0.143	0.029	0.903
Primary school (Not educated)	3018	0.120	0.325	0	1
Secondary school	3018	0.077	0.267	0	1
Tertiary school	3018	0.019	0.137	0	1
University	3018	0.025	0.155	0	1
Informal salaried(formal)	3018	0.062	0.241	0	1
Agricultural self-employed	3018	0.564	0.496	0	1
Nonagricultural self-employed	3018	0.219	0.413	0	1
Non-working	3018	0.066	0.248	0	1
Haussa (Ref. Djerma/Songhai)	3018	0.370	0.483	0	1
Kanouri-Manga	3018	0.095	0.293	0	1
Peul	3018	0.067	0.251	0	1
Touareg	3018	0.164	0.371	0	1
Other Niger Ethnicities	3018	0.034	0.182	0	1
Foreigners	3018	0.017	0.128	0	1
Monogamous(Ref. Single)	3018	0.684	0.465	0	1
Polygamous	3018	0.182	0.386	0	1
Household Size	3018	6.50	3.350	1	30
Share age group 0_10	3018	0.360	0.213	0	0.833
Share age group 10_20	3018	0.201	0.185	0	1
Share age group 20_30	3018	0.158	0.175	0	1
Share age group 30_40	3018	0.104	0.128	0	1
Share age group 40_50	3018	0.065	0.100	0	1
Mobile Phone	3018	0.585	0.493	0	1
Bank/ Microcredit Center	3018	0.347	0.839	0	6
Distance home-Market (/100 km)	3018	0.579	0.544	0.001	20.373
Livestock mortality	3018	0.552	0.497	0	1
Insects' damage	3018	0.511	0.500	0	1
work incapacity sickness duration	3018	10.218	10.825	0	18

Source: Author calculations

Most of these households heads are agricultural self-employed. The proportion of these latter among the total number of households heads is 56.4% of the total while that of non-agricultural self-employed is 21.9%. The percentage of non-working and informal salaried households heads are respectively 6.6% and 6.2%. With respect to households' heads ethnicity, despite its diversity the Hausa are the majority group with a proportion of 37% followed by Djerma/Songhai ethnic group. The proportion of Kanuri-Manga is 16.4%, that of peul 6.7% and Touareg 16.4%. The analysis of marital status shows that households are predominantly monogamous with a proportion of 68.4% while the percentages of polygamous and single are 18.2% and 13.4% respectively. The average household size is 6.5 members with members aged from 0 to 10 years representing the largest share with a proportion of 0.36, followed by those of the age group from 10 to 20 years old with a proportion of 0.20. The share of members aged from 20 to 30 years olds is 0.158 while that of those aged from 30 to 40 years olds is 0.104. In these households, the mobile phone ownership seems widespread. About 58.5% of households are mobile phone owner. With regard to microcredits agency or bank access only 34.7% of households live in a community with such structure. The access to market seems also a constraint for households as the average distance to reach a market is 57.9 km. Furthermore, 55.2% and 51.2% of the households live in villages hit respectively by livestock mortality and insect damage. Finally, the average work incapacity sickness duration in the last month is 10.218 days. This denotes that health shocks is also a major problem for households in Niger.

Figure 1: welfare variation distributions



Source: Author calculations

To further the descriptive analysis, the distributions of consumption growth according to the type of shocks occurred in the villages are mapped. Four groups are identified and depicted in figure 1, the group of households living in villages that are not affected by any of the shocks (livestock _0_&insect_0), those living in villages affected by livestock mortality only (livestock _1_&insect_0), those living in villages affected by insects damage only (livestock _0_&insect_1) and those living in villages affected by the two shocks (livestock _1_&insect_1). It appears that, the consumption growth distribution of households group not affected by any shock is more spread to the right than the other distribution indicating that the households living in villages not affected by shocks have the higher consumption growth. The households living in villages hit by the livestock mortality and insects seems to have the lowest consumption growth. To find out if there is significant statistical difference between the distributions, that of the group of households living in villages that are not affected by any of the shocks is taken as the reference and the test of komolgorov-Sirmirnov is conducted. The results are displayed in table 2.

Table 2: Komolgorov-Smirnov tests of distributions

Smaller groups	Difference	P-Value
livestock _1_&insect_0	-0.2551	0.000
livestock _0_&insect_1	-0.1761	0.000
livestock _1_&insect_1	-0.3195	0.000

Source: Author calculations

The hypothesis tests the group of households living in villages that are not affected by any of the shocks contains larger values than the other groups. For any of the test, the approximate P-value is 0.000 which is significant. In other words, the group of households living in villages that are not affected by any of the shocks contains larger values than the other groups. The order of the largest difference between the distribution functions is livestock _1_&insect_1, livestock _1_&insect_0 and livestock _0_&insect_1.

4 EMPIRICAL FINDINGS

4.1 Econometric findings

Table 2 presents the results of the econometric estimations of the model defined in the methodology. The first column contains the estimates of the model from the ordinary least square regression method and the last three columns are the unconditional quartile regressions results. The different regressions have each an R-squared greater than 0.20. Moreover, it should be stated the standards errors of the unconditional quartiles regressions are bootstrapped.

Table 1: econometric estimate of the model

VARIABLES	MEAN	QUANTILE(0.25)	QUANTILE(0.50)	QUANTILE(0.75)
Sex (Ref. Male)	0.142(0.045)***	0.092(0.068)	0.181(0.066)***	0.163(0.066)**
Age(/100)	1.004(0.443)**	0.870(0.686)	1.123(0.634)*	0.674(0.725)
Age(/100) square	-0.826(0.433)*	-0.571(0.688)	-0.977(0.631)	-0.429(0.698)
Primary school (Not educated)	0.138(0.028)***	0.106(0.045)**	0.102(0.042)**	0.171(0.042)***
Secondary school	0.304(0.036)***	0.186(0.044)***	0.187(0.050)***	0.354(0.059)***
Tertiary school	0.412(0.069)***	0.182(0.061)***	0.258(0.075)***	0.563(0.126)***
University	0.701(0.064)***	0.169(0.050)***	0.306(0.060)***	0.824(0.099)***
Informal salaried(formal)	-0.255(0.049)***	-0.124(0.067)*	-0.337(0.077)***	-0.271(0.087)***
Agricultural self-employed	-0.424(0.040)***	-0.399(0.056)***	-0.502(0.062)***	-0.432(0.081)***
Nonagricultural self-employed	-0.057(0.040)	0.026(0.046)	-0.060(0.051)	-0.034(0.081)
Non-working	-0.159(0.050)***	-0.180(0.072)**	-0.127(0.066)*	-0.226(0.094)**
Haussa (Ref. Djerma/Songhai)	0.028(0.023)	0.103(0.044)**	0.036(0.032)	-0.029(0.033)
Kanouri-Manga	0.193(0.035)***	0.337(0.049)***	0.197(0.054)***	0.059(0.044)
Peul	0.217(0.038)***	0.364(0.063)***	0.251(0.061)***	0.118(0.064)*
Touareg	0.239(0.031)***	0.385(0.050)***	0.327(0.048)***	0.124(0.046)***
Other Niger Ethnicities	0.441(0.051)***	0.756(0.071)***	0.597(0.089)***	0.107(0.074)
Foreigners	0.253(0.070)***	0.209(0.056)***	0.316(0.072)***	0.162(0.135)
Monogamous(Ref. Single)	0.058(0.044)	0.036(0.063)	0.134(0.069)*	0.061(0.067)
Polygamous	0.090(0.050)*	-0.007(0.071)	0.165(0.075)**	0.155(0.079)*
Household Size	-0.035(0.004)***	-0.037(0.007)***	-0.042(0.006)***	-0.039(0.006)***
Share age group 0_10	-0.523(0.083)***	-0.454(0.128)***	-0.478(0.118)***	-0.446(0.127)***
Share age group 10_20	-0.156(0.088)*	-0.061(0.130)	-0.187(0.123)	-0.017(0.148)
Share age group 20_30	0.248(0.092)***	0.100(0.135)	0.283(0.124)**	0.445(0.144)***
Share age group 30_40	0.149(0.096)	0.039(0.146)	0.142(0.128)	0.315(0.149)**
Share age group 40_50	0.094(0.107)	-0.060(0.152)	0.001(0.140)	0.194(0.170)
Mobile Phone	0.151(0.021)***	0.149(0.036)***	0.149(0.033)***	0.138(0.029)***
Bank/ Microcredit Center	0.034(0.011)***	0.054(0.016)***	0.037(0.017)**	0.018(0.016)
Distance home-Market (/100 km)	-0.024(0.019)	0.019(0.027)	0.000(0.026)	-0.075(0.032)**
Livestock mortality	-0.054(0.022)**	-0.028(0.037)	-0.058(0.030)*	-0.120(0.040)***
Insect Damage	-0.068(0.020)***	-0.114(0.032)***	-0.110(0.033)***	-0.038(0.029)
work incapacity sickness duration	-0.010(0.005)**	-0.019(0.008)**	-0.011(0.007)	0.000(0.008)
Constant	0.811(0.142)***	0.326(0.204)	0.787(0.202)***	1.277(0.213)***
Observations	3,018	3,018	3,018	3,018
R-squared	0.448	0.219	0.294	0.310

Source: Author calculations. Standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Significant results emerge from these estimates. First, the ordinary least squares method, which gives an average effect, indicates that livestock morality and insect damage have a negative impact on the household's consumption growth in Niger. In other words, living in a village that experienced livestock mortality or insect damage shocks reduced households' consumption growth by about -5.26% at 5% and -6.57% at 1% respectively. These results indicate that households' consumption is vulnerable to natural shocks that negatively affect its growth. The results from the distributive analysis based on the unconditional quartiles regression lead to the same conclusion and evidence the heterogeneous effects of these natural shocks on households' consumption growth. In fact, livestock mortality shock effect is only significant at the second and third quartiles at the significance level of 10% and 1% respectively and the size of the impact is higher at the third quartile than at the second one. This indicates that it is the households that experienced a higher consumption growth that have most felt these effects. This result can be explained by the fact that these households depend not only on livestock but also on other sources of livelihood and this high observed consumption growth results from these sources which compensate the negative effect of livestock mortality. However, insect damage has only a significant negative effect on the first and second quartiles with higher effect at the first quartile that is to say households that observed weak consumption growth. This indicates that these households are those depending mainly on agriculture and have less other sources of livelihood which can compensate the negative effect of insect damage. These are particularly the poor households who dependent only on agriculture for their subsistence.

The other explanatory variables reveal several determinants of households' consumption growth that can serve as policy levers to increase the resilience of households to natural shocks. First, there is a positive effect of the sex of the household head. More precisely, the fact that the household is headed by a woman positively impacts the consumption growth in average. However, it is important to note that this effect is heterogeneous as only at the second and third quartiles that it is significant at 1% and 5% respectively. In other words, female gender contributes positively to households' consumption growth with a higher effect among household experiencing higher welfare variation. This result indicates that it is important to increase not only the income of the households but also its control by women to combat poverty in Niger. Another important finding is related to the educational level of the household head. It appears that the fact that a household head has attained at least primary school is positively correlated to consumption growth in average and the higher the level of education the higher the return on consumption growth. In addition, the effect of educational level is higher among households experiencing high consumption growth as revealed by the unconditional quartiles regression results. The socioeconomic groups of the household determines also its consumption growth as being informal salaried, agricultural self-employed or non-working affects negatively the welfare growth at 1% in average compared to formal worker. The difference due to socioeconomic group is more pronounced at the second quartile for informal salaried and agricultural self-employed while for non-working it is a third quartile. The ethnic group also matters for households' consumption growth. In fact, being Kanuri-Manga, Peul or Touareg significantly improves household consumption compared to being zarma at 1% significance level in average. This finding is also similar to those at the first and second quartiles. With respect to marital status of the household head, even if the effect of monogamous modality is not significant in average, the fact that a household head is monogamous impacts positively the consumption growth at the second quartile at 10% compared to being single. The polygamous status also influences significantly the consumption growth at 10% in average and at

5% and 10% at the second and third quartiles respectively. Another important finding is related to household structure which denote that, in average the shares of members aged from 0 to 10 years and from 10 to 20 years reduced significantly the consumption growth at 1% and 10%. With respect to the share of member aged from 0 to 10 years, the results are significant at all quartiles. However, the share members aged from 20 to 30 years olds affects positively the welfare variation in average and at the third quartile at the significance level of 1%. The effect is significant also at the second quartile but with less magnitude than at the third quartile. These members are generally part of the active population that can contribute to household labor income. The results from the structure of the households' show that the increase of dependence rate due to high fecundity rate increases the vulnerability of households' consumption in Niger. In other word, family planning is necessary to increase the resilience of household to natural shocks. The finding with respect to mobile phone is also interesting, in fact owning a mobile phone increases positively the households' consumption growth at the significant level of 1% in average and at all the quartiles. Living in a village with Bank or microcredit center influences also positively the households' consumption growth with the highest effect at the first and second quartile. However, access to market indicated by the distance from the household dwelling to market, seems to influence significantly the households' consumption growth only at the third quartile at 5%. The last finding is that of the idiosyncratic shock related to health shock that reveals that the work incapacity sickness duration reduces significantly the households' consumption growth at 5% in average. Nevertheless, it is important to precise that the effect is only significant at the first quartile. In other words, households that observe small consumption growth are those more affected by this health shock because as we show above these households dependent mainly on agriculture activity which is based on muscle power in Niger.

4.2 Poverty Simulations

In this section we conduct the simulations of poverty impact of livestock mortality and insect damage. Two hypothetical scenarios of simulations are conducted on poverty status of the country whose results are displayed in table 4.

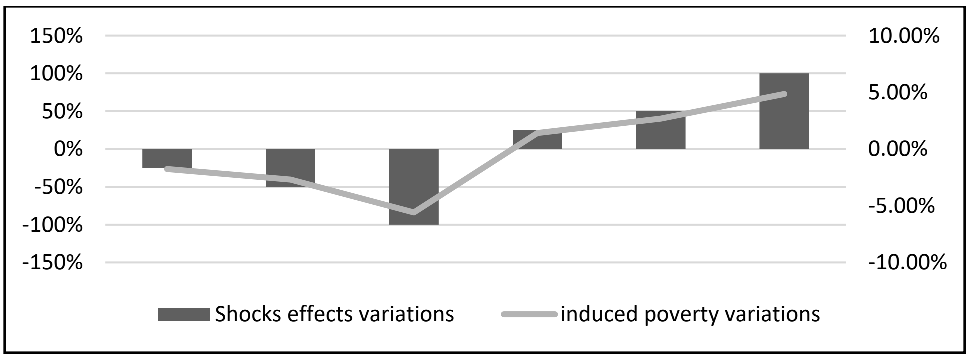
Tableau 4: Poverty simulations results

		Effects Reduction			Effects Increase		
	Base line	-25%	-50%	-100%	+25%	+50%	+100%
Livestock mortality	-0.054	-0.0405	-0.027	0	-0.0675	-0.081	-0.108
Insect Damage	-0.068	-0.051	-0.034	0	-0.085	-0.102	-0.136
FGT(0)	42.45%	-1.77%	-2.69%	-5.59%	+1.41%	+2.68%	+4.85%
FGT(1)	12.29%	-0.53%	-1.04%	-1.98%	+0.55%	+1.12%	+2.31%
FGT(2)	4.94%	-0.25%	-0.48%	-0.91%	+0.26%	+0.54%	+1.14%

Source: Author calculations

The first simulations group is the reduction of shocks severity from the decrease of the magnitudes of their effects. Here we assume that there are mechanisms in place that reduce the impact of shocks like insurance or social protection. Three simulations are conducted consisting in a simultaneous reduction of 25%, 50% and 100% of the actual observed effect of livestock mortality and insect damage. Interestingly, all the simulations reveal the improvement of households' welfare through the reductions of poverty rate. In fact, a 25%, 50% and 100% reduction of actual effect of these shocks decrease poverty rate compared to what is observed currently in the data by 1.77%, 2.69% and 5.59% respectively. The severity of the poverty is also reduce by 0.53%, 1.04% and 1.98% which indicates that the gap to fill in order to move households out of poverty is reduced. The second group of simulations inquire what would be the poverty status in Niger if the magnitudes of the observed shocks were higher. A simultaneous increase of 25%, 50% and 100% of the livestock mortality and insect damage shocks magnitude are simulated. It is found that the increase of the shocks intensity of 25%, 50% and 100% deteriorates households' welfare by increasing the poverty rate of 1.41%, 2.68% and 4.85% respectively. The severity of the poverty has also worsened as the gap to fill in order to move households out of poverty has increased of 0.55%, 1.12% and 2.31% compared to the actual situation observed in the data. Figure 2 displays the induced poverty rate variation according to shocks effects variations.

Figure 2: Poverty Evolution according



Source: Author calculations

If nothing is done the efforts of poverty reduction will be undermine by natural shocks as they will frequently hit with higher intensity with the climate change that the world will experience. The number of chronic poor households may also increase as shocks that reduce consumption are most severe for poor households (Dercon et al., 2005) and for non-food items (Skoufias and Quisumbing 2005). Natural shocks have also the capacity of keeping the poor in vicious circle of the poverty by discouraging them from high return investment. For example, Dercon and Christiaensen (2011) investigates the impact of the risk of reduced consumption on the adoption of agricultural technology by farmers in rural Ethiopia and find that the possibility of failed harvests – resulting in reduced consumption – is an important factor preventing farmers from using fertilizer.

These results call for households' protection from natural shocks. Social protection should be in place in order to protect households and, due to heterogeneous effects of shocks, targeting is also necessary to maximize the impact of the intervention. In addition, factors increasing households' resilience should be strengthen like households' income control by women, education, diversification of livelihood for household depending only on agriculture, reduction of fecundity, access to microcredit and access to mobile phone. Finally, Agriculture insurance against a common shock (index insurance) like group insurance policies should be active in Niger with incentive to households to subscribe. As stated by de Janvry et al. (2014), group insurance policies which exclude the feasibility of free riding are likely to be preferred and, from a commercial perspective, such policies are likely to be offered at a lower cost because they spread fixed costs over a larger insured area.

5 CONCLUSION

The present study seeks to assess the vulnerability of households' consumption to livestock mortality and insect damage in Niger. The data used are two waves panel data from the *Enquête Nationale sur les Conditions de Vie des Ménages et Agriculture* (ECVMA). Linear least square regression is performed to estimate the average effects and unconditional quartiles regressions are performed to analyze the effect along the households' consumption growth distribution. Furthermore, a simulations is conducted to estimate the effect of livestock mortality and insect damage on poverty.
The results indicates that livestock morality and insect damage have a negative impact on the household's consumption growth in Niger as living in a village that experienced livestock mortality or insect damage shocks reduced households consumption growth. This highlights that households' consumption is vulnerable to natural shocks. In addition, it is found that the effects of these shocks are heterogeneous according to households' consumption growth. In fact, households which experienced a higher consumption growth have most felt the effect of livestock mortality while, insect damage has only a significant negative effect on households that observed a lower consumption growth. The simulations of poverty impact of livestock mortality and insect damage reveal that these natural shocks are poverty drivers and protecting households from their effects is important for poverty reduction in Niger. Accordingly, social protection should be in place and due to heterogeneous effects of these shocks targeting is also necessary. Finally, agricultural insurance against a common shock (index insurance) like group insurance policies should be also active in Niger.

The other explanatory variables analysis reveals several determinants of households' consumption growth that can serve as policy levers for protecting households to natural shocks effects. Indeed, factors like household income control by women, education, diversification of livelihoods sources for household depending only on agriculture, reduction of fecundity, access to microcredit and access to mobile phone seem to increase households' resilience and accordingly should be strengthened.

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