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Poverty, Malnutrition and Vulnerability in Mali

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Abstract

This paper provides new insight into the poverty, malnutrition and vulnerability issues in Mali, using existing household survey data. First, it presents a profile of households that are poor, "food poor," or have malnourished children. Second, it explores the impact of recent weather and price shocks on household welfare and identifies those affected most by the shocks. Finally, it estimates vulnerability to poverty by modeling both households' expected consumption and their consumption volatility, and by distinguishing between idiosyncratic and covariate risks. The basic results of the analysis match conventional knowledge about poverty, food poverty, and malnutrition. The prevalence of chronic malnutrition is high in Mali, with 44 percent of Malian households and 66 percent of food poor Malian households having at least one stunted child. A 25 percent increase in cereal prices and a 25 percent decrease in cereal production are estimated to increase the number of food poor by 610,000 people. An estimated US$ 5.4 million of extra aid per year will be needed to lift the newly food poor above the food poverty line. About US$ 182 million is needed to do this for all existing and new food poor. Vulnerability incidence is in general two to three times higher among the poor than the non-poor, except in urban areas and in the region of Sikasso where the vulnerability incidence is five to six times higher among the poor. Overall, vulnerability is mostly driven by poverty induced vulnerability, except in the capital, Bamako, where vulnerability is more driven by risk induced vulnerability.

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Poverty, Malnutrition and Vulnerability in Mali

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Introduction

The objective of this paper is to shed light on the poverty, malnutrition and vulnerability profile in Mali before the March 2012 coup and assess the impacts of some production and price shocks the country has sustained recently. The Malian economy was buffeted by a partial drought in 2011. Furthermore, by summer 2012, the coup and internal strife had led to some 320,000 refugees, of which some 40-45% was internally displaced refugees. That is about 27% of the population of the North of Mali. The disruption of the normal life and production capacity of a large number of Malians are expected to have considerable effects on their vulnerability and ability to cope.

The paper identifies the poor, food poor and malnourished in Mali, providing a short profile of their characteristics and where they are. It assesses the impact of the recent food price and food production shocks on these different groups. We also estimate the impact of the internal refugees staying with relatives, finding that this arrangement affects the welfare of host families. The study then analyzes the vulnerability of Malians, looking at whether this vulnerability is poverty induced (low mean consumption) or risk induced (high consumption volatility), as well as whether it is induced by idiosyncratic risk or covariate risk. A final section provides suggestions for further analytical extensions. The data used for this analysis are from the household survey ELIM/MICS 2009/2010, the latest available for such an analysis.

A household is considered poor if its per capita consumption is below the national poverty line. This was set at 165,431 FCFA (approx. 346 USD) per capita per year for the ELIM/MICS 2010 survey. A household is said to be 'food poor' (or extremely poor) if its level of total expenditure per capita is below the national food poverty line. In 2010, this food poverty line was set at 118,173 FCFA per person per year (approx. 247 USD). This food poverty line is defined as the minimum consumption expenditure needed to meet the cost of consuming 2,450 kilocalories per day, reflecting Malian consumption habits.

Malnutrition indicators are based on nutritional outcomes (weight and height) measured for all children aged 0-59 months in the ELIM-MICS 2009/10 survey. Three basic malnutrition indicators are considered here (stunting, wasting and underweight). Stunting is based on a child's height and age. It is a measure of chronic nutritional deficiency.[i,ii] Wasting is based on a child's weight and height. It is a measure of short-term nutritional deficiency.[iii] Underweight is based on a child's weight and age. It is a composite measure of chronic and acute nutritional deficiency.[iv]

I. The characteristics of the poor, the food poor and the malnourished

In this section we look at different groups of vulnerable households and we compare them across common dimensions such as: household characteristics, location characteristics, activity, assets owned, welfare, and transfers received. We compare the general Malian population to (1) the poor, (2) the food poor and (3) malnourished (households with at least a 'stunted' child; stunting is also referred to as chronically malnourished).

For the analysis of malnourishment, we focus on the subsample of households for which information on children's nutritional outcomes is available. These are all the households with at least one child under the age of 5 years old. Using population weights, this subsample is representative for about 937,400 households or 10.8 million people (the total population of Mali was 14.5 million in 2010).

Overall, the prevalence of malnutrition in Mali is high. This counts especially for chronic malnutrition. 44 percent of households have at least one child that is chronically malnourished. This prevalence of malnutrition is even higher among the poor (59%) and among the food-poor (66%).[v] In 2010, the proportion of people in Mali who were food poor (lived in a household whose consumption per person was below the food poverty line) was 22 percent (or some 3.1 million people).

Table 1: Prevalence of malnutrition among the whole population, the poor and the food poor (%)

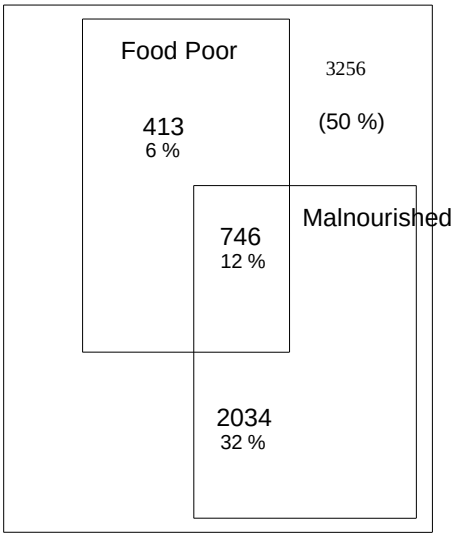
Households with at least:	Whole population	Poor	Food poor
one wasted child	18	23	25
one stunted child	44	59	66
Both	11	17	20

***Source**: Authors' calculations using ELIM –MICS 2010*

Food poverty is positively associated with malnutrition. The graph plots in Annex 1 show that there is a positive association between food poverty and malnutrition at the district level in Mali. This relation is strongest for chronic malnutrition. The correspondence is however not perfect, and we find households who are food poor but not malnourished (upper-left part of the graph plots) as well as households who are not food-poor but who are malnourished (lower-right part of the plots). Furthermore, it is noteworthy that while food poverty affects malnutrition outcomes by restricting access to food resources, lack of access is not the unique channel to malnutrition. A proper utilization of the resources, as well as other environmental factors such as sanitation and access to health services, also influence nutritional outcomes.

Looking at the intersection between food poverty and chronic malnutrition, we find that 12 percent are both malnourished and food poor. Six percent are food poor but not chronically malnourished and 32 percent are malnourished but not food poor at the time of the survey. The remaining 50 person are neither food poor nor malnourished.

Figure 2.1: Distribution Between Food Poverty And Chronic Malnutrition



Source: June 5, 2012

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A. Household characteristics

Poor, food poor and malnourished households are larger than the median household size in Mali. The median household in Mali is composed of 9 members. In comparison, the food poor households have 12 members and malnourished households have 15 members. The poor and vulnerable households are also characterized by a larger average number of dependent members (1.5-1.6 dependent members for every active member compared to 1.4 on average for the whole population). In addition, poor and food poor households are also more likely to have an older head of household (51-52 years old of median age compared to 48 for the whole country) and they are more likely to be headed by members with no primary level education. On the other hand, households with heads that have secondary or more education are much less affected by poverty, food poverty and stunting. Female headship does not appear to affect households negatively, as fewer of these households are food poor. This phenomenon is seen often in poverty analysis and follows largely from our definition of welfare[vi] (Table 2).

Table 2: Household characteristics of the poor, the food poor and the malnourished

Household characteristics	Overall population	Poor	Non-poor	Chronically malnourished
Household size (median)	9	11	12	10
Age dependency ration	1.4	1.6	1.6	1.5
Female headed (proportion of column)	7%	6%	4%	7%
Head's age (median)	48	51	52	50
Head: no education	77%	87%	90%	85%
Head: primary education only	11%	9%	9%	10%
Head: secondary education or more	12%	4%	2%	6%
Total	**100%**	**100%**	**100%**	**100%**
Total number of sample households	6449	2335	1159	2095
Population estimate- individuals (millions)	10.8	5.1	2.6	
Population estimate – households (millions)	0.9	0.35	0.16	0.31

Source: authors' calculations using ELIM –MICS 2010

B. Location characteristics

While 77 percent of the overall Malian population lives in rural areas, nearly all the poor (90%) and the food poor (93%) are concentrated in rural areas and (table 3). Most (84%) of the malnourished live in rural areas. Households with malnourished children are spread across the country in proportion to the population. The only exception perhaps is Sikasso where the chronically malnourished are more overrepresented (19% of the chronically malnourished live there while only 16% of the population does) (table 3). While 11 percent of our population resides in the northern regions of Mali (Timbuktu, Gao, and Kidal) the share of poor and food-poor households living in the North is actually smaller than the national average. This is because the northern regions are the least populated in Mali. Poverty rates in the Sikasso region are fairly high despite despite good agricultural conditions and cotton production. This so-called 'Sikasso Paradox' is partly caused by the relatively high poverty line that is set for this region (Delarue etal. 2009, Dury and Bocoum 2012, World Bank, 2012).

Table 3: Distribution of the poor, the food poor and the malnourished among regions and among rural/urban areas (%)

	Whole population	Poor	Food poor	Chronically malnourished
Rural	77	90	93	84
Urban	23	10	7	26
Total	**100**	**100**	**100**	**100**
Northern regions	11	8	6	11
Rest of Mali	89	92	93	89
Total	**100**	**100**	**100**	**100**
Kayes	13	8	5	12
Koulikorou	17	14	11	17
Sikasso	16	34	45	19
Segou	16	18	19	17
Mopti	15	16	13	16
Timbuktu	6	4	3	6
Gao	5	3	3	4
Kidal	0	0	0	0
Bamako	13	2	1	8
Total	**100**	**100**	**100**	**100**

Source: Authors' calculations using ELIM –MICS 2010 household survey

C. Occupational activity

In terms of occupational activity of the household's head, those mainly engaged in agricultural activities are overrepresented among the poor, food-poor and the malnourished. That is especially so for farmers working in cotton producing districts (Table 4).[vii,viii]

Table 4: Distribution of the poor, the food poor and the malnourished among main sector of activity of the head of household (%)

	Whole population	Poor	Food poor	Chronically malnourished
Wage earner (public sector)	13	6	4	9
Wage earner (private sector)	5	2	0	3
Employer	1	0	0	1
Farmer	59	81	86	69
Other independent	22	11	9	18
No job	5	3	2	4
Total	**100**	**100**	**100**	**100**
Farmer in cotton producing district	21	41	52	28
Farmer outside cotton producing district	40	41	35	44
Not farmers	39	18	12	29
Total	**100**	**100**	**100**	**100**

Source: authors' calculations using ELIM –MICS 2010 household survey data

D. Assets and welfare[ix]

Food-poor households appear to have few assets (worth 10.107 FCFA per capita). This implies that in addition to being extremely poor they also tend to be very vulnerable. In case of weather or health shocks they have limited assets that they can sell to meet emergency needs. The food-poor and the malnourished are over-represented among livestock owners: 35 percent of the poor and 36 percent of the food-poor own livestock while 27 percent of all Malian households do (Table 5). However in case of shocks such as droughts, livestock prices often tend to drop dramatically reducing the ability of these households to turn them into cash to purchase emergency needs.

Table 5: Assets of the poor the food poor and the chronically malnourished

	Whole population	Poor	Food poor	Chronically malnourished
Mean consumption expenditure per capita (FCFA)	206,901	121,025	95,092	177,942
Value of owned durable goods (median per capita, FCFA)	18,571	11,062	10,107	15,408
Owns livestock (cows, sheep, goat, camels) (% of column total that does)	27%	35%	36%	32%
Value of livestock (median, FCFA)	393,519	450,640	477,897	433,088

Source: authors' calculations using ELIM –MICS 2010 household survey data

We analyze the characteristics of the food poor and malnourished households with low levels of assets (Table A 2 in Annex). Results suggest that the group with low assets tend to have smaller households and a higher ratio of dependent/ active household members compared to those with high assets. Malnourished households with low assets are more likely to be headed by a member with less than primary education. Furthermore, the amount of assets held does not reveal any geographical pattern, except for Sikasso. While this region houses only 16% of the Malian population, it has 36% of the food-poor with low-asset holdings. Malnourished households with low levels of assets are only over-represented in farming and primary sector (respectively 84% and 85%).

E. Transfers

Transfers such as remittances from household members or support from the state or NGOs can improve household resilience. We find that the poor food poor and malnourished households are as likely as other households to receive domestic transfers (21-22%) (Table 6). The median value of these transfers (in per capita terms) is however about 2500, 1875 and 3333 FCFA per capita for the poor, the food poor and the malnourished respectively, less than other households , who receive 4166 FCFA per capita. Fewer poor and food-poor households receive foreign remittances compared to all households (12-14% against 19%) but the median value of the transfers received is about the same (about 5000 FCFA). The

poor and food poor households who do not receive family assistance are over-represented in Sikasso and Segou, while the malnourished without family remittances are over-represented in Sikasso, Segou and Mopti. The incidence of public transfers is marginal with less than 1% of the population receiving transfers.

Table 6: Transfers received by the poor, food poor and the malnourished

	Whole population	**Poor**	**Food poor**	**Chronically malnourished**
Proportion receiving domestic remittances	22%	22%	21%	22%
Value (median per capita, FCFA)	4167			
Proportion receiving foreign remittances	19%	14%	12%	19%
Value ((median per capita, FCFA)	10,000	5,556	5,000	9,339
Proportion receiving public transfers	0.8%	0.7%	0.3%	0.6%
Value ((median per capita, FCFA)	13,636	9,545	11,604	8,438

Source: authors' calculations using ELIM –MICS 2010 household survey data
Note: percentages are across columns, i.e. 22 % of the whole population receives domestic remittances.

II. Impact of recent cereal price and production shocks on the food-poor

Mali has experienced shocks to cereal prices due to the international rise in cereal prices in recent years (2008/2009 food price rises as well as 2011 price rises). Also, the country experienced partial drought in 2011, affecting production of cereals, especially rice. In February 2012 the government of Mali assessed 111 communes at risk of food crisis while another 85 were identified as communes in economic difficulty due to the drought. Globally, there was need to assist some 3.575 million Malians. In this section we use the ELIM-MICS 2010 data to simulate the impact on the food poor of such cereal price and production shocks.

The food-poor are highly dependent on purchases and self-production of cereals in their total consumption. Nationwide, cereals form on average about a quarter of household consumption, half of which are purchased grains with the other half being self-produced grains. The share of purchased grain in overall consumption is highest in Timbuktu and Gao (22%) and lowest in Sikasso (6%). In Timbuktu and Gao (Northern Mali) cereals form about a third of total household consumption indicating the overall vulnerability of this region to changes in cereal prices and production.

Table 7. Share of purchased and self-produced cereals in total consumption by region

Region	Share of purchased cereals in total consumption (%)	Share of self-produced grain in total consumption (%)	Share of both purchased and self-produced grain in total consumption (%)
Kayes-Koulikourou	11	11	22
Sikasso	6	17	23
Mopti-Ségou	11	16	27
Tombouctо-Gao	22	10	32
Bamako	15	1	16
Total	12	12	24

Source: authors' calculations using ELIM –MICS 2010

We assess the impact of recent cereal price and production shocks on the number of food poor, that is, the people that have a total consumption level that is below the food poverty line of 118 173 FCFA per person per year. We do this by looking first at the amount of cereals households purchased in 2010 using the ELIM survey of that year and the share of purchased and self-produced cereals in total consumption. We then calculate the extra amount those households would have to pay to purchase that same amount of cereals, given the post price increase. We assume that quantities of cereals bought do not change

and that there is no substitution into other food items. We subsequently reflect the loss of purchase power by reducing household consumption expenditure by the extra costs they would incur to buy the same amount of cereals at higher prices. For self-produced cereals we calculate the value of the reduction in cereal production following the drought and adjust total consumption expenditure accordingly. We then assess the effect these changes in consumption expenditure have on food poverty rates across the country.

In 2010 the total number of these food poor people was 3.2 million (22% of the population), of which a majority lived in Sikasso, Mopti and Segou. Following the 2011 drop in cereal production (estimated at 25% at end December 2011) due to localized drought, the number of the food poor is estimated to have increased by 363,000 people. If we also take into account the rise in cereal prices and the consequent drop in purchase power, the total amount rises by another 174,000 people, *increasing the number of food-poor Malians from 22% to 26% of the population or an additional 610.000 people.* The largest absolute increase is in Mopti-Segou where 227,000 more people become food poor as consequence of the combined shocks. The largest relative increases are witnessed in northern regions of Mali where the proportion of people living in food poor households increases by 41% (in total an additional 58,000 households) (See Table 8). This implies that even before the March 2012 coup, the northern regions of Mali was already witnessing the largest relative increase in the number of food poor households in the country, following the price and production shocks of 2011.

Table 8. Number of people (in '000) per region under the fod poverty line without and with shocks

	No of existing food poor	**Food poor if cereal prod reduces by 25% (a)**	**Food poor if cereal prices rise by 25% (b)**	**Both shocks (a) + (b)**	**Number of additional food poor people**	**% increase in food poor people**
Kayes-Koulikoro	578	674	636	744	166	29%
Sikasso	1504	1619	1543	1653	149	10%
Mopti-Ségou	977	1122	1013	1204	227	23%
Tombouctou-Gao-Kidal	141	159	173	199	58	41%
Bamako	51	47	66	66	14	28%
Total	3210	3574	3385	3821	610	19%
Additional (no)		363	174	610		
Additional (% of total population)		2.5%	1.2%	4.2%		

Source: Authors' calculations using ELIM –MICS 2010.

Those who have become food poor following both shocks are overwhelmingly located in rural areas. However, the rise in cereal prices also increases the number of the food poor

households in urban areas by some 30,000 people. Most of the newly food poor are farmers or livestock owners (88%) while 6% are self-employed and 4% without employment. The elderly are somewhat overrepresented: 40% of the newly food poor live in a household headed by someone older than 60 years, whereas this group represents only 32% of the population.

Asset ownership among those who have fallen below the food poverty line due to these shocks is relatively low. The median worth of these household assets is on average about 10,100 FCFA per capita compared to the median of 18,400 FCFA for the rest of the population (table 9). In contrast, livestock ownership tends to be higher among the group that has fallen below poverty line (a median of 27,000 FCFA per capita compared to 18,000 FCFA among the rest of the population).. The median worth of household assets and livestock combined is 48,000 FCFA per capita among this group, or about half the food poverty line. So if they fall 10% below the food poverty line, selling all their assets would enable them to get back to the food poverty line for just six months. This clearly would be nothing more than a very temporary solution.

Table 9. Value of assets per capita in FCFA for the new food poor (following shocks)

	The new food poor following production and price shocks	**Rest of the population**
Median value of household assets	10,100	18,400
Median value of livestock assets	27,104	17,934
Median value of both household and livestock assets	47,800	57,200
Mean family remittances	2,400	10,400
Median transfers from NGOs or government	8,000	12,500

Source: Authors' calculations using ELIM –MICS 2010 household survey data. Note: The "new food poor" are those that will fall below the food poverty line following the production and price shocks.

Remittances and support by NGOs and the government can play an important role in cushioning shocks. Households can be identified using the ELIM 2010 survey. Using this data we estimate that of the 610,000 people who have become food poor following the two shocks about 33% receives family remittances. But only about 0.1% have received any transfers from NGOs or the government The amounts received per person per year are small. Average levels per capita of these remittances are FCFA 2400 per year for those that have fallen under the food poverty line following the shocks as compared to FCFA 10.400 for the rest of the population.

Under the scenario of the country experiencing a 25% drop in cereal production and a 25% cereal price increase, and assuming perfect targeting of aid, an estimated 2.7 billion FCFA (US$5.4 million) per year of additional assistance will be needed to raise the level of consumption of the households who have fallen below the food poverty line back up to the

food poverty line. 39 percent of these funds are needed in Mopti-Segou, as the largest number of people who have fallen below the food poverty line are located there. About 12 percent of this amount is needed in northern Mali. These are not very large amounts. If we include the households that already were below the food poverty line before the shocks, the total amount is much higher: about 182 million USD per year.

A. The welfare effect of the current political/security crisis on Malian households

The March 2012 coup and consequent events have led to the vulnerabilization of an additional number of Malians. The 87 communes forming the three regions of north Mali (Timboucou, Gao, Kidal) and the 17 communes of the neighboring Mopti are now in humanitarian crisis. The government places the preliminary number of individuals affected at an additional 1.76 million Malians. Some the 320,000 Malians have fled. Some 55% have taken refuge in neighboring countries (Mauritania, Niger, Burkina and Algeria) while some 45% are domestically displaced persons. The domestically displaced Malians have moved to all southern regions, but an important number have remained in the Mopti – Segou area, region that is immediately adjacent to the conflict area due to language and familial affinities. This influx of displaced persons is reportedly placing economic pressure on both host and guest households. Food prices since then have increased even further and the increase in the number of food poor household is therefore expected to be even higher than estimated above.

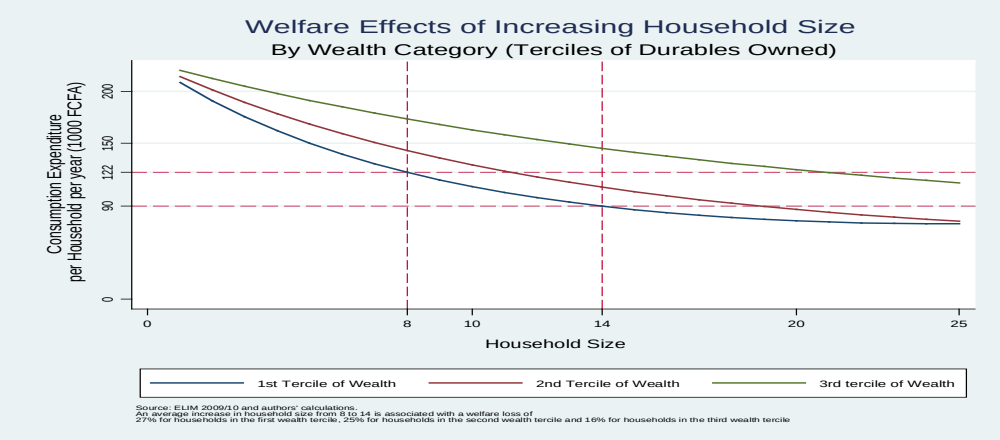
Welfare loss for the northern household is large, regardless of whether they have been dislocated or not. It is associated with loss of current assets and revenues as well as earning potentials in the future, not to mention the health and educational consequences of the crisis on the welfare of all northern households. Undertaking an estimation of this welfare loss is not feasible at this stage as it requires a thorough survey.

The southern households are also bound to be affected by the political, security and economic uncertainties. One element of this impact is the welfare effect of the dislocation of a typical northern household on a typical southern host household. This will likely increase the vulnerability of the recipient households. We estimate this welfare loss as follows. We note that the median household size is 6 in the Northern regions and 8 in the South. On average, an increase in household size from 8 to 14 (+75%) is associated with a welfare loss of about 27% if the host household belongs to the first wealth tercile, 25% if it belongs to the second tercile, and 16% if it belongs to the third (see figure 2). These welfare changes are rough estimates for short term effects and do not take into account any welfare contribution by the displaced household.[x]

The security situation in the north of Mali and continued political uncertainty in the south will affect the prospects for economic recovery as the transitional government prepares for reunification of the country and elections in 18 to 24 months. This uncertainty suggests

further downside risks for the welfare of the Malians, but especially the sizeable vulnerable groups.

Figure 2.1: Poverty Rate And Vulnerability Incidence At The District Level
(Cercles)



III. Vulnerability to poverty

A. Concept and methodology

Household income in developing countries is generally very volatile because poor households are often exposed to household specific and community level shocks. Moreover, available insurance mechanisms to protect income from the influence of these shocks are often absent or imperfect. Therefore, poverty status observed at some point in time might not be the best guide to inform about households' long term wellbeing.

In this section, we assess the households' ex-ante vulnerability to poverty. We use Chaudhury (2003) methodology to estimate vulnerability based solely on cross-sectional data. We measure vulnerability as the conditional probability of a household's income to fall below the poverty line in the next period. A household will be classified as vulnerable if its predicted vulnerability level is above a defined threshold. Usually a threshold of 0.5 is chosen in the literature. Under this framework, the source of vulnerability can be decomposed into high volatility (risk induced vulnerability) and low mean consumption (poverty induced vulnerability).

This approach is extended by introducing idiosyncratic and covariate risks. This is done by introducing a multilevel random effect model (Gunther and Harrtgen (2009)). [2] The consumption risk faced by households is defined by household specific risks (idiosyncratic

[2] This approach has also been taken more recently by Imai etal. (2011) and Imai (2011).

risks) and community level risks (covariate risks). Distinguishing between idiosyncratic and covariate risks is important for two reasons. First, informal risk sharing mechanisms taking place at the community level can be effective in partially insuring idiosyncratic risk but will remain vulnerable to the realization of aggregate risks (covariate risks). Second, making this distinction is relevant from a policy perspective to design the most appropriate safety net mechanisms. The targeting of the vulnerable population for example will differ according to whether shocks are dominantly idiosyncratic or covariate. The details of this methodology are presented in the annex.

B. Results

We estimate two specifications for our empirical model of log consumption per capita. The set of explanatory variables X_{ij} includes household demographics (household size, age dependency), head of household's characteristics (gender, education level, activity), some indicators of wealth (livestock ownership, wealth index[3]) and rainfall shocks experienced at the commune level in 2008 and in 2009.[4]

The first specification is a simple OLS model (column 1 in Table 10). The sizes of the household and female headship each has a negative marginal contribution to welfare and is associated on average with 4% lower consumption per capita. Households where the head has completed primary education have on average a 3% premium on consumption per capita compared to households where the head has no education. For households where the head has completed secondary education, this premium is close to 12%. Wealth is positively associated with total consumption expenditure per capita, whether we look at livestock ownership or at measures based on durable goods ownership and housing.

Farming households living in districts where cotton production is an important activity are significantly worse off compared to the other households. [5] Consumption per capita is almost 30% lower for these households, everything else held equal. This is not a new finding since – as mentioned above - many studies have already documented the so-called "Sikasso paradox" situation in which poverty rates are surprisingly high in a fertile region dominated by cash crop production (Delarue etal. 2009, Dury and Bocoum 2012, World

[3] The wealth index is based on a principal component analysis based on durable goods ownership and on housing conditions.

[4] Rainfall data come from the NASA Tropical Rainfall Measuring Mission (TRMM) which provides a narrowly gridded (0.25x0.25 degrees of longitude and latitude) dataset of accumulated precipitation. Monthly data at aggregated for 2008 and 2009, and commune level rainfall is imputed from the 5 closest grid points using an Inverse Distance Weighting (IDW) algorithm. Rainfall shocks are then constructed based on the yearly standardized deviation from the 1998-2011 commune-specific precipitation average: $z_{ct} = \frac{R_{ct} - \overline{R_{c,1998-2011}}}{\sigma^{R}_{c,1998-2011}}$ where R_{ct} is the accumulated rainfall in commune c and year t, $\overline{R_{c,1998-2011}}$ is the average yearly rainfall for commune c between 1998 and 2011, and $\sigma^{R}_{c,1998-2011}$ is the standard deviation of yearly accumulated rainfall for commune c between 1998 and 2011.

[5] The ELIM 2010 survey did not ask directly to the respondents whether households were explicitly engaged in cotton production. Our cotton variable is constructed as the intersection between the set of households engaged in agriculture and the set of households living in districts where the Malian state owned cotton company (CMDT) operates (http://www.maliagriculture.org/services_tech/cmdt/page-cmdt.html).

Bank, 2012). However, to our knowledge, this is the first study looking at the issue with a regression analysis.

Finally, rainfall shocks experienced at the commune level in 2008 and 2009 are positively associated with welfare. Households experiencing a one standard deviation drop in local precipitation in 2009 have on average a 6% lower consumption per capita (-5% for a similar magnitude shock experienced in 2008).

We also estimate a multilevel random effect model (second column in Table 10) with a cluster level specific effect. The estimated coefficients for the household and the cluster level variables remain in the same order of magnitude. We are now able however to decompose the unexplained variance into a between cluster component and a within cluster component. The unexplained variance in consumption accounted for by the covariate (between cluster variance) accounts for about 28% of the total unexplained variance. The remainder is explained by idiosyncratic risk only (within cluster variance).

Table 10

Dependent: Log consumption per capita

VARIABLES	OLS	Multilevel Random Effect
Household size	-0.0457***	-0.0427***
	(0.001)	(0.001)
Household size squared	0.0005***	0.0005***
	(0.000)	(0.000)
Age dependency over size	-0.322***	-0.350***
	(0.024)	(0.021)
Female Head	-0.0418***	-0.0636***
	(0.015)	(0.014)
Primary education	0.0334**	0.0463***
	(0.015)	(0.013)
Secondary+ education	0.115***	0.129***
	(0.015)	(0.014)
Secondary sector	-0.0431**	-0.0360**
	(0.019)	(0.018)
Tertiary sector	-0.00087	0.00919
	(0.015)	(0.015)
Public sector	0.0013	0.0031
	(0.016)	(0.015)
Cotton district	-0.354***	-0.229***
	(0.014)	(0.020)
Small cow herder (<10)	0.0334***	0.0495***
	(0.012)	(0.011)
Large cow herder (>10)	0.122***	0.136***
	(0.021)	(0.019)
Small sheep herder (<10)	0.0394***	0.0306***
	(0.011)	(0.010)
Large sheep herder (>10)	0.113***	0.0722***
	(0.020)	(0.019)
Wealth index Q1	-0.207***	-0.158***
	(0.015)	(0.014)
Wealth index Q2	-0.0837***	-0.0754***
	(0.014)	(0.013)
Wealth index Q4	0.102***	0.140***
	(0.015)	(0.015)
Wealth index Q5	0.390***	0.404***
	(0.018)	(0.018)
Yearly rainfall shock (z-score) 2008	0.0569***	0.0623***
	(0.004)	(0.008)
Yearly rainfall shock (z-score) 2009	0.0625***	0.0833***
	(0.011)	(0.020)
Constant	12.73***	12.66***
	(0.019)	(0.021)
Between cluster variance		0.051***
		(0.003)
Within cluster variance		0.129***
		(0.002)
Observations	9,036	9,036
R-squared	0.487	.

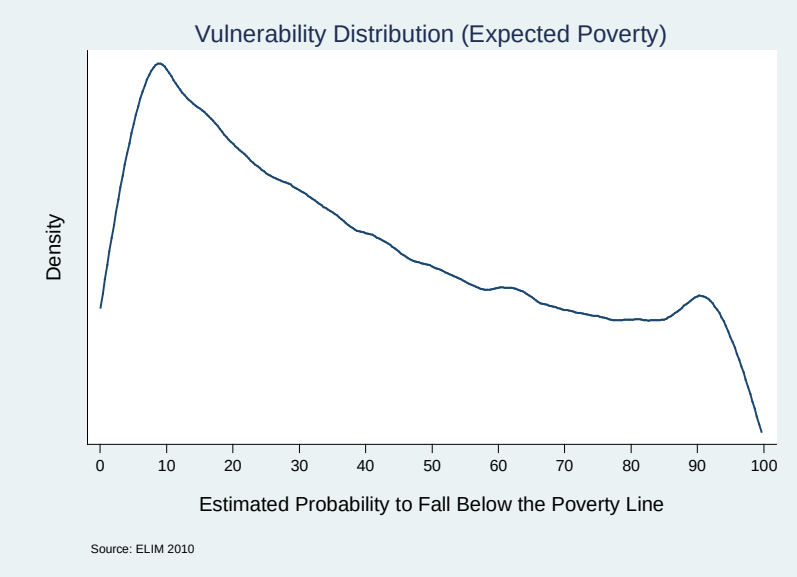
Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Source:

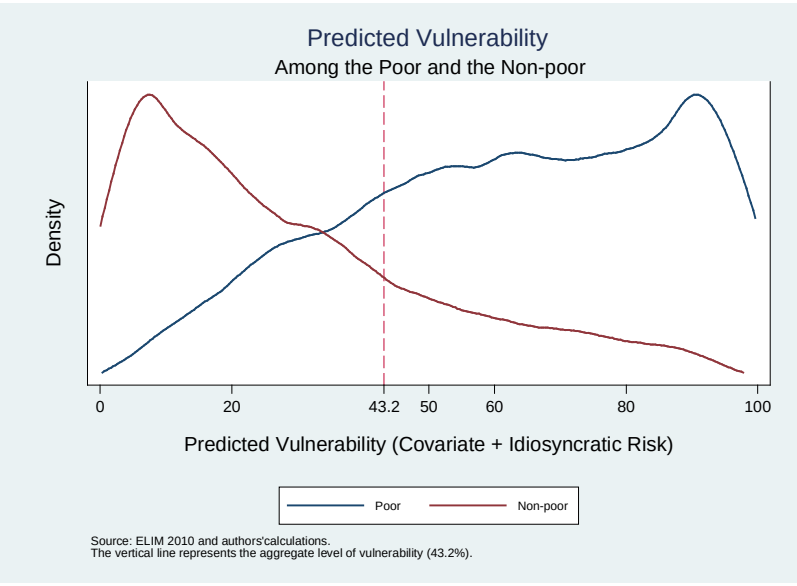
27. The population weighted means vulnerability is close to 43%, ranging from 0.1% to 99%. We plot its distribution in Figure 3.

Figure 3:



While poverty and vulnerability to poverty are closely related, the two concepts are not the same and the set of vulnerable households does not overlap exactly with the set of poor households (Figure 4). Poor households are on average more vulnerable (61.8%) than non-poor households (28.7%).

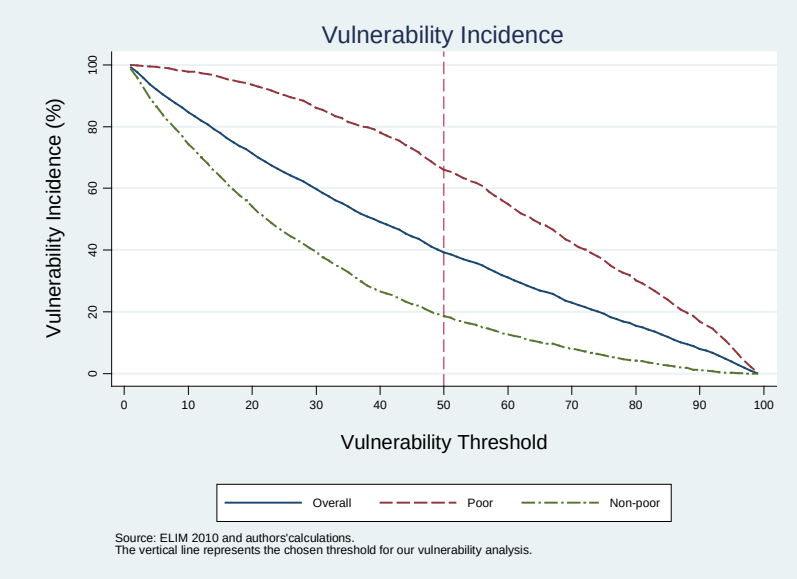
Figure 4



However, if we choose 0.5 for our vulnerability threshold (i.e. a household will be classified as vulnerable if its probability to fall below the poverty line is higher than 50%), we note that not all the poor households are classified as vulnerable (34% are not vulnerable), and some non-poor households are classified as vulnerable (19%). Figure 5

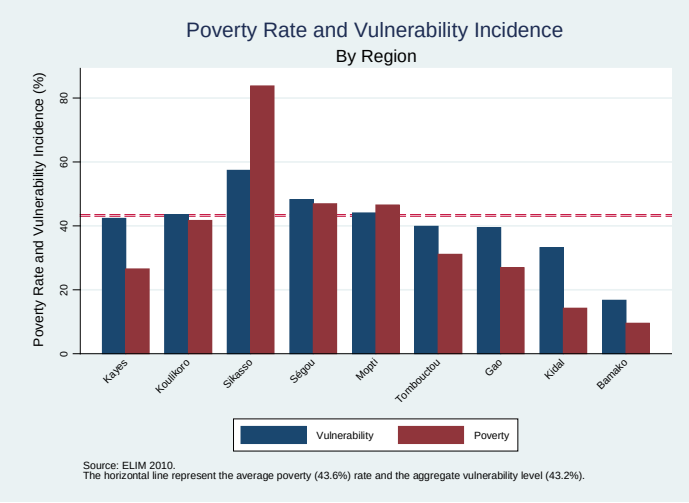
below also shows how the vulnerability incidence varies between poor and non-poor when we vary the threshold above which households are classified as vulnerable.

Figure 5



At the regional level, average vulnerability also tends to be higher where poverty rates are higher, but again, there is no one to one mapping between poverty and vulnerability. Sikasso appears to be the region where both poverty and vulnerability are the highest in the country (Figure 6).

Figure 6



From Figure 7 and 8, we see however, that the high vulnerability incidence in Sikasso is mostly a concern of the households who are already poor. Among households with levels of welfare above the poverty line, vulnerability is not higher in Sikasso than other regions. One implication is that to reduce vulnerability in a region like Sikasso, designing safety net

mechanisms such as cash transfers targeting the poor seems to be a valid option. In other regions, like Segou for example, where vulnerability seems to be driven as much by high consumption volatility as by low mean consumption, introducing insurance mechanisms may also be a viable policy to consider.

Figure 7

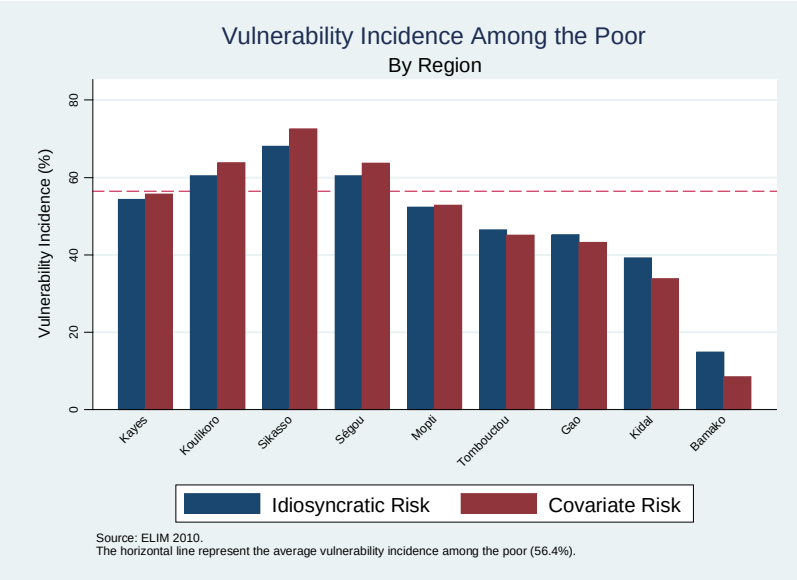


Figure 8

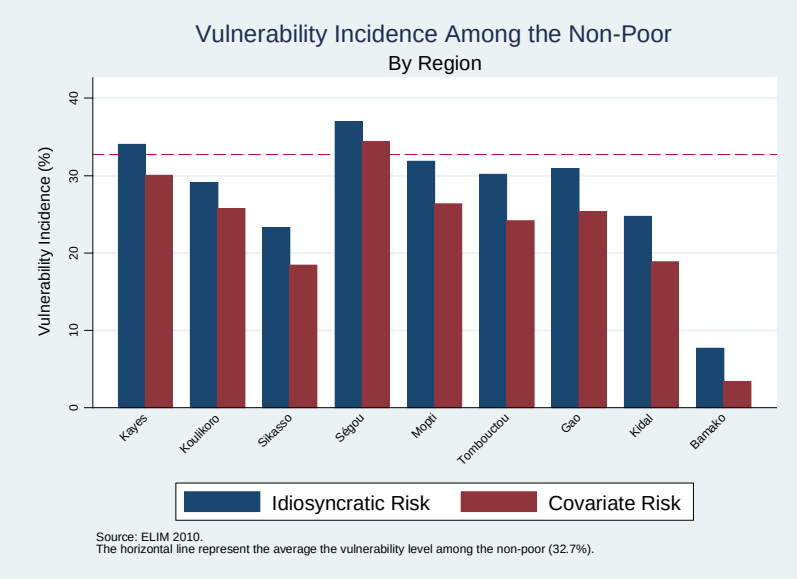
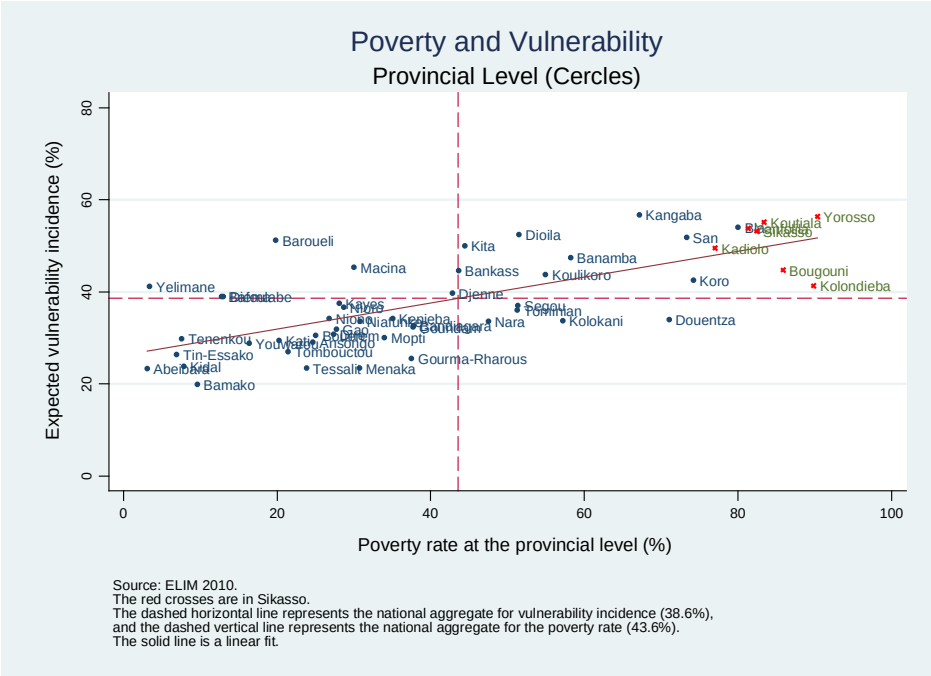


Figure 9 suggests that poverty and vulnerability in Sikasso are equally high in all districts. Plotting the poverty rate against the vulnerability incidence at the district (cercle) level, we

see that all the districts of Sikasso are in the upper right quadrant (high poverty-high vulnerability).

Figure 9



In Table 11 we compare the poverty rate and the vulnerability incidence across regions. Overall, vulnerability among the poor is 3.5 times higher than among the non-poor. However, in Bamako, in other urban areas, and in the region of Sikasso vulnerability among the poor is between 5 and 6 times higher than among the non-poor.

Table 11: Vulnerability and poverty across regions

	Poverty Rate	Vulnerability Rate			
		Overall (1)	Poor (2)	Non-poor (3)	(2) / (3)
Overall	43.6%	39.2%	65.9%	18.6%	3.5
Urban	30.7%	15.7%	37.3%	6.1%	6.1
Rural	50.6%	48.1%	69.9%	25.9%	2.7
Regions					
Kayes	26.5%	33.4%	56.5%	25.0%	2.3
Koulikoro	41.7%	41.2%	66.6%	23.0%	2.9
Sikasso	83.8%	73.0%	84.0%	16.5%	5.1
Segou	47.0%	51.0%	69.4%	34.7%	2.0
Mopti	46.6%	31.1%	47.9%	16.4%	2.9
Tombouctou	31.1%	19.9%	35.9%	12.7%	2.8
Gao	26.9%	19.9%	33.2%	15.0%	2.2
Kidal	14.3%	9.0%	16.8%	7.8%	2.2
Bamako	9.6%	1.4%	5.4%	1.0%	5.3

Source: ELIM 2010 and authors' calculations.

In Table 12 we decompose vulnerability by distinguishing between poverty induced vulnerability (i.e low mean consumption) and risk induced vulnerability (i.e high consumption volatility). This distinction is important because the policies seeking to reduce households' vulnerability would differ according to which source of volatility is most prevalent. If vulnerability is driven only by high volatility in consumption then designing policies to reduce exposure to risks or to strengthen households' ability to cope with risks once they occur might be right strategy. If however vulnerability is also driven by low mean consumption, then policies aimed at improving livelihoods such as cash transfers might be necessary to complement risk reduction strategies.

If we focus on this dimension of vulnerability, we see from the table below that in Bamako, vulnerability is mostly driven by high volatility (risk induced). In other cities and also in rural areas however, vulnerability seems to be mostly driven by low mean consumption.

Table 12: Vulnerability decomposition

	National	Bamako	Urban	Rural
Poverty rate	*43.6%*	9.6%	30.7%	50.6%
Mean vulnerability	*43.2%*	12.2%	26.7%	50.1%
Vulnerability rate	*39.2%*	1.4%	15.7%	48.1%
Poverty induced vulnerability	*28.7%*	0.5%	11.5%	35.3%
Risk induced vulnerability	*10.5%*	0.9%	4.3%	12.8%
Poverty/risk	*2.7*	0.6	2.7	2.8
Idiosyncratic vulnerability	*43.1%*	10.8%	25.0%	50.5%
Covariate vulnerability	*40.7%*	3.3%	19.6%	49.2%
Idiosyncratic/covariate	*1.1*	3.3	1.3	1.0

Source: ELIM 2010 and authors' calculations.

The other dimension along which we can differentiate the sources of vulnerability is whether vulnerability is induced mostly by community level (covariate) or household level (idiosyncratic) variations in consumption. The study finds that community level and household level are about equally important drivers of vulnerability in Mali, both in rural and urban areas. Bamako is the exception to this finding: idiosyncratic risk is the dominant source of vulnerability in the capital.

IV. Analytical extensions

Based on the latest household expenditure survey available for Mali, we have analyzed the determinants of poverty, food poverty and of vulnerability to poverty in Mali up prior to the March 2012 coup.

Poverty, food poverty and vulnerability in Mali are mostly concentrated among the rural farmers. One region stands out with relatively high rates of poverty and vulnerability despite being a rich agricultural area where cotton represent the main cash cropping activity. This so-called "Sikasso-paradox" could be further analyzed either through qualitative methods, or through additional data collection combining agricultural information with household data. A first round of LSMS-ISA survey was scheduled to be conducted in Mali just before the coup of March 2012. This type of dataset could inform in more depth about the factors driving the Sikasso paradox.

Were additional and comparable household surveys be conducted in Mali after the situation is stabilized, small area based methods using repeated cross sections could extend the present analysis of vulnerability which is based on a single cross-section only.

Finally, poverty measurement can be improved in Mali through (1) strengthening the calculations of regional consumer price indices, (2) ensuring household survey comparability by keeping questionnaires and seasonal timing of surveys constant and (3) reviewing calculations of regional poverty lines.

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Annex 1: Methodology To Measure Vulnerability To Poverty

We assess the households' ex-ante vulnerability to poverty. Following Chaudhury etal. (2002) and Chaudhury (2003) we measure vulnerability as the conditional probability of a household's income to fall below the poverty line in the next period, or:

$$V_{it} = \Pr(\ln c_{it+1} < \ln z)$$

where c_{it+1} is household's consumption per capita in the next period, and z is the relevant poverty line.

Since panel data is not available, we follow Chaudhuri (2003) who proposed a method to estimate vulnerability under such a framework based solely on cross-sectional data. In order to do so, we need to assume that consumption is a stationary process and that it is log-normally distributed.

A. Baseline model

The empirical strategy consists in first estimating a model for log consumption:

$$Ln\ c_i = \alpha + \beta X_i + e_i$$

where c_i represents total expenditure per capita for household i, X_i is a vector of observable household characteristics, β is a vector of coefficients for these household characteristics and e_i is a mean zero error term.

Furthermore, the level of consumption risk faced by household i is also assumed to depend on observable characteristicsX_i:

$$\sigma_{e_i}^2 = \tau + \theta X_i$$

The parameters $\hat{\beta}$ and $\hat{\theta}$ are consistently estimated with a three-steps Feasible Generalized Least Square (FGLS) method. These parameters are then used to compute the (conditional) expected log consumption and its conditional variance for each household i:

$$E[\ln c_i | X_i] = \hat{\beta} X_i$$

$$VAR[\ln c_i | X_i] = \hat{\theta} X_i$$

With the distributional assumption imposed on consumption, the ex-ante vulnerability is then computed as:

$$VEP_i = \Pr(\ln c_i < \ln z | X_i) = \phi\left(\frac{\ln z - \hat{\beta} X_i}{\sqrt{\hat{\theta} X_i}}\right)$$

where $\phi(.)$ Is the CDF of the standard normal distribution.

This estimated probability to fall under the poverty line z is then used to calculate the vulnerability rate, i.e the proportion of the population considered vulnerable. A household will be classified as vulnerable if its predicted vulnerability level is above a defined threshold. Usually a threshold of 0.5 is chosen in the literature.

Under this framework, the source of vulnerability can be decomposed into high volatility (risk induced vulnerability) and low mean consumption (poverty induced vulnerability). Risk induced vulnerability characterizes households for which both $VEP < 0.5$ and $C > z$, while poverty induced vulnerability characterizes households for which $VEP < 0.5$ and $C < z$.

B. Multilevel random effect model

Following Gunther and Harrtgen (2009) [6] we extend the baseline specification by considering a multilevel random effect model. We do this for two reasons. The first is to assess the robustness of our results to survey design effects. Since the survey is clustered, household consumption is likely to be correlated within clusters due to unobservable characteristics. This violates an independence assumption needed for OLS to deliver efficient estimates. The second reason why we choose to estimate a multilevel random effect model for consumption is because it allows us to decompose the unexplained variance in consumption into cluster specific effects (covariate) and household specific effects (idiosyncratic). This is relevant if we want to understand the relative importance of covariate and idiosyncratic risk when analyzing households' vulnerability to poverty. The first stage regression model becomes:

$$Ln\ c_{ij} = \alpha + \beta_1 X_{ij} + \beta_2 Z_j + u_j + e_{ij}$$

where c_{ij} represents total expenditure per capita for household i in cluster i, X_{ij} is a vector of observable household level characteristics, Z_j is a vector of cluster level characteristics, β_1 and β_2 are a vectors of coefficients for these characteristics, u_j is a cluster specific mean zero error term capturing covariate shocks from the households' perspectives and e_{ij} is a household specific mean zero error term capturing the influence of idiosyncratic shocks.

The consumption risk faced by households can now be decomposed into a covariate and an idiosyncratic component. The idiosyncratic risk $\sigma^2_{e_{ij}}$ can be written as a function of household level and community level variables.

$$\sigma^2_{e_{ij}} = \theta_0 + \theta_1 X_{ij} + \theta_2 Z_j$$

[6] This approach has also been taken more recently by Imai etal. (2011) and Imai (2011).

The covariate risk on the other hand is assumed to depend only on community level characteristics:

$$\sigma_{u_j}^2 = \gamma_0 + \gamma_1 Z_j$$

Overall risk is the sum of $\sigma_{e_{ij}}^2$ and $\sigma_{u_j}^2$.

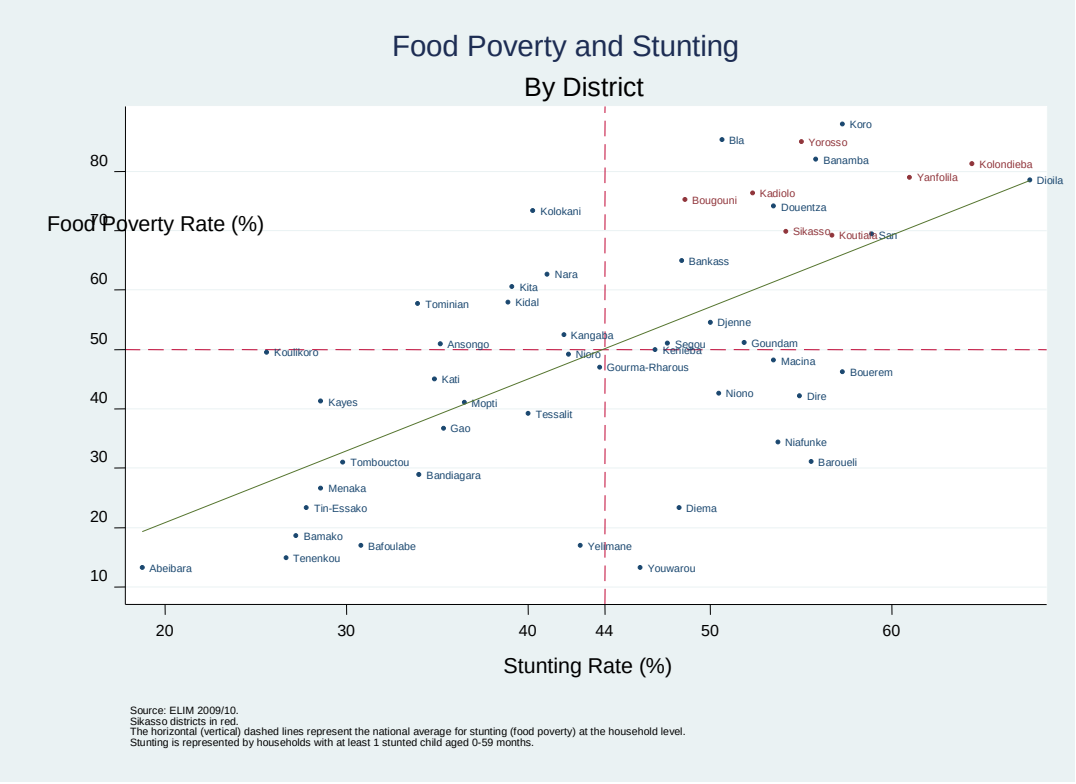
Vulnerability can then also be decomposed into idiosyncratic risk induced vulnerability (VEP_{ij}^{idi}) and covariate risk induced vulnerability (VEP_{ij}^{cov}):

$$VEP_{ij}^{idi} = \Pr\left(\ln c_{ij} < \ln z \,\middle|\, X_{ij}, Z_j\right) = \phi\left(\frac{\ln z - \hat{\beta}_1 X_{ij} + \hat{\beta}_2 Z_j}{\hat{\sigma}_{e_{ij}}}\right)$$

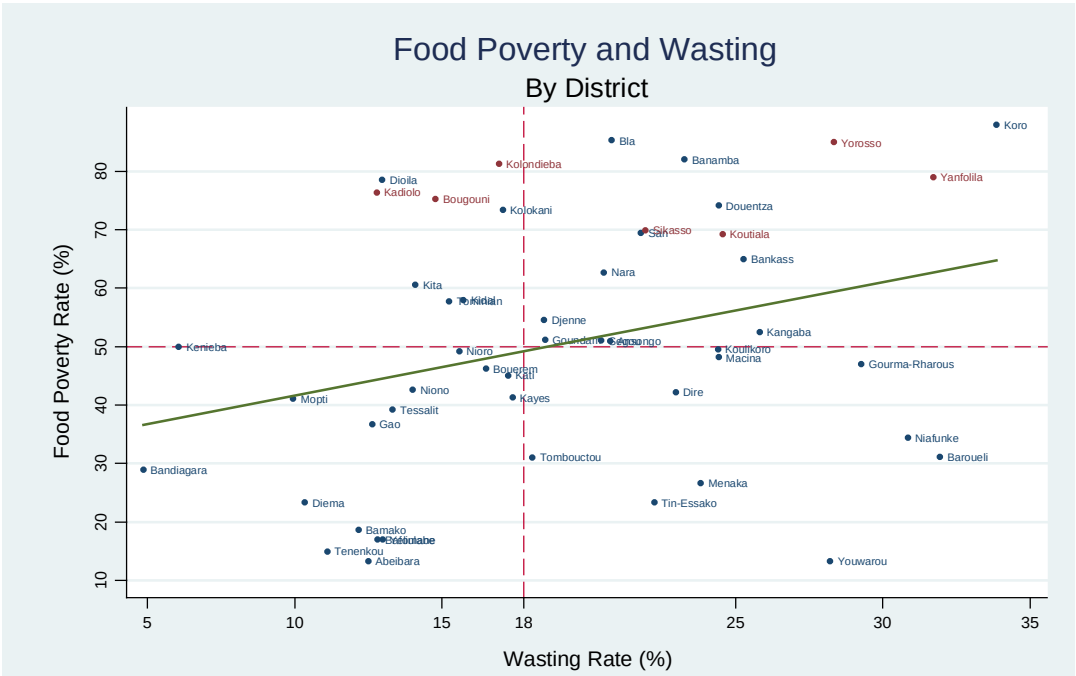
$$VEP_{ij}^{cov} = \Pr\left(\ln c_{ij} < \ln z \,\middle|\, X_{ij}, Z_j\right) = \phi\left(\frac{\ln z - \hat{\beta}_1 X_{ij} + \hat{\beta}_2 Z_j}{\hat{\sigma}_{u_j}}\right)$$

Distinguishing between idiosyncratic and covariate risk is important first because informal risk sharing mechanisms taking place at the community level can be effective in partially insuring idiosyncratic risk but will remain vulnerable to the realization of aggregate risks. Making this distinction is also relevant from a policy perspective in order to design the most appropriate safety net mechanisms. The targeting of the vulnerable population for example will differ according to whether shocks are dominantly idiosyncratic or covariate.

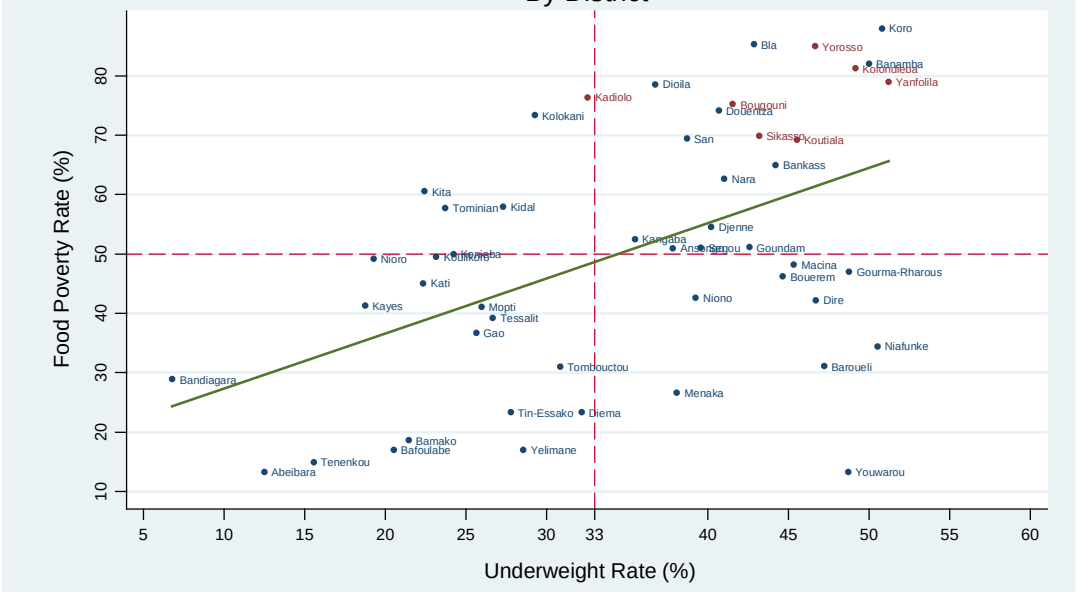
Annex 2: Graphs



Source: ELIM 2009/10.
Sikasso districts in red.
The horizontal (vertical) dashed lines represent the national average for stunting (food poverty) at the household level.
Stunting is represented by households with at least 1 stunted child aged 0-59 months.



Source: ELIM 2009/10.
Sikasso districts in red.
The horizontal (vertical) dashed lines represent the national average for stunting (food poverty) at the household level.
Wasting is represented by households with at least 1 wasted child aged 0-59 months.



Source: ELIM 2009/10.
Sikasso districts in red.
The horizontal (vertical) dashed lines represent the national average for underweight (food poverty) at the household level.
Underweight is represented by households with at least 1 underweighted child aged 0-59 months.

Annex 3: Tables.

Table A1: Exhaustive table on characteristics of different subgroups in Mali:

	All	Poor	Food-poor	Not malnourished	Wasting	Stunting
Household Characteristics						
Household size (median)	9	11	12	8	9	10
Age dependency ratio	1.40	1.57	1.58	1.33	1.38	1.49
Female headship	7%	6%	4%	8%	7%	7%
Head's age (median)	48	51	52	45	47	50
Head: no education	77%	87%	90%	71%	75%	85%
Head: primary education only	11%	9%	9%	13%	10%	10%
Head: secondary education or more	12%	4%	2%	16%	14%	6%
Location Characteristics						
Rural	77%	90%	93%	70%	75%	84%
North	11%	8%	6%	10%	14%	11%
Kayes	13%	8%	5%	14%	12%	12%
Koulikoro	17%	14%	11%	17%	22%	17%
Sikasso	16%	34%	45%	13%	12%	19%
Segou	16%	18%	19%	13%	14%	17%
Mopti	15%	16%	13%	15%	11%	16%
Timbuktu	6%	4%	3%	5%	8%	6%
Gao	5%	3%	3%	5%	6%	4%
Kidal	0%	0%	0%	0%	0%	0%
Bamako	13%	2%	1%	17%	14%	8%
Activity (Head)						
Primary sector	61%	83%	88%	52%	55%	72%
Secondary sector	7%	4%	4%	8%	7%	6%
Tertiary sector	18%	7%	4%	23%	20%	13%
Public sector	13%	6%	4%	17%	17%	9%
Wage earner (public)	5%	2%	0%	7%	8%	3%
Wage earner (private)	8%	3%	2%	10%	8%	5%
Employer	1%	0%	0%	1%	1%	1%
Farmer	59%	81%	86%	50%	54%	69%
Other independent	22%	11%	9%	25%	24%	18%
No job	5%	3%	2%	6%	5%	4%
Farmer in cotton producing district	21%	41%	52%	15%	15%	28%
Farmer out of cotton producing districts	40%	41%	35%	37%	40%	44%
Non-farmers	39%	18%	12%	49%	45%	29%
Assets and welfare						
Welfare (median expenditure, FCFA per capita)	206901	121025	95092	243079	215604	177942
Value of owned durables (median per capita, FCFA)	18571	11062	10107	23125	19156	15408
Herders (cows, sheeps, goats, camels)	27%	35%	36%	21%	25%	32%
Value of livestock (median, FCFA)	393519	450640	477897	326921	372349	433088
Transfers						
Domestic transfer recipient	22%	22%	21%	21%	17%	22%
Domestic transfer value (recipients only, median per capita, FCFA)	4167	2500	1875	5401	4583	3333
Foreign transfer recipient	19%	14%	12%	19%	19%	19%
Foreign transfer value (recipients only, median per capita, FCFA)	10000	5556	5000	12500	10000	9339
Public transfer recipient	0.8%	0.7%	0.3%	0.9%	1.3%	0.6%
Public transfer value (recipients only, median per capita, FCFA)	13636	9545	11604	17400	44286	8438
N	6449	2335	1159	3202	467	2094
Population estimate (individuals)	10800000	5081102	2620218	.	.	.
Population estimate (households)	937406	353979	167044	458886	64417	311180

Note: The percentages are all taken across column totals, i.e 8 percent of the poor households live in the North compared to 11 percent in our total population.
Source: ELIM-MICS 2009/10

Source:

Table A2: Role of assets.

	All	Food Poor		Malnourished (W+S)	
		High assets (? 8350 FCFA)	Low assets (< 8350 FCFA)	High assets (? 14200 FCFA)	Low assets (< 14200 FCFA)
Durables ownership and welfare					
Value (median per capita, FCFA)	17283	17704	3325	32621	6143
Welfare (median expenditure, FCFA per capita)	202233	91311	88114	177793	131321
Household Characteristics					
Household size (median)	9	14	11	16	13
Age dependency ratio	1.25	1.43	1.50	1.28	1.43
Female headship	7%	3%	5%	5%	5%
Head's age (median)	48	54	51	51	53
Head: no education	77%	89%	90%	82%	86%
Head: primary education only	11%	9%	8%	9%	10%
Head: secondary education or more	12%	2%	2%	9%	4%
Location Characteristics					
Rural	77%	94%	93%	86%	93%
North	11%	6%	7%	10%	13%
Kayes	13%	2%	7%	7%	8%
Koulikoro	17%	8%	15%	12%	15%
Sikasso	16%	53%	36%	25%	21%
Segou	16%	18%	20%	21%	25%
Mopti	15%	12%	13%	16%	17%
Timbuktu	6%	3%	3%	7%	9%
Gao	5%	2%	3%	3%	4%
Kidal	0%	0%	1%	0%	0%
Bamako	13%	1%	1%	9%	2%
Activity (Head)					
Primary sector	61%	89%	86%	65%	85%
Secondary sector	7%	3%	5%	5%	6%
Tertiary sector	18%	4%	4%	20%	5%
Public sector	13%	4%	5%	11%	5%
Wage earner (public)	5%	1%	0%	4%	2%
Wage earner (private)	8%	2%	3%	4%	3%
Employer	1%	0%	0%	2%	1%
Farmer	59%	87%	85%	61%	84%
Other independent	22%	8%	10%	26%	9%
No job	5%	2%	2%	3%	2%
Farmer in cotton producing district	21%	62%	42%	31%	31%
Farmer out of cotton producing districts	40%	27%	44%	33%	54%
Non-farmers	39%	11%	14%	37%	16%
Livestock					
Herders (cows, sheeps, goats, camels)	27%	44%	26%	46%	36%
Value of livestock (median, FCFA)	124633	517527	253870	484088	326138
Transfers					
Domestic transfer recipient	22%	22%	20%	22%	29%
Domestic transfer value (median, FCFA)	4167	2000	1667	3125	2181
Foreign transfer recipient	19%	15%	10%	22%	12%
Foreign transfer value (median, FCFA)	10000	5556	3992	7143	4495
Public transfer recipient	0.8%	0.4%	0.3%	1.1%	0.2%
Public transfer value (median, FCFA)	13636	13604	6053	2593	13636
N	6449	612	547	343	343
Population estimate (households)	937406	88813	78232	51669	51254

Note: The percentages are all taken across column totals, i.e 7 percent of the poor households with low assets live in the North compared to 11 percent in our total population.

Source: ELIM-MICS 2009/10

Table A2B: Regression results: Household Characteristics

Log expenditure per capita [OLS, beta]	(1)	(2)	(3)	(4)	(5)
Household size	-0.0371***	-0.0436***	-0.0435***	-0.0435***	-0.0447***
	(0.00148)	(0.00145)	(0.00134)	(0.00134)	(0.00134)
Household size squared	0.000448***	0.000525***	0.000517***	0.000518***	0.000531***
	(3.03e-05)	(2.95e-05)	(2.72e-05)	(2.72e-05)	(2.70e-05)
Age dependency over size	-0.465***	-0.415***	-0.392***	-0.392***	-0.383***
	(0.0253)	(0.0246)	(0.0227)	(0.0228)	(0.0226)
Female Head	-0.0696***	-0.0562***	-0.0506***	-0.0505***	-0.0459***
	(0.0163)	(0.0161)	(0.0148)	(0.0148)	(0.0147)
Primary education	0.0751***	0.0592***	0.0689***	0.0687***	0.0700***
	(0.0155)	(0.0150)	(0.0138)	(0.0138)	(0.0137)
Secondary+ education	0.258***	0.225***	0.237***	0.237***	0.233***
	(0.0157)	(0.0152)	(0.0141)	(0.0141)	(0.0140)
Milieu Urbain	0.133***	0.0952***	0.0355***	0.0362***	0.0413***
	(0.0128)	(0.0125)	(0.0129)	(0.0130)	(0.0129)
Secondary sector	0.0747***	0.0738***	0.0803***	0.0804***	0.0802***
	(0.0199)	(0.0192)	(0.0178)	(0.0178)	(0.0177)
Tertiary sector	0.168***	0.151***	0.156***	0.156***	0.158***
	(0.0156)	(0.0151)	(0.0141)	(0.0141)	(0.0140)
Public sector	0.133***	0.121***	0.123***	0.124***	0.126***
	(0.0167)	(0.0162)	(0.0150)	(0.0150)	(0.0149)
Cotton district	-0.369***	-0.374***	-0.158***	-0.158***	-0.151***
	(0.0147)	(0.0143)	(0.0160)	(0.0160)	(0.0159)
Livestock ownership	Yes	Yes	Yes	Yes	Yes
Durables ownership	No	Yes	Yes	Yes	Yes
Transfers received	No	No	Yes	Yes	Yes
Regional effects	No	No	No	Yes	Yes
Rainfall shocks	No	No	No	Yes	Yes
Interaction: Rainfall X Durables	No	No	No	No	Yes
Interaction: Rainfall X Livestock	No	No	No	No	Yes
Interaction: Rainfall X Transfers	No	No	No	No	Yes
Constant	12.73***	12.38***	12.41***	12.41***	12.21***
	(0.0170)	(0.0246)	(0.0273)	(0.0313)	(0.0355)
Observations	9,036	9,036	9,036	9,036	9,036
R-squared	0.407	0.446	0.531	0.531	0.539

Standard errors in parentheses, unstandardized beta coefficients are reported.
*** p<0.01, ** p<0.05, * p<0.1

Tables on the impact of shocks on the food poor

Table A3. Percentage of people under the food poverty line without and with shocks, by region

	Proportion of people that is:			
	Already food poor	food poor if cereal prod reduces by 25% (a)	Food poor if cereal prices rise by 25% (b)	Food poor under both shocks (a) + (b)
Kayes-Koulikoro	13.1%	15.3%	14.4%	16.9%
Sikasso	56.9%	61.3%	58.4%	62.5%
Mopti-Ségou	22.3%	25.7%	23.1%	27.5%
Tombouctou-Gao-Kidal	11.0%	12.4%	13.5%	15.5%
Bamako	2.8%	2.6%	3.6%	3.6%
Total	22.1%	24.6%	23.3%	26.3%

Source:

Table A4. Number of people (in '000) per region under the food poverty line without and with shocks

	Number of people that are:				
	Already food poor	**Food poor if cereal prod reduces by 25% (a)**	**Food poor if cereal prices rise by 25% (b)**	**Food poor under both Both shocks (a) + (b)**	**% increase in number of food poor**
Kayes-Koulikoro	578	674	636	744	29%
Sikasso	1504	1619	1543	1653	10%
Mopti-Ségou	977	1122	1013	1204	23%
Tombouctou-Gao-Kidal	141	159	173	199	41%
Bamako	51	47	66	66	28%
Total	3210	3574	3385	3821	19%
Additional (no)		363	174	610	
Additional (%)		2.5%	1.2%	4.2%	

Source

Table A5. Distribution (%) by region of those that have become food poor following shocks

	Distribution (%) of newly food poor following:			
	A reduction in cereal production by 25% (a)	**Increase in cereal prices by 25% (b)**	**Under both shocks**	**Whole population**
Kayes-Koulikoro	27	31	28	30%
Sikasso	29	18	23	18%
Mopti-Ségou	39	28	37	30%
Tombouctou-Gao-Kidal	5	15	9	9%
Bamako	0	7	2	12%
Total	100	100	100	100%

Source:

Table A6. Distribution (%) over rural/ urban of those that have become food poor following shocks

	Percentage of newly food poor if cereal prod reduces by 25% (a)	**Percentage of newly food poor if cereal prices rise by 25% (b)**	**Percentage of newly food poor under both shocks (a) + (b)**	**Whole pop**
Urban	3.6	17.4	7.6	22
Rural	96.4	82.6	92.4	78
Total	100	100	100	100

Source:

Table A7. Distribution of people (in '000) over rural/ urban of those that have become food poor following shocks

	Distribution (number of people) of newly food poor (in thousands) following:			
	reduction of cereal production by 25% (a)	**increase in cereal prices by 25% (b)**	**Under both shocks (a) + (b)**	**Whole population**
Urbain	13	30.3	46	22
Rural	350	144	564	78
Total	363	174	610	100

Source:

Table A8. Distribution (%) by socio-economic group of those that have become food poor following shocks

Occupation of head of household	Distribution (%) of newly food poor following Reduction in cereal production by 25% (a)	Increase in cereal prices by 25% (b)	Both shocks(a) + (b)	Whole pop
Salarié public	0	1	0	5
Salarié privé	1	5	2	6
Employeur	0	0	0	1
Agriculteurs	91	77	88	62
Autres indépendants	3	15	6	20
Sans emploi	5	3	4	6
Total	100	100	100	100

Source:

Table A9. Distribution (%) by age group of those that have become food poor following shocks

Age of head of hh	distribution (%) of newly food poor if cereal prod reduces by 25% (a)	Distribution (%) of newly food poor if cereal prices rise by 25% (b)	Distribution (%) of newly food poor under both shocks (a) + (b)	Whole pop
15-30 yrs	2	1	1	5
31-45 yrs	20	20	22	26
46-60 yrs	32	49	37	36
61-75 yrs	36	24	32	25
75+ yrs	10	5	8	8
Total	100	100	100	100

Source:

Table A10. Value of assets per capita in FCFA for those that have become food poor following both production and price shocks, and for the rest of the population

	Those that have become food poor following both production and price shocks	Rest of the population
Median value of household assets	10,100	18,400
Median value of livestock assets	27,104	17,934
Median value of both household and livestock assets	47,800	57,200
Mean family remittances	2,400	10,400
Median transfers from NGOs or government	8,000	12,500

Source:

[i] These three indicators are expressed in terms of standard deviations to a normal reference population (Z-scores)[i] taking age and gender into account.

[ii] A child is considered stunted if his height-for-age Z-score (HAZ) falls below 2 standard deviations below the normal height for his age-gender group. If the HAZ falls below 3 standard deviations below the normal, the child is considered extremely stunted. In our sample of Malian children aged 0-59 month, the average standard deviation for height varies between 2-4 cm for the younger children (0-24 months) to 4-6 cm for the older children (24-59 months). The results of the analysis suggest that on average, the sampled children are about 4.8 **c**entimeters shorter than they should be given their age.

[iii] A child is considered wasted if his weight-for-height Z-score (WHZ) falls below 2 standard deviations below the normal weight for his height-gender group. If the WHZ falls below 3 standard deviations below the normal, the child is considered extremely wasted. The analysis suggests that on average, the sampled children are about 0.9 Kg lighter than they should be given their height.

[iv]A child is considered underweighted if his weight-for-age Z-score (WAZ) falls below 2 standard deviations below the normal height for his age-gender group. If the WAZ falls below 3 standard deviations below the normal, the child is considered extremely underweighted. In our sample of Malian children aged 0-59 month, the average standard deviation for weight varies between .5-1.5 kg for the younger children (0-24 months) to 1.5-2 kg for the older children (24-59 months). The analysis suggests that on average, the sampled children are about 1.6 Kg lighter than they should be given their age.

[v] Note that consumption and thus food poverty is measured at the household level, while malnutrition indicators are measured at the individual (child) level. In order to compare food poverty and malnutrition, we convert the malnutrition indicators to household level variables. For example, we consider a household to be subject to stunting if at least one of the children aged 0-59 months in the household is stunted. Similar definitions apply for wasting, and for underweight.

vi It follows largely from the fact that female headed households often contain fewer members and from our definition of welfare as household consumption divided by the total number of household members. This ignores economies of scale in consumption and thus puts larger households to a disadvantage. When economies of scale of consumption are taken into account, female headed household often tend to be come out poorer than when it is not.

[vii] Note that consumption and thus food poverty is measured at the household level, while malnutrition indicators are measured at the individual (child) level. In order to compare food poverty and malnutrition, we convert the malnutrition indicators to household level variables. For example, we consider a household to be subject to stunting if at least one of the children aged 0-59 months in the household is stunted. Similar definitions apply for wasting, and for underweight.

vii These are the districts (circles) where the CMDT is operating.

viii The fact that welfare (whether we look at consumption expenditures or at malnutrition indicators) is so low in Sikasso has been puzzling to many observers given that Sikasso is a fertile and productive region with a concentration of cash-crop (cotton) farmers. This has been called the "Sikasso paradox" by some researchers. The ELIM-MICS 2009/10 survey does not allow us to investigate further the links between welfare and agricultural activity because production information is absent. Conducting integrated

household surveys with production modules together with standard welfare measurement modules, or more focused qualitative surveys in the region so Sikasso could be options to consider by the authorities to remedy to this knowledge gap.

ix The threshold between high and low asset holdings is set to the median value of durables owned in per capita terms.

x We use the value of durable goods owned and breaking the distribution in terciles, we estimate the welfare loss along the wealth distribution.