

Reaching the Chronic Poor and Food Insecure after a Disaster:
The Case of Niger

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Abstract

Using a cross section data collected in 2005, this study uses both parametric and semi-parametric methods to investigate key factors associated with household vulnerability to drought and economic downturns from exposure to shocks in Niger, conditioned on household and community assets. The findings provides evidence that factors positively affecting ability to overcome drought and economic condition downturns are the educational levels of the heads of households, livestock ownership, access to income generating activity opportunities, and participation to government decision taking. Household size and dependency ratio are found to negatively impact household ability to cope or manage shocks. Descriptive statistics are also used to determine major shocks faced by households after the drought and common coping strategies after the shocks. The results show that the prevailing shock experienced by Niger's population (especially the rural population) in 2004/05 is drought, followed by important loss of agricultural products. The most common coping strategy employed after these shocks is food aid and receiving assistance from other households.

Dedication

To my late dad and my late young brother

And

To my mother and my daughter

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Chapter 1: Introduction

Niger is a country with limited natural and human resources and is the poorest nation in the world by many standards. Gross National Income (GNI) per capita was around US\$230 in 2004 (nearly the level in 1976 and about half that of 1980). The country is ranked the lowest in the world (177th out of 177 countries in 2005 and 2006) according to the United Nations Development Program (UNDP) Human Development Index. Life expectancy is only 46 years and adult literacy is less than 15 percent (UNPD, 2005). Poverty remains widespread and social indicators compare poorly to the average in Sub-Saharan Africa. For example, while the mean Human Development Index for the Least Developed Countries was 48.8 percent in 2007, the corresponding figure for Niger was 37.4 percent¹. The share of the population living in poverty was estimated at 64 percent in 2004 and has remained at the level of the early 1990s. As in other African countries, vulnerability to poverty and extreme poverty are even more severe in rural areas where close to 80 percent of the population still lives. Factors contributing to high poverty vulnerability in Niger are both structural and temporary.

1.1. Factors affecting Poverty

1.1.1. Structural factors affecting poverty

Among the most prominent structural factors contributing to vulnerability to poverty in Niger is low agricultural productivity combined with rapid population growth. In fact about 80 percent of the

¹ The Human Development Index is a comparative measure of life expectancy, literacy, education, and standards of living for countries. It is used to distinguish whether a country is a developed, a developing, or an under-developed country.

population in Niger relies on agriculture for a living. Yet, Niger's agricultural productivity growth has not kept up with its population growth. As shown in Table 1, there has been a drastic increase in Niger's population over the period 1960-2002 while its agricultural production, subject to fluctuations, grew very slowly. One major cause for the low productivity in Niger is the lack of natural resources. Arable land and irrigated land in Niger constitute only about 3.5 and 1 percent of the total land, respectively. Another major cause of Niger's low agricultural production is inadequate technology, in particular the low level of fertilizer use by farmers. For instance, the mean intensity of fertilizer use in SSA in 1999 was 12 kg per hectare while in Niger the corresponding figure was only 1 kg per hectare². The consequence of this low level of fertilizer use in Niger combined with other factors is very low levels of average crop yields for cereals. Indeed, average crop yield for cereals for SSA was about 1,220 kg per hectare over the period 1999-2001 compared to only 360 kg per hectare for Niger over the same period (World Resources Institute, 2006). This low productivity combined with fast population growth results in low levels of output per capita and, consequently, high risk that a high share of the population become poor or vulnerable to poverty.

1.1.2. Temporary factors or shocks affecting poverty

Experience shows that Niger's economy is often strongly impacted by exogenous factors, including high rainfall variability, sudden shifts in international terms of trade, and volatile aid flows, stemming from international actions often unrelated to the economic situation in Niger (Aker, 2006). The most recent shock seriously impacting Niger's population well-being is the extended drought and the locust

² Note that fertilizer use in SSA is very low relative to the rest of the world. The average of 12 kg per hectare in SSA compares poorly with an average of 94 kg per hectare for the rest of the world.

invasion in 2004-05. In fact, following the locust invasion and the drought, the 2004-05 agricultural season was marked by a decline of more than 12 percent in agricultural production (Word Bank, 2008). A loss of nearly 40 percent of the country's fodder in 2004 recorded subsequent to the drought endangered the health and survival of livestock. This resulted in significant decrease of market prices for livestock as pastoral and agro-pastoral households sold undernourished animals for income to buy cereals.

In contrast to decreasing the market prices for livestock, the drought resulted in increases in the prices of cereals (millet and sorghum) and staple foods. For example, prices of local cereals (millet and sorghum) increased rapidly: 100 kg of millet cost up to 30,000 FCFA in July compared to 25,000 FCFA in May 2005. Concurrently, the monetary value of livestock compared to the equivalent in cereals decreased between 42 and 55 percent. Given the high reliance on livestock as a key source of income and savings, the deterioration of the terms of trade for livestock combined with the extreme high cereal prices and the deteriorating condition of livestock seriously impacted rural household well-being by reducing their purchasing power and increasing their vulnerability to poverty.

1.2. Vulnerability: Costs and Consequences

Economists generally use the term “vulnerability” to describe the likelihood that a person will face a situation in which his well-being will be adversely impacted by risky events. Understanding and assessing vulnerability is essential for two reasons. The first is the intrinsic cost of vulnerability, and the second is its instrumental cost. The intrinsic cost of vulnerability is the cost of, or utility loss associated with being poor (i.e., the fact of not being capable of acquiring basic needs necessary for a decent living

standard). The instrumental cost of vulnerability is the economic efficiency loss for not taking advantage of high return activities due to risks, or inefficiencies associated with coping with loss from risky events. These costs are related to the behavior responses of households, vis-à-vis their exposure to risk. In order to understand the nature of these costs, it is important to know how households react in the face of such risks. These reactions may adversely impact their well-being. Reactions include use of formal and informal insurance mechanisms. In order to understand the nature of intrinsic and instrumental costs associated with risk management, it is useful to examine common risk management techniques.

In most developing countries characterized by missing formal insurance markets, households mostly adopt informal insurance practices. One form of informal consumption insurance is risk pooling. Risk-averse households will tend to group together to bear the burden of risks when those risks are highly idiosyncratic (Townsend, 1995)³. One example of risk pooling is credit transactions, which consist of borrowing and lending for consumption following times of stress (Bardhan and Udry, 1999). Another informal instrument is sale of assets, including distress sales of productive assets, such as livestock. When there are no adequate asset holdings for coping strategies, especially for poor households often do not avail of liquid assets, households may be constrained to take some extreme decisions such as the reduction of the number or the quantity of daily meals, the interruption of children's education, and suppression of some non-food expenditures.

³ Idiosyncratic risks are risks affecting a particular individual (such as illness, job loss, or serious injury) and covariate risks are risks that effect a large number of people or groups of people. Covariate risks include drought, flood, locust invasion, economic crisis etc.

Except for the risk pooling option (which is generally not effective in cases of high covariate risk), a close consideration of the other coping strategies indicates that they may imply high costs to the vulnerable. For example, having fewer meals or insufficient quantity of meals can impair health and may negatively impact productivity. When children are affected, future productivity and educational attainment may be compromised. In addition, interruption of children's education may hinder their ability to emerge out of poverty over time. Thus, vulnerable households and future generations may be permanently trapped in poverty as a consequence of their risk coping strategy. This constitutes the intrinsic cost of vulnerability and is identified in the vulnerability literature as *dynamic poverty traps*.

The instrumental cost of vulnerability arises from ex-ante risk management strategies. Households often mitigate their exposure to shock by diversifying sources of income such as being engaged in off-farm activities besides agriculture. For instance in India, some groups of households whose agricultural income is subject to high volatility are more likely to have some of their members employed in more stable wage sectors (Rosenzweig and Stark, 1989). Households may also reduce their exposure to shocks at the expense of high profit by choosing low risk activities that are also associated with low returns (Morduch, 1995; Bliss and Stern, 1982). By choosing to reduce their risk, households have to bear long term losses which may possibly lock them in long term poverty. This instrumental cost of vulnerability is known as *risk-induced poverty*.

1.3. Who is vulnerable?

It is important to identify the most vulnerable households because the impacts of drought and other stresses are not uniform. Vulnerability to drought varies across households. The occurrence of a

drought does not necessarily mean that everyone living in the affected area will experience harmful effects. For example, experience shows that while some households are afflicted by food insecurity during and after the occurrence of a drought, others, with relatively more wealth, can take advantage of the situation by lending to destitute households at high interest rates (Boken et al., 2005)⁴. Moreover, it is important to identify the most vulnerable groups after a drought because ability to cope differs across households. Coping strategies implemented by households with significant asset holdings will be more effective than those of households with relatively few assets.⁵

Finally, it is important to identify groups that are the most vulnerable to a drought in order to better target those in need. In fact, since the most common form of assistance to victims of drought is food aid, reaching the most food insecure groups of households is essential due to the four reasons mentioned by Taylor and Seaman (2004). The first and most obvious reason is to increase the likelihood that the food reaches those in the greatest need. The second reason is to limit the quantity of food supplied in order to avoid economic distortions. In fact, lack of adequate targeting can lead to the extension of food distribution to those not in need and this excess of food supply may depress food prices, which in turn will reduce the incentives for food production. The third reason is that successful targeting can lead to efficient and effective use of resources by reducing transaction costs. The fourth and final reason for targeting is to overcome late and inadequate food delivery due to early warning failure.

⁴ Surveys with communities in Niger after the drought of 2004 reveal that local retailers lent staple food to destitute families at abnormally high interest rates (

⁵ In the context of coping strategies, household assets may encompass both human capital (such as educational attainment of the head of household and household structure) and physical capital (i.e., savings, livestock, jewelry etc.).

1.4. Problem Statement

In the case of Niger where about 80 percent of the population is vulnerable to chronic poverty and food insecurity, it is important to understand which households are vulnerable and how they respond to the risks they face. The present study aims to design a framework leading to empirical findings that will be used to identify a set of readily observable indicators of household vulnerability to food and total expenditure shortfalls. These indicators could then be used to improve the targeting of food assistance in crisis situation.

1.5. Objectives

General objectives

This study has two general objectives. The first is to assess the impact of the 2004/05 drought on household well-being and exposure to poverty. The second general objective is to identify household assets (education and livestock) and community assets as well as social protection program interventions that were effective in mitigating the negative impact of the drought on household well-being and exposure to poverty.

Specific objectives

The specific objectives of the study are to identify demographic and economic characteristics of households associated with exposure to shocks and with household economic downturns conditional upon exposure to shocks. Identification of these factors will assist in the identification of households that are particularly vulnerable to food and total expenditure shortfalls following realization of shocks.

The effectiveness of alternative coping strategies in mitigating downturns will also be documented in order to inform alternative food assistance strategies.

1.6. Methods

The methods used in this study include:

- Binomial logit estimation to generate the probability of suffering the adverse effects of drought
- Multinomial logit estimation to generate the probability of experiencing changes in well-being
- Nonparametric and semi-parametric kernel density estimation of household size-adjusted consumption expenditures and total expenditures using density reweighting techniques to control for differences in the distribution of underlying assets.

1.7. Roadmap

The remainder of the study is organized in five additional chapters. Chapter 2 discusses the conceptual and theoretical frameworks used. Descriptive statistics and non-parametric estimation are presented in chapter 3. Chapters 4 and 5 present the empirical strategies and the estimation results, respectively. The empirical strategies consist of parametric and semi-parametric methods. The semi-parametric method uses re-weighting techniques following the decompositions by Alwang et al. (2002), Mills et al (2001), and DiNardo and Johnston, (1986) to investigate how changes in assets affect household economic well-being. The last chapter (i.e., chapter 6) discusses the main points of the study and provides some policy implications.

Chapter 2: Conceptual Framework

Households in Niger are exposed to natural disasters such as recurrent droughts and crop invasions by locusts and other risks. This exposure has negative impact on households' well-being, especially on rural households when important production losses occur. The main objective of this study is to identify the most vulnerable and food insecure groups of households in Niger with respect to and as a result of the drought of 2004, and examine how these households cope with economic shocks and natural disasters. It is useful to identify not only the determinants of vulnerability to poverty and the characteristics of food insecure households but also to explore strategies used by households to mitigate economic shocks and natural disasters. This chapter provides a conceptual and a theoretical framework to help guide the latter analysis.

2.1. Defining the Concept of Vulnerability

The concept of vulnerability has been examined by several disciplines: economics, sociology/anthropology, disaster management, environmental science and health/nutrition (Alwang et al., 2002). In this study, the term vulnerability is viewed from an economic context. Vulnerability is conceived as the likelihood of suffering from future deteriorations in standard of living which may result in socially unacceptable outcome such as the state of poverty, or inability to meet basic needs.

There is a clear distinction between the concept of poverty and that of vulnerability. Many authors perceive vulnerability as an ex-ante state of being vulnerable to shocks and a forward-looking concept

whereas poverty is considered an ex-post state (Chaudhuri et al., 2002, Ligon and Schechter 2002, Christiaensen, 2004). Chaudhuri et al., (2002) highlight that one can determine whether a household is currently poor or not by simply observing the right variables, while concerning a household's vulnerability, one can only make inferences. However, a more recent paper (Cafiero and Vakis, 2006) stresses that the distinction between the concept of poverty and notion of vulnerability is misleading. Cafiero and Vakis (2006) maintain that an individual is poor because of his or her inability to insure against all the risks that might lead to outcomes considered socially unacceptable and, therefore, poverty is also considered as an ex-ante and forward-looking concept. As for the concept of vulnerability, there is no controversy about its forward-looking aspect.

Because of its relationship to the future and given the uncertainty of the future, vulnerability can be perceived as the outcome of risk (Dercon, 2001). Indeed, Alwang et al. (2001) consider the concept of vulnerability as a risk chain and decompose it into three main components: (i) the risk, or risky events (exposure to risk), (ii) management of the risk, and (iii) the outcome in terms of welfare loss resulting from the first and second components. The outcomes of a shock depend on both its frequencies and its magnitudes. Rare shocks but that are large in magnitude may be more difficult to deal with than recurrent but small shocks (Dercon, 2000).

There are two major advantages in analyzing vulnerability. First, due to its dynamic and forward-looking character, the approach of vulnerability requires us to consider both current and future outcomes. Second, the analysis of vulnerability is carried out in a stochastic framework and incorporates the uncertainty associated with future well-being states such as the impact of external shocks and strategies adopted by households, community, and public institutions to reduce risk

Empirical studies attempting to measure vulnerability use two approaches. The first approach is based on analysis of spells of poverty where the outcome of a risky environment leads to socially unacceptable welfare outcomes (such as having a consumption level below the poverty line). The second approach analyzes vulnerability as fluctuations in welfare (consumption or income) which are inherently utility-reducing but ex-post level of well-being is not necessarily socially unacceptable.

1.1.3. Vulnerability to Poverty

This type of vulnerability measures vulnerability as the expected probability that a household becomes poor over a reference period. Vulnerability in this context is seen as expected poverty and can be described as poverty dynamics literature- that is, risk related poverty and non-risk poverty (Alwang et al., 2001). The risk related poverty, also called stochastic poverty, occurs because of the inability of a household to smooth income fluctuations (Morduch, 1994), which may arise due to several factors including a dysfunctional credit market (Alwang et al., 2001). Formally, Morduch (1994) defines a stochastically poor household as a household for whom $c < z < x$ where c is the household's current consumption, z , the poverty line, and x , the household's permanent income. Non risk-related poverty (structural poverty) arises when the household's permanent income is reduced due to a negative shock (such as sufferance from illness of the earner) that reduces the household's earning capacity below the poverty line-that is, $c \leq x \leq z$ or $c \geq x \leq z$ (Morduch, 1994).

A large body of the literature analyzes the transition of households in and out of poverty. For example, Chaudhuri and Christiaensen (2002) define vulnerability to consumption poverty as the probability that a household's consumption will fall below the poverty line regardless whether that household is

currently poor or not. A useful aspect of this definition of vulnerability is that it not only allows the determination of the probability of future poverty, but also considers how far consumption will fall below the poverty line. For example, the measures can indicate the expected depth and severity of poverty⁶. Vulnerability to consumption poverty can also be measured with respect to calorie intake rather than food expenditure. Christiaensen and Boisvert (2000) for example, using data from Northern Mali, define vulnerability to food consumption poverty as the probability of having a future caloric consumption below the minimum caloric intake requirement.

Another useful work from the literature on poverty dynamics is Pritchett, et al. (2000) who defines vulnerability as the risk that a household will fall into poverty at least once in the next few years. Because of the uncertain nature of the future, this definition allows the degree of vulnerability to rise with the time horizon. In other words, the vulnerability of a household within a year is higher than the one within a month (Pritchett, et al., 2000). Akin to Pritchett, et al., (2000), Mensuri and Hall (2000) define vulnerability as the probability of future poverty using both permanent and changing characteristics of households. A useful insight of their measure of vulnerability is the possibility of adapting it to repeated cross section data in cases where panel data are not available.

The measure of vulnerability in the context of poverty dynamics varies depending on the definition of poverty. If we are interested in adding up the number of vulnerable in a population, vulnerability as

⁶ Foster, Greer and Thorbecke defined a class of decomposable poverty measure as
$$P_{\alpha}(y : z) = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - y_i}{z} \right)^{\alpha}$$
 where y_i is the income of the household i , z represents the poverty line, n , the total number of households, q the number of poor (having income no greater than z), and p , the poverty measure. Poverty depth is the difference between a household's income and the poverty line and severity of poverty is when $\alpha = 2$. It gives the mean of squared consumption deficits and this makes it sensitive to well-being distribution of the poor.

spells of poverty can be measured with respect to the expected headcount (Chaudhuri, Jalan and Suryahadi, 2002)⁷. Ravallion (1998) uses expected squared poverty gap. Kamanou and Morduch (2002) use another alternative of vulnerability measure which consists of considering expected changes in poverty rather than expected poverty.

Looking at vulnerability only as the probability of future poverty ignores welfare losses of the upper or middle income classes due to fluctuations in income and consumption. As an illustration, consider a nearly poor household and a middle income household. The middle household may experience very large consumption variability but still remain above the poverty line while the nearly poor household with any small loss of consumption will be shifted below the poverty line. Clearly, even if the two households both have a concave utility function, the welfare loss experienced by the middle income household could be greater than that experienced by the nearly poor household. However, perceiving vulnerability as a forward-looking poverty concept will give no consideration to the welfare loss experienced by the middle income household while higher weights will be conferred to the shift of the nearly poor under the poverty line. In fact, as pointed out by Gaiha and Imai (2004), vulnerability can be high even if measured poverty is low. They further support the idea that in the context of semi-arid regions characterized by harsh production environment, anti-poverty strategies should be broadened to include those who might not be poor but are highly vulnerable to production shocks.

⁷ Poverty headcount is the proportion of poor households. It corresponds to $\alpha = 0$ (see formula in footnote 1) and poverty gap is the percentage by which the average well-being (consumption or income) of the poor is below the poverty line. It corresponds to $\alpha = 1$

2.1.2. Vulnerability as Fluctuations in Welfare

An important feature of the literature on vulnerability to welfare fluctuations compared to that on vulnerability to poverty is that the outcomes of the former do not necessarily move the household below the poverty line, but rather, create a welfare loss for the household. The analysis of vulnerability to shocks is concerned with the possibility of consumption smoothing in the face of income fluctuations. Income fluctuations may be triggered by factors including natural hazards such as drought, serious illness of the main income earner, or macroeconomic shocks (Chaudhuri, 2006).

Previous studies attempting to measure vulnerability to fluctuations in welfare use two main approaches: the utility-based approach and the approach based on consumption variability. Defining vulnerability in a risky environment, Ligon and Schechter (2003) use the first approach to measure vulnerability. Their measure is based on a certainty-equivalent consumption represented by a given amount of food expenditure (i.e., the amount of food expenditure which, if held, would yield with absolute certainty the same expected utility as a household's actual consumption with higher mean but more variable). Thus, any household whose consumption utility is less than the utility from that certainty equivalent level of consumption is considered vulnerable. One insight of their measure of vulnerability is its decomposability into distinct components of poverty, exposure to aggregate risk, exposure to idiosyncratic risk, unexplained risk, and measurement error. The application of this method raises, however, a practical issue as utility is not observable. One possible way to address the non-observable character of utility is to record information on household's perception of changes in satisfaction of their economic well-being (which is a technique used in the current study).

Among the empirical research having used the approach based on consumption variability is the work by Glewwe and Hall (1998). In determining which groups of households are more vulnerable to economic shocks, Glewwe and Hall (1998) use a threshold of consumption variability. They consider vulnerable households as those who experienced large decreases in consumption subsequent to the economic shocks occurred during the structural adjustment between 1985 and 1990 in Peru. They find that the degree of vulnerability decreases with educational attainment of the head of the household and increases with number of children. Another useful work is Suryahadi and Sumarto (2005) in the investigation of consumption vulnerability in Indonesia after the Asian economic crisis. Using nationally representative cross section data from household survey data, they defined the high vulnerability group based on low level of expected consumption and high variability of consumption. They also define the total vulnerable group as a combination of the high vulnerable group and those who are currently poor. Their results suggest that the vulnerable population is significantly greater than the number of the currently poor.

Summary

In summary, the concept of vulnerability embodies two dimensions. The first aspect perceives vulnerability as spells of poverty--the probability that a household's well-being level will fall below a certain threshold deemed socially unacceptable. The second type of vulnerability deals with fluctuations in welfare. Vulnerability may be caused by losses due to high income variability caused by natural hazards such as drought, economic shocks such as high price variability, and social or political shocks such as riots. Two types of costs are associated with vulnerability. The first is an intrinsic cost that occurs with welfare losses. Those losses may be associated with fluctuations in welfare or

probability of falling below poverty line. The second is an instrumental cost which arises because of loss of efficiency created by risk-aversion behavior as we will see in section 3.

2.2. Theoretical framework

Households facing income shocks undertake risk management strategies in order to smooth consumption. The strategies may take place either after the occurrence of the shock (i.e., ex-post risk management or coping strategies) or before (i.e., ex-ante risk management strategies). The objective of this section is to provide a theoretical framework to explore those strategies.

2.2.1. Consumption smoothing

The theoretical framework developed in this sub-section follows Bardhan and Udry (1999) and Kazianga and Udry (2006).

Let $i=1, 2, \dots, N$ index risk-averse households living in communities v . There are $t=1, 2, \dots, T$ periods in each of which a state of nature s occurs with fixed and known probability. Let h_t denote the history of states realized over period t . Each household has a concave utility function defined over the consumption of two goods: commodity c and leisure l . Each household is assumed to maximize its expected utility:

$$(2.1) \quad U_t = E \sum_{t=1}^T \alpha^{t-1} u(c_{ivt}(h_t), l_{ivt}(h_t)),^8$$

Assuming complete markets, the budget constraint of household i in community v is represented by

$$(2.2) \quad \sum_{t=1}^T \sum_{h_t \in H_t} (1+r_{vt}) [p_{vt} c_{ivt} + (w_{vt} l_{ivt})] \\ = A_{iv1} + \sum_{t=1}^T \sum_{h_t \in H_t} (1+r_{vt}) [\pi_{ivt}^* + w_{vt} T_{ivt}] = y_{ivt}$$

The left hand side terms of equation (2.2) represents the present discounted value of consumption of commodity c and leisure l of the household where r_{vt} is the discount rate between period 1 and period t in history h_t . The variables p_{vt} and w_{vt} are the village-specific state-contingent prices of the good and leisure in period t in history h_t . A_{iv1} is the initial wealth of household i in community v at the initial period 1 and T_{ivt} is the total time spent on non farm labor market at period t of history h_t . π_{ivt}^* is the amount of profits of the farm in period t of history h_t .

Risk sharing: If risks are largely idiosyncratic as supported by some empirical evidence, risk-averse households may group together to efficiently pool all risks (Townsend, 1995). Considering a model of fully efficient risk sharing within a community, the fundamental implication is that variations in individual consumption depend only on aggregate consumption and are independent of a household's own income and any other factors (Kazianga and Udry, (2006) and Townsend, (1995). Formally, define consumption as

$$(2.3) \quad c_{ivt} = \eta_1 y_{ivt} + \eta_2 c_{vt} + \eta_3 z_{ivt} + \lambda_i,$$

⁸ Unless otherwise specified, all variables are function of the history of states realized over period t . For simplicity purposes, the notation h_t will be dropped.

where y_{ivt} is household's own income, c_{vt} is aggregate per capita per capita consumption, z_{ivt} represents a set of household demographic variables, and λ_i is a household fixed effect. Complete risk pooling implies that $\eta_1=0$ and $\eta_2 = 1$.

Self insurance: A perfect risk pooling system within local communities is seldom achieved and this leaves some idiosyncratic risk uninsured (Udry, 1999). In addition, when shocks are covariate, cross-sectional risk pooling will inevitably fail as every household would be afflicted by the harmful effects of the shocks. In these conditions, an alternative for maintaining a smooth consumption over time for households facing income fluctuations is the use of saving and credit markets. It is assumed that households face a world with missing insurance markets but with well-functioning credit markets-that is, households have no access to insurance markets but can borrow or save at a market interest rate.

Let the household's initial asset stock at period t be A_t and its expected utility defined as

$$(2.4) \quad U_t = E \sum_{t=1}^T \alpha^{t-1} u(c_{it}, l_{it}).$$

A_t is positive if the household is a lender and negative if the household is a borrower. Consider π_{it} as a random profit received by the household. In the next period, the household decides how to allocate its resources between consumption and net saving such that

$$(2.5) \quad A_{it+1} = (1+r)(A_{it} + \pi_{it} - c_{it})$$

The household chooses to maximize (2.4) subject to (2.5). The decisions of saving or lending are made such that the marginal utility of current consumption is equal to the discounted expected marginal utility of future consumption.

$$(2.6) \quad u'(c_{it}) = \alpha(1+r)Eu'(c_{it+1}).$$

If the subjective discount rate $\alpha(1+r)$ is offset by the yields on the assets, the marginal utility of the current consumption is equal to the expected marginal utility of next period's consumption- that is

$$(2.7) \quad u'(c_{it}) = Eu'(c_{it+1}).$$

Since we assume that the utility function is quadratic, equation (2.7) becomes

$$(2.8) \quad c_{it} = c_{it+1}$$

Thus, households manage their consumption plan such that expected consumption is constant and, therefore, consumption is smoothed over time.

The mechanisms mentioned above are ex-post risk management or coping strategies since they take place after the realization of the shock. Nevertheless, assuming that households are risk averse and acquire experience over time, it is legitimate to consider that households anticipating the occurrence of shocks will take some ex-ante measures to smooth their income in order to reduce or mitigate their exposure to risks. Actions taken to this end are mentioned below.

2.2.2. Income smoothing or ex-ante risk management

Ex-ante risk management strategies are intended to smooth income by reducing variability (Dercon, 2000). They consist of reducing or eliminating risk in order to reduce the likelihood of exposure to risk or to mitigating risk so as to lessen or offset losses after being affected by a risky event (Alwang, et al., 2001). Actions for risk reduction include income diversification. However, being involved in multiple activities does not necessary translate into risk reduction since risk may be increased by undertaking a combination of risky activities instead of specializing in a single conservative activity (Morduch, 1995). Thus, households who intend to reduce risk usually undertake a mix of activities with low positive or negative covariance (Dercon, 2000 and Morduch, 1995). Indeed, in a study of migration in Thailand, Paulson (1995) finds that the tendency to migrate in Bangkok for those who make remittances to their

family members in their province of origin increases when there is low correlation between income patterns in their home province and income patterns in Bangkok.

Although ex-ante risk managements may be effective in terms of risk prevention or risk mitigation, the likelihood of their adoption may be hindered by the costs (real and opportunity costs) that their adoption involves (Alwang, et al., 2001). In fact, households may bear the cost of forgone potential benefits by choosing to be involved in low-return activities provided that those activities are associated with low risk (Morduch, 1995). The costs of risk reduction may also be higher for poor households compared to relatively wealthier households. Binswanger and Rosenzweig (1993) using the ICRISAT data set from rural India find that high risk, represented by weather variability, would have no noticeable impact on the profitability of farmer households in the top wealth quartile. However, the same level of risk would reduce the profitability of median and bottom wealth quartiles by 15 and 35 percent, respectively.

Another costly way of income smoothing is low use of farming inputs. Bliss and Stern, (1982) find that although fertilizer is a highly productive input in wheat cultivation, farmers opt to use less fertilizer in order to reduce investment losses in case of bad times. This low level of fertilizer, while providing a more smooth income results in low profits for farmers. The tradeoff between high profits and low risk can be perceived as the cost of risk premium that farmers bear for achieving a smooth consumption (Bliss and Stern, 1982). The long term cost of the risk-mitigating strategies is *risk-induced poverty traps*. In fact, by opting for ex-ante risk managements that offer income stability while yielding low returns, risk-averse households may be trapped in perpetual poverty (Christiaensen, 2004).

Why do some households experience consumption shortfall despite the available risk-coping and risk management strategies? The simplest answer to this question is that, these strategies are not accessible to every household. Risk sharing assumes strong solidarity among households. However, even if idiosyncratic shocks can be insured through risk-sharing, the poor may not be able to take advantage of the practice. In fact, poorer households may have limited or no contact with the richer as the later tend to collaborate with each other (De Weerd, 2001). Goldstein et al. (2001) show that community contacts have no impact on insurance against idiosyncratic shocks in Northern Ghana. In addition, poor households' ability to practice self insurance through credit markets may be limited because of lack of access to financial institution services. Finally, consumption smoothing via income diversification may not be accessible to all households because of entry constraints (Dercon, 2001).

2.3. *Determinants of vulnerability*

Several previous empirical works aimed at establishing factors affecting vulnerability. These factors include geographical factors (such as residence area), socio-economic and demographic factors (such as educational attainment of the head of households and household assets), government policies (such as macroeconomic shocks), and international assistance (such as availability of food aid). This section provides some determinants of vulnerability based on the existing literature.

Residence area

Residence area may impact the likelihood of becoming poor as rural and urban areas present different employment or source of income opportunities. Previous studies indicate the presence of concentration of more remunerative activities in urban areas compared to rural areas (Whitener et al., 2003). This idea is supported by the fact that we observe labor migration from rural to urban areas and by the fact that in

many developing countries, the poverty rate in rural areas has been and remains higher than in urban areas (Fan et al., 2005). Using cross section data from Indonesia, Suryahadi and Sumarto (2001) find more than double the rate of vulnerable people in rural areas compared to urban areas.

Education

Lack or low education may increase the risk of vulnerability as it may hinder the ability to quickly and adequately adapt to economic or natural shocks (Schultz, 1975). A household headed by a better educated member may be less vulnerable as better educated individuals can take advantage of other sources of income opportunities as they have increased labor market flexibility or economic mobility, and better or higher-paying jobs. In addition, a better educated head of household is more apt to use assets more efficiently, and access credit easily (Hall, 1997). For example, using data from Peru, Hall (1997) finds that each year of education attained by the head of household reduces vulnerability to consumption loss by 2 percent.

Main sector of activity of the head of household

Stability of income of the main earner plays an important role in household consumption stability. For example, for a household where the main sector of activity of the head is agriculture (especially when the main agricultural activity is growing rainfed crops), the vulnerability to consumption poverty subsequent to a natural disaster such as drought is high because of income uncertainty compared to a household headed by a member employed in a formal sector. Vulnerability among households headed by a member employed in the informal sector is also accentuated by lack of formal and reliable safety nets for the workers in that sector (International Labor Organization, 2007). Moreover, risk-averse

households in the informal sector may be victims of *risk-induced poverty traps* as they may experience long term profit losses by adopting low return activities in order to mitigate risks (Chaudhuri, 2004).

Household size

Despite the existence of economies of size in household consumption, a growing body of the literature show that households in developing countries tend to be poorer the larger the household size and the larger the dependency ratio. This may be because food, a rival good, tends to represent a substantial share of the budget of the poor (Lanjouw and Ravallion, 1995). In addition, there are high risks of declining soil productivity in a subsistence economy where large household size is likely to increase competition for land use between cash crops and food crops (Abuka et al., 2007). This decline in soil productivity may result in long run poverty, as it may lead to low output levels, and, consequently, high risks of being consumption poor. Furthermore, household saving constitutes an important tool of consumption smoothing by providing protection against income shortfalls and is inversely related to family size (Orbeta, 2006). Indeed, using data from the Philippines, Orbeta (2006) examines the relationship between household saving and family size and finds that additional children expose households to income shortfalls. Nonetheless, it is useful to mention that the impact of household size on vulnerability to poverty is not unanimous. There is countervailing evidence that household size may contribute to vulnerability reduction as larger households may have more diverse employment portfolio such as participation to labor migration and involvement in diverse economic activities. In addition, empirical evidence shows that when economies of size is taken into account, the positive correlation between household size and poverty tend to vanish (Ravallion and Lanjouw, 1995)

Household composition

Household composition may affect vulnerability to consumption shocks. Households with high dependency ratios may have fewer opportunities for income diversification because of fewer employable members. For example in determining household food security in Guatemala, Carletto (IFAD,1998) finds that although larger families tend to be relatively better off, households with high dependency ratios appear more vulnerable to food insecurity⁹. Moreover, female-headed households may be more vulnerable due to limited income generation opportunities caused by *gender discrimination*. Experience also shows that women in general tend to have more burden of caretaking responsibilities and this may also narrow their income generating opportunities (Hall, 2007). Snyder et al. (2006) find that in the US, the poverty rate was highest among female-headed households with children without other adult earners. However, other studies found that vulnerability to aggregate sources of risk does not differ among female headed households and male-headed households (Glewwe and Hall, 1998)

Household assets

Substantial evidence shows that households subject to income shocks and facing imperfect insurance markets use their assets to maintain smooth consumption (Deaton, 1992). Household assets include livestock, farmland, jewelry, etc and can be used to smooth consumption either by borrowing against them or by liquidating them. A common asset used for consumption smoothing in developing countries especially in SSA is livestock (Fafchamps, et al., 1996). For instance Rosenzweig and Wolpin (1993) present compelling evidence that sales and purchases of livestock are used as consumption smoothing strategies. Kinsey et al., (1998) find that during the four droughts occurred in rural Zimbabwe over the period 1983-96, the most common self insurance form used to smooth consumption is the sale of cattle.

⁹ Larger households were found to be better off but the marginal effect of the size of the household quite low.

Their findings suggest that livestock is used by the rural population as a buffer stock to drought. They also find that households most exposed to the adverse effects of drought are those without livestock.

The role of livestock as buffer stock is not universally supported by empirical evidence. Kazianga and Udry (2006) find that livestock as buffer stock for consumption smoothing during the Burkina Faso's extended drought (from 1981 to 1985) was not effective. The ineffectiveness of livestock as buffer stock during a drought may be explained by the fact that drought may cause the death of a large number of animals, decrease both their weight and fertility, or lower their value as many households liquidate their stocks (Dercon, 2001).

Access to health service

Existence of health facility and easy access to health service may impact a household's ability to smooth its consumption. For example, when access to health services is expensive, households with limited wealth may devote high proportions of their income to health care. This makes the near poor more vulnerable to poverty and exacerbates poverty among households who are already poor (Yoshihiro Iwasaki, 2002). For example in India, although the government offers free primary health care to the poor, evidence shows that poor households are at high risk of destitution subsequent to serious illness of a household member (Parker and Kozel). In addition, as mentioned in Wei (2005), there is a positive relationship between health and productivity. Thus, as a severe disease would inevitably lead to a loss of productivity, in absence of adequate health facilities, a household may run out of livelihood if the principal earner is afflicted by a severe disease.

Infrastructure

Lack of infrastructure can increase vulnerability to poverty for remote population. Infrastructure may ease trade between rural and urban area by reducing input and product transportation costs. Infrastructure may also increase farmers' productivity by facilitating transfer of new technology through access to information, and, therefore, reduce vulnerability (Parliamentary Office of Technology, 2006). Furthermore, seasonal migration constitutes an important source of income diversification and may be facilitated by road infrastructure.

Economic policies and safety net programs

Ability to engage in self insurance through income-based strategies may be hindered by limited access to formal credit. Economic policies that promote macroeconomic stability, better functioning of asset markets, and pro-poor financial institutions such as microfinance may reduce vulnerability to consumption shortfalls (Dercon, 2001, Morduch and Sharma, 2002). In fact, increased access to loans through microfinance programs may not only ease these financial constraints, but may also provide a source of extra cash for vulnerable households and, consequently, increase their purchasing power in case of consumption shortfall (Morduch and Sharma, 2002). Public safety nets such as food aid, creation of new jobs, and cash transfers in crisis times may also reduce vulnerability to consumption shortfalls¹⁰. Using data on three Southern African countries (Namibia, Mozambique, and Zambia), Devereux (2002) provides strong evidence that social safety nets do not merely lessen transitory and livelihood shocks, but can also play an important role chronic poverty alleviation.

¹⁰ Public safety nets may crowd-out existing informal arrangements (Dercon, 2001). However, given limitations of informal arrangements, safety net programs may be desirable when the programs allow achievement of more efficiency and equity than existing informal risk-sharing arrangements (Morduch and Sharma, 2001).

Conclusion

We learned from this chapter that households subject to vulnerability bear two costs: an intrinsic cost, which, as described earlier, represents the possibility of becoming poor or experiencing welfare losses, and an instrumental cost, which constitutes long run losses due to risk-avoidance behavior. Coping strategies may also involve instrumental costs such as liquidation of assets during crisis, which is not necessarily efficient. The question of whether which type of vulnerability is most important raises an ethical issue. Proponents of human rights perceiving poverty as a denial to human rights would be inclined to prioritize strategies aimed to reduce vulnerability to poverty. On the other hand, given that most risk-management strategies lead to non optimum use of resources which may hamper long term economic development, advocates of economic growth would favor strategies designed to reduce efficiency loss. In this study, both vulnerability as spells of poverty and vulnerability to welfare fluctuations will be explored.

Chapter 3: Descriptive Statistics and Nonparametric Estimation

3.1. Data

3.1.1. Data Origin

The main objective of this study is to identify the most vulnerable and food insecure households and explore how they can most effectively cope with economic shocks and natural disasters. Household well-being, in this case, will be determined by the poverty level and by food consumption. Variations in these measures of well-being by socio-economic and demographic groups of households will be examined. Variation in the poverty level and consumption (food and non-food consumption) with household exposure to natural disasters will also be explored. The main objective of this chapter is to provide basic descriptive statistics for the data used in the analysis.

The data were collected in 2005 by the National Institute of Statistics of Niger in collaboration with the World Bank, financed by the latter. One objective of the survey was to provide immediate data on basic indicators of well-being (such as literacy, education, health, nutrition of children five years, lodging, employment, possession of durable goods, agricultural production, and possession of livestock) for the population of Niger following the 2004-2005 drought. Another objective was to assess the impact of policies, programs, and poverty reduction projects on the living conditions of the population in the framework of Poverty Reduction Strategy (SRP).

3.1.2. Sampling

The sampling is a stratified random sample and uses the list of the polling zones of the General Census of the Population and the Housing organized in 2001 (RGP/H 2001). First, the sample was stratified

into 8 regions. Each region was then stratified into rural and urban areas, except Niamey which is exclusively urban. Polling zones were then drawn (in first degree) proportionally to the number of households in the RGP/H2001 from each stratum. A polling zone in Niger's rural areas may be composed of one or several villages but only one village is actually surveyed when there is more than one village. A total of 335 polling zone were selected nationwide in this fashion. The distribution of the polling zones by region is based not only on the size of the region in terms of households, but also by the proportion of poor households in the region (given the profile of poverty in Niger elaborated in 1994 with the data from the National Survey on the Budget and Household Consumption (ENBC) of 99/90 and 92/93). The distribution of the 335 pooling zones according to regions is shown in Table A3.1.

In each selected pooling zone, a sample of 20 households was drawn. Thus, the survey was designed to cover 6700 households. However, because of the mobility of the nomadic households in the zone of Agadez only 10 households were interviewed in that zone which leads to a total of 6690 households effectively interviewed in the survey. Among the 6690 households, 4670 are from rural areas and 2020 are from urban areas.

Each household and individual in the survey has been assigned a weight. When applied, the weights make the sample representative of the 1,983,460 households and total population (12,627,063 individuals) in Niger. Because the unit of observation in this study is the household, only the weights assigned to households will be used in the descriptive statistics.

3.2. *Descriptive Statistics*

Exposure to Niger's 2004 drought varied across households depending on several factors such as socio-economic and demographic characteristics of households (mainly educational level of the head of household, livestock ownership, poverty status, area and region of residence, and coping mechanisms available to households). The descriptive statistics in this sub-section shed light on these factors. The sub-section also provides a thorough poverty analysis (household perception-based poverty headcount decomposed into transient and chronic poverty and expenditure-based poverty, which is used to compute the depth and severity of poverty).

3.2.1 Heads of households socio-demographic and economic characteristics

It is important to determine the socio-demographic characteristics of the heads of households because they are the main contributors to the livelihood of their households in more than 95 percent of all households. Table A3.2 summarizes the socio-demographic and economic characteristics of the heads of households. The average age of household heads is about 45 years but urban heads are on average older than those in rural areas. Distribution by gender shows that about 93 percent of Niger's households are headed by a male member. A striking finding from Table A3.2 is the extremely low educational attainment of the heads of households. The adult illiteracy rate is about 85 percent. Of the 15 percent of households who have some education, about 16 and 0.7 percent have completed primary and secondary school, respectively.¹¹ However, about 21 percent of the educated households have postsecondary education. This is surprising as one may expect a lower proportion of college education due the very low level of secondary education. According to the respondents interviewed, major reasons for the low educational levels are high rates of failures (34.53%), burden of domestic chores (24.06%), and surprisingly, the perception of education as being useless (8.2%) (QUIBB, 2005).

¹¹ The 16 and 0.7 percents are obtained as follows: $16=(2.4/15)\times 100$ and $0.7=(0.1/15)\times 100$

The main sector of employment is agricultural sector. This result is not surprising as most of the population is rural.

3.2.2. Exposure to Shocks by Poverty and Expenditure-Quintile Distribution

Exposure to types of shock (faced by households 12 month prior to the survey) by poverty and expenditure-quintile distributions is presented in Table A3.3.¹² The most widespread shock was drought followed by loss of agricultural products. Overall, the poor appear to be more vulnerable to most of the shocks but the difference between the poor and non-poor exposed to shocks are not statistically significant. The results also indicate that disaggregating by income quintiles does not lead to a conclusive relationship between income levels and exposure to shocks. This is consistent with the result from analysis based on poverty status as poverty status and expenditure-quintiles are determined based on the same metric (i.e., per-capita total expenditures).

3.2.3. Distribution of Households Exposed to Drought across Regions of Residence

The distribution of households that experienced the negative impacts of the drought is provided in Table A3.4. A mere comparison of the statistics in column B may be misleading since households are not evenly distributed across regions. For example, looking at column B (i.e., the distribution of households exposed to drought) would lead to the conclusion that Tahoua is the region where most households experienced the adverse impacts of the drought. However, note that Tahoua is also the region with the highest share of Niger's households (20.8 percent). In order to accurately analyze the magnitude of the drought in each region, the relative shares in the last column were computed. According to the measures in column B, Diffa shows the fourth lowest share of households exposed to drought, while the region is

¹² The poor are defined using the 2005 expenditure-based poverty measure. The determination of the poverty line is provided in Box 1

in the first rank according to the relative share. Conversely, while Zinder presents the third highest share of households exposed to drought (column B), it is ranked fifth when the relative share criterion is considered. Table A3.4 shows that the regions where relatively most households experienced the negative impact of the drought of 2004 are Diffa, Tahoua, Maradi and Tillabery.

3.2.4. Coping Strategies after Drought and other Shocks

Households subject to shocks use a variety of coping strategies to mitigate the adverse impacts of the shocks they face. In most developing countries, these coping strategies include sales of productive assets, seasonal migration, reduction of daily food consumption, consumption of lower quality of food, having recourse to community solidarity, and relying on public and international assistance. Common coping strategies available to Niger's households subsequent to a drought are summarized in Table A3.5. Food aid was the prevailing coping mechanism post-shock. This strategy alone was used by about 75 percent of the households who experienced drought.

3.2.5 Food aid reception by poverty and expenditure-quintile distribution

Distribution of food aid after drought by poverty status and expenditure-quintile distribution is presented in Table A3.6. Perhaps the most startling finding from the analysis is the negative correlation between poverty and receipt of food aid. Overall, more non-poor households received food aid than poor households, especially in rural areas, suggesting a poor targeting of food aid to the rural population.¹³ Although this finding is surprising, it may be explained by the fact that a relatively higher proportion of non-poor households experienced drought in rural areas than poor households. Another justification

¹³ One may argue that this result was to be expected as a relatively higher proportion of non-poor experienced drought in rural areas.

This finding should be considered with a caveat as the statistics are for households who experienced the negative effects of drought. The available data does not allow an accurate investigation of how well food aid was targeted because it does not provide food aid distribution to households who were not subject to shocks.

could be the difficulty of distinguishing the poor from the non-poor in rural areas where living standards are more homogenous than in urban areas.

3.2.6. Analysis of drought exposure and coping mechanisms by livestock ownership

Livestock production in Niger accounts for almost 33 percent of the value added in the agricultural sector (World Bank, 2007). The occurrence of drought can deplete sources of animal nutrition, which may result in death or significant weight loss of animals and, consequently, cause important asset losses for livestock holders. As a result, drought may adversely impact the well-being of some groups of households such as pastoralists and agro-pastoralists who mainly rely on livestock production as a source of livelihood. It is therefore useful to investigate vulnerability to drought by livestock holding and explore post-drought coping mechanisms of livestock-owning households. The analysis treats rural and urban livestock-holding households separately as the characteristics of the two groups of households may differ in terms of asset-holdings.

Vulnerability to drought by livestock holding: The results on vulnerability to drought by livestock holding reported in Table A3.7 show a negative correlation between livestock holding and the likelihood of suffering from drought in rural areas while the opposite correlation is observed in urban areas, meaning that livestock holders in urban areas tend to be more vulnerable than those in rural areas. This finding may be due to the fact that livestock keeping in urban areas is more likely to be undertaken by the poor as a means to protect themselves against food insecurity due to limited alternatives of livelihood options (Guendel, 2003).

Coping Strategies by livestock holding after vulnerability to drought: Table A3.8 and Table A3.9 report the statistics on coping strategies by different levels of monetary values of livestock after

vulnerability to drought in rural and urban areas, respectively. Overall, the findings are similar to the results on the coping mechanisms for the entire households (Table A3.5). That is, the more commonly used mechanisms in both rural and urban areas are food aid, get assistance from other households, and agricultural product sales. An interesting finding from the analysis is the negative correlation between food aid and livestock value in rural areas and the positive correlation between food aid and livestock value in urban areas. These results are logical as the statistics in Table 3.7 indicate that higher value of livestock owning is associated with higher vulnerability to drought in urban areas whereas the opposite is observed for rural areas.

3.2.7. Subjective Trends in Economic Well-Being

Households were asked to self-report their economic condition at the time of the survey compared to that of one year prior. There are three alternatives: (1): Much worse than the previous year; (2) Worse than the previous year; and (3) Same or better than the previous year.¹⁴ Self-perceived trends in economic situation are presented in Table A3.10. The distribution by area of residence shows that the group of households most likely to report themselves as much worse off or worse off is the group of currently urban expenditure-based poor. Disaggregating the rural area by poor and non-poor does not yield a noticeable difference in trends in economic situation (Table A3.11), meaning that economic situation downturns have been uniform among rural households. This may be because most rural households are involved in the agricultural sector, which was widely hit by the 2004 drought.

¹⁴ There were initially five alternatives of trends (much worse, worse, same, better, and much better). The last three categories (i.e., same, better, and much better) are put together because the proportions of households in these categories are very low (See Table 3.10a Annex 3).

Tillaberi is the region with the highest prevalence of households that reported having a “much worse” economic situation followed by Tahoua. However, overall, Diffa is the place where most households experienced hardship in terms of economic well-being as almost about 89 percent of the percent of households in that region reported having declining economic conditions.

The literature on household vulnerability provides evidence that larger households, especially those with a high dependency ratio, tend to be more vulnerable. The statistics in Table A3.10 do not support this. In fact, even though the smallest households are the highest proportion with a reported increased or steady economic well-being, they are not overall better off as they also have the highest proportion of those reporting a much worse economic situation. However, the differences in proportions between the categories of households are not statistically significant.

Households with the head employed in the public sector are least vulnerable. About one half of these households reported having the same or a better economic situation while the corresponding figures for households with the head employed in the other sectors are less than one third. These results again suggest that workers in the public sector are more likely to have a more stable income relative to workers in other sectors, especially those in the agricultural sector where income is subject to high fluctuations due to natural shocks and price instability. Indeed, the results indicate that households headed by a member employed in the agricultural sector were the most vulnerable even though they present the lowest prevalence of much worse off households. For the distribution by the sex of the head of household, a higher share of female-headed households reported to have a worsened economic situation than did male-headed households.

Vulnerability to drought is also associated with a high likelihood of economic condition deterioration. Furthermore, the results show that if a household is exposed to drought, its economic situation is worsened independently of current poverty status. For example, the percentage of all households exposed to drought and poor households exposed to drought that reported declining economic conditions are 81.4 and 81.5, respectively.

3.2.8. Poverty Analysis

Knowing the characteristics of the poor and their location is an important tool for poverty reduction strategies and for better targeting of the poor (especially for an effective early emergency response). This subsection analyses the distribution of the poor by their geographical location (area and region of residence) and by the socio-economic and demographic characteristics of heads of households . The analysis adopts two approaches of poverty measures: (1) Household perception-based poverty, which will be used to identify the chronic and transient poor and (2) Expenditure-based poverty, also used to compute the depth and severity of poverty.

Household perception-based poverty: Households are asked to self report their well-being level on a scale of 1 to 10 at the survey time and five years prior to the survey. Level 1 is where the poorest are located and level 10 is where the richest are located. Household perception-based poor are identified as those having a level lower or equal to 6.

The poverty measure based on households' self-perception of well-being shows that about 78.5 and 81.7 percent of Niger's population were subjective poor in 2000 and 2005, respectively (Table A3.12), suggesting an increasing trend in subjective poverty. Overall, the analysis of the subjective poverty provides five major findings: (1) Household perception-based poverty does not significantly differ

between rural areas and urban areas; (2) Maradi, Diffa, and Zinder present the highest subjective poverty incidences. The fact that Maradi and Zinder have the highest subjective poverty incidences may be due to the high prevalence of acute food crises recorded in these two regions¹⁵; (3) Inconsistent with the results on households' self-perception of trends in economic well-being where a lower proportion of male-headed households reported a declining economic conditions, the statistics on the subjective poverty incidence with respect to the sex of the heads of households show that poverty incidence was higher among individuals from male-headed households; (4) Surprisingly, the result from the distributions with respect to the educational level of the heads of households indicate a positive correlation between educational attainment of the head and poverty. In other words, individuals in households headed by higher educated persons have higher subjective poverty rates. Finally, (5) households headed by a person employed in the formal sector disproportionately reported higher poverty incidences. This finding is consistent with finding (4) as people employed in the formal sector are more likely to be the ones with the highest educational attainment.¹⁶

Transient and Chronic Poverty: Transient poor (vulnerable) are defined as households having a rank lower or equal to 6 in 2000 or in 2005 but not in both and chronic poor are households having a rank lower or equal to 6 in 2000 and 2005 (Table A3.12). Disaggregating household perception-based poverty into transient and chronic poverty shows that about 36 and 49 percent of Niger's households

¹⁵ Global Acute Malnutrition in the three regions was higher than 15% (Center for Disease Control, 2006).

¹⁶ Although this finding is unexpected, recall that the subjective poverty measures are based on household self-perception and is not necessarily related to per capita expenditure. Higher educated people may also be more likely to report increased subjective poverty because they have more awareness of what is happening in other places in the world, have more ambition (such as enrolling their children to better schools), and have higher expectations from the future while uneducated people (who present the highest poverty prevalence) content themselves with their daily life as long as they are able to satisfy their basic needs (which are mainly limited to food and health).

were transient poor and chronic poor, respectively. Only approximately 15 percent were never poor. In general, the groups of households with higher household-perception poverty incidence tend to have the highest chronic poverty rates. This may be because the same groups of households present higher poverty incidences in both 2000 and 2005. No difference is seen between rural and urban areas. Note that although Maradi is among the regions with the highest chronic poverty rates, households in this region are also more likely to be transient poor. Indeed, only about 5 percent of the households in the region are never poor. The analysis by education of the heads shows that households headed by a better educated person have higher chronic poverty rate, but lower transient poverty rate. Finally, being in a household headed by a person employed in the formal sector leads to higher chronic poverty, but lower transient poverty. This may be due to higher income stability in the formal sector.

Expenditure-based poverty¹⁷: Using the expenditure-based poverty line described in Box 1(Annex 3), about 62.1 percent of Niger’s population was poor in 2005 (Table A3.14). The distribution by area of residence shows that akin to many developing countries, poverty prevalence in rural areas is much higher (65.68 percent versus 44.14 percent for urban areas). It is also important to mention that the poverty rate in the other urban areas is much higher than the poverty rate in the capital city (i.e., Niamey).¹⁸ This result suggests the existence of more income generation opportunities in the capital city relative to other cities. As Cohen (2006) points out, capital cities in developing countries are where modern productive activities are concentrated and more diverse employment opportunities and higher paying jobs are located.

¹⁷ Any household in which average expenditure per person is below the poverty line is considered poor. Because living standard is higher in urban areas than in rural areas, different monetary poverty lines were set up according to areas of residence. The thresholds were 118,442 FCFA and 159,674 FCFA for rural and urban areas respectively (Please refer to Box 1 for details in the determination of poverty line).

¹⁸ Poverty incidence in Niamey (The capital city) and other urban areas is 20.06 and 55.52 percent, respectively.

The regions with the highest poverty incidences are Maradi, Zinder, and Tillaberi while those with the lowest incidences are Diffa and Niamey. Decomposing the regions of residence by rural and urban areas shows the same ranking of poverty incidences for both rural and urban areas (i.e., regions with highest rural poverty incidence have also the highest urban poverty incidence) except for Zinder and Maradi. This means that when region A is poorer than region B, both rural and urban poverty rates in the former region are higher than those in the later. For all regions, rural poverty is statistically and significantly higher than urban poverty except for Tahoua and Zinder, meaning that these two regions present the lowest income inequality between rural and urban areas.

Contrary to the view that female-headed households are more likely to be disadvantaged due to the “triple burden” (Fuwa, 2000), the results indicate that being held by a male member significantly increases the likelihood of being poor in rural areas.¹⁹ Although this result is unexpected, a possible explanation is that some female households (de jure married) may be receiving remittances from migrant spouses, allowing them to maintain decent living standards. Another possible explanation that emerges from this finding is community solidarity toward widows. This second explanation is more plausible as more than 85 percent of the female heads are widows. The analysis with respect to the educational attainment of the heads of households suggests the existence of a threshold of educational level before ripping off the benefits of education, especially in the rural area. In other words, educated people have to achieve a certain level of education in order to have a higher income than uneducated persons. For example, while individuals from households headed by a person with primary education tend to have the same likelihood of being poor as individuals from households headed by a person with no education,

¹⁹ “The triple burden” is perceived as labor market disadvantages for women, being the main income earner and the caregiver, and in most cases, being the only income earner.

individuals from households headed by a person with secondary or postsecondary education present a significantly lower probability of being poor.²⁰ Finally, as expected, employment of the head of household in the formal sector is associated with low poverty headcounts, especially in urban areas. The results also show that individuals held by an unemployed person or a person employed in the informal sector tend to have the same likelihood of being poor. Although surprising, an explanation that merge from this finding is that most unemployed heads of households are not the main provider of livelihood for their households²¹

Depth and Severity of Poverty Measures: Poverty depth (poverty gap) provides information about the distance between the well-being measure of the poor (total expenditures in this case) and the poverty line. In other words, it provides the total resources to bring all the poor to the level of the poverty line, divided by the number of individuals in the population (World Bank, undated). The poverty severity considers how far off individuals are from the poverty line and inequality among the poor as it puts a higher weight on households who are farther from the poverty line.

The measures of depth and severity of poverty are presented in Table A3.14. The statistics are in line with those on poverty headcount measures (i.e., the ranking of the depth and the severity of poverty follows the same order as the ranking of the headcount measure) with the exception of Dosso. Although Dosso shows the fourth highest poverty rate according to the poverty headcount measure, it is ranked in the second highest level according to depth and severity of poverty, implying a higher inequality among

²⁰ Note that although individuals from households headed by a person with no education appear to have lower poverty head-count (66.48 percent) than those headed by a person with primary education (67.11 percent), the difference between the two groups is not statistically different from zero.

²¹ External contribution to the livelihood of households where the head is unemployed is 15 percent while the corresponding figure for households in which the head is employed is only 2 percent (QUIBB, 2005).

the poor in that region. The decomposition by gender of the head of household shows a greater poverty depth and poverty severity for male-headed households than for female-headed households. The analysis with respect to the educational levels of heads shows a greater poverty depth and income inequality among households in urban areas than those in rural areas. In addition, the comparison within each class of education of the head of households shows high poverty depth and poverty severity rates among individuals from households held by an uneducated person. A possible explanation that emerges from this finding is the heterogeneity of the heads in this group. In fact, uneducated persons tend to be self-employed. This may contribute to increased inequality among the group as business size substantially differs across households.

Finally, the distribution by the main employment sector of the heads shows that depth and severity of poverty measures tend to be similar for unemployed heads of households and heads employed in the informal sector. Note that, individuals from these two groups present greater poverty indexes than those from households headed by a person employed in the formal sector. This suggests that households headed by higher educated person tend to be more homogeneous.

Conclusion

The findings from the descriptive statistics indicate that the 2004 drought unambiguously affected the well-being of Niger's population. The analysis show that the likelihood of suffering from the drought does not depend on current poverty status, but rather on the main employment sector of the head of household. For example, households headed by a person employed in the formal sector were less likely to report declining economic conditions while households headed by a person employed in the agricultural sector disproportionately self-reported downturns in economic conditions. Furthermore,

there is evidence that rural livestock-holding households were relatively less affected by the drought than urban livestock-holding households. The analysis with respect to coping strategies after vulnerability to drought show that food aid was the prevailing coping strategy followed by “assistance from other households”. The findings from the expenditure-based poverty analysis support the literature on the relationship between education and poverty vulnerability. In fact, households headed by a better educated person tend to have a lower probability of being expenditure-based poor. The study also shows that subjective poverty (i.e., household perception-based poverty) incidence is higher than expenditure-based poverty incidence in 2005 and has increased between 2000 and 2005. Furthermore, subjective poverty does not appear to be related to per capita expenditure levels confirming Sen’s theory that poverty is not just a matter of money metrics.

3.3. Nonparametric Estimation

3.3.1. Kernel Density Estimation

A mere comparison of means (Table A3.15 and Table A3.16) gives only limited information about the nature of differences in the underlying distribution of household consumption expenditure and total expenditure among the three categories of households (i.e., same or better off, worse off, and much worse off) and among drought-prone and non-drought-prone households. The nonparametric kernel density estimation techniques allow the analyst to view the entire distribution and identify the nature of differences in expenditures without imposing rigid assumptions associated with parametric specification of the distributions (Mills, et al., 2001). In addition, when sampling probabilities are provided, the application of kernel density estimation methods is straightforward (DiNardo and Johnston, 1997).

3.3.2. Results of the Kernel Density Estimation

The kernel density estimation present the distributions of the log of per-capita food expenditures and per-capita total expenditures based on household subjective-perception of being affected by the drought and household subjective perception of trends in economic well-being (MWO, WO, and SOBO). The distributions with respect to exposure to drought are analyzed separately for the rural area and the urban area as exposure to drought may be impacted by different patterns of asset distribution given to the residence area.

The urban density distributions of the log of per capita total food expenditures and per-capita total expenditures based on exposure to drought are presented in Figure A3.1 and Figure A3.3, respectively. The density distributions for households not affected by the shock lie to the right of the distributions for the drought-prone households. This means that urban households not affected by the 2004/05 drought enjoyed higher economic well-being relative to those affected by the drought. However, the distributions with respect to the rural area (Figure A3.2 and Figure A3.4) lead to the opposite finding as the drought-prone households are the ones who tend to have higher per-capita expenditures. This unexpected finding suggests that more relatively wealthier urban households tend to self-report being exposed to drought than households with limited economic resources. As wealthier households are more likely to have larger farms, a logical explanation to this finding may be that the wealthier households incurred more losses due to bad harvest caused by the drought, making them more susceptible to self-report being affected by the drought.

The per-capita food expenditure and per-capita total expenditure distributions with respect to trends in economic situation are presented in Figure A3.5 and Figure A3.6, respectively. As expected, the SOBO distributions lie to the right of the MWO and WO distributions, meaning that more households in the SOBO have higher per capita expenditure levels than the MWO and WO households. This is supported by Figure A3.7 (per capita total expenditures), which shows negative density differences for low consumption levels and positive density differences for high consumption levels. The Kolmogorov-Smirnov tests of the equality of the MWO and SOBO distributions and the equality of the MWO and SOBO distributions (for both food and total expenditures) indicate that the density difference between the SOBO and the MWO distributions and that between WO and SOBO are statistically significant at the p-value of 0.01.

3.3.3. Re-weighting the MWO, the WO, and the drought-prone households

Distributions

The density re-weighting techniques used in this study follow the decomposition by Mills et al. (2001) and DiNardi and Johnston, (1986). The density reweighting techniques help identify the underlying factors that contributed to differences in well-being distributions of the three groups. Two experiments are conducted. The first reweighs the MWO and WO well-being distributions by adjusting the educational levels of the heads of households in the MWO and WO to that of the heads in the SOBO group. More specifically, the experiment answers the question “What would be the distribution of per capita expenditures for those MWO and those WO if the heads in those groups had the same educational levels as the heads in the SOBO group?” The second experiment investigates the impact of livestock

ownership on differences in well-being distributions between households affected by the 2004/05 drought and those not affected by the drought.

Impact of education of the heads of households well-being distributions with respect to trends in economic situation

In this experiment, the frequencies of the heads of SOBO in each education category (no education (level 0), primary education (level 1) and secondary or postsecondary education (level2)) are divided by that of the heads of MWO or WO.²² While this procedure decreases the frequency of the heads of MWO and WO with no education, it increases their proportions in levels 1 and 2. Applying the new weights to the MWO and WO distributions enables the investigation of how an increase in the educational levels of

heads of households will affect their per-capita well-being distributions

The actual and re-weighted density distributions of the log of per capita food consumption and the log of per capita total expenditures for MWO are presented in Figure A3.8 and Figure A3.9, respectively, and the distributions for WO are presented in Figure A3.10 and Figure A3.11, respectively. In all cases, the graphs show a rightward shift of the distribution after the re-weighting. A Kolmogorov-Smirnov test of the equality of the actual and the counterfactual distributions cannot be applied in this case as the counterfactual is just a reweighting of the actual (Mills et al., 2001). The fact that the re-weighted distribution lies to the right of the actual distribution suggests that increasing the educational levels of

²² For example, the proportion of heads in the MWO with no education, primary education, and secondary/post-secondary education is 86.13, 8.53, and 5.34, respectively while the corresponding percentages for the heads in the SOBO group are 72.85, 12.40, and 14.75, respectively.

the heads would result in an improvement of the well-being of their respective households. An interesting finding from the experiment is that the density difference between the actual and counterfactual is always negative for the lowest expenditure levels (generally for log of expenditure less than 11). This means that increasing the level of education of the heads will unambiguously positively affect the well-being of the least favored households in the two groups (i.e., MWO and WO). Indeed, counting the number of households in the area where the density difference is negative and per-capita expenditures is lower than the poverty indicates that increasing the educational level of the MWO and WO heads will reduce the proportion of the rural poor in the two groups by 18.4 and 30.6 percent, respectively. The corresponding figures in the urban area are 12 and 10.8 percent for MWO and WO, respectively.

Impact of livestock ownership on household well-being distributions with respect to drought exposure

The current experiment uses the same density reweighting techniques as the ones used in the preceding experiment. In this case, the frequencies of the non-drought-prone households in each category of livestock ownership (no livestock, monetary value below the median and monetary value above the median) are divided by the frequencies of the drought-prone households. The results for the rural per-capita total expenditures and urban per-capita total expenditures are presented in Figure A3.12 and Figure A3.13, respectively. The results for the rural area show that the actual and the reweighted distributions are virtually identical, suggesting that adjusting the value of livestock owned by the drought-prone households to that of the non-drought-prone households would have no impact on the well-being of the former group. A plausible explanation to this unexpected finding is that the distribution of households according to livestock ownership does not seem to noticeably differ between drought-prone households and non-drought-prone households. For the experiment with respect to the

urban areas, the results are inconclusive. In fact, as shown in Figure A3.14 and Figure A3.15 it is not clear whether the reweighted distributions lie to the right or to the left of the actual distributions.

Summary

The findings from the descriptive statistics indicate that the 2004 drought unambiguously affected the well-being of Niger's population. The analysis shows that the likelihood of suffering from the drought does not depend on current poverty status, but rather on the main employment sector of the head of household. For example, households headed by a person employed in the formal sector were less likely to report declining economic conditions while households headed by a person employed in the agricultural sector disproportionately self-reported downturns in economic conditions. Furthermore, there is evidence that rural livestock-holding households were relatively less affected by the drought than urban livestock-holding households. The analysis with respect to coping strategies after vulnerability to drought shows that food aid was the prevailing coping strategy followed by "assistance from other households". The findings from the expenditure-based poverty analysis support the literature on the relationship between education and poverty vulnerability. In fact, households headed by a better educated person tend to have a lower probability of being expenditure-based poor. There is also evidence that subjective poverty (i.e., household perception-based poverty) incidence is higher than expenditure-based poverty incidence in 2005 and has increased between 2000 and 2005. Furthermore, subjective poverty does not appear to be related to per capita expenditure levels confirming Sen's theory that poverty is not just a matter of money metrics. Finally, the non-parametric estimation consisting of the re-weighting of the MWO and WO per-capita expenditure distributions by adjusting the educational levels of the heads in the two groups to the educational levels of the heads in the SOBO group provides

evidence that increasing the levels of education of the heads in the MWO and WO groups will clearly results in increased economic well-being for households in these two groups.

Chapter 4: Empirical Methods for Parametric and Semi-Parametric Estimations

The calamitous effects of Niger's 2004 crisis were not uniformly distributed. In fact, while some households reported having the same or better level of well-being in 2004 compared to those of the year prior to the survey, others reported having a worse, or even, a much worse level of well-being. The objective of this chapter is to present an empirical approach for the estimation of the impact of the crisis on household well-being using cross section data, and for identifying households who were most adversely affected by the crisis. The chapter is organized in two sections. The first presents the parametric methods and the second section presents the semi-parametric method. The parametric methods present the estimation of multinomial and binomial logit models. The multinomial logit will be used to generate the probability of being same or better off, worse off, or much worse off, conditioned on household and community assets.²³ The binomial logit will be used to generate the probability of being subject to drought given household characteristics and community assets. Indicators of changes in states of well-being and vulnerability to drought obtained from the binomial and multinomial model estimations will be used to estimate the log of household size-adjusted food expenditures and total expenditures. The semi-parametric method consists of experiments that answer the question "what would be the well-being distribution for the group of households who experienced shocks (i.e., drought) or economic hardship if those households had the same assets as those who were relatively well off?"

²³ Households are asked to reveal how they would compare their economic situation at the time of the survey to that of a year ago. There were initially 5 alternatives (much worse, worse, same, better, and much better). However, the proportions of households in the categories same and much better are small (5.88 and 2.52, respectively) and have been added to the third category (i.e., "better").

4.1. Parametric Estimations

4.1.1. The Binomial and Multinomial Cases

4.1.1. a. Connection between the econometric model and economic theory

The econometric specification for the estimation of vulnerability to drought within the 12 months preceding the survey and changes in economic situation compared to one prior year on is based on the theory of consumption smoothing. The assumption is that risk-averse utility maximizing households prefer smooth consumption over time. For example, consider two levels of consumption smoothing, 0 and 1. Level 0 occurs when the household is completely unable to smooth its consumption after experiencing drought, and, therefore, experiences a decrease in its consumption. Level 1 takes place when the household is able to maintain a smooth consumption despite the occurrence of the drought. If a household is risk-averse, with consumption smoothing level 1 it will achieve a higher utility than a household with level 0. Ability to smooth consumption is associated with an intrinsic benefit in the form of higher utility.

Because the data used in this study come from a cross section, changes in household consumption over time are not observed. However, some information about these changes can be derived from the self-reported states in 2005 compared to one year prior (i.e., “much worse economic situation”, “worse economic situation” and “same or better economic situation”). For example, a substantial decrease in household consumption between 2004 and 2005 can be inferred when the household reports being in

“much worse economic situation” whereas a stable or increased consumption is perceived from the alternative “same or better economic situation”.

Since the degree of consumption smoothing is reflected by the alternative chosen by a household and a household’s objective is to maximize its utility which is determined by the degree of consumption smoothing, the probability that a household will report itself as being subject to drought or having a deteriorated economic situation depends on its ability to manage and cope with shocks.

Binomial case

Let y_i^* be a latent utility of household i defined as

$$(4.1) \quad y_i^* = x_i\beta + u_i$$

where x_i is a vector of regressors that determine household ability to cope with shocks. In other words, x_i represents the determinants of household vulnerability to shocks. This equation cannot be estimated as utility is not observed. Instead, we observe households’ responses about whether they were exposed to drought or not. Assume δ_0 , a threshold of consumption utility below which a household would be adversely affected by drought. Following Cameron and Trivedi (2005),

$$(4.2) \quad \begin{aligned} y_i &= 1 \text{ if } y_i^* < \delta \\ y_i &= 0 \text{ if } y_i^* \geq \delta \end{aligned}$$

The threshold of δ is a normalization explained in the following equation

$$(4.3) \quad \begin{aligned} \Pr[y_i = 1] &= \Pr[y_i^* < \delta] \\ &= \Pr[x_i\beta + u_i < \delta] \\ &= \Pr[-u_i > x_i\beta + \delta] \\ &= F(x_i\beta + \delta) \end{aligned}$$

Where $F(.)$ is a cumulative density function of $-u_i$ which is a random error term. The probability of being subject to drought (reported by the household) can be expressed as a function of determining variables and estimated in this fashion.

Multinomial case

Assume three levels of consumption utility γ_0 , γ_1 , and γ_2 . Correspondingly to the binomial case, each alternative is chosen with respect to the same latent consumption utility specified in equation (X.1). Thus, the probability for each alternative to be chosen can be expressed as follows

$$(4.4) \quad \begin{aligned} y_i &= 0 \text{ if } y_i^* < \gamma_1 \\ y_i &= 1 \text{ if } \gamma_1 \leq y_i^* < \gamma_2 \\ y_i &= 2 \text{ if } y_i^* > \gamma_2. \end{aligned}$$

4.1.1.b. Parameterization of the econometric model

The dependent variables are qualitative variables and this precludes the use of the classical linear regression as it may generate negative fitted values which will translate into negative probabilities or positive fitted values which may translate into probability which exceed 1. Logit and probit models restrict the values of the probability to lie between zero and one. In this study, the logit model will be used. Since there are two alternatives in the vulnerability to drought (i.e., exposure and non exposure), the binomial logit is used. Thus, the function F in equation X is defined as

$$(4.5) \quad F(x_i, \beta) = \frac{\exp(x' \beta)}{1 + \exp(x' \beta)}$$

An advantage in the use of the binomial logit instead of the bivariate probit is the ease of interpreting the results in terms of the odds ratio. For example, consider p as the probability of being subject to drought and the $1-p$ the probability of non exposure. The odds ratio which is $p/(1-p)$ represents the odds of being subject to drought relative to those of non vulnerability to drought. Specifying p by the logistic expression gives

$$(4.6) \quad p = \exp(x\beta)/(1 + \exp(x' \beta))$$

$$\Rightarrow \frac{p}{1-p} = \exp(x' \beta)$$

$$\Rightarrow \ln \frac{p}{1-p} = x' \beta$$

For the multinomial case of trends in economic situation, there are three choice alternatives (“much worse”, “worse”, and “same or better”). Therefore, the multinomial logit is used to estimate the probabilities of being in each of these states. Other multinomial functional forms (such as conditional logit and the ordered logit) exist for this type of estimation. The choice of the multinomial logit is motivated by the fact that the outcome depends on characteristics of individuals. In other words, the probability of being in a given state of well-being is determined by the characteristics of households.

The multinomial logit is defined as

$$(4.7) \quad F_j(x_i, \beta) = \frac{\exp(x' \beta)}{\sum_{k=0}^2 \exp(x' \beta)}$$

Where $j=0,1,2$ and $i=1,2,\dots,n$

4.1.1.c. Explanatory variables description and hypothesis

Based on the existing literature on household vulnerability, a set of relevant explanatory variables are chosen from the available data set. The description and summary statistics of the selected variables are provided in Table A4.1 and Table A4.2, respectively.

Household demographic and socio-economic characteristics

Household demographic characteristics include household size, dependency ratio, and the demographic characteristics of the head of household (age and sex). Household economic characteristics encompass educational attainment and main sector of activity of the household head, and household physical assets represented by livestock ownership. The rationale behind the use of the socio-economic characteristics of the head of household is that among almost 95 percent of the households, the main contributor to household income is the head of household.

Household size represents the number of persons living in a household. Household is defined as a group of persons among which a member is given authority. All members of the household live together and share the same meals. The impact of household size on the ability to smooth consumption may be either positive or negative. In fact, larger households may have more income diversification opportunities such as the participation of some members to labor migration. On the other hand, larger households with few employable members may be more vulnerable to consumption shock because of limited

income diversification opportunities. Thus, I reserve making an explicit hypothesis on the impact of household size on household ability to smooth consumption²⁴.

Dependency ratio is represented by the ratio of household members not participating in the labor force to the total number of members in the households. Specifically, members in the dependency group are those in the age groups of 0 to 14 and 65 or more. Many empirical studies show that households with fewer employable members tend to be more vulnerable to consumption shocks. This may be because of the inability of those households, to accumulate saving, which is an important tool for consumption smoothing (Orbeta, 2006). As a result, I expect high dependency ratio to negatively impact ability to smooth consumption.

Age of the head of household

Based on the findings of previous studies, the age of the head can either positively or negatively impact a household ability to cope with shocks or to manage risk. For example, an older head of household may be more likely to cope with shocks through experience. Conversely, since older people may be less able to quickly develop new working skills, age may increase the likelihood of being exposed to shocks when it is necessary to work in other fields. Given these contradictory effect of the head's age on household economic well-being, I reserve making any specific hypothesis on the sign of that variable.

Sex of head of household

²⁴ The use of the terms “ability to smooth consumption”, “consumption shortfalls”, “consumption variability” and “being vulnerable to shocks” in this section refers to the probability of suffering (or not suffering) the adverse impact of drought or the probability of being much worse off, worse off, or same or better off.

There is a large literature on women's limited access to income generation opportunities. Not only do women tend to have less employment opportunities due family responsibilities, but also they are found to earn less than men because of *gender discrimination*. Therefore, I expect female headed households to be more likely to experience consumption shortfalls.

Education is represented by the educational attainment of the household head, which takes three different levels: "no education", "started or completed primary level", and "secondary or post secondary level". Based on the positive impact of human capital on income generation opportunities, I expect that, the higher the educational level of the head of household, the higher the likelihood of maintaining a smooth consumption. The probability of being subject to drought or having a deteriorated economic situation is expected to be negatively correlated with the educational level of the head of household

Household assets are represented by livestock ownership, which is characterized by four different groups: no livestock holding, small livestock holding (goats and sheep), big livestock holding (bovines and donkeys), and both small and large livestock holding. As highlighted in the second chapter, the role of livestock as a buffer stock for consumption smoothing in developing countries is controversial. While some studies support the use of livestock as a buffer stock, other show that distress livestock sales are extremely rare and generally only occur under the most severe circumstances. Despite these countervailing empirical evidences, I make the hypothesis that livestock holding strengthens ability to smooth consumption.

Main sector of activity of the head of household

There are two main sectors of activities of the head of household: the formal sector and the informal sector. The formal sector encompasses the public sector and the formal private sector. The informal sector is composed of agriculture and other self employments. Since workers employed in the formal sector are more likely to receive a steady income, I expect households headed by a member in the formal sector to be less vulnerable to income shock in the face of drought and, consequently, more likely to maintain a smooth consumption.

Community assets

Community assets are represented by proximity to health and veterinary centers, road infrastructure, income generation opportunities, and participation to government decisions.

Proximity to a health center

This variable is a qualitative variable that takes three different walking times to the nearest health center: less than 29 minutes, between 30 and 59 minutes, and more than an hour. Given the limited transportation means in developing countries and the positive impact of health on labor productivity, households dwelling near a health center may be relatively better off as they may easily access health services. Thus, I expect households closer to a health center to be more likely smooth consumption.

Proximity to a veterinary center

This variable represents walking times to the closest veterinary center and is defined in the same way as the proximity to a health center. Because drought may undermine the health of animals, I expect households closer to a veterinary center to be relatively better off, especially in the estimation of drought exposure. In fact, being close to a veterinary center may not only allow households to have their sick

animals receive health care, but can also enable them to easily access technical advice that may help them ensure a good health for their herd.

Road infrastructure

Similarly to the two preceding variables, road infrastructure is characterized by walking times to a practicable road. Good roads may create income diversification opportunities by, for example, facilitating seasonal labor migration or increasing trade opportunities by allowing households to sell their products on local common markets (OECD, 2006). Therefore, I expect proximity to a good quality road to have a positive impact on households' ability to maintain a smooth consumption.

Level of difficulty of economic activity creation is a qualitative variable that asks respondents how difficult it is to create an economic activity at the survey time compared to one prior year. The variable takes three levels: 1, when it is easier to create a new economic activity, 2, when it is the same as the preceding year, and 3, when it is more difficult to engage in a new lucrative activity. Because this variable clearly represents income diversification opportunities, it is expected to have a positive impact on consumption smoothing.

Participation to government decisions is also a qualitative variable that provides information on whether decisions made by the government take into account the public opinion compared to a year before the survey. Level 1 is when public opinion is more considered, level 2 when there is change, and level 3, when it is less considered. Although the government can have financial and logistic capacities to assist people in distress, it may not be able to accurately identify their real needs, as the recipients themselves. Taking into account the opinion of the public can make government interventions more

effective and more efficient. Indeed, Knutson et al. (1998) argue that informed and equitable policy formulation for drought reduction necessitates collaboration at all levels (the general public, community advisory, and policy makers). Consequently, I expect that the more the public opinion is considered, the less likely will households be vulnerable to shocks.

4.1.2. Estimation of Household-Size Adjusted Food Consumption Expenditures and Total Expenditures

Household vulnerability to drought and economic conditions downturns have been estimated using the binomial and multinomial logit, respectively. The objective of this section is to use the indicators of worse off and much worse off than previous year and indicators of vulnerability to drought based on these estimations to measure current economic well-being represented by household-size adjusted food consumption expenditures and total expenditures. Other explanatory variables include household and community assets and the use of food aid, which constitutes an important variable of interest in the estimation.

One concern that the use of food aid as an explanatory variable in the estimation of household-size adjusted consumption may raise is an endogeneity and simultaneity problems as food aid cannot be treated as exogenous to household per-capita total expenditures. To overcome these problems, I use participation of household members to community development cooperatives and associations as instrumental variables for food aid. The use of household social activities as instruments is appropriate as these variables are correlated with food aid reception but not correlated with food and non food expenditures. In fact, a household will be more likely to receive food aid when it has members who participate to associations because exposure to the social economic environment increases the

household's awareness of what is happening in the community and this can increase its chance of food aid reception. For household-size adjusted expenditure, it does not depend on whether members in the household participate to socio-economic association or not. The estimation will treat rural and urban areas separately as households from the two regions present different characteristics (human and physical assets) that may impact the probability of their food aid reception or their expenditure levels.

4.2. *Semi-parametric estimation*

The simple density reweighting techniques presented in chapter 3 are developed by reweighting the distribution of expenditures to reflect different patterns of livestock ownership and educational attainment of the head of household. Although these techniques have some predictive power, they are based on the assumption that the distribution of expenditures within each asset (such education class) is unchanged. It is useful to highlight that changes in well-being distribution are not completely attributable to the two factors. The objective of this section is to provide a semi-parametric analysis that adjusts the asset distributions of the different groups of households. Two experiments will be developed. The first answers to the question “How would well-being distribution change if the people who were most subject to the negative impact of drought had the assets of those who did not experience the drought?” The second experiment answers the question “What would be the MWO and WO per-capita expenditure distributions if households in those groups had the assets of the SOBO households?” Akin to the simple density reweighting techniques, the semi-parametric techniques employed follow the decomposition by Mills et al (2001), and DiNardo and Johnston, (1986).

4.2.1. Experiment 1: Reweighting the asset distribution of the group subject to drought

The procedure for reweighting is as follows. Consider $f(w, z, x)$ as the joint distribution of household size-adjusted expenditure (w), the states of being subject to drought or not (z), and household and community attributes (x). Household and community assets can have important impacts on the probability of being subject to drought. To account for the impact of these assets, a counterfactual density adjusting household and community characteristics with the households and community characteristics of the group not subject to drought is generated for the well-being distribution of the group subject to drought. Besides attributing the assets of the non-drought-prone households to the drought-prone households, this experiment also adjusts the propensities of drought exposure of households exposed to the drought to the propensities of exposure of the non-drought households. The procedure is as follows:

$$\begin{aligned}
 (4.8) \quad & f(w; t_w = drought, t_{z/x} = nodrought, x = nodrought) \\
 & = \iint f(w/z, x, t_w = drought) dF(z/x, t_{z/x} = nodrought) dF(x/t_x = nodrought) \\
 & = \iint f(w/z, x, t_w = drought) dF(z/x, t_{z/x} = drought) dF(x/t_x = drought) \Psi_{z/x} \Psi_x
 \end{aligned}$$

Where $t_w = drought$ is the per capita expenditure distribution of the group who experienced drought and $t_x = drought$, the corresponding household and community attributes.

$$\Psi_{z/x} = \frac{dF(z/t_x = nodrought)}{dF(z/t_x = drought)}, \quad \text{and} \quad \text{by} \quad \text{Bayes' rule}$$

$$\begin{aligned}
 \Psi_x & = \frac{dF(x/t_x = nodrought)}{dF(x/t_x = drought)} \\
 & = [(pr(t_x = nodrought) / x) / (pr(t_x = drought) / x)] * [(pr(t_x = drought)) / (pr(t_x = nodrought))].
 \end{aligned}$$

$\Pr(t_x = t/x)$ is the probability of being exposed to drought given household and community characteristics x and is estimated using a simple binomial logit model. $pr(t_x = t)$ is the number of observations in group t (i.e., group of drought and group of no drought) divided by the total number of observations.

4.2.2. Experiment 2: Reweighting the asset distribution of the MWO and WO groups of households

The experiments are carried out by adjusting the assets of the MWO and WO groups of households to the assets of the SOBO households in the SOBO. The experiment techniques used are similar to those described in Experiment 1. Here “drought” is replaced by MWO and “nodrought” is replaced by SOBO in the reweighting of MWO. For the reweighting of WO, “drought” is replaced by WO and “nodrought” is replaced by SOBO.

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Summary

The current chapter presented the different empirical methods selected for the parametric and semi-parametric analyses. The binomial logit and the multinomial logit are selected to estimate the determinants of the probability of being negatively affected by the 2004 drought and the determinants of changes in economic conditions, respectively. Density re-weighting techniques following the decomposition by Mills et al (2001), and DiNardo and Johnston, (1986) are used to develop two experiments. The first experiment investigates “How the well-being distribution for the drought-prone households would be if those households had the same assets as households not affected by the drought.

The secondt experiment answers the question “What would be the per-capita expenditure distributions for the MWO and WO groups of households if those households had the same households and community characteristics as the SOBO households?” The following chapter provides the empirical results of the different analyses

Chapter 5: Results and Implications

This chapter is organized in two sections. The first section presents the interpretation of estimation of the binomial and the multinomial logit models and the interpretation of the estimation of household-size adjusted food expenditures and total expenditures. The binomial logit is used to investigate determinants of vulnerability to drought; it identifies factors affecting ability to cope with drought. The multinomial logit estimation is used to explore determinants of changes in perceived household economic conditions (much worse, worse, and same or better). The second section presents the results of the semi-parametric estimations. Two experiments are developed. The first answers to the question “How would well-being distribution change if the people who were most subject to the negative impact of drought had the assets of those who did not experience drought?” and the second address the question “What would be the per-capita expenditure distributions for the MWO and WO groups of households if those households had the same household and community assets as households in the SOBO groups?”

5.1. Parametric Results

5.1.1 Determinants of vulnerability to drought

Estimation results for vulnerability to drought are presented in Table A5.1. The first and second columns give the coefficients and standard errors from logit regression and the third and fourth columns provide the marginal effects and their respective standard errors. The marginal effects are computed for households with livestock holding below the median monetary value and headed by a male with no

education and employed in the informal sector. The continuous variables are set at their mean values, and all the other dummies are set to zero except for *clinicdist2*, *road3*, *vet3*, *actdif3*, and *partic3*, which are set to 1.

In general, the parameter estimates associated with household demographic characteristics have the expected sign. Employment of the household head in either the formal or the informal sector reduces the likelihood of suffering the adverse impacts of drought. The impact of formal sector employment on probability of drought exposure reduction is stronger than that of employment in the informal sector, and it is statistically significant. In fact, being headed by a member employed in the formal sector reduces the probability of vulnerability to drought by about 9 percentage points while being headed by a member employed in the informal sector reduces (but not significantly) the probability by only about 4 percentage points (See ME column). This result is not surprising as individuals employed in the formal sector tend to have a more stable source of income relative to those employed in the informal sector. The parameter estimate on the sex of head indicates that female-headed households are more likely to be exposed to drought but the gender effect is not significant.²⁵ As expected, households with high dependency ratios have significantly higher vulnerability to drought.

Except for the primary education of the head of household, household human assets (i.e., education of the household head) and physical assets (i.e., livestock) reduce the probability of suffering the negative effects of drought. As expected, households headed by a better educated person are significantly protected against shocks (*edu3* in ME column). This result corroborates the theory that better educated

²⁵ Using panel data from Northern Mali, Christiansen and Boisvert (2000) find that female-headed households appear to be less exposed to drought shocks partly because of community solidarity. Some female-headed households may also present lower vulnerability to shocks due to remittances received from migrant spouses.

individuals show higher ability to quickly and efficiently adapt to economic or natural shocks (Shultz, 1975). The fact that livestock ownership reduces the probability of vulnerability to drought may imply that households use their livestock as a buffer stock for consumption smoothing. However, it is useful to mention that drought may also adversely impact livestock owners as it may cause the death or weight loss of their herds which will result in a reduction in the values of their asset holdings. Such effects might be expected to lead livestock-owning households to report greater vulnerability to drought other factors held constant. In addition, given that livestock constitutes physical assets for households, one may argue that households who are able to smooth consumption through livestock sales are still victims of drought since those households lose a part of their assets in the attempt to maintain a smooth consumption.

Community characteristics

As expected, closeness to a veterinary center is associated with lower probability of experiencing adverse impacts of drought. This suggests that livestock owners residing far from a veterinary center may be more likely to lose their animals during a drought due to lack of access to technical advice and veterinarian services. Nearness to a veterinary center may also imply more infrastructure in the community and, consequently, less vulnerability to drought. The results also show that the more the public opinion is considered in government decision making, the less the likelihood of suffering from drought. A close analysis of the marginal effects on “the consideration of public opinion by the government” (*partic2 and partic3*) yields some interesting interpretations. The marginal effects suggest that households belonging to communities where consideration of the public opinion by the government remained at the same level as that of the previous year show an increased exposure of about 5 percentage points relative to households living in communities where the level of consideration of the

public opinion was higher than that of the previous year. For households in communities where the level of public opinion consideration was lower than that of the previous year, the corresponding figure is about 12 percentage points.²⁶ It is important to mention that the positive correlation between consideration of the public opinion in government decision taking and ability to cope with drought could emerge from an endogeneity between the two variables. In fact, it may also be the case that households with the lowest vulnerability to drought are those in good relationship with the government.

Another interesting result is the impact of ease of economic activity creation. Households who reported facing more difficulties to engage in new economic activities show a higher risk of experiencing the negative impacts of drought than those for whom economic activity creation was relatively easier (*actdiff3*). The significant and positive impact of ease of economic activity creation on ability to manage risk provides evidence that diversification of the economic activity portfolio constitutes an effective means of risk reduction.

Surprisingly, proximity to a health center significantly increases the probability of drought exposure. Although this result seems counterintuitive, one possible explanation may be the presence of endogeneity between location of health centers and the most vulnerable groups of households. More specifically, selection of health center locations may be made such that they are easily accessible to the most vulnerable population. Another explanation that may support this finding is an endogeneity between nearness to health centers and more awareness of drought related problems.

²⁶ Participation of the public to the decision making of the government can reduce vulnerability to poverty because taking into account the public opinion in government decision may make government intervention more effective. This is because the local communities are more likely to better identify their needs than the government does.

Finally, perhaps the most disturbing finding is the impact of easy access to road infrastructure on ability to cope with drought. In fact, contrary to my expectations, easy access to adequate road infrastructure has no significant impact on ability to cope with drought. This finding conflicts with those of previous studies where roads significantly reduce poverty prevalence through increased agricultural productivity and non-farm employment opportunities (Fan et al., 2002). Previous studies argue that market price volatility was the determinant factor of the 2004/05 crisis (Beekhuis, 2005). Given that less remote households have greater chance to interact with markets, a possible explanation of this unexpected finding might be greater exposure to price volatility of households near good roads

Drought vulnerability index for better food targeting

Identifying the most vulnerable group of people to drought is essential for an adequate and effective food aid targeting for a successful early emergency response. The results from the parametric estimation provide valuable information to this end as they can be used to construct indices for drought vulnerability. The findings show that the households most vulnerable to drought are those with no livestock holding and headed by a person with the following characteristics: uneducated; poorly educated; unemployed; or employed in the informal sector. Households with high dependency ratio are also proven to be highly vulnerable to drought. The usefulness of these results is the possibility to use the findings to construct different drought vulnerability indices. This can be implemented by (i) collecting data on household and community characteristics (i.e., the characteristics for which the coefficients are significant) in drought prone areas, and (ii) using the estimated regression coefficients to compute a predicted response that will serve as in a drought vulnerability index for each household.

Effective food targeting could then be achieved by distributing food to households with the highest indices of vulnerability to drought

5.1.2. Determinants of Economic Conditions Downturns

Following the 2004 drought (one year after the drought), some households self-reported having a worsened economic situation while others self-reported steady or improved economic conditions. The multinomial logit estimation investigates factors associated with these changes. The marginal effects obtained from the multinomial regression of perceived trend in economic situation are presented in Table A5.2. The first column represents the marginal effect of each variable on the probability of becoming much worse off, the second, the marginal effects on the probability of being worse off, and the last column reports the marginal effects on the probability of becoming same or better off.²⁷ The marginal effects are computed by setting the explanatory variables at the same values as those in the estimation of drought exposure.

Household characteristics

Overall, the results support the hypotheses laid out in the preceding chapter. Among the explanatory variables associated with household characteristics, the most important contributing factor to probabilities of changes in household well-being (i.e., largest elasticity and magnitude of significance) is secondary or post secondary education of the head of household, followed by employment in the formal sector, and small livestock ownership.

²⁷ The MWO group is the comparison group in the multinomial logit estimation. However, it is essential to have the marginal effects of the explanatory variables for each category of economic trend in order to investigate the marginal impact of each variable on the probability of being in each category of trends in economic situation.

The results on the impact of high educational attainment of the head of household (i.e., secondary or post secondary education *edu3*) indicate that households headed by a higher-educated person are more likely to maintain or improve their perceived living standards. The marginal effects suggest that being headed by a person with secondary or post-secondary education (*edu3*=1) reduces the probability of being much worse off by about 5 percentage points, that of being worse off by about 13 percentage points, and increases the probability of being same or better off by about 18 percentage points. These results support evidence from previous studies in Niger that indicate that higher educational levels are associated with significant reduction of poverty (World Bank, 1996).²⁸

The negative sign of marginal effect of *formalsector* in column 1 suggests that having the head of the household employed in the formal sector reduces the probability of self-perception of being much worse off. This point is reinforced in columns 3 and 5 where *formalsector* significantly reduces the probability of being worse off while significantly increasing the probability of being same or better off.²⁹ Note that the impacts of the *edu3* and *formalsector* on the probability of self-perception of being worse off or same or better off are much higher than those on the probability of being much worse off.

As expected, livestock owners appear to be relatively better off and perceive improvements in their own household well-being compared to non-owners. The estimates of the marginal effects of livestock ownership (especially *smalllivestock* and *bothstock*) indicate that non-owners of livestock were subject

²⁸ Despite the empirical evidence on the benefit of education on economic well-being, some people (especially in the QUIBB 005 survey) still believe that education is useless. This may be due to high rates of drop outs before reaching a certain threshold of educational levels, which can significantly reduce returns on education.

²⁹ A Wald test indicates that the impact of formal sector employment of the head across all the three groups is statistically different from zero at the 5 percent level.

to increased vulnerability to economic hardship. The impact of small livestock holding is much stronger than that of large livestock holding. This is consistent with the results from the estimation of drought exposure where large livestock does not have a significant impact on ability to cope with drought.

The literature on household vulnerability supports the theory that households with higher dependency ratios tend to be among the most vulnerable. This theory is substantiated by the estimates of the marginal effects of *depratio*, which suggest that households with higher dependency are more likely to perceive themselves to be worse off whereas, those with lower dependency present higher chance to enjoy better economic situations.

The analysis by demographic characteristics of the household head shows that older household heads are more likely to perceive deteriorating economic well-being compared to younger ones. The results suggest that the older the head, the higher the likelihood of becoming much worse off or worse off, and the lower the probability of being same or better off.³⁰ It is useful to mention that although the impact of the head's age is statistically significant, its economic significance is negligible. In fact, the associated marginal effects imply that, increasing the head's age by 10 years will only increase the probability of being "much worse off" and that of being "worse off" by 0.04 and 0.1 percent, respectively and decrease the probability of being "same or better off" off by about 0.2 percent.

Community characteristics

³⁰ Empirical evidence shows that older household heads (but who are still participating in the labor force) tend to have lower levels of vulnerability as they tend to have higher experience, and greater accumulation of physical assets.

The coefficients and marginal effects on variables representing community assets lead to similar interpretations as those in the estimation of vulnerability to drought, but with two exceptions. First, in contrast to the findings of the estimation of the determinants of vulnerability to drought where good roads have no impact on ability to cope with drought, the estimation of the determinants of perceived changes in economic conditions provide some evidence that proximity to good roads seems to significantly impact the probabilities of positive perceived changes in economic well-being. However, it is important to note that while the estimates of the marginal effects from the estimation of the probability of being WO and SOBO have the expected signs (as they indicate that proximity to a good roads reduces the probability of being WO while increasing the probability of being SOBO), the findings on the marginal effects from the estimation of the probability of being MWO is inconsistent with the economic theory. In fact, the results (negative sign of the marginal effect of *road2* and *road3* in column 1) indicate that households who reside at 30 to 59 minutes and those residing at more than an hour of walking time to good roads are less likely to be MWO compared to households dwelling at less than 29 minutes of walking time.³¹ Second, in opposition to the binomial logit results, the impact of walking time to a veterinary center appears to have no impact on the probabilities of perceived changes in economic well-being.

5.1.3. Determinants of Household-Size Adjusted Food Consumption Expenditure and Total Expenditures

³¹ The inconsistency in the impact of proximity to good roads on the probability of being much worse off may stem from the low number of observations on households who reported being much worse off. Another plausible factor may be measurement error in the data.

The results of the estimations of household-size adjusted food consumption and total expenditures for rural and urban areas are presented in Table A5.3 and Table A5.4, respectively. The findings provide evidence that the impact of food aid on per capita expenditures is stronger in the rural areas than in urban areas and this difference may be because a relatively higher proportion of households in the rural area receive food aid compared to households in the urban area, confirming the necessity of treating the two areas separately. However, it is important to mention that the impact of food aid on per-capita expenditures is not significant except for the rural per-capita total expenditures. There is also evidence that the impact of education is stronger in the urban area than in the rural area. In fact, while both primary and secondary/post-secondary education of the heads positively and significantly affect food and total expenditures in urban areas, only secondary/post-secondary education has a significant impact in the rural area. This finding is consistent with the results from the descriptive statistics where individuals headed by an uneducated person and those held by a person with primary education tend to have the same likelihood of being poor. This may explain perception of education as useless by some people.

As expected, drought negatively affects per capita expenditures in both rural and urban areas but these effects are not statistically significant. It is important to mention that the impact of drought is stronger in rural areas than in urban areas, confirming the theory that rural households tend to be more vulnerable to drought than urban households. An interesting finding is the impact of livestock ownership. The results show that per capita expenditures increase with livestock value in rural areas while the opposite effect is observed in urban areas. These results may stem from the fact that urban livestock owners tend to show higher vulnerability to drought than rural livestock owners (see Table A3.7). Finally, the

coefficients on the dependency ratio and household size show that larger households and households with high dependency ratio show significantly lower per-capita expenditure levels

5.2. *Semi-Parametric Results*

As shown in Figures A3.1-A3.6, the density distributions of per-capita expenditures for households affected by the drought are different from the density distributions for households who did not experience the drought. Likewise, households who self-reported declined economic conditions show different density distribution of well-being compared to those who self-reported steady or improved economic well-beings. This section presents the results of the semi-parametric estimations that allows to see how the well-being distributions of drought-prone households and households with declined economic conditions would be if those households had the same assets as the non-drought households and households with steady or improved economic well-being, respectively.

5.2.1. *Experiment 1: Reweighting the distributions of households exposed to drought*

Experiment 1 generates a counterfactual density adjusting household and community assets of the non-drought-prone households for the distributions of drought-prone households. Figures A5.1 to A5.8 present the actual and counterfactual density distributions with respect to exposure to drought. Figure A5.1 and Figure A5.3 present the actual and counterfactual density distributions of per-capita food expenditures and per capita total expenditures for the urban area, respectively, while Figure A5.5 and Figure A5.7 present the distributions for the rural area. The reweighting with respect to the urban area yields the expected results shown by the clear rightward shifts of the counterfactual densities. These rightward shifts strongly suggest that well-being losses (i.e., declines in per capita expenditures) caused

by the drought would be mitigated if the drought-prone households had the same asset levels as the non-drought-prone households. Indeed, counting the number of households contained in the area under the curve in Figure A5.4 (the urban density difference of per capita total expenditures) shows that monetary poverty headcount among the urban drought-prone households would have decreased by 25.4 percent if those households had had the same assets as the households who did not experience drought.

The experiments with respect to the rural area yields opposite findings to those obtained from the urban area. As shown in Figure A5.5 and Figure A5.7, there is a leftward shift of the well-being distributions after the reweights, implying that adjusting the asset levels of the rural drought-prone households to those of the non-drought-prone households would lead to the deterioration of the economic well-being of the former group of households. Although surprising, this finding is consistent with both the descriptive statistics in Table A3.16 and the kernel density distributions (Figure A3.2 and Figure A3.4) as those results show that rural households affected by the drought tend to show higher per-capita expenditures levels.³²

5.2.2. Experiment 2: Reweighting the distribution of the MWO and WO groups of households

The results from the estimation of the multinomial logit model show that the probability for a household to be in a given state of economic well-being (i.e., MWO, WO, or SOBO) is determined by different levels of household and community assets. Therefore, households in the three categories of economic conditions present different level of assets. The current experiment addresses the question “What would be the well-being distributions of the MWO or WO groups of households if those households had the same asset levels as the SOBO group of households?” The results of the reweighted distributions for

³² An explanation for this unexpected finding is provided in section 3.3.2 (chapter 3)

MWO and WO are presented in Figure A5.9 through A5.16. The graphs show strong rightward shifts of the distributions after the application of the reweights. These rightward shifts results in negative values of the density differences for low levels of per-capita expenditures and positive values for high levels of per-capita expenditures, implying that reweighting the distributions of the MWO and WO by adjusting their asset levels to those of SOBO would reduce the number of households with low per capita expenditure levels, while increasing the number of households with high levels of per capita expenditures. Indeed, if the MWO households had had the same levels of assets as the SOBO households, the poverty headcount would have been reduced by about 28 and 11 percent in rural and urban areas, respectively. For the WO households, the reduction would have been about 30 and 12 percent in rural and urban areas, respectively.³³

³³ These percentages are obtained by computing the number of households under the curve up to where per capita total expenditures is less or equal to the poverty line (105,827 FCFA for the rural area and 144,750 FCFA for the urban area).

Chapter 6: Summary and Conclusions

6.1. Summary

This study investigated key factors associated with household vulnerability to drought and household economic downturns from exposure to shocks in Niger. The data come from a cross section collected in 2005 to cover the aftermath period of the 2004 drought. Because consumption variability cannot be observed with a cross section data, household self-perception of changes in their well-being compared to one year prior to the survey is used to proxy consumption shortfalls.

A logit model was used to estimate the probability of household being subject to drought conditioned on household and community characteristics. The major findings can be summarized in six points: (1) There is evidence that livestock holding increases ability to cope with drought, suggesting that livestock-owning households smooth consumption through distress sales of livestock; (2) As expected, a high dependency ratio significantly impedes household ability to cope with drought; (3) Consistent with the vulnerability literature, income diversification opportunities significantly increase ability to manage shocks; (4) Consideration of the public opinion in governmental decisions is associated with low vulnerability to drought, meaning that enabling households living in drought prone areas communicate with the government could allow them have their needs executed by the government, which will allow them better manage drought shocks; (5) Employment of the head of household in the formal sector significantly reduces vulnerability to drought as persons employed in this sector tend to have more stable income; and (6) Surprisingly, proximity to a health center is found to significantly increase the probability of being vulnerable to drought. This has been explained by the possibility of simultaneity or endogeneity between the location of the most vulnerable population and the health center. In other words, it may be the case that health centers tend to be located where people have precarious health

conditions. Another explanation for this unexpected finding is endogeneity between nearness to health centers and more awareness of drought related problems.

In contrast to my expectations, proximity to a good road infrastructure appears to have no effect on ability to reduce drought shocks. This finding is startling as many previous work unambiguously confirm the positive impact of road infrastructure on ability to reduce shocks (Dercon, 2006; Ali and Pernia, 2003; Dercon, 2000).³⁴

Household vulnerability to economic downturns characterized by perceived changes in economic conditions (much worse, worse, and same or better than a year prior) was estimated using a multinomial logit specification conditioned on household and community characteristics. Secondary or post-secondary education of the head of household has the largest impact on household ability to maintain a steady economic situation or acquire improved economic conditions. This finding was further confirmed by the results of the nonparametric density re-weighting experiments. The multinomial logit estimation also shows that households headed by a person employed in the formal sector are less likely to face economic downturns. Moreover, livestock-holding reduces vulnerability to economic downturns, confirming the finding from the logit estimation that livestock-owning households are better able to cope with drought. Similar to the binary logit results, the multinomial logit estimation shows the important role of income diversification in reducing vulnerability. Finally, in contrast to the results from

³⁴ Access to good roads may reduce vulnerability to natural disasters by not only increasing wages and income generation opportunities (such as increased farm productivity through ease of technology transfer and increased non-farm employment opportunities), but also by allowing the spread of emergency assistance such as food aid to remote areas where the poor and food insecure are most likely to be located.

the estimation of drought exposure, the results from the multinomial logit estimation confirm the hypothesis that access to adequate road infrastructure significantly increases ability to manage shocks.³⁵

Household-size adjusted food expenditures and total expenditures with food aid as the variable of interest was also estimated. The results provide evidence that the impact of food aid on consumption expenditures is negligible except for the rural per-capita total food expenditures, where the impact is marginally significant at the 10 percent significance level.

6.2. Policy Recommendations

Both the binomial and multinomial logit estimations shed light on the positive and significant impact of education on household ability to manage shocks and to maintain steady or improved economic conditions. These findings are further enforced by the results of the non-parametric estimations, which showed that increasing the level of education of the heads will unambiguously have a positive impact on the economic well-being of the least favored households in the MWO and WO groups. These findings suggest the need to promote Niger's educational system, which is poor by most standards. Improvement of Niger's educational system requires not only increased enrollment rates but also higher completion rates. We learn from the descriptive statistics that some of the major reasons of non attendance of school are domestic chores, high drop-out rates, and perception of education as useless (only 1.6 and less than 0.5 reported distance and schooling costs as reasons for non-enrollment, respectively). These findings imply that a mere increase in the number of schools or making education more affordable may

³⁵ The contrast between the roles of proximity to good roads in the two estimations (determinants of vulnerability to drought and determinants of changes in economic conditions) may be due to omitted variable bias or problems related to the quality of the data.

not be sufficient to boost Niger's educational quality and quantity. Other measures aimed at decreasing domestic chores (such as easy access to potable water) and increased awareness of the benefits of education should also be considered. Alternatives to improve the quality of the educational system and better targeting of the poorest population could be the adoption of reforms such as "PROGRESA" initially implemented in Mexico.³⁶ An advantage of adopting such a reform is the potentiality of not only achieving higher enrollment and completion rates but also improvement of nutritional and health conditions.

Moreover, the estimated determinants of vulnerability to drought and economic condition downturns provide evidence that livestock holding increases household ability to cope with shocks and achieve an improved economic situation. This implies the need for collaborative efforts between Niger's government and international development assistance organizations to design programs aimed at promoting Niger's livestock sector. Livestock holders are more likely to be negatively affected by drought because drought may result in large herd losses and significant animals weight loss, which in turn can extremely decrease livestock prices. This could be prevented by easing access to veterinary services and increasing veterinary facilities especially in drought prone areas. Indeed, the estimation of the determinants of vulnerability to drought shows that proximity to a veterinary center significantly reduces the probability to be negatively affected by drought. In addition, the adverse impact of drought on livestock could be lessened by providing food bank for livestock, especially in drought prone areas. Besides the vulnerability reduction reason for investing in the livestock sector are other economic

³⁶ PROGRESA is an educational, health, and nutritional program developed by the Mexican government. Its implementation began in 1997 in localities where malnutrition, morbidity, high infant mortality rates, and healthy living conditions are rampant. See Skoufias and McClafferty (2001), which is available at <http://www.ifpri.org/divs/fcnd/dp/papers/fcndp118.pdf> for more details on the background and evaluation of the program.

incentives. For example, livestock keeping activities are mostly undertaken the pastoralist people who make productive and sustainable use of natural resources in arid and semi-arid areas that would otherwise remained unexploited (FAO, 2008).

Another important contributing factor to household vulnerability to drought (not empirically explored in this paper) is the inflation of the price of staple food following a drought. As shown in Figure A6, monthly average prices of millet (a major staple food in Niger) were highest over the 2004-2005 period (SIMA, 2005). In order to control the inflation of the price of staple food price, regional cooperation might control fluctuations in food prices and ease food import from regions with excess of food production.³⁷

Similar to the findings of previous studies, the evidence from this paper confirms the role of income diversification opportunities as an important mechanism of risk management. However, evidence shows that Nigerien households' ability to develop non farm activities is hindered by many factors (finance constraints that create entry barriers and lack of adequate infrastructures such as good roads that can ease seasonal labor migration). For example, less than 7 percent of Niger's rural households have access to microfinance services (QUIBB, 2005). In addition, Niger is among countries with the poorest road infrastructures in the world. It has only 985 km of highway among which barely 655 km is paved and most of them are poor condition. Therefore, there is a need for policymakers to device economic policies aimed at reducing these barriers in order to promote income diversification activities.

³⁷ One of the major reasons of the inflation of staple food prices in Niger is the significant reduction of imports over the period 2004-2005. Factors contributing to this reduction are higher prices in the Northern Nigeria markets (which is a major supplier for Niger), banned of cereal export from Burkina Faso by the government of Burkina Faso, and higher cereal prices in the Malian markets although the country recorded excess food production over the agricultural period of 2004.

Finally, this study provides evidence that food aid has a limited impact on well-being. This may be because food aid intervention occurs after people have been hit by the crisis. In addition, the impacts of food aid are short term and do not address the underlying factors of the crises (such as poor education, lack of agricultural training, lack of pro-poor livestock policies, or poor food storage management). This suggests the necessity to focus on long-term investment rather than short term aid. Long term food security could be achieved through the implementation of the policy recommendations mentioned above. It is important to bear in mind that focusing on long term food security achievement does not rule out food aid programs. Short term food aid should be implemented while working toward the achievement of long term goals.³⁸

6.3. *Limitations of the Study*

Due to the lack of panel data, the analysis of household vulnerability in this study relied on household self-perception of changes in their economic well-being. A weakness with this approach is the subjectivity of the responses, which may hinder an accurate assessment of the real impact of the drought on household well-being. In addition, it would have been useful to have information on livestock sales in order to better examine the role of livestock as a buffer stock for Niger's households in the face of a drought. Moreover, the impact of some variables such as migration and remittances on household's ability to manage or cope with risk need to be explored as these variables may play an important role as risk management tools. The current study failed to investigate this issue because of the absence of such variables in the data.

³⁸ A use full source for a long term food security scheme is the work by Staatz (2005) available at: http://www.aec.msu.edu/fs2/mali_fd_strtgy/PROMISAM_final_technical_report_2008.pdf

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Tables

Table A3.1. Sampling

Regions	Number of polling zone	Number of HH at RGP/H 2001	Polling zone of QUIBB	Number of households in QUIBB
Agadez	350	51,665	20	400
Diffa	250	64,667	25	500
Dosso	1,131	191,358	28	560
Maradi	1,512	299,502	53	1,060
Tahoua	1,482	318,304	45	900
Tillaberi	1,326	230,042	56	1,120
Zinder	1,613	362,030	57	1,140
CUN	378	111,209	51	1,020
Total	8,042	1,628,777	335	6,700

Source: ME/F/INS/QUIB (2005)

Table A3.2. Distribution of heads of HH by socio-economic and demographic characteristics

Age (years)	
Total	45.1
Rural	44
Urban	47.6
Sex of head of HH (%)	
Male	92.8
Female	7.2
Educational level of the household head (%)	
None	85.1
Some primary	5.7
Complete primary	2.4
Partial secondary	3.6
Complete secondary	0.1
College	3.1
Principal sector of main employer of HH head (%)	
Agriculture	63.2
Commerce/retailing	16.3
Other	20.6

Source: QUIBB 2005

Table A3.3. Percentage of HH Exposed to Shocks by Poverty and Expenditure-Quintile

	Loss of agri.		Funeral	Severe or chronic illness	Flood	Job loss	Important loss of land
	Drought	products					
All HH	47.62	16.59	11.22	10.55	1.99	1.48	0.9
Poor	49.03	19.16	10.91	10.84	2.09	0.63	1.59

Non-poor	46.04	13.68	11.57	10.22	1.88	1.21	1.36
Quintile1	47.57	21.87	10.28	10.9	2.28	0.56	1.94
Quintile2	46.76	14.73	10.82	10.53	1.97	1.15	0.8
Quintile3	45.6	16.34	10.52	10.56	2.01	0.86	1.39
Quintile4	47.85	13.98	10.99	10.2	1.65	0.61	1.1
Quintile5	50.5	15.59	13.99	10.51	2.01	1.37	2.15

Source: QUIBB 2005

Table A3.4. Distribution of HH Exposed to Drought Across Regions of Residence (% of HH)

	(A)	(B)	(B/A)
Region	Share in total HH (%)	Share in total exposed HH	(B/A)
Agadez	3.2	2.36	0.74
Diffa	3.7	5.88	1.59
Dosso	9.7	5.12	0.53
Maradi	19.7	20.81	1.06
Tahoua	20.8	32.45	1.56
Tillabery	15.9	16.51	1.04
Zinder	20.2	16.7	0.83
Niamey	6.6	0.18	0.03
Total	100	100	1

Source: QUIBB 2005

Column (A): Percentage of total number of Niger's households residing in the region

Column (B): Percentage of total number of Niger's households having suffered the negative effects of drought residing in the region

Column (B/A): Ratio of (B) by (A). A ratio greater than 1 means households in the region disproportionately suffered from the drought.

Table A3.5. Number and Percentage of HH by Type of Coping Strategies after Drought³⁹

Strategies	Drought
Food aid	74.76
Sell agricultural products	15.29
sell agricultural materials	3.03
Sell HH assets	8.02
Get help from other HH ⁴⁰	40.04
Assistance from NGOs	8.1
International assistance	6.15
Borrowing	7.29
Others	1.2

Source: QUIBB 2005

³⁹ These coping strategies are for households affected by the drought of 2004.

⁴⁰ "Get help from other HH" is a combination of "request for money" and "get help".

Table A3.6. Food aid reception after drought by poverty and expenditure-quintile distribution

	% of HH received food aid
Food aid by poverty status	
Poor	72.25
Non-poor	78.09
Poor rural	72.17
Non-poor rural	79.31
Poor urban	73.04
Non-poor urban	52.36
Food aid by expenditure-quintile distribution	
Quintile 1	73.93
Quintile 2	67.76
Quintile 3	72.1
Quintile 4	82.5
Quintile 5	78.55

Source: QUIBB 2005

Table A3.7. Exposure by monetary value of livestock holding in rural and urban areas

Class of livestock holding	% of HH exposed (Rural)	% of HH exposed (Urban)
No livestock holding	62.66	9.17
Livestock value below the median	54.04	33.24
Livestock value above the median	49.87	40.61

Source: QUIBB 2005

Table A3.8. Coping strategies after drought exposure by monetary value of livestock (Rural)

Coping mechanisms	No livestock holding (%)	HH with Livestock value below the median (%)	HH with Livestock value above the median (%)
Food aid	80.71	74.65	72.69
Sell agricultural products	10.69	14.73	18.58
Sell agricultural equipments	3.62	2.45	2.83
Sales of HH assets	7.96	8.34	8.17
Get help from other HH	42.78	33.83	40.47
Assistance from NGO's	7.64	7.47	10.13
International assistance	5.98	4.43	8.34
Borrowing	9.39	5.56	6.95
Others	2.19	1.12	1.51

Source: QUIBB 2005

Table A3.9. Coping strategies after drought by monetary value of livestock (Urban)

Coping mechanisms	HH with No livestock holding (%)	HH with Livestock value below the median (%)	HH with Livestock value above the median (%)
Food aid	55.77	72.69	76.09
Sell agricultural products	18.63	6.27	32.98
Sell agricultural equipments	1.5	7.37	5.89
Sales of HH assets	1.33	11.3	3.5
Get help from other HH	69.98	48.43	61.26
Assistance from NGO's	3.98	0.95	2
International assistance	11.44	0.95	0
Borrowing	20.5	7.95	5.36
Others	0	0	2

Source: QUIBB 2005

Table A3.10. Trends in Economic Situation

	Much worse off (% of HH)	Worse off (% of HH)	Same or better off (% of HH)	Total
All households	21.9	49.8	28.3	100
Residence area				
Rural	22.9	49.2	27.9	100
Urban	17.4	52.8	29.8	100
Region of residence				
Agadez	24.2	54.5	21.3	100
Diffa	23.1	66.1	10.8	100
Dosso	7.1	44.7	48.2	100
Maradi	21.1	50	28.9	100
Tahoua	29.2	46.7	24.1	100
Tillaberi	43.2	35.4	21.4	100
Zinder	8.3	60.6	31.1	100
Niamey	12.2	56.9	30.9	100
Poverty Status				
Poor	22.53	51.48	25.99	100
Non-poor	21.28	47.95	30.77	100
Size of household				
1-2 pers	24.3	43.9	31.8	100
3-4 pers	22.4	49.3	28.3	100
5-6 pers	21.5	50.2	28.3	100
7 and more	21.3	51.3	27.4	100
Main sector of employment of the heads of HH				
Public sect	16.3	34	49.7	100
Formal private	23.5	53.6	22.9	100
informal private	21.6	50.8	27.6	100
Agriculture	9.9	71.4	18.7	100
Other self employed	16.4	51.4	32.2	100
Unemployed	26.9	47.7	25.4	100
Other self employed	20.5	46.7	32.8	100
Sex of the head of HH				
Male	21.6	49.5	28.9	100
Female	26.4	53.6	20.0	100
Vulnerability to drought				
Vulnerability to drought	30.9	50.5	18.6	100
Non vulnerability to drought	13.8	49.2	37.0	100

Source: QUIBB 2005

Table A3.11. Trends in Economic Situation by Poverty Status according to

Area and Region of residence

	<i>Much worse off</i>		<i>Worse off</i>		<i>Same or better off</i>	
	Poor	Non-poor	Poor	Non-poor	Poor	Non-poor
Rural	21.88	24.14	51.49	46.28	26.63	29.58
Urban	27.39	11.65	51.38	53.56	21.24	34.79
Region of residence						
Agadez	32.02	19.48	53.44	55.06	14.53	25.46
Diffa	31.24	21.71	60.45	67.04	8.31	11.25
Doss	6.99	7.24	42.49	47.75	50.42	45.07
Maradi	22.07	18.54	52.5	43.57	25.43	37.88
Tahoua	29.56	28.97	45	42.18	16.45	28.85
Tillaberi	42.63	44.14	38.73	30.14	18.64	25.28
Zinder	9.44	6.45	60.82	60.3	29.74	33.25
Niamey	9.59	9.59	56.06	56.06	34.35	34.35

Source: QUIBB 2005

Table A3.12. Household Perception-based poverty

	HH perception based poverty 2005 (%)	HH perception based poverty 2000 (%)
All HH	81.25	78.51
Urban areas	78.99	77.12
Rural areas	81.71	78.79
By region of residence		
Agadez	71.86	64.32
Diffa	81.67	85.7
Dosso	74.97	63.81
Maradi	91.29	88.04
Tahoua	79.28	84.69
Tillabey	80.72	78.21
Zinder	80.33	76.05
Niamey	76.12	72.71
By sex of head of household		
Male	81.79	78.68
Female	69.97	75.07
Educational level of head of HH		
No education	52.99	78.29
Started/completed primary	59.11	79.85
Started/completed secondary	67.39	80.06
Post secondary	82.83	88.51

Main sector of employment of the head of HH		
Unemployed	74.13	72.44
Informal sector	81.83	77.96
Formal sector	89.83	81.61

Source: QUIBB 2005

Table A3.13. Transient and chronic Poverty

	Transient poor	chronic poor	Never Poor	Total
All HH	35.71	48.92	15.37	100
Niamey	30.42	46.16	23.42	100
Other urban areas	33.35	50.57	16.08	100
Rural areas	36.41	48.95	14.64	100
By region of residence				
Agadez	37.11	30.41	32.48	100
Diffa	33.32	56.73	9.95	100
Dosso	31.92	42.69	25.39	100
Maradi	39.64	55.1	5.26	100
Tahoua	37.51	49.96	12.53	100
Tillabey	40.86	44.82	14.32	100
Zinder	29.85	51.85	18.3	100
Niamey	30.42	46.16	23.42	100
By sex of head of household				
Male	35.78	49.18	15.04	100
Female	34.07	43.49	22.44	100
Educational level of head of HH				
No education	35.76	47.74	16.5	100
Started/completed primary	36.26	51.29	12.45	100
Started/completed secondary	31.58	57.89	10.53	100
Post secondary	16.96	77.16	5.88	100
Main sector of employment of the head of HH				
Unemployed	34.6	45.14	20.26	100
Informal sector	36.36	48.72	14.92	100
Formal sector	25.51	63.9	10.59	100

Source: QUIBB 2005

Table A3.14. Expenditure-based poverty and depth and severity of poverty

	Expenditure-based poverty		Poverty depth		Poverty severity	
	Rural	Urban ⁴¹	Rural	Urban	Rural	Urban
All HH	65.68	44.14	25.92	15.3	13.29	7.27
By region of residence						
Agadez	51.65	40.58	15.82	16.33	7.06	9.02

⁴¹ Poverty incidence in Niamey (The capital city) and other urban areas is 20.06 and 55.52 percent, respectively.

Diffa	17.21	28.9	4.72	8.64	2.04	3.4
Dosso	69.04	48.51	29.96	15.93	15.99	7.4
Maradi	81.49	63.84	36.23	25.65	19.64	12.96
Tahoua	45.7	48.1	14.45	14.84	6.2	6.44
Tillabery	69.54	56.18	27.11	20.58	14.12	10.28
Zinder	70.83	72.07	25.89	28.34	12.69	14.33
Niamey	27.06		7.2		2.77	
By gender of the head of household						
Male	66.01	44.13	22.77	33.47	11.93	19.85
Female	56	44.3	13.92	23.98	8.25	13.59
By educational level of head of household						
No education	66.48	55.38	24.02	35.07	12.61	20.89
Started/completed primary	67.11	41.4	17.94	29.17	0.37	16.38
Secondary/postsecondary	35.71	12.58	3.94	8.64	2.6	4.49
Monetary value of livestock ownership						
No livestock	63.29		14.39		8.56	
Value below median	67.98		25.78		13.85	
Value above median	65.07		23.92		12	
Main sector of employment of the head of HH						
Unemployed	65.76	45.05	22.48	32.84	12.42	19.89
Informal sector	66.27	49.46	23.28	34.23	12.13	20.26
Formal sector	38	19.37	3.27	9.51	2.46	4.52

Source: QUIBB 2005

Table A3.15. Per Capita Total Food Expenditures and Per Capita Total

Expenditures by Trends in Economic Conditions

	Food Expenditures (FCFA)	Total Expenditures (FCFA)
Much Worse off	109,640	152,190
Worse off	105,010	153,327
Same or Better off	111,865	176,740

Source: QUIBB 2005

Table A3.16. Per-Capita Total Food Expenditures and Per-Capita Total

Expenditures by Exposure to Drought and Residence Area

	Rural		Urban	
	Food	Total	Food	Total
Drought	88,279	124,383	104,774	177,143
No Drought	79,077	115,192	140,034	278,977

Source: QUIBB 2005

Table A4.1. Description of variables used in estimation

Variable	Description	Value taken
Dependent variables		
Tren	Trends in economic situation compared to one year ago	1 if much worse, 2 if worse, and 3 if same or better
drought	Vulnerability to drought	1 if yes and 0 if no
Independent variables		
hhsiz	Number of people in the household	Continuous
formalsector	Head of HH is in the formal sector	1 if yes and 0 otherwise
infsector	Head of HH is in the informal sector	1 if yes and 0 otherwise
edu1	Head of HH has no education	1 if yes and 0 otherwise
edu2	Head of HH started or completed primary education	1 if yes and 0 otherwise
edu3	Head of HH has secondary or post secondary education	1 if yes and 0 otherwise
livestock1	No livestock holding	1 if yes and 0 otherwise
livestock2	Monetary value of livestock below the median	1 if yes and 0 otherwise
Livestock3	Monetary value of livestock above the median	1 if yes and 0 otherwise
hhsex	Head of HH is male	1 if yes and 0 otherwise
hage	Age of the head of HH	Countinous
depratio	Dependency ratio	Continous (between 0 and 1)
clinicdist1	Walking distance to health center is less than 29 minutes	1 if yes and 0 otherwise
clinicdist2	Walking distance to health center is between 30 and 60 mns	1 if yes and 0 otherwise
clinicdist3	Walking distance to a health center is more than 1 hour	1 if yes and zero otherwise
road1	Walking distance to a practicale road is less than 29 minutes	1 if yes and zero otherwise
road2	Walking distance to a practicable road is between 30 and 60 mns	1 if yes and zero otherwise
road3	Walking distance to a practicable road is more than 1 hour	1 if yes and zero otherwise
vet1	Walking distance to veterinary center is less than 29 minutes	1 if yes and zero otherwise
vet2	Walking distance to veterinary center is between 30 and 60 mns	1 if yes and zero otherwise
vet3	Walking distance to a veterinary center is more than 1 hour	1 if yes and zero otherwise
actdif1	Economic activity creation is easier than previous year	1 if yes and zero otherwise
actdif2	No change in level of difficulty of economic creation compared to previous year	1 if yes and zero otherwise
actdif3	Economic activity creation is more difficult than previous year	1 if yes and zero otherwise
partic1	Better consideration of public opinion in government decisions compared to previous year	1 if yes and zero otherwise
partic2	No change in consideration of public opinion in	1 if yes and zero otherwise

partic3 government decision
 Less consideration of public opinion in government decisions 1 if yes and zero otherwise

Note: For simplicity purposes in the estimation processes, the qualitative variables that take three different levels are transformed into dummy variables. For example instead of having the variable on education taking 0 (for no education), 1 (for started or completed primary education) and 3 (for secondary and post secondary education), three new variables edu1 (taking 1 if the head has no education and 0, otherwise), edu2 (taking 1 if the head started or completed primary education and 0, otherwise), and edu3 (equals to 1 the head has secondary or post secondary education and 0, otherwise).

Table A4.2. Descriptive Statistics of dependents and independents variables

Variable	Obs	Mean	Std. Dev	Min	Max
tren	4598	2.047194	0.699725	1	3
drought	4598	0.534363	0.498872	0	1
hhsiz	4598	6.473249	3.607277	1	31
formalsector	4598	0.025228	0.156835	0	1
infsector	4598	0.865811	0.340892	0	1
edu2	3501	0.096258	0.294987	0	1
edu3	3501	0.045987	0.209487	0	1
Livestock1	4598	0.086994	0.281857	0	1
Livestock2	4598	0.242932	0.428901	0	1
Livestock3	4598	0.511962	0.499911	0	1
hhsex	4598	0.943671	0.230581	0	1
hage	4598	44.10657	14.74465	15	99
depratio	4598	0.479158	0.211881	0	1
clinicdist2	4598	0.113093	0.316741	0	1
clinicdist3	4598	0.739669	0.438863	0	1
road2	4598	0.10983	0.312712	0	1
road3	4598	0.550457	0.497502	0	1
vet2	4598	0.233145	0.64189	0	2
vet3	4598	2.321444	1.255218	0	3
actdif3	4598	0.250109	0.433123	0	1
actdif2	4598	0.168769	0.374589	0	1
partic2	4598	0.26903	0.443504	0	1
partic3	4598	0.15224	0.359293	0	1

Note: The dependent variable is the trends in economic condition compared to a year prior to the survey and takes three levels: 1 for much worse economic situation (MWO), 2 for worse economic conditions (WO), and 3 same or better economic conditions (SOBO).

Following the same logic as that in the interpretation of the results of drought exposure estimation, coefficients on all variables with levels 2 and 3 (such as vet2 and vet3) are expected to be positive for both “much worse off” and “worse off” and negative for “same or better off”.

Table A5.1. Results of the binomial estimation of vulnerability to drought⁴²

Variable	Coeff	SE	ME	SE
hhsiz (Size of household)	0.02854**	0.01254	0.006825**	0.00303
formalsector (Head works in formal sector)	-0.32230	0.27586	-0.07397	0.06035
infsector (Head works in informal sector)	0.01159	0.12323	0.002769	0.02941
edu2 (Head started or completed primary education)	0.23307*	0.13049	0.056866*	0.03235
edu3 (Head has secondary/post secondary education)	-0.19017	0.20898	-0.04447	0.04781
Livestock2 (livestock value below the median)	-0.15407	0.11277	-0.0362	0.02665
Livestock3 (livestock value above the median)	-0.29686***	0.10726	-0.06839**	0.02537
Credit (use of microfinance services)	-0.29104*	0.15145	-0.0671**	0.03362
hhsex (Sex of the head of HH)	-0.07495	0.15597	-0.01806	0.03781
hage (Age of head of HH)	-0.00046	0.00278	-0.00011	0.00066
depratio (Dependency ratio)	0.22900	0.18745	0.05477	0.04479
Community Characteristics				
clinicdist2 (within 30-59 mn to a health center)	-0.39700**	0.16787	-0.09771**	0.04113
clinicdist3 (within more than 1 hour to a health center)	-0.12537	0.12863	-0.02956	0.02977
road2 (within 30-59 mn to a good road)	-0.36236***	0.13409	-0.08905***	0.0326

⁴² To control for perfect colinearity, edu1, clinicdist1, road1, vet1, and partic1 are dropped. Except for edu1 which represents zero educational level of the household head, variables defined as var1 represent the best situation. For example, clinicdist1 is the shortest walking time to a health center while clinicdist3 is the longest. Thus it is legitimate to expect all coefficients on variables representing community assets to be positive. Please refer to chapter 4 for more detailed description of the variables in the regression.

road3 (within more than 1 hour to a good)	-0.07875	0.09292	-0.01867	0.02172
vet2 (Within 30-59 mn to a veterinary center)	0.17729**	0.08894	0.042402**	0.02077
vet3 (Within more than 1 hour to a veterinary center)	0.17488***	0.04888	0.041826***	0.01125
partic2 (No change in public opinion consideration)	0.09662	0.08731	0.022862	0.02076
Partic3 (Public opinion less considered by government)	0.50443***	0.11284	0.124554***	0.02834

Regional Dummies

Agadez	0.75444***	0.17846	0.186093***	0.04355
Diffa	2.05671***	0.17575	0.45689***	0.03332
Dosso	-0.84339***	0.16470	-0.18038***	0.03288
Maradi	0.06142	0.11395	0.014745	0.02746
Tahoua	1.41471***	0.13289	0.339427***	0.02939
Tillabery	0.07407	0.11147	0.017788	0.02682

Table A5.2. Determinants of perceived changes in economic situation

Variable	MWO	WO	SOBO ME	ME	ME
hhsiz (Size of household)			-0.00431	0.008851***	-0.00454**
formalsector (Head works in formal sector)			-0.05835	-0.07174	0.130084***
informalsector (Head works in informal sector)			-0.07651***	0.083679***	-0.00716
edu2 (Head started or completed primary education)			0.041383	-0.04459	0.003208
edu3 (Head has secondary/post secondary education)			-0.04544	-0.06072	0.106164***
Livestock2 (livestock value below the median)			-0.04903**	-0.03735	0.086377***
Livestock3 (livestock value above the median)			-0.06327***	-0.05071*	0.113978***
Credit (Use of microfinance services)			-0.00056	-0.00043	0.000994
hhsex (Sex of the head of HH)			-0.03128	0.009302	0.02198
hage (Age of head of HH)			0.000793	0.000287	-0.00108**
depratio (Dependency ratio)			-0.02897	0.072194	-0.04323
Community characteristics					
clinicdist2 (within 30-59 mn to a health center)			0.083299**	-0.10337***	0.020075
clinicdist3 (within more than 1 hour to a health center)			0.070597**	-0.08237**	0.011774
road2 (within 30-59 mn to a good road)			-0.06792**	0.091034***	-0.02311
road3 (within more than 1 hour to a good road)			-0.01754	0.066486***	-0.04894***
vet2 (Within 30-59 mn to a veterinary center)			-0.00056	-0.00043	0.000994
vet3 (Within more than 1 hour to a veterinary center)			-0.00716	0.00232	0.004836
partic2 (No change in public opinion consideration)			-0.00524	0.008818	-0.00358
Partic3 (Public opinion less considered)			0.015067	0.020966	-0.03603**

Regional Dummies

Agadez	0.149806**	-0.02467	-0.12514***
Diffa	0.26273**	-0.11133**	-0.15141***
Dosso	-0.0527	-0.11835***	0.171054***
Maradi	0.240674***	-0.21687***	-0.02381
Tahoua	0.304683***	-0.2522***	-0.05248***
Tillabery	0.430842***	-0.37791***	-0.05293***

Note: The dependent variable is the trends in economic condition compared to a year prior to the survey and takes three levels: 1 for much worse economic situation (MWO), 2 for worse economic conditions (WO), and 3 same or better economic conditions (SOBO).

Following the same logic as that in the interpretation of the results of drought exposure estimation, coefficients on all variables with levels 2 and 3 (such as vet2 and vet3) are expected to be positive for both “much worse off” and “worse off” and negative for “same or better off”.

Table A5.3. Determinants of HH-size adjusted food and total expenditures (rural area)

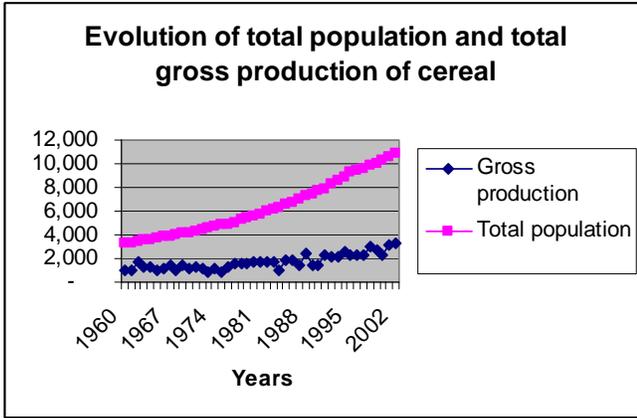
Variable	Food Expenditures		Total Expenditures	
	Coeff	RSE	Coeff	RSE
foodaid	0.79253	0.55453	0.8679*	0.4889
hhsex	0.06896	0.07841	-0.0068	0.065
hhsiz	-0.07133***	0.00509	-0.0683***	0.0045
formalsector	0.31095***	0.09052	0.3282	0.0866
infsector	-0.00718	0.05844	-0.0375	0.0497
edu2	0.0288	0.05331	0.0559	0.0468
edu3	0.25046***	0.0717	0.2988	0.0681
depratio	-0.50671***	0.08752	-0.5337	0.0769
drought	-0.05847	0.13588	-0.1164	0.1191
hage	0.00014	0.00133	0	0.0011
actdif2	-0.05374	0.06624	-0.0995	0.0586
actdif3	0.02303	0.04827	0.0287	0.0418
livestock2	0.07921	0.04978	0.0695	0.0447
livestock3	0.30768***	0.06411	0.2882	0.0584
road2	0.01508	0.07944	0.0046	0.072
road3	-0.02594	0.05326	-0.0349	0.047
_cons	11.46899	0.13927	12.0053	0.1123

Table A5.4. Determinants of HH-size adjusted food and total expenditures (Urban area)

	Food Expenditures		Total Expenditures	
	Coeff	RSE	Coeff	RSE
foodaid	0.617988	1.756604	0.427699	1.581663
hhsex	0.139869**	0.064889	0.068235	0.064458
hhsize	-0.06117***	0.005362	-0.05569***	0.005415
formalsector	0.17101**	0.071366	0.251973***	0.064974
infsector	0.080546	0.052327	0.07105	0.045415
edu2	0.106735**	0.049658	0.144348***	0.049371
edu3	0.321525***	0.045214	0.500006***	0.046887
depratio	-0.82112***	0.083328	-0.92748***	0.07352
drought	-0.2424	0.351569	-0.2662	0.322417
hage	0.000322	0.001477	0.000176	0.001379
actdif2	0.010606	0.058929	-0.01451	0.056529
actdif3	0.040287	0.045578	0.045263	0.043132
livestock2	-0.28904***	0.052014	-0.36286***	0.051948
livestock3	-0.01595	0.064574	-0.07701	0.060834
_cons	12.08178	0.094226	12.75217	0.09161

Figures

Figure A1.1. Population, cereal production, and cereal needs over 1990-2002 in Niger



Source: Direction de Statistiques Agricoles, 2004

Figure A3.1. Urban Per Capita Food Expenditure Distribution by Drought

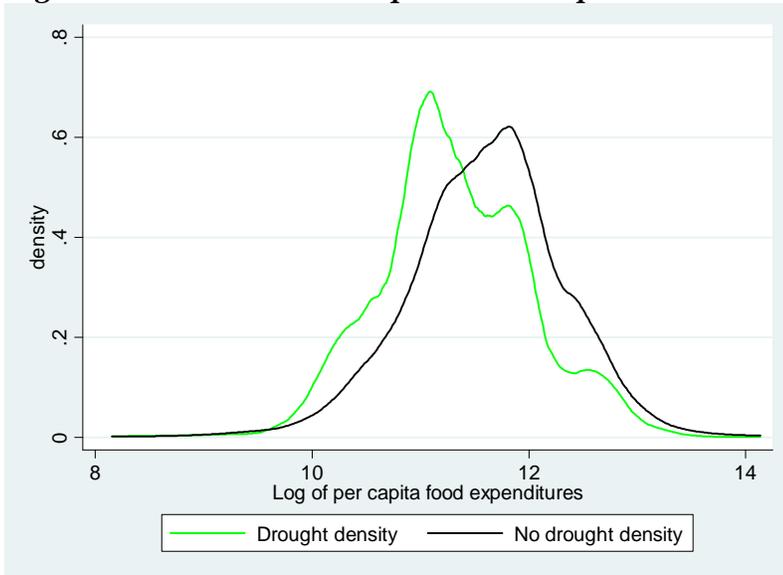


Figure A3.2. Rural Per Capita Food Expenditure Distribution by Drought

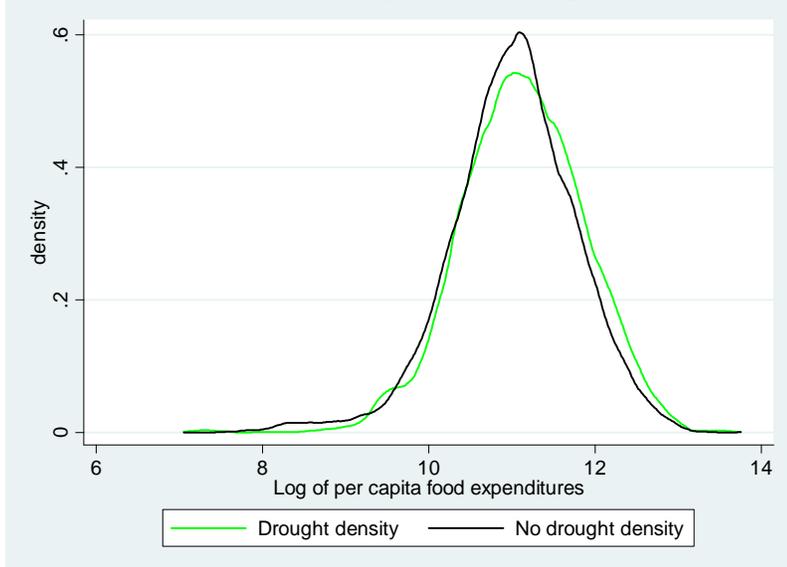


Figure A3.3. Urban Per-Capita Total Expenditure Distribution by Drought

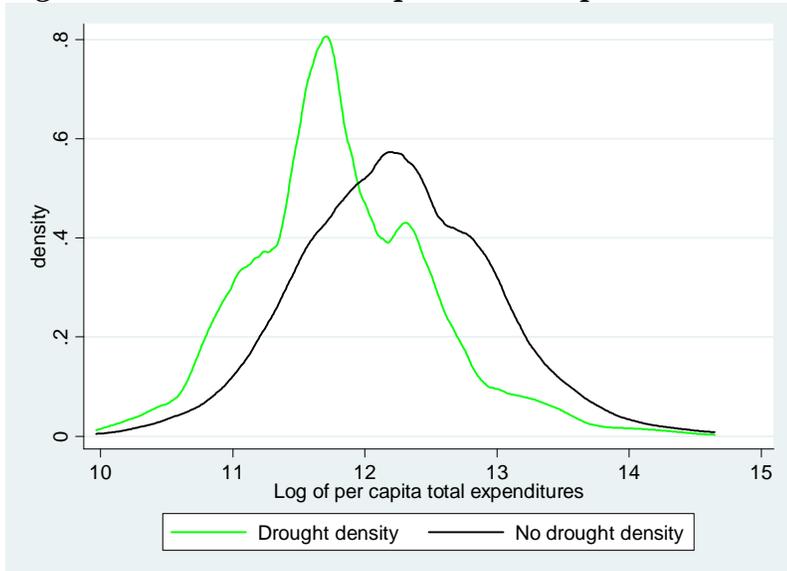


Figure A3.4. Rural Per Capita Total Expenditure Distribution by Drought

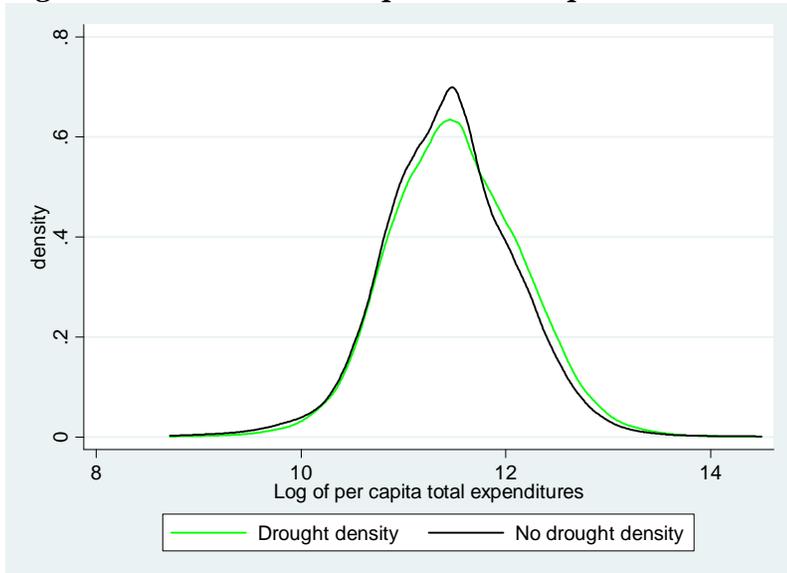


Figure A3.5. MWO, WO, and SOBO Per Capita Food Expenditures

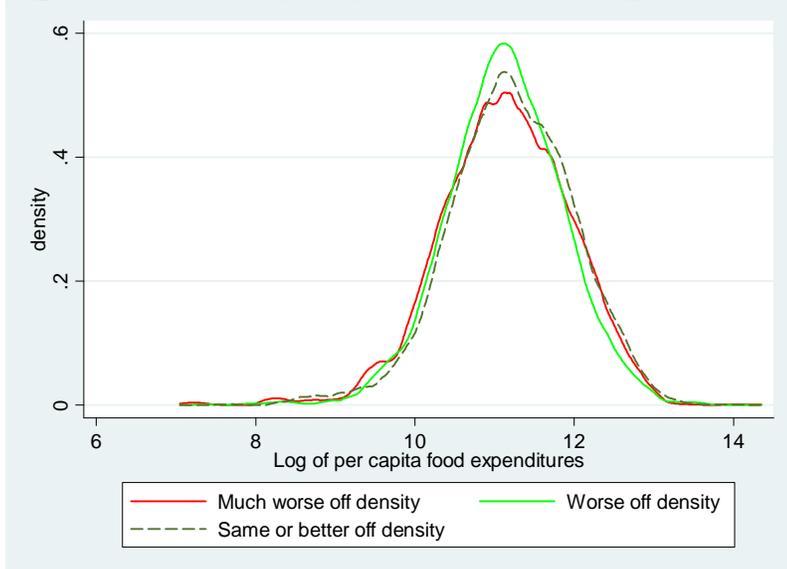


Figure A3.6. MWO, WO, and SOBO Per-Capita Total Expenditures

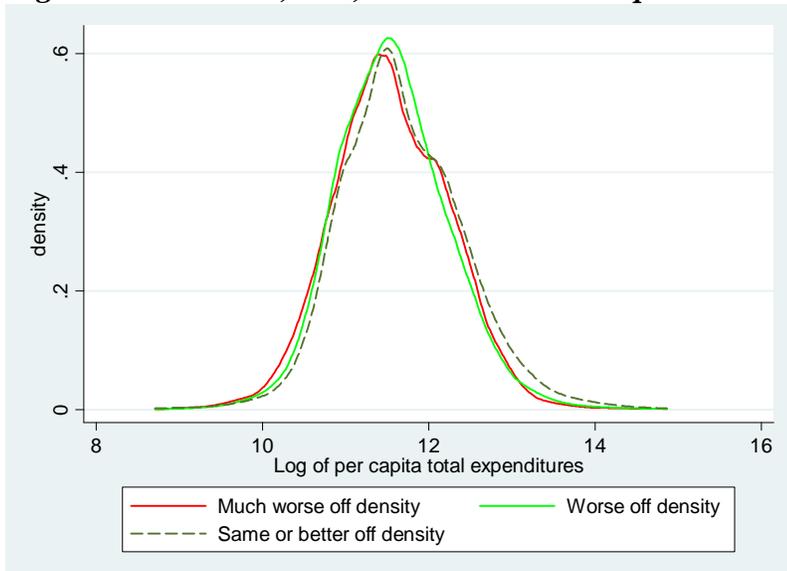


Figure A3.7. Density Differences with respect to Trends in Well-being

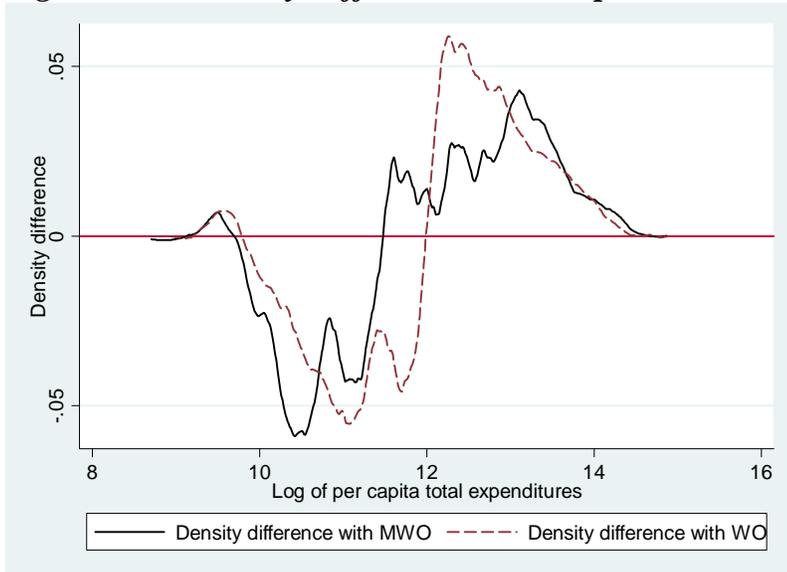


Figure A3.8. MWO Reweighted Per-Capita Food Expenditures

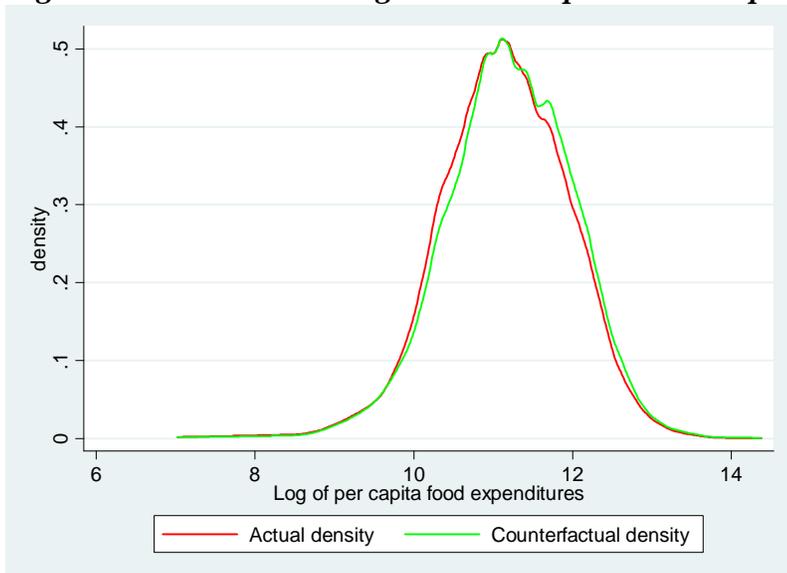


Figure A3.9. MWO Reweighted Per-Capita Total Expenditures

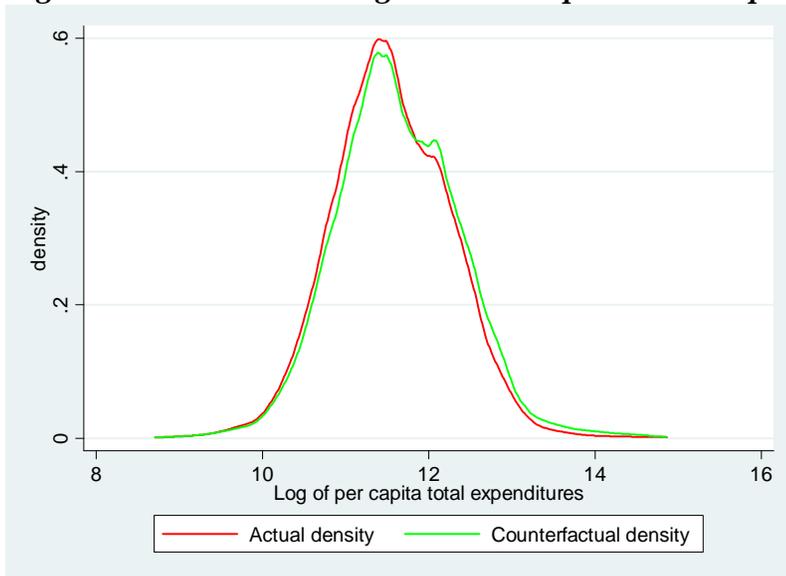


Figure A3.10. WO Reweighted Per-Capita Food Expenditures

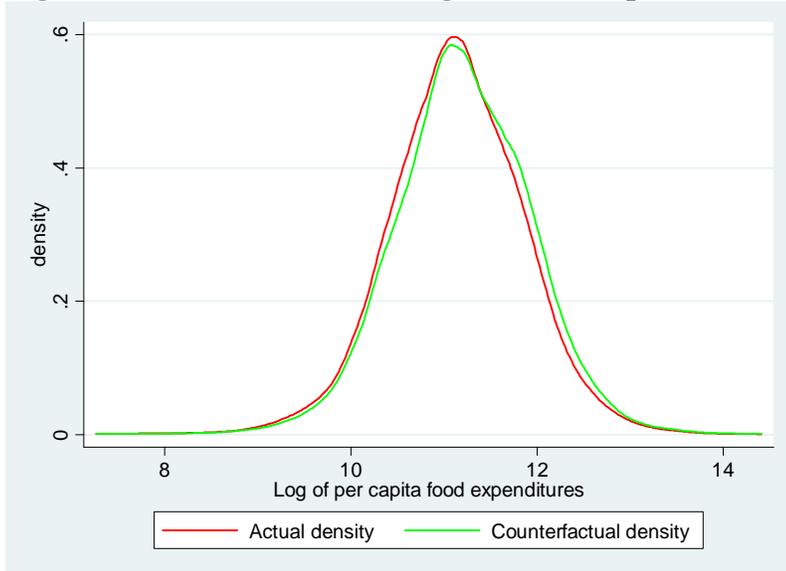


Figure A3.11. WO Reweighted Per-Capita Total Expenditures

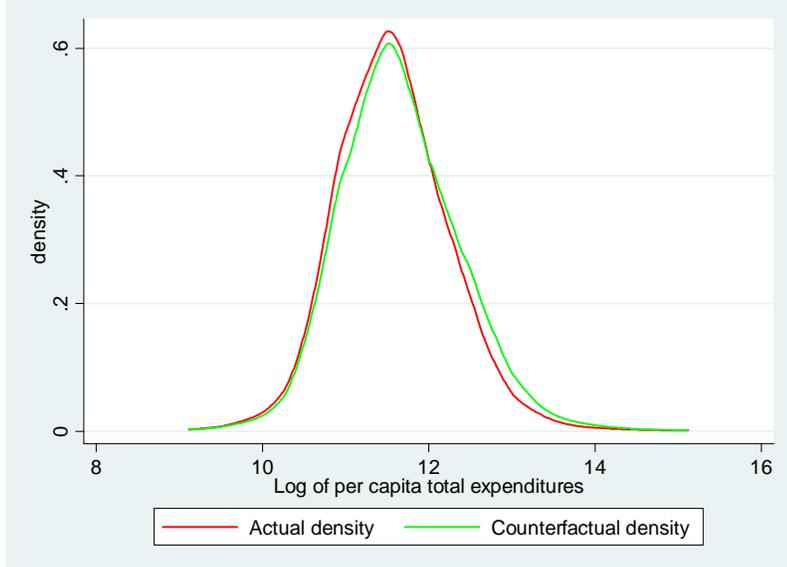


Figure A3.12. Rural Reweighted Per-Capita Food Expenditures by Drought

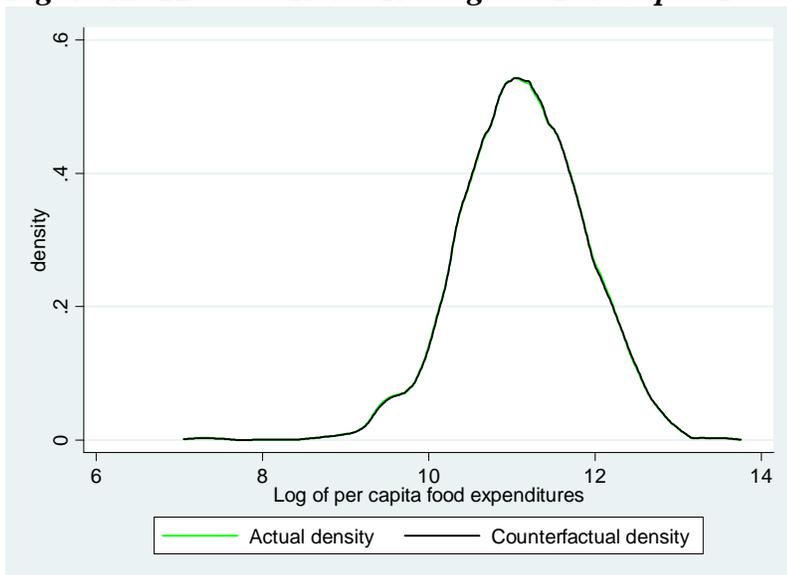


Figure A3.13. Rural Reweighted Per-Capita Total Expenditures by Drought

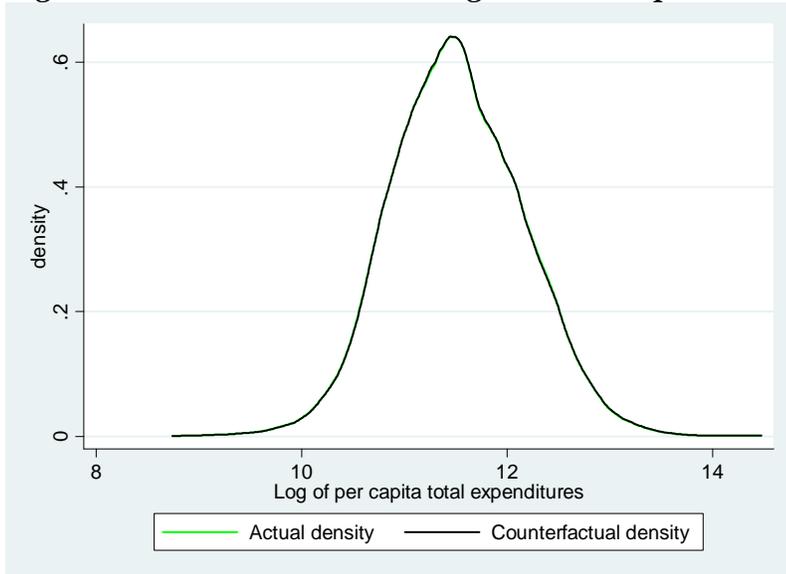


Figure A3.14. Urban Reweighted Per Capita Food Expenditures

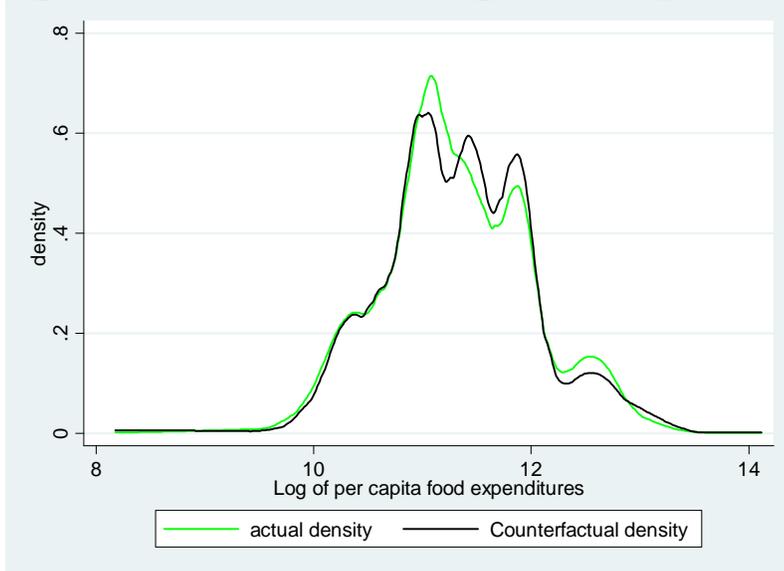


Figure A3.15. Urban Reweighted Per capita Total Expenditures

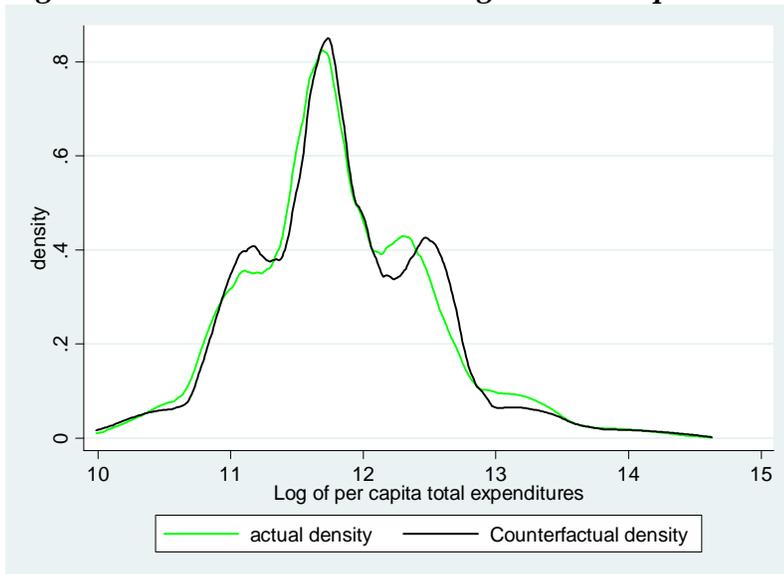


Figure A5.1. Urban Reweighted Per Capita Food Distributions by Drought

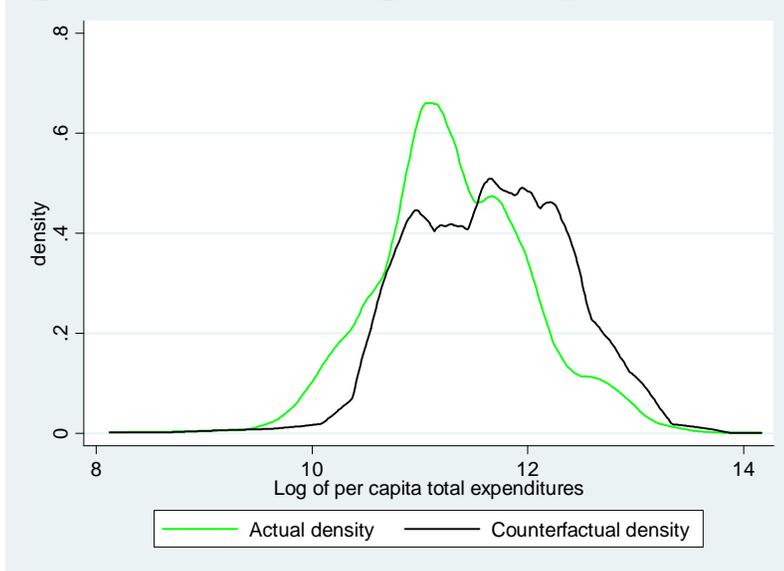


Figure A5.2. Urban Reweighted Per Capita Food Density Difference by Drought

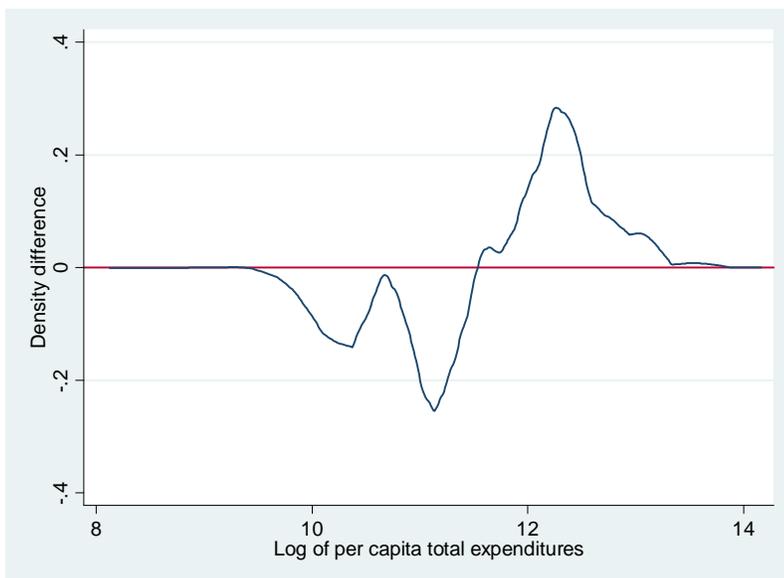


Figure A5.3. Per Capita Total Expenditure Distributions by Drought

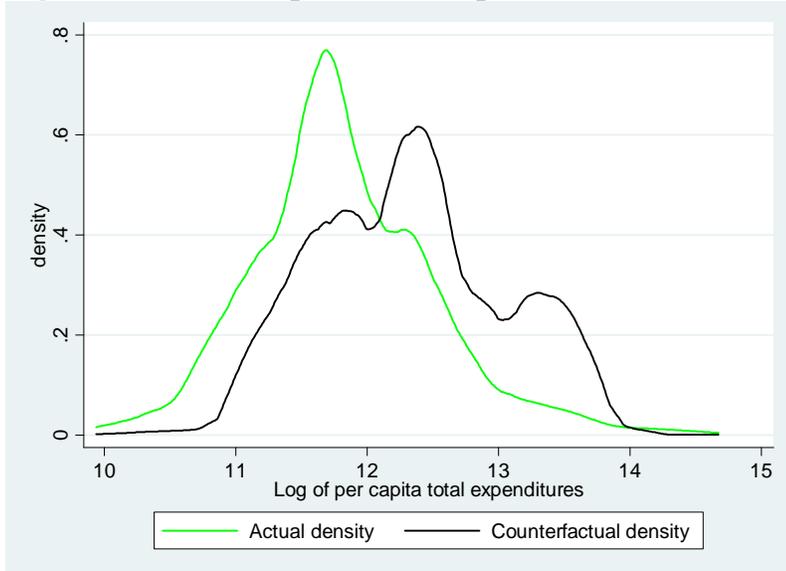


Figure A5.4. Per Capita Total Expenditure Density Difference by Drought (Urban)

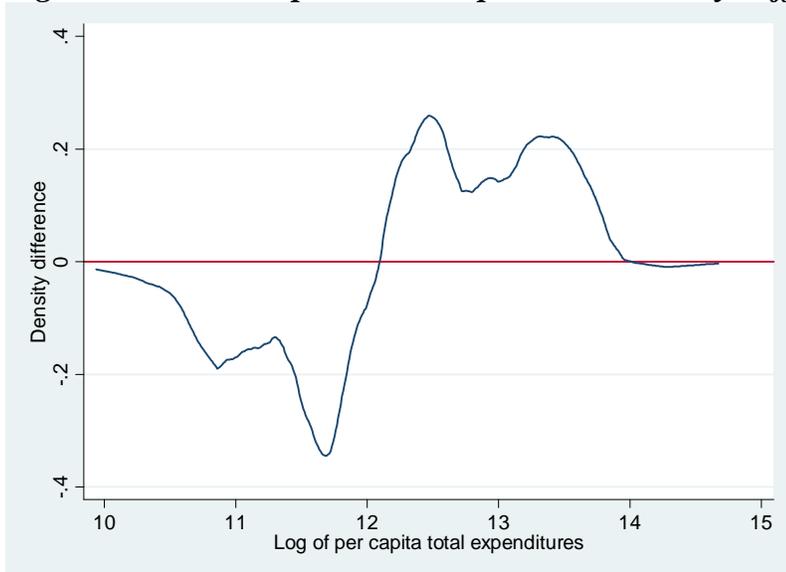


Figure A5.5. Per Capita Food Distributions by Drought (Rural)

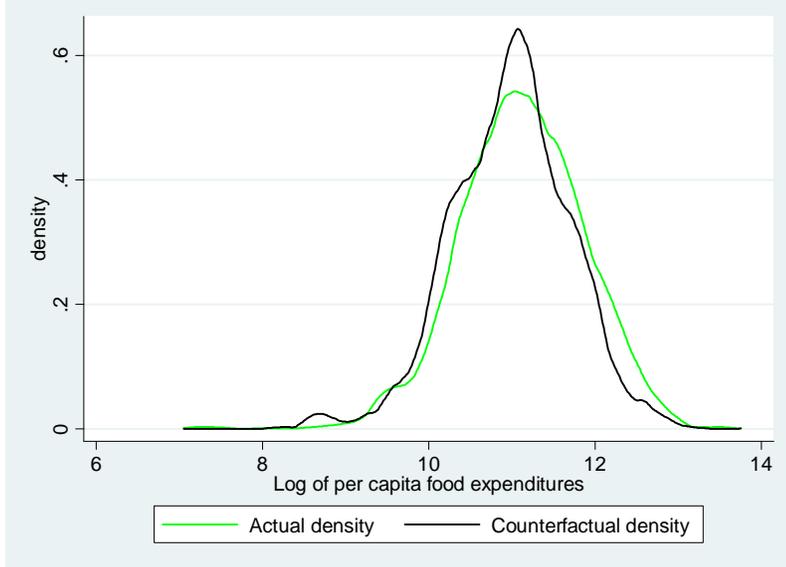


Figure A5.6. Per Capita Food Density Difference by Drought (Rural)

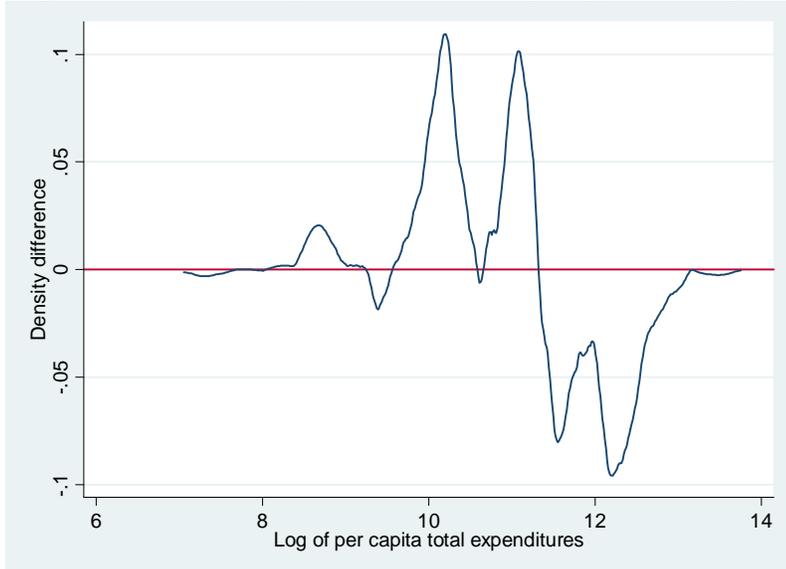


Figure A5.7. Per Capita Total Expenditure Distributions by Drought (Rural)

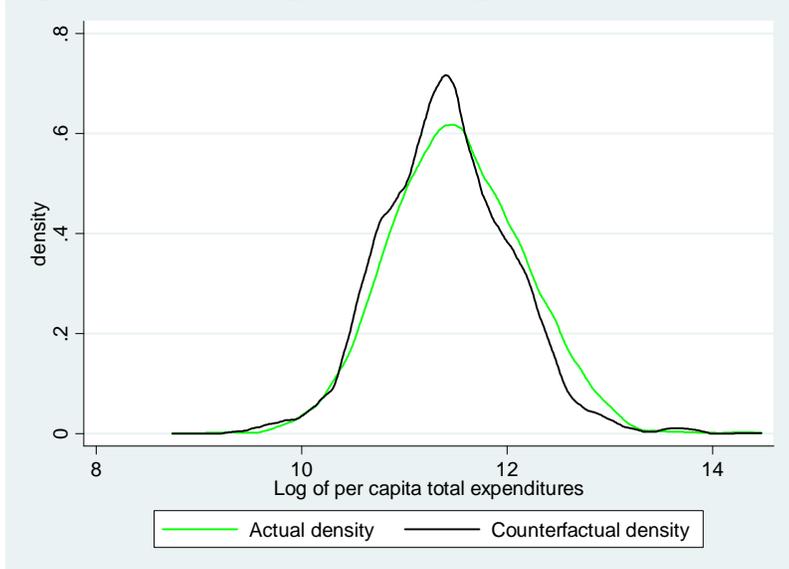


Figure A5.8. Per Capita Total Expenditure Density Difference by Drought (Rural)

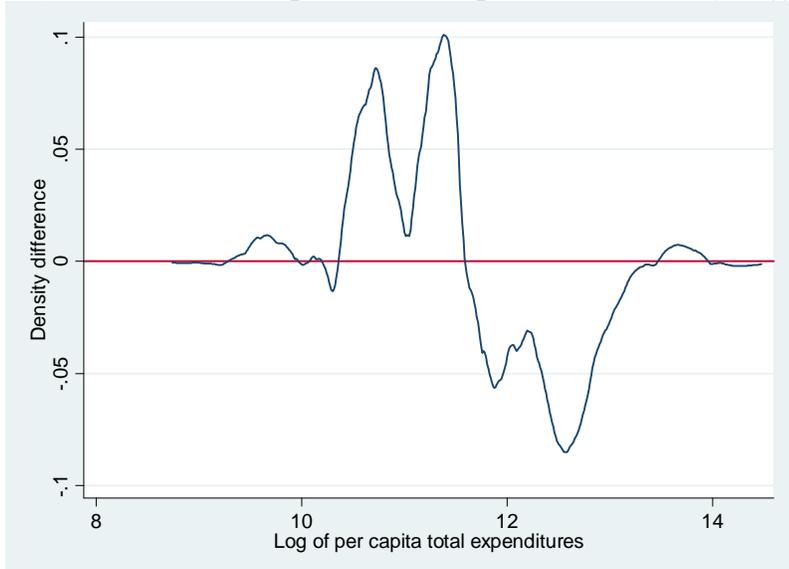


Figure A5.9. Per Capita Food Distribution by WO

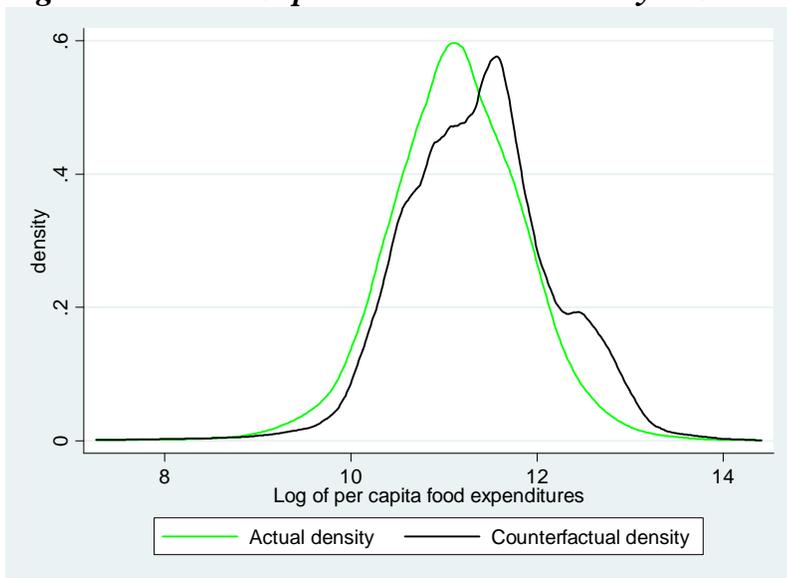


Figure A5.10. *Per Capita Food Expenditure Density Difference by WO*

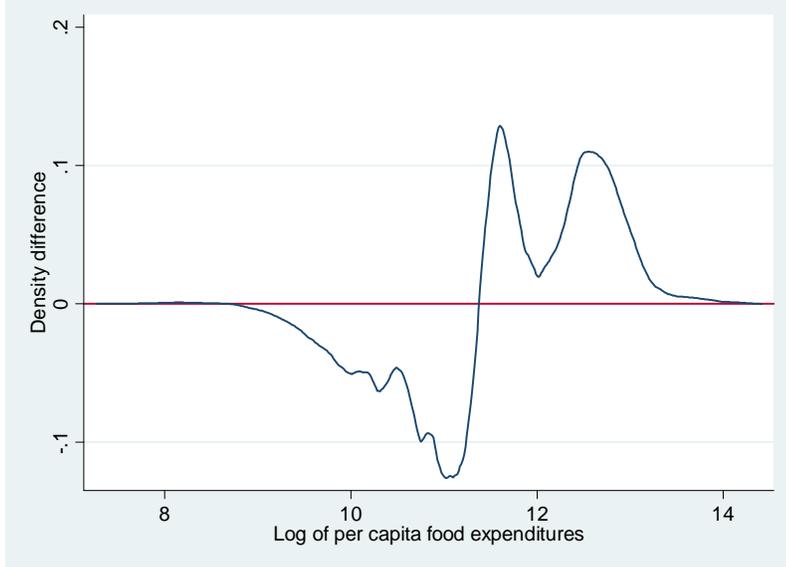


Figure A5.11. *Per Capita Total Expenditure Distributions by WO*

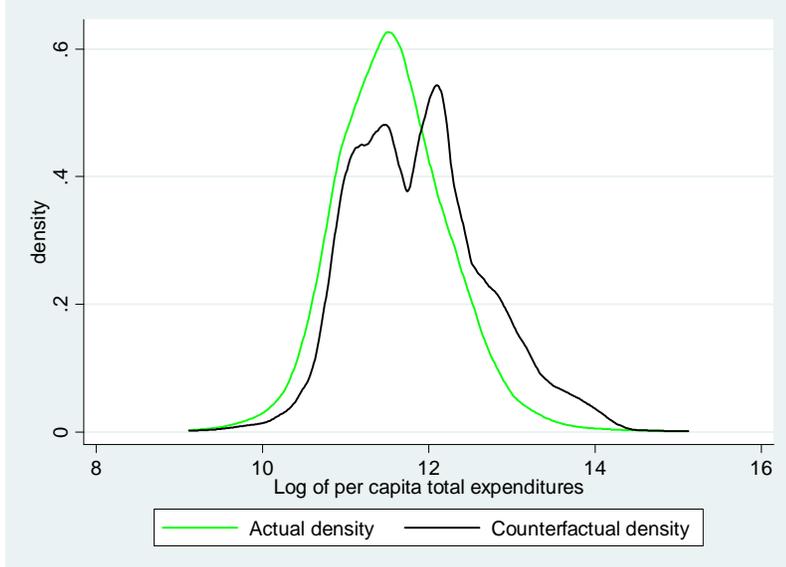


Figure A5.12. *Per Capita Total Expenditure Density Difference by WO*

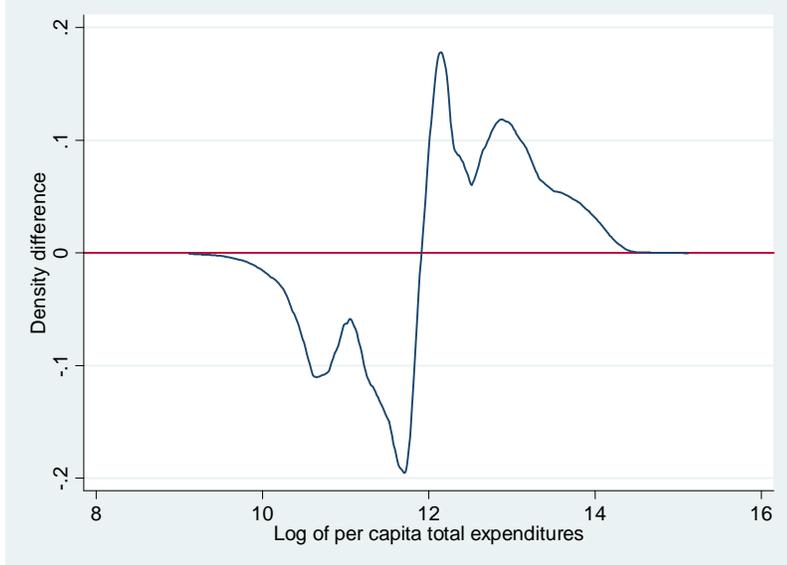


Figure A5.13. *Per Capita Food Distribution by MWO*

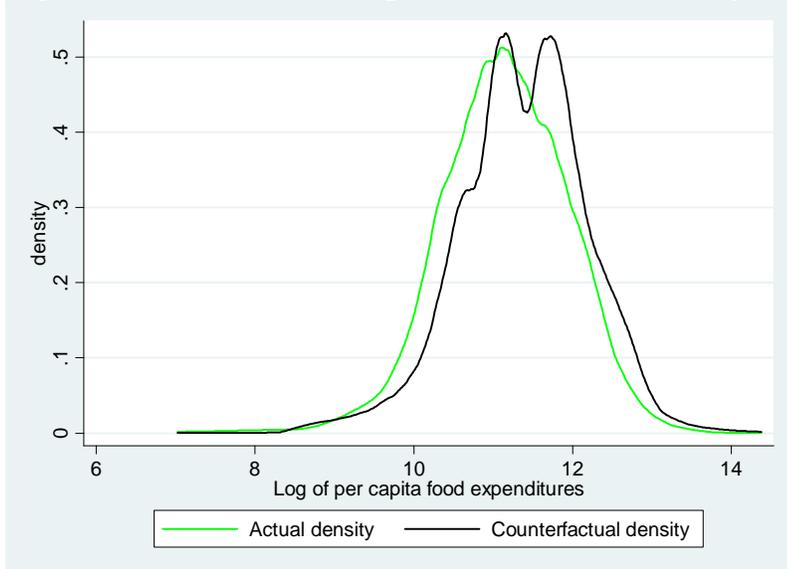


Figure A5.14. *Per Capita Food Expenditure Density Difference by MWO*

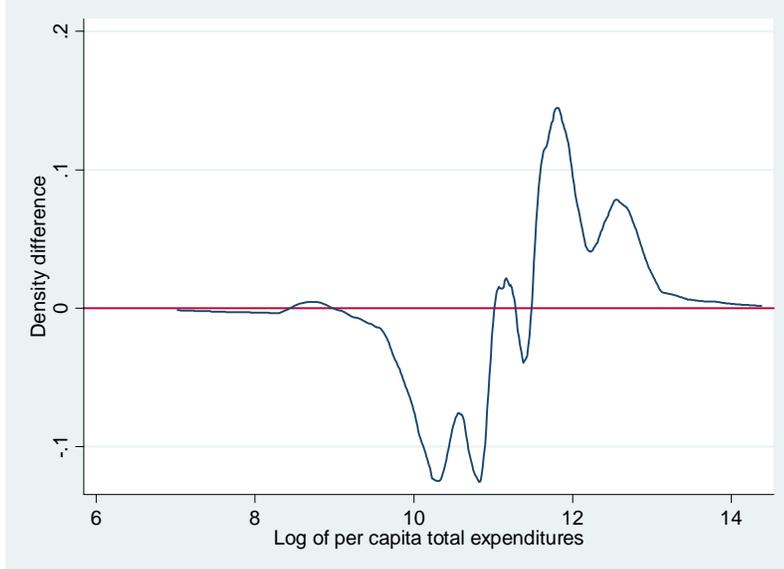


Figure A5.15. *Per Capita Total Expenditure Distributions by MWO*

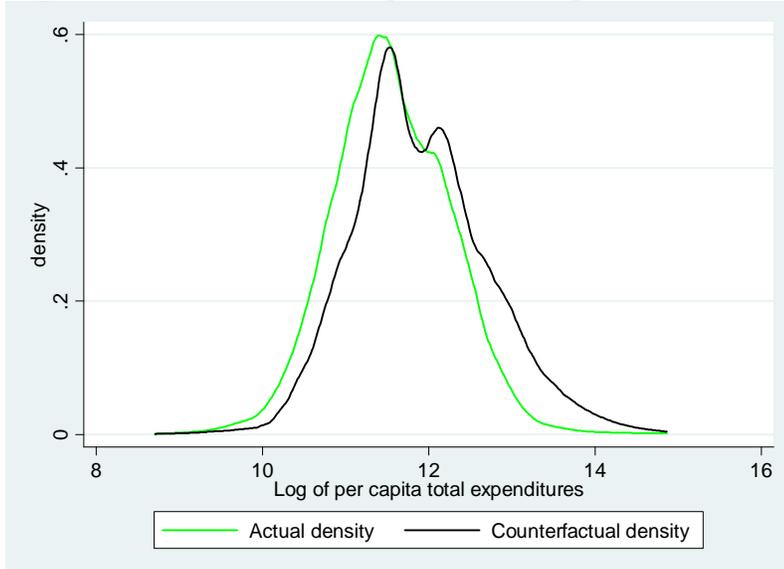


Figure A5.16. *Per Capita Total Expenditure Density Difference by MWO*

