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How does information on minimum and maximum food prices affect measured monetary poverty? Evidence from Niger

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Evidence from Niger[1]

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Abstract

Do households facing an interval of prices rather than a simple price alter the results of poverty analyses? To address this question, we exploit a unique dataset from Niger in which agropastoral households provide the *minimum and maximum prices* they paid for each consumed product in each season. We estimate poverty measures based on this price information using several absolute poverty line methodologies. Prices are used for valuing household consumption bundles, estimating household-specific price indices, valuing minimal calorie requirements, and extrapolating the link between food poverty and consumption.

The results for Niger show statistically significant differences in the estimated chronic and dynamic poverties for these approaches, especially for international poverty comparisons and seasonal transient poverty monitoring. Specifically, using minimum and maximum prices generates gaps in the estimated poverty rates for Nigerien agropastoral households that exceed regional poverty disparities, which implies that regional targeting priorities in poverty alleviation policies would be reversed if these alternative prices are utilized.

This result suggests that typically estimated poverty statistics, which assume that each household, or even cluster, faces a unique price for each product in a given period, may be less accurate for policy monitoring than generally believed.

Keywords: Poverty, Prices, Niger, Social Policies.

JEL Codes: I32, D12, Q12.

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1. Introduction

Price deflation is a major component of analyzing living standards and poverty in developing economies and elsewhere. This is notably the case in countries for which the spatial and time price differences that households face can be substantial. In this context, pioneering authors[2] stressed that accounting for price differences is essential for assessing deprivation and wealth, especially for poor individuals. Price discrepancies are typically corrected by dividing household income or household total consumption by price indices. In this work, we examine an issue that has been much overlooked in the literature: the fact that any given household can face, in addition to the abovementioned discrepancy, an interval of prices for the same product in the same period instead of a unique price. Does this change the perspective of poverty analyses?

Spatial and time price differences have been scrutinized in the literature. By focusing on price differences in Rwanda for several seasons, Muller (2002) identifies substantial spatial price differences and price discrimination faced by poor individuals, even in a small rural country. Poor individuals may sometimes live in remote areas that are distant from marketplaces and hence pay higher prices. As an alternative, poor individuals may consume lower quality products, thereby be appearing to pay lower prices in data insufficiently accounting for parities. However, Muller (2005) shows that when there is a weak association between prices and nominal living standards, price dispersion should be globally beneficial to social welfare, thanks to the functional shape of the price deflation in

[2] Such as Sen (1981), Pinstrup-Andersen (1985) and Stern (1989).

the formula of living standard indicators. Therefore, neutral price dispersion across households could reduce aggregate poverty. A consequence of these conflicting mechanisms is that the effect of price corrections on poverty is theoretically ambiguous and is an issue that should be empirically studied.

Deflation has been found to be crucial in estimating poverty lines and poverty indicators, and special attention has been devoted to rural-urban price gaps[3]. Purchasing power parities within countries have been particularly studied in large countries[4] and found to substantially influence poverty assessments. Even for smaller countries, precise spatial deflators have been found to matter for poverty analyses (e.g., in Vietnam, Gibson et al. 2016). Typically, in these absolute poverty studies, food Engel curve adjustments are used to convert a minimal calorie requirement into a poverty line level that can be compared to household total consumption expenditure or incomes in distinct places or periods, which raises the question of how price data affect the estimation of poverty statistics, even when this poverty line estimation method is utilized. Failing to accurately correct for price dispersion generally leads to biased estimates of chronic and transient poverty. For example, sizable biases have been found to emerge from seasonal and geographical price gaps across households in Rwanda (Muller, 2008).

Unfortunately, accurate seasonal and local price information is rarely available. However, when such price information can be obtained, it can be used to improve poverty alleviation policies, for example, by promoting the development of focused

[3] See Black (1952), Ravallion and Bidani (1994) and Rao (2000).
[4] E.g., studies conducted in India and China by Deaton and Dupriez (2011), Majumder et al. (2012), Li and Gibson (2014).

antipoverty transfer schemes, such as those introduced by Muller and Bibi (2010) for Tunisia, with living standards deflated by estimated true price indices. In that case, more precise price information enhanced the targeting efficiency of social policies and reduced the need for social funds.

However, one issue that arises when considering price correction in poverty analysis is that a household may pay different prices for the same product in the same period. These differences, faced separately by each individual, may correspond to differences in the quality of the products, which may or may not be taken into account by the estimation methods used. These 'individual-specific' differences may also emerge from the social relationship that exists between buyers and sellers that incite some individuals to adjust the asked or given price to the benefit or detriment of their transaction partner. Furthermore, prices can vary with the timing of the transaction during the market day, as sellers are more willing to offer bargains at the closing time of the market. In addition, buyers and sellers may learn about prices during the day, and they may even make mistakes. Other transaction costs, such as those related to bulk purchases, transport, packaging costs, or purchases on distinct days, may contribute to idiosyncratic price dispersion. These individual-specific price differences may also be generated by other unobserved reasons. In all these cases, rather than facing a unique price for a given product at a given time, each household faces an interval of prices, empirically bounded by a minimum price and a maximum price. Significant variations in the mean prices paid by different buyers, and even the same buyer, have been found in studies of specific markets, such as the Marseille fish market, suggesting that the notion of a unique price may sometimes be misleading (Kirman, 2010, Chapter 3).

In developing countries, for which market price data are rarely available, observations of unit values are often used to proxy prices. The unit value is calculated as the ratio of value over quantity for a given good, using records of purchases of this good obtained from a household survey. Sophisticated estimation methods, for example, those used for demand systems, have been developed to account for household choices of varieties, often of different qualities, involved in the unit value data, particularly the method proposed by Deaton (1987, 1988). [5] The simplest of these methods use spatial location to identify price variability, which may be a strong assumption if there are local, and even individual, dispersions in prices. Moreover, purging the quality choice by households may disregard information about price dispersion that each given household may face.

Regardless of the source of these individual-specific price dispersions – quality choice, social relations, transaction constraints or mere randomness – a question remains regarding the impact of the gap between the minimal and maximum prices paid by the same household. If this impact is large, it may change the way price deflation is considered in social welfare and poverty analyses and policy. If this impact is small, this information should be made available so related concerns can be addressed, and better analysis methods can be developed.

Does this residual price dispersion, possibly occurring for each individual separately, affect poverty measurements? The aim of this study is to investigate

[5] See also Deaton (1990, 1997), Crawford, Laisney and Preston (2003), and Ayadi et al (2003).

this question in agropastoral households in Niger. Using alternative information, maximum and minimum food prices, may potentially generate a substantial interval of (partially identified) poverty estimates. To the best of our knowledge, this is the first time these issues have been assessed using precise economic and statistical methods.

In a study on Niger, Backiny-Yetna et al. (2017) found that the collection method, particularly the recall period used for the survey, may generate significant gaps in poverty measurement. We complement this local interest in observation issues by turning our attention to the interval of individual prices used for poverty measurement. Our study is based on a unique dataset on Niger that includes information provided by agropastoral households regarding the minimum and maximum prices they have paid for each food product that they consumed. Using these data, we estimate poverty by considering three alternative poverty lines (and three associated deflated living standard variables): This study employs the World Bank international poverty line of 1.90 purchasing power parity (PPP) US $ a day, which represents an absolute poverty line based on a minimal calorie requirement and minimum prices, and a similar poverty line based on maximum prices. Using the 1.90 dollar a day poverty line will allow this study to consider a complementary perspective of how international poverty lines that mostly account for country price differences perform when compared to more precise cost-of-basic-needs methods that account for within-country price differences and here even account for the interval of prices faced by individuals. All these variants are extended to chronic and transient poverty measures across seasons.

Our results exhibit statistically significant differences in poverty levels when they are measured with these three approaches. The gaps found in poverty that are caused by using minimum prices instead of maximum prices are considerable when considering the international poverty line that is typically used for international poverty comparisons. These gaps are also substantial when considering seasonal transient poverty, even when using the estimated absolute poverty lines based on basic nutritional needs. In that case, the impact of using one type of price rather than the other is small when considering annual or chronic poverty. However, these changes remain large enough to reverse the North vs South targeting priority in poverty alleviation policies that are derived from estimated poverty profiles. Therefore, at least in the case under study here, the poverty statistics generally estimated, which overlook the price intervals faced by each household and consider that each household, or cluster, face identical and uniform prices, may be misleading for some typical poverty analyses. Moreover, using the 1.90 dollar a day poverty line produces a clearly distinct picture not only of poverty but also of the consequences of the price interval. In that case, poverty estimated with maximum prices is approximately one-tenth less than poverty estimated with minimum prices, which is substantial.

The rest of the paper is organized as follows. In Section 2, we present the context of Niger and the data used. Section 3 discusses the methods used to compute the poverty indices. Section 4 reports the estimation results. Finally, Section 5 presents the conclusion.

2. Context and Data

Niger is a large landlocked country and in 2014, the population was 17 million. The country's economy is essentially based on agriculture (40 percent of the GDP), with a large contribution from the livestock sector (11 percent of the GDP; Ministère de l'Elevage, 2016). In fact, the livestock sector is a mainstay of the country's economy, since 87 percent of the population is involved in this sector as a primary or secondary activity. Moreover, the income of 10 percent of rural households and up to 43 percent of households in pastoral zones directly come from livestock.

In a survey conducted in 2011 by the National Institute of Statistics in Niger on living standards and agriculture, 77 percent of the 4,000 households interviewed raised livestock as a source of income or to compensate for low agricultural income. However, agropastoral households are far from being the poorest individuals in Niger, as noted, for example, in Gueye et al. (2008). In particular, agropastoral households have generally been able to preserve at least part of their animal capital, sometimes over several drought periods.

Nonetheless, raising cattle and sheep is not enough to lift these households out of poverty. Between 2008 and 2013, on the basis of their income or expenditure levels, up to 30 percent of the pastoral and agropastoral populations were considered to be "very poor", 30 percent "poor", 20 percent "middle" and 20 percent "better off" by Haan (2016).

The data used in this study were obtained from a specialized survey collected by the Ministry of Livestock in Niger. This survey was conducted in the framework of two development projects in Niger: the "PRAPS: Projet Régional D'appui au

Pastoralism au Sahel" and the "PASEL: Programme d'Appui au Secteur de l'Elevage". We were able to access data obtained during the first round of this survey, which was conducted in October 2016 and is the only round useful for our purpose. The survey covered all seven regions of the country. Ninety villages were first selected based on their size. Then, within each of these villages, pastoral and agropastoral households were surveyed randomly. We first truncate the sample to eliminate urban and peri-urban households that are not part of our population of interest: true pastoral and agropastoral households. The excluded households were often too rich to be included in estimations of nutrient subsistence minima and consumption habits of poor individuals. Most excluded households did not produce milk and live in urban communes in the Dosso region. We controlled for peri-urban characteristics and then verified that this truncation step did not significantly affect the balance of the sample across regions or number of cattle owned.

After cleaning the data and removing obvious outliers in terms of household caloric consumption, total expenditures, and food prices, we obtained a total of 671 observations. Our sample is mainly (more than 85 percent) composed of households that owned cattle and sheep. Appendix 7 provides details on how these variables were calculated.

The surveyed households provided information about their sociodemographic characteristics, budgets, food consumption, agropastoral activities, and crucially, the minimum and maximum prices they faced for each food product in each season. Specifically, to obtain the minimum price paid by a household during a given season s for a given product p, the following question was asked: "*During season s, what is <u>the lowest price</u> at which you bought product p?*". For the maximum price, the corresponding question was: "*During season s, what is the highest price at which you bought product p*?". The collected price[6] information reflects the instability of prices during some periods when they varied every day or each week. This price instability, especially for cereals, is partly related to the seasonality of production. Araujo et al. (2012) have shown that for Niger, Mali and Burkina Faso, cereal price fluctuations are a determining factor in the prevention of food crises.

This detailed information on the food prices faced by each household enables us to compute households' food expenditure using alternatively the minimum and maximum prices collected at the household level. However, the mean and median prices cannot be computed for each household from these data.

Individual price indices are constructed by using the same price information used for computing nominal living standards. That is, the minimum prices and maximum prices are used to calculate both variables. Therefore, the measurement of the real living standard variables depends on the chosen price information in a complex fashion that may be less elementary than can be addressed by employing normalization by a typical price index based on village-level mean prices.

The estimate of the caloric price for calculating the food poverty line also depends on whether minimum prices or maximum prices are considered. Moreover, as we discuss later, the extrapolation step in the estimation of the absolute poverty line, which is driven by a food Engel curve estimation, may generate an additional gap in the poverty statistics due to the use of two kinds of different price information and notably, when prices are included as regressors in the Engel curve equation.

[6] The survey collected information on the prices paid by households in the market rather than unit value.

Finally, we construct the price and living standard indicators not only at the year level, as is customary for poverty statistics but also separately for three distinct seasons. This added step mitigates the cases of observed minimum and maximum prices for the same product that would correspond to prices measured over long time periods.

By convention, the questionnaire distinguishes three seasons. The hot and dry season lasts from March to June, the rainy season begins in July and ends in October, and the cold and dry season lasts from November to February. Most harvests take place between October and December. Of course, these patterns basically fit the diverse local circumstances in such a large country.

The hot and dry season and the rainy season are both lean seasons for agropastoral households. The hot and dry season negatively affects livestock activity, while the rainy season is a planting period in which households generally have no cereal stocks. During the hot and dry season, agropastoral households are confronted with a lack of pasture and water for their animals, resulting in weight loss and lower market value. However, four-fifths of the total consumption of these households is still food during this time of the year.

In the rainy season, agropastoral households work on their fields, and they progressively exhaust their cereal stock. Moreover, even if the first rains in this season benefit the animals, some of the abovementioned negative effects of the hot and dry season may persist in the rainy season. The market value of animals may not be sufficient to buy enough cereals, which are costly in that period. Food accounts for 87 percent of total consumption and almost as much as 86 percent in the cold and dry season. The strong seasonality of food prices has been well acknowledged, particularly for millet, for which recurrent price spikes have been studied (Araujo-Bonjean and Simonet, 2016)

3. Food Expenditure and Food Prices

This study is based on a unique survey for which each surveyed household provided information on the lowest and highest prices at which they had purchased each of the consumed food products for the three seasons of the year. However, as in most consumption surveys, price information was occasionally missing for some products consumed by some households. In that case, we applied an imputation algorithm to replace these data with the median values of the prices observed in the nearest upper geographical level (see the Appendix for details).

Moreover, for some households and some products, the stated minimum and maximum prices are identical. Table 1 indicates the proportions of these households for each product used to construct the price index and by season. The proportions range from 1 percent (cowpea in the hot and dry season) to 60 percent (tobacco) percent depending on the product and season. Although these proportions are high for some products in some seasons, it is fair to say that overall, and for a high proportion of households, the stated minimum and maximum prices differ for all seasons. During the cold and dry season, for ten of these products, more than one-third of households stated a unique price; this is the case for seven products in the hot and dry season but only five products in the rainy season. Additionally, these data clearly do not suggest that the differences between the minimum and maximum prices arise from quality differences. Finally, household price dispersion is supported by the results of a survey conducted by the Institut National de la

Statistique (2015), showing that in eight[7] regions of the country, the respondents greatly vary in terms of their assessments of changes in the price of cereals. These responses are hard to reconcile with the common belief that a unique price exists, at least at the village level. Under these conditions, clearly, the issue of individual-specific price dispersion that has been overlooked thus far should be taken seriously.

Table 1: Percentage of Households with Identical Minimum and Maximum Prices

Products	Cold and dry season	Hot and dry season	Rainy season
Millet	26.53	16.39	8.94
Sorghum	17.88	19.67	6.26
Cowpea	31.15	1.04	2.53
Maize	49.18	14.75	25.19
Groundnut	30.25	49.03	71.39
Butter	59.17	59.02	42.32
Kola nut	23.40	11.17	9.24
Okra	7.45	25.48	25.63
Oil	33.83	28.02	21.01
Fresh milk	42.92	42.62	30.10
Curdled milk	15.05	48.29	15.35
Bread	41.13	41.13	41.13
Edible pasta	24.74	25.04	7.15
Fish	42.03	42.03	42.03
Sugar	15.80	14.61	27.27
Tobacco	36.36	59.91	21.76
Tea	17.59	9.69	9.99
Condiments	34.28	33.68	23.99
Meat	27.42	28.46	21.61
Poultry	23.25	4.92	23.85

The seasonal means of the minimum and maximum price values are presented in Table 2. The mean gap between the minimum price and the maximum price (see the Diff column) greatly varies from one product to another and from one season to another for the same product. For most products and seasons, this gap is significant. In the cold and dry season, for 8 of 20 products, the gap exceeds 100 CFA per kg or per liter; this also occurs for 11 products in the hot and dry season and 12 products in the rainy season that satisfy the same conditions. Broadly, the products with the greatest relative gaps between the minimum and maximum

[7] Seven regions (Agadez, Diffa, Dosso, Maradi, Tahoua, Tilabéri, and Zinder) plus Niamey, the capital.

prices are sorghum, okra, cowpea, fresh and curdled milk, fish, tobacco, meat, and poultry. In contrast, maize, butter, and kola are products with the smallest gaps. Moreover, for some products, this gap greatly varies according to the season, while for others, even when the gap is large, it is stable across seasons, as occurs for meat. For millet or maize, the difference between the maximum and minimum prices can vary by three or four times from one season to another (e.g., for millet, the price ranges from 15 CFA/kg in the cold dry season to 54 CFA/kg in the rainy season).

Table 2: Mean Seasonal Prices (CFA)

Products	Cold and dry season				Hot and dry season				Rainy season			
	N	Pmax	Pmin	Diff	N	Pmax	Pmin	Diff	N	Pmax	Pmin	Diff
Millet (kg)	671	246.4 (.639)	230.5 (.643)	15.9 (.907)	671	239.1 (.310)	211.7 (.080)	27.4 (.320)	671	268 (.545)	213.3 (.076)	54.7 (.550)
Sorghum (kg)	671	187 (.080)	163.8 (.069)	23.2 (.105)	671	227.9 (.383)	208.9 (.383)	19 (.542)	671	230.3 (.077)	210.1 (.068)	20.3 (.103)
Cowpea (kg)	671	342 (.289)	309.8 (.256)	32.2 (.387)	671	361.8 (.416)	318.6 (.259)	43.2 (.491)	671	378.9 (.234)	333.3 (.196)	45.6 (.306)
Maize (kg)	559	197.6 (.083)	188 (.068)	9.6 (.108)	671	244.6 (.161)	227.5 (.079)	17.1 (.180)	559	242.2 (.324)	217 (.078)	25.2 (.334)
Groundnut (kg)	470	440.5 (.290)	390.9 (.286)	49.6 (.408)	470	472.9 (.161)	383.4 (.200)	89.5 (.257)	470	604.5 (1.21)	470.5 (.245)	134 (1.23)
Butter (kg)	402	1301.4 (.714)	1024.2 (.377)	277.3 (.807)	275	1563.9 (1.37)	1157 (.755)	406.9 (1.57)	387	1309.8 (.936)	1002.9 (.908)	306.6 (1.30)
Kola nut (kg)	630	561.2 (2.36)	506.7 (2.25)	54.4 (3.27)	630	501.1 (1.90)	377.5 (1.45)	123.6 (2.39)	630	590.6 (2.35)	451.3 (1.80)	139.2 (2.96)
Okra (kg)	630	967.5 (1.03)	781.5 (.89)	185.9 (1.37)	630	1075.7 (1.27)	938.7 (1.07)	136.9 (1.66)	503	1161 (1.88)	984 (1.58)	177 (2.46)
Oil (l)	671	869.6 (.641)	802.6 (.466)	67.1 (.792)	671	882.5 (1.23)	779.2 (.477)	103.2 (1.32)	671	902.6 (.908)	803.8 (.469)	98.8 (1.02)
Fresh milk (l)	514	362.3 (.470)	288.9 (.202)	73.4 (.512)	514	455.1 (.348)	334.8 (.278)	120.3 (.446)	597	417.1 (.273)	296.5 (.177)	120.7 (.325)
Curdled milk (l)	630	312.5 (.941)	235.8 (.647)	76.7 (1.14)	597	373.71 (2.28)	343.1 (2.28)	30.6 (3.23)	630	453 (4.48)	310.5 (2.26)	142.4 (5.02)
Bread (kg)	630	350.8 (.330)	304.9 (.311)	45.9 (.453)	630	394.5 (.510)	342 (.485)	52.5 (.704)	630	378.6 (.464)	331.4 (.404)	47.3 (.615)
Pasta (kg)	671	520.8 (.369)	467.1 (.318)	53.7 (.487)	671	522.4 (.371)	468.8 (.319)	53.6 (.489)	671	526.3 (.359)	469.4 (.320)	56.9 (.481)
Fish (kg)	559	1299.5 (1.69)	1080.6 (1.45)	218.9 (2.23)	559	917.1 (1.45)	774.2 (1.14)	142.9 (1.85)	518	1306.4 (2.15)	1110.7 (1.87)	195.7 (2.85)
Sugar (kg)	671	617.8 (.472)	555.7 (.428)	62.1 (.637)	671	602.5 (.456)	541.1 (.420)	61.4 (.620)	671	632.1 (.625)	570.9 (.414)	61.2 (.750)
Tobacco (kg)	638	2012.9 (3.54)	1665.8 (2.60)	347.1 (4.40)	638	1971.7 (3.37)	1767.4 (2.50)	204.3 (4.20)	638	2994.6 (5.71)	2520.9 (4.47)	473.7 (7.26)
Tea (kg)	671	1018.6 (2.65)	883.1 (2.07)	135.5 (3.36)	671	1089.3 (2.49)	907.5 (1.97)	181.9 (3.18)	671	1078 (2.08)	942.7 (1.92)	135.3 (2.83)
Condiments (kg)	671	1014.4 (2.22)	880.9 (1.68)	133.5 (2.79)	671	1040.9 (2.07)	924.8 (1.78)	116.1 (2.73)	671	1046.8 (2.03)	914.1 (1.74)	132.7 (2.68)
Meat (kg)	671	1932.3 (2.09)	1560.9 (1.52)	371.5 (2.58)	671	1958.6 (2.03)	1713.7 (1.72)	244.9 (2.67)	671	1981.8 (1.87)	1730.6 (1.68)	251.2 (2.52)
Poultry (kg)	638	2100.7 (2.58)	1513.7 (1.37)	587 (2.92)	638	1987.8 (2.57)	1441.7 (1.34)	546.1 (2.90)	638	2123 (2.45)	1527.6 (1.32)	595.4 (2.78)

Notes: Pmin=Minimum price, Pmax=Maximum price. The values in parentheses are standard errors. The values presented in this table are means weighted by the sample weights.

The significant differences observed between the maximum and minimum food prices faced by the same household generate a corresponding gap in the valuation of food expenditure. In Table 3, the mean food expenditure per adult equivalent, evaluated at maximum prices, is 14, 14.3 and 24.6 percent greater in the cold and dry, hot and dry and rainy seasons, respectively, than that calculated using the minimum prices. Over the year, on average, the measured consumption increases by 17 percent when minimum prices are substituted with maximum prices.

Table 3: Nominal Food Expenditure and Laspeyres' Food Price Index using Alternative Prices

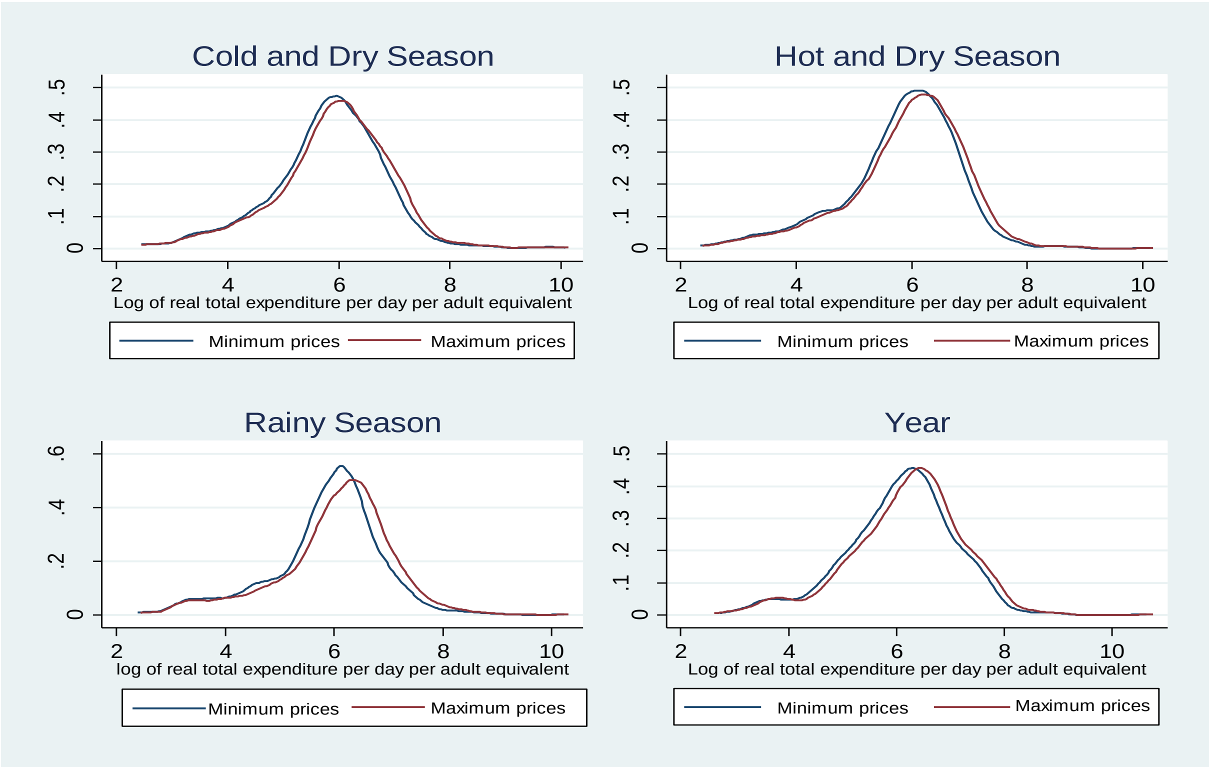
Variables	Prices	Cold and dry season (N=671)		Hot and dry season (N=671)		Rainy season (N=671)		Year (N=671)	
		Mean	Std	Mean	Std	Mean	Std	Mean	Std
Food expenditure (CFA/day/adult equivalent)	Pmax	588.82	1223.70	509.71	892.87	639.14	1139.39	579.23	960.55
	Pmin	527.21	1144.21	455.53	869.19	520.26	971	501	896.13
	R.Diff	.140	.209	.143	.458	.246	.794	.173	.303
Food price index	Pmax	1.00	.504	.977	.258	1.017	.595	.921	.701
	Pmin	1.01	.529	.986	.211	1.00	.230	.917	.674
	R.Diff	.001	.092	-.009	.164	.008	.501	.015	.270
Real food expenditure (CFA/day/adult equivalent)	Pmax	583.51	1390.77	530.81	1106.76	656.73	1423.58	768.07	1957.05
	Pmin	509.41	1228.75	466.51	1032.36	535.98	1253.65	665.28	1722.24
	R.Diff	.137	.102	.145	.206	.230	.186	.161	.117

Note: See Appendix 7 for details on how the adult equivalent scale is calculated. The mean values presented in the table are sample means. The three seasonal food expenditures are summed to obtain their annual values. The base of the seasonal food price indices is the mean national price of the corresponding season. The annual food price index is computed using the weighted average of seasonal food prices, where the weights indicate the quantity of food consumed by the household. For the seasonal food price indices, the base of the annual food price index is the national average price of the year. Pmin=Minimum prices, Pmax=Maximum prices, R. Diff= Relative difference between the minimum and maximum prices.

Figure 1 presents the estimated densities of the log of living standard variables annually and for each season, calculated with minimum and maximum prices. It seems fair to say that the shifts in these curves caused by changing the kind of price used do not seem dramatic. However, this is partly due to the logarithmic transformation that dampens income differences.

The Laspeyres food price index is slightly sensitive to the choice of using minimum or maximum prices. However, because the national average is used as the index base, the mean price index changes by less than one-half of a percent when substituting minimum prices with maximum prices in each season. We now turn to the estimation of the poverty measures.

Figure 1: Density of the Real Total Expenditure per Day and per Adult Equivalent (Epachenikov kernel estimator)



4. Results

We first examine the poverty estimates calculated for the whole year and based on the $1.90 a day international poverty line, then yearly and seasonal poverty estimates based on the estimated cost-of-basic-needs poverty lines.

4.1. Poverty estimates using the World Bank's international poverty line

The current World Bank's international poverty line is $1.90 per day per capita at 2011 PPP (Jolliffe and Beer Prydz, 2016). This poverty line is equivalent to $3.08

per adult equivalent per day in our case[8] and is applied to all regions of the country, which are regrouped into two larger regions: the North and the South. The North is formed by the regions of Agadez, Diffa, Maradi and Zinder, and the South is formed by the regions of Tahoua, Dosso and Tillabery.

Table 4: Poverty Measures Calculated with Minimum and Maximum Prices and the International Poverty Line

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South (T-test)		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	.735*** (.0004)	.375** (.0003)	.246*** (.0002)	.713*** (.0006)	.347*** (.0004)	.214*** (.0003)	.749*** (.0005)	.394*** (.0004)	.268*** (.0003)	-.036*** (.0007)	-.047*** (.0005)	-.054*** (.0004)
Using minimum food prices	.823*** (.0003)	.425*** (.0003)	.279*** (.0002)	.819** (.0005)	.402*** (.0004)	.249*** (.0003)	.826*** (.0004)	.441*** (.0003)	.300*** (.0003)	-.006*** (.0006)	-.039*** (.0005)	-.050*** (.0005)
Differences	-.088*** (.0002)	-.050*** (.00005)	-.032*** (.00003)	-.106** (.0004)	-.054** (.0001)	-.035** (.00004)	-.076** (.0003)	-.047** (.0001)	-.031** (.00004)	-.029*** (.0005)	-.007*** (.0001)	-.003*** (.00006)
Relative difference	-.11	-.12	-.11	-.13	-.13	-.14	-.09	-.11	-.10	4.83	.18	.06

Note: The values in parentheses are standard errors. ** and *** imply significance at the 5% and 1% levels, respectively. The North represents the regions of Agadez, Diffa, Maradi and Zinder, and the South represents the regions of Tahoua, Dosso and Tillabery. FGT_0 is the poverty head-count ratio, FGT_1 is the poverty gap index and FGT_2 is the poverty severity index.

As seen in Table 4, the poverty estimates obtained using the two types of food prices are significantly different. Of course, since the poverty line level does not change when using either type of price, the poverty measures obtained with the maximum prices are smaller than those obtained with the minimum prices. At the national level and for the North, the incidence of poverty measured with maximum prices (73.5 percent and 71.3 percent, respectively) is almost one-tenth smaller than that obtained with minimum prices (82.3 percent and 81.9 percent, respectively), which is substantial. This difference is less pronounced for the South, where the poverty incidence estimated with the minimum prices (82.6 percent) is

[8] This number is obtained by multiplying the $ 1.90 per capita per day poverty line by the average household size (7.11) and dividing it the average adult-equivalent scale (4.39). The conversion rate of PPP used for 2016 is FCFA 220.6 for $ 1 PPP for private consumption.
(source: https://data.worldbank.org/indicator/PA.NUS.PRVT.PP?locations=NE, consulted 14 March 2020).

only 7.6 percent greater than that obtained with maximum prices (74.9 percent). As a consequence, the ranking of regions according to poverty is reversed by substituting the type of price information used. Indeed, the differences in the estimated poverty rates caused by this change in price information are greater than the poverty difference between the North and South, which is only almost 1 percent when using minimum prices and 4 percent when using maximum prices. This matters if the national poverty alleviation strategy tends to target regions where poverty is found to be more severe, which is generally the case.

When considering poverty measures that are sensitive to living standard differences among poor individuals, the same substantial impact of choosing the minimum price vs the maximum price emerges. Poverty intensity and poverty severity estimated with minimum food prices are 4 to 5 percent and 3 percent significantly greater, respectively, than those estimated with maximum food prices, depending on the region. However, this impact is smaller than the North-South poverty gaps, and therefore, the ranking of the regions does not reverse. Let us now turn to poverty estimates based on a poverty line stipulated from minimal nutritional requirements.

4.2 Poverty estimates with cost-of-basic-needs poverty lines

The sign of the effect when using minimum prices instead of maximum prices for estimating poverty is theoretically ambiguous. Prices intervene at four stages of the estimation process: (1) the construction of the consumption aggregate for each household, (2) the construction of each household price index, (3) valuing the minimal calorie requirement and finally, (4) the extrapolation of the poverty line when using an estimated Engel curve that also involves price effects.

We estimated three types of poverty indicators: annual poverty, which is defined as the arithmetic average of the three seasonal poverty indices; chronic poverty, which is formulated by considering the poverty measures applied to total annual consumption expenditure and therefore assumes that households smooth their consumption over the year; and finally, transient poverty, which is specified as residual poverty after accounting for chronic poverty in annual poverty (see the Appendix for more details on how these poverty measures are computed). Ravallion (1988) proposed using this dynamic decomposition, and Muller (2008) extended it to seasonal variations as a convenient way to assess the basic magnitude of the contribution of transient variations in well-being to poverty. Of course, more sophisticated measures are based on modeling consumption smoothing and the risk-sharing behavior of households, such as those proposed in Deaton and Paxson (1994). However, these methods could not be used with the data employed by the current study, and we prefer to employ methods that do not depend on specific hypotheses about behavior models.

Absolute poverty lines

Table 5: Seasonal Food and Absolute Poverty Lines in Real Terms (CFA/day/adult equivalent)

Poverty lines	Geographic location	Cold and dry season		Hot and dry season		Rainy season		Year	
		Pmin	Pmax	Pmin	Pmax	Pmin	Pmax	Pmin	Pmax
Food poverty line	North	107.7	121.2	130.2	142.1	130.8	151.7	118.6	134.6
	South	138.7	150.2	137.5	150.8	160.7	197.4	140.4	162.4
	National	124.9	137.2	134.5	147.1	147.5	176.9	130.8	150
Absolute poverty line	North	219.7	246.8	260.6	284.5	261.7	301.7	239.6	270.9
	South	241.8	259.7	240	260.6	276.2	333.2	244.5	278.7
	National	232.5	254.2	248.8	270.7	270.1	319.9	242.4	275.4

Note: Pmin=Minimum prices, Pmax=Maximum prices. The national poverty line is composed of the two regional poverty lines and considers the value of the North poverty line if the household lives in the North and the South poverty line if the household lives in the South. The national poverty line presented in this table is the mean of the national poverty line.

The absolute poverty lines are estimated using the cost-of-basic-needs method (see the Appendix for details). Table 5 shows that the estimated poverty lines are substantially higher when using maximum prices than minimum prices for all seasons and all regions. Over the year, the poverty lines calculated by using maximum prices are greater than those with the minimum food prices by almost 14 percent, and they slightly vary between regions. The gaps between these two kinds of estimated poverty lines are more pronounced in the rainy season (between 15 and 20 percent) and the hot and dry season (8 and 9 percent) than in the cold and dry season (7 and 12 percent).

The seasonal variations in the diverse poverty lines are greater than their regional variations. The seasonal absolute poverty lines lie between 220 and 333 CFA per day per adult equivalent, while over the year, their values lie between 240 and 279 CFA per day per adult equivalent, depending on the region. In addition, the gap between the poverty lines alternatively estimated with minimal and maximal prices also dominates the variation in the poverty lines between the two regions.

This result provides more information about the potential influence of the household-specific price interval on poverty monitoring. Moreover, if this influence is patent and sizable for mean living standards or poverty standards calculated with the international poverty line, it is less obvious for poverty estimated with the absolute poverty line. Indeed, the changes in the poverty line and changes in living standards may offset each other.

Seasonal poverty

The results of the seasonal poverty estimates are presented in Tables 6a to 6c. For all three seasons, the two seasonal poverty estimates with alternative prices always differ at the 1 percent level of significance. However, the differences due to using alternative prices are always relatively moderate, with the greatest magnitude reaching slightly more than a 7 percent variation, but these differences can also be positive or negative, with no obvious structure determining these signs. It seems that, in that case, the poverty line estimation has partly compensated for the changes in living standards measures computed by using alternative prices.

For the cold and dry season (see Table 6a), the impact of using minimum prices versus maximum prices is more pronounced for the North and South than when considering the country as a whole. During this season, the poverty rate varies from 27.7 to 33.5 percent, while poverty intensity and poverty severity vary from 10 to 16 percent and from 5 to 10 percent, respectively, depending on the region and the use of alternative prices. Moreover, the differences in the poverty rates in the North and the South are larger when they are assessed with minimum prices than maximum prices, while they are larger for poverty intensity and poverty severity when using maximum prices than minimum prices.

Table 6a: Poverty with the Absolute Poverty Line
(for the Cold and Dry Season with Minimum and Maximum Prices)

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South (T-test)		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	.312*** (.0004)	.136*** (.0002)	.083*** (.0002)	.277*** (.0006)	.103*** (.0003)	.053*** (.0002)	.335*** (.0005)	.159*** (.0003)	.104*** (.0002)	-.057*** (.0008)	-.055*** (.0004)	-.050*** (.0003)
Using minimum food prices	.307*** (.0004)	.136*** (.0002)	.083*** (.0001)	.292*** (.0006)	.102*** (.0003)	.052*** (.0002)	.317*** (.0005)	.160*** (.0003)	.104*** (.0002)	-.025*** (.0008)	-.058*** (.0004)	-.052*** (.0003)
Differences	.005*** (.0001)	.000 (.00002)	.000 (.00001)	-.014*** (.0002)	.001*** (.00002)	.001*** (.00001)	.018*** (.0001)	-.001*** (.00002)	.000 (.00002)	-.032*** (.0002)	.003*** (.00003)	.002*** (.00002)
Relative difference	.016	.000	.000	-.051	.009	.019	.056	-.006	.000	1.28	-.051	-.038

Note: The values in parentheses are standard errors, and *** indicates significance at the 1 percent level. The national poverty measures are computed with the regional poverty lines.

Table 6b: Poverty with the Absolute Poverty Line
(for the Hot and Dry Season with Minimum and Maximum Prices)

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	.306*** (.0004)	.144*** (.0002)	.088*** (.0002)	.291*** (.0006)	.118*** (.0003)	.061*** (.0002)	.315*** (.0005)	.162*** (.0003)	.107*** (.0002)	-.024*** (.0008)	-.043*** (.0004)	-.046*** (.0003)
Using minimum food prices	.310*** (.0004)	.146*** (.0002)	.090*** (.0002)	.293*** (.0006)	.116*** (.0003)	.060*** (.0002)	.321*** (.0005)	.167*** (.0003)	.111*** (.0002)	-.028*** (.0008)	-.050*** (.0004)	-.051*** (.0003)
Differences	-.004*** (.00005)	-.002*** (.00001)	-.002*** (.00001)	-.002*** (.00006)	.002*** (.00001)	.001*** (.00001)	-.006*** (.00008)	-.005*** (.00002)	-.004*** (.00002)	.004*** (.0001)	.007*** (.00003)	.005*** (.00003)
Relative difference	-.013	-.014	-.022	-.007	.017	.017	-.019	-.030	-.036	-.142	-.140	-.098

In all regions the poverty rates estimated for the hot and dry season (see Table 6b) are generally higher than those obtained for the cold and dry season. The poverty rate extends from 29 to 32 percent, while poverty severity and the poverty gap vary from 6 to 11 percent and from 11.6 to 16.7 percent, respectively, depending on the region and the prices used. The regional discrepancy in poverty is more pronounced than the gap between the two poverty estimates using alternative prices.

Table 6c: Poverty with the Absolute Poverty Line

(for the Rainy Season with Minimum and Maximum Prices)

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	.332*** (.0004)	.157*** (.0002)	.102*** (.0002)	.317*** (.0006)	.116*** (.0003)	.066*** (.0002)	.342*** (.0005)	.185*** (.0003)	.126*** (.0002)	-.025*** (.0007)	-.069*** (.0004)	-.060*** (.0003)
Using minimum food prices	.337*** (.0004)	.157*** (.0002)	.101*** (.0002)	.343*** (.0006)	.120*** (.0003)	.067*** (.0002)	.333*** (.0005)	.182*** (.0003)	.124*** (.0002)	.01*** (.0007)	-.062*** (.0004)	-.057*** (.0003)
Differences	-.005*** (.0001)	.000 (.00002)	.001*** (.00002)	-.026*** (.0003)	-.004*** (.00002)	-.001*** (.00001)	.009*** (.0001)	.003*** (.00003)	.002*** (.00003)	-.035*** (.0002)	-.007*** (.00004)	-.003*** (.00003)
Relative difference	-.015	.000	.009	-.075	-.033	-.015	.027	.016	.016	-3.5	.11	.053

Finally, the poverty measures estimated for the rainy season are higher than those estimated for the two other seasons. The results may differ because the rainy season is a lean period for agropastoral households. Indeed, during this season, the head-count index of poor individuals moves from 31 to 34 percent, while poverty severity and the poverty gap vary from 6.6 to 12.6 percent and from 12 to 18 percent, respectively, depending on the region and the prices used. In all seasons, there is more poverty in the South than in the North, except for the rainy season, which follows an opposite pattern.

Annual, chronic, and transient poverty

As previously mentioned, the annual poverty measures are defined as the arithmetic means of the seasonal poverty measures (see the Appendix for details). Table 7 shows that the annual poverty rates among agropastoral households remain stable for all regions and types of price used at 31.7 and 31.8 percent for the whole country, 29 and 31 percent for the North, and 32 to 33 percent for the South. Moreover, annual poverty severity, which lies between 14.6 and 14.7 percent for the whole country, is higher in the South than in the North. The estimated poverty measures are generally lower (or almost equal) when using maximum food prices than when using minimum food prices. The only exception is the head-count index of the North, which is approximately five percent higher when using minimum prices. However, the differences in annual poverty intensity and poverty severity using alternative prices are always very small and even nonsignificant in one-half of the cases.

Table 7: Annual Poverty with the Absolute Poverty Line (with Minimum and Maximum Prices)

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	.317*** (.0004)	.146*** (.0002)	.091*** (.0002)	.295*** (.0005)	.113*** (.0003)	.060*** (.0002)	.331*** (.0005)	.168*** (.0003)	.112*** (.0002)	-.036*** (.0007)	-.056*** (.0004)	-.052*** (.0003)
Using minimum food prices	.318*** (.0004)	.147*** (.0002)	.091*** (.0002)	.309*** (.0005)	.113*** (.0003)	.060*** (.0002)	.324*** (.0005)	.169*** (.0003)	.113*** (.0002)	-.014*** (.0007)	-.057*** (.0004)	-.053*** (.0003)
Differences	-.001*** (.00006)	-.001*** (.00001)	.000 (.00001)	-.014*** (.0001)	.000 (.00003)	.000 (.00001)	.007*** (.00007)	-.001*** (.00002)	-.001*** (.00002)	-.021*** (.0001)	.001*** (.00002)	.001*** (.00002)
Relative difference	-.003	-.006	.000	-.045	.000	.000	.021	-.006	-.009	1.5	-.017	-.019

Table 8: Chronic Poverty with the Absolute Poverty Line (with Minimum and Maximum Prices)

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	.265*** (.0004)	.112*** (.0002)	.063*** (.0001)	.270*** (.0006)	.095*** (.0002)	.044*** (.0001)	.262*** (.0005)	.123*** (.0003)	.076*** (.0002)	.007*** (.0007)	-.028*** (.0004)	-.032*** (.0003)
Using minimum food prices	.273*** (.0004)	.109*** (.0002)	.061*** (.0001)	.270*** (.0006)	.098*** (.0002)	.047*** (.0001)	.275*** (.0005)	.117*** (.0003)	.070*** (.0002)	-.005*** (.0007)	-.018*** (.0004)	-.023*** (.0003)
Differences	-.008*** (.0001)	.003*** (.00002)	.002*** (.00002)	.000 (.0002)	-.003*** (.00002)	-.003*** (.00001)	-.013*** (.0002)	.006*** (.00004)	.006*** (.00002)	.013*** (.0003)	-.009*** (.00004)	-.009*** (.00003)
Relative difference	-.029	.027	.033	.000	-.03	-.064	-.047	.051	.085	-2.6	.5	.39

Table 8 displays the estimates of chronic poverty, which is the closest estimation to typically published poverty statistics, which are based on annual consumption indicators. The results show moderate poverty levels among agropastoral households, approximately 27 percent for the head-count index, as expected, with households deemed to be generally better off than most other Nigerien households.

The results again show that poverty is more severe in the South than in the North, even though there may appear to be a smaller proportion of poor individuals in the South when using maximum prices. This result is consistent with national statistics on poverty published in 2011 and indicates that 52.2 percent of poor individuals live in the South, while 47.8 percent live in the North (Institut National de la Statistique, 2013). Moreover, according to the Institut National de la Statistique (2017), in 2011, in Niger, 29.9 percent of poor individuals and 19.7 percent of nonpoor individuals lived in agropastoral areas.

Calculating chronic poverty using the mean living standards across seasons changes the national head-count index results little (27.3 percent with maximum prices and 26.8 percent with minimum prices). Even though these changes are larger for the poverty gap (12.4 percent with maximum prices vs 12.3 percent with minimum prices) and poverty severity (7.5 percent with maximum prices vs 7.4 percent with minimum prices), the impact of choosing one type of price remains negligible.

On the whole, distinguishing the minimum prices and maximum prices only slightly, although significantly, affects the estimate of chronic poverty at the national level, which is only slightly higher with minimum prices. Similar marginal effects can be found for each region, with, again, opposite patterns. The poverty gap and poverty severity are slightly higher in the North when using minimum prices and in the South when using maximum prices.

Table 9: Transient Poverty with the Absolute Poverty Line (with Minimum and Maximum Prices)

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	.051*** (.0003)	.034*** (.0001)	.028*** (.0001)	.025*** (.0006)	.017*** (.0003)	.015*** (.0002)	.068*** (.0003)	.045*** (.0001)	.036*** (.0001)	-.043*** (.0006)	-.028*** (.0003)	-.020*** (.0002)
Using minimum food prices	.044*** (.0003)	.037*** (.0001)	.030*** (.0001)	.038*** (.0006)	.014*** (.0003)	.012*** (.0002)	.048*** (.0003)	.052*** (.0001)	.042*** (.0001)	-.009*** (.0006)	-.038*** (.0003)	-.030*** (.0002)
Differences	.007*** (.0001)	-.003*** (.00002)	-.003*** (.00002)	-.013*** (.0002)	.003*** (.00002)	.003*** (.00001)	.020*** (.0002)	-.007*** (.00003)	-.006*** (.00002)	-.034*** (.0003)	.010*** (.00004)	.010*** (.00003)
Relative difference	.16	-.081	-.10	-.34	.21	.25	.42	-.13	-.14	3.78	-.26	-.33

Table 10: Percentage of Transient Poverty in Annual Poverty

	National (N=671)			North (N=284)			South (N=387)			Difference between the North and the South		
	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2	FGT_0	FGT_1	FGT_2
Using maximum food prices	15.77	23.29	30.77	8.47	15.04	25	20.54	26.78	32.14	-12.07	-11.74	-7.14
Using minimum food prices	13.84	25.17	32.97	12.30	12.40	20	14.81	30.77	37.17	-2.51	-18.37	-17.17
Differences	1.93	-1.88	-2.2	-3.83	2.64	5	5.73	-3.99	-5.03	-9.56	6.63	10.03
Relative difference	.12	-.08	-.07	-.45	.17	.2	.28	-.15	-.16	.79	-.56	-1.40

Finally, Tables 9 and 10 show that using one kind of price is found to have greater consequences for estimated transient poverty. The seasonal transient poverty rates are significantly higher at the national level (5.1 percent vs 4.4 percent) and in the South (6.8 percent vs 4.8 percent) when using maximum prices and lower in the North (2.5 percent vs 3.8 percent). The opposite pattern is observed for transient poverty severity and the poverty gap across regions. Note that, again, the ranking of the two regions in terms of poverty rates is reversed, which hints at numerous crossings of the poverty line by households in some seasons in a context of high levels of chronic poverty. However, the share of transient poverty in annual poverty remains relatively modest, nationally and for each season. When using maximum prices, the poverty rate (poverty severity) ranges from 8 percent in the

North to 20 percent in the South (25 and 32 percent). This result suggests that pastoral activities are particularly effective for smoothing seasonal consumption shocks and thereby limiting the role of transient poverty. In addition, these moderate fluctuations of poverty over seasons are relatively robust to the choice of the type of prices used, especially from a national perspective.

5 Conclusion

Price deflation is a fundamental step in the construction of living standard indicators for poverty analyses. However, rather than facing a unique price for each given product, as typically assumed, each household faces an interval of prices in a given period. We show that this specific price information can be used to generate an interval of poverty estimates, which can be used for the partial identification of poverty levels, and this information may affect poverty alleviation policies.

To conduct this analysis, we use a unique dataset from Niger compiled from a survey in which agropastoral households provide information about the minimum and maximum prices they paid in each season for each consumed food product. Then, we estimate poverty measures based on these alternative price data and three alternative poverty lines: The World Bank international poverty line of 1.90 PPP US $, an estimated absolute poverty line based on minimum prices, and a similar poverty line based on maximum prices.

The results show statistically significant differences in the estimated poverty levels obtained with these three approaches, which are mostly used for international annual poverty comparisons or seasonal transient poverty analyses. The results of this study suggest that typically estimated poverty statistics, which consider that each household, cluster, or region, face a unique price for each product at a given period, may be less accurate than often believed, at least for the latter two analyses. In particular, the impact of alternatively using minimum and maximum prices for computing real living standards is found to generate gaps in estimated poverty rates for Nigerien agropastoral households that are larger than the corresponding gaps between estimated poverty in the South and North regions. A policy consequence of these differences is that the targeting priorities of regions in terms of food aid or cash transfer programs included in poverty alleviation policies would be reversed between the South and the North by using maximum prices instead of minimum prices when monitoring poverty.

The consequences for poverty alleviation policies are therefore substantial. First, caution is advised when using typical poverty statistics that do not account for the dispersion of prices that each household faces, which is the only current standard practice. The estimated gaps between the results based on using minimal and maximal prices, in the case of agropastoral households in Niger, are large enough to indicate prudence is needed. Second, policies changing price distributions may affect measured poverty in complex ways, for example, when the impacts differ for the minimum, maximum, and mean prices faced by each household. The latter may be the case for public price subsidies that may put more pressure on the maximum prices paid by consumers than on the minimum prices if they are below the legal subsidy price level.

A few issues remain that have to be resolved in a broader context. First, richer data covering whole countries and detailed consumption and price information over several years would better allow the exploration of the issues uncovered here. Second, the respective determinants of maximum and minimum prices need to better theoretically and empirically understood.

Some avenues of research could be developed from this initial exploration. First, poverty estimators based on partial identification could be thoroughly developed and implemented, for example by accounting not only for individual price dispersion but also for measurement errors in consumption quantities and frequencies. Second, the economic determinants of the observed gaps in minimum and maximum prices paid by the same household in the same period need to be better understood. Third, the distributions of prices faced by typical households should be more systematically investigated. Fourth, minimum and maximum prices could be used for analyses other than those estimating poverty. For example, these prices can be alternatively included in demand system estimation. Fifth, it is unclear whether minimum and maximum prices have the same economic and normative importance. For example, maximum prices may sometimes correspond to emergency circumstances or even forced purchases, which points to the need to monitor the high priority given to social relief.

6 References

Araujo C., Araujo-Bonjean C., Brunelin S. (2012). *Alert at Maradi: Preventing Food Crises by Using Price Signals.* World Development. Vol.40. pp.1882-1894.

Araujo-Bonjean C. and C. Simonet (2016). *Are grain markets in Niger driven by speculation?* Oxford Economic Papers. Vol.68. pp.714-735.

Ayadi, M., J. Krishnakumar and M.S. Matoussi, (2003). *Pooling surveys in the estimation of income and price elasticities: An application to Tunisian Households.* Empirical Economics, 28, 181-201.

Backiny-Yetna, P., D. Steele and I. Yacoubou Djima (2017). *The Impact of Household Food Consumption Data Collection Methods on Poverty and Inequality Measures in Niger*. Food Policy, 72, 7-19.

Crawford, I., F. Laisney and I. Preston. (2003).*Estimation of household demand systems with theoretically compatible Engel curves and unit value specifications.* Journal of Econometrics, 114, 221-241, 2003.

Deaton, A. (1988). *Quality, Quantity, and Spatial Variation of Price*. The American Economic Review, pp 418-430.

Deaton, A. (1987).*Estimation of own- and cross-price elasticities from household survey data*. Journal of Econometrics, N. 36, 7-30.

Deaton, A. (1990). *Price Elasticities from Survey Data. Extensions and Indonesian Results*. Journal of Econometrics, N. 44, 281-290.

Deaton, A., (1997). *The Analysis of Household Survey: A Microeconomic Approach to Development Policy*. John Hopkins University Press.

Deaton A. and Dupriez O. (2011). *Spatial price differences within large countries. Working Papers* 1321, Princeton University, Woodrow Wilson School of Public and International Affairs, Research Program in Development Studies.

Deaton A. and C. Paxson. (1994). *Intertemporal Choice and Inequality*. Journal of Political Economy, Vol.102, No 5, pp 417-467.

Deaton, A. and A Tarozzi. (2005). *Prices and Poverty in India*. The Great Indian Poverty Debate. New Delhi : MacMillan.

Deaton, A., and Zaidi, S. (2002). *Guidelines for Constructing Consumption Aggregates for Welfare Analysis*. Living Standards Measurement Study, Working Paper No.135. The World Bank. Washington DC.

Foster, J., J. Greer and E. Thorbecke (1984). *"A class of decomposable poverty measures"*. Econometrica. 3. 52 (3): 761–766.

Gibson, J., T. Le and B. Kim (2016). *Prices, Engel Curves, and Time-Space Deflation: Impacts on Poverty and Inequality in Vietnam*, The World Bank Economic Review, 1-34

Gueye B., B.A. Godo, S. Hawa and M. Sall. (2008). *Pauvreté chronique au Niger. Perceptions, stratégies et questions émergentes.* Programme de Recherche sur la Pauvreté Chronique en Afrique de l'Ouest. Document de Travail N°2, Niamey.

Haan, D. (2016). *Prospects for Livestock- Based Livelihoods in Africa's Drylands*. The World Bank Group, Washington DC.

Institut National de la Statistique du Niger et Banque Mondiale. (2013). *Profil et Determinants de la Pauvreté au Niger en 2011*. Rapport. Niamey, Niger.

Institut National de la Statistique du Niger. (2015). *Enquête conjointe sur la vulnérabilité à l'insécurité alimentaire des ménages au Niger (décembre 2014-janvier 2015)*. Rapport. Niamey, Niger.

Institut National de la Statistique du Niger. (2017). *Agriculture et Conditions de Vie des Ménages au Niger*. Rapport Niamey. Niger

Jolliffe D. and Beer Prydz E. (2016). *Estimating International Poverty Lines from Comparable National Treshold*. Journal of Economic Inequality. 14. 185-198.

Kirman, A., (2010). *Complex Economies*. Routledge, Abingdon, 2010.

Li, C. and J. Gibson (2014). *Spatial Price Differences and Inequality in the People's Republic of China: Housing Market Evidence*. Asian Development Review, vol. 31, no. 1, pp. 92–120.

Majumder, A., R. Ray and K. Sinha (2012). *Calculating Rural-Urban Food Price Differentials from Unit Values in Household Expenditure Surveys: A Comparison with Existing Methods and A New Procedure*. American Journal of Agricultural Economics, 94(5): 1218-1235.

Ministère de l'Elevage, M. (2016). *Enquete sur les revenus et la vulnérabilité des ménages agropastoraux et pastoraux*, Niamey, Niger.

Muller, C., (2002). *Prices and Living Standards. Evidence for Rwanda*. Journal of Development Economics, Vol. 68, 187-203.

Muller, C. (2005a). *Price Index Dispersion and Utilitarian Social Evaluation Function*. Economic Letters, 89, 141-146.

Muller, C. (2005b). *The valuation of non-monetary consumption in household surveys*. Social Indicators Research, 72(3), 319–341.

Muller, C. (2008). *The Measurement of Poverty with Geographical and Temporal Price Variability. Evidence from Rwanda*. Review of Income and Wealth, Ser. 54, No. 1, 27-49, March.

Muller C. and S. Bibi (2010). *Refining Targeting against Poverty: Evidence from Tunisia*. Oxford Bulletin of Economics and Statistics, Vol. 72, No. 3.

Pinstrup-Andersen, P. (1985). *Food prices and the poor in developing countries*. European Review of Agricultural Economics 12, 069 – 085.

Rao, V., (2000). *Heterogeneity and "Real" inequality: a case study of prices and poverty in rural south India*. Review of Income and Wealth 46 (2), 201 – 211.

Ravallion, M. (1988). *Expected Poverty Under Risk-Induced Welfare Variability.* The Economic Journal, Vol.98. N°393, pp.1171-1182.

Ravallion, M. and Bidani, B., (1994). *How robust is a poverty profile?* The World Bank Economic Review 8 (1), 75 –102.

Sen, A., (1981). *Poverty and Famines*. Clarendon Press, Oxford.

Stadlmayr, B., Charrondiere, R., Enujiugha, V., Bayili, R., Fagbohoun, E., Samb, B., … Burlingame, B. (2012). *West African food composition table [Table de composition des aliments d´Afrique de l´Ouest,* Food and Agricultural Organization. Rome, Italy.

Stern, N., (1989). *The economics of development: a survey*. The Economic Journal 99, 597 – 685.

7 Appendix: Construction of poverty indicators

The poverty measures employed in this work are widely used in the literature on poverty and are typically based on household income or total consumption expenditure. Monetary poverty is defined as a shortfall in income or total expenditure, given a specified poverty line. In the literature, the most widely used monetary poverty indicators are from the Foster-Greer-Thorbecke (FGT) family (Foster, Greer & Thorbecke, 1984).

$$FGT_\alpha = \frac{1}{\sum_{i=1}^{N} w_i \times T_i} \left[\sum_{i=1}^{N} w_i \times T_i \times \left(\frac{z - y_i}{z} \right)^{\alpha} \times I(y_i < z) \right]$$

where N is the number of households in our sample, y_i is the living standard of each household i, w_i is the household sample weight, T_i is family size, a is a parameter that can be viewed as describing poverty aversion, and z is the poverty line. The three values of a = 0, 1 and 2 correspond to the head-count ratio, the poverty gap index, and the squared poverty gap (poverty severity index), respectively. These indices are calculated at the aggregate level for the whole population and each of three seasons of the same agricultural year under study. These three seasons have the same length (four months) and are denoted as the *cold and dry season*, the *hot and dry season,* and the *rainy season*.

We use $y_{it} = c_{it} / (E \times FPI_{it})$ to denote the real living standards for household i in season t, where c_{it} is its total consumption expenditure in season t, E the adult equivalent scale and FPI_{it} its Laspeyres' food price index in season t calculated with the annual budget shares, the mean household over the year and the whole population as its base. Seasonal poverty is estimated by replacing y_i with y_{it} and using the corresponding seasonal poverty line z_t in the abovementioned FGT_α formula. Consumer price indices (CPIs) covering the whole consumption would be better, but in our case, there is no price information on nonfood products.

The annual living standard of household i over the studied agricultural year is equal to $y_i = c_i / (E \times FPI_i)$, where c_i represents household total annual consumption (the sum of the three seasonal consumption) and FPI_i is its Laspeyres' food price index over the year. When computing these living standards, we neglect the discount factor between the three seasons because of the short observation period. In addition to seasonal poverty, three other poverty measures, namely, annual poverty, chronic poverty, and transient poverty, are estimated. Following Muller (2008), annual poverty (AP) is defined as the arithmetic mean of the three seasonal poverty indices; that is, AP=(P_1 + P_2 + P_3)/3. Chronic poverty (CP) is the obtained poverty measure applied to the annual living standard. CP corresponds to a situation where households could have smoothed their consumption if they had desired (Muller, 2008). Transient poverty (TP), over the studied agricultural year, is residual poverty after chronic poverty is taken into account in annual poverty: TP= AP-CP.

All these poverty estimators are estimated alternatively using the minimum and maximum prices faced by each household.

7.1 Construction of the consumption aggregate

As previously stated, the monetary living standard indicator is the household's total consumption per adult equivalent and per day in real terms. In Niger, it is difficult to obtain accurate data on household income. Instead, in our data, we have information on households' expenditures and consumption. The steps used to compute the total consumption variable are as follows.

Database preparation and missing value processing

To construct this aggregate, we needed data on prices and quantities for each product consumed by the household. In the database, the quantities of food consumed by households had sometimes been evaluated in local units of measurement (*lum*), for which the equivalent levels in kgs or liters had been calculated. The same applies to the prices given by *lum*. One initial task therefore consisted of converting these quantities into kgs or liters and prices into CFA/kg or CFA/liter.
However, for some *lum*, the equivalent conversion rates were missing. These missing *lum* values were replaced as follows. First, *lums* were divided into two categories: *lums* that we call "conventional", such as 50 kg or 100 kg bags and a 25 g pack of millet, and "nonconventional" lums that are local, such as tia and tongolo. The latter are often used as weighting measures for the purchase of cereals in local markets in West Africa. The equivalent rates for "conventional" *lum* are known and standardized. On the other hand, for the "nonconventional" *lum*, we used equivalent rates provided in the database. Given that for this type of *lum*, the equivalent rates in kg or in liter vary across regions, we built a database containing, for each of these *lum,* equivalent rates by geographical zone (region, department, commune, and locality or village). In practice, we retained the smallest geographical level for which we had a sufficient number of observations of equivalent rates. Then, for each *lum*, the missing equivalent rates were replaced with the median value of equivalent rates observed for that *lum* in that geographical level to ensure robustness to outliers.

The second task was to deal with the missing values observed for the prices of the consumed goods. Note that the observed prices are purchase prices as stated by households rather than unit values. However, not all of the products consumed by households are purchased at the market. In particular, for these households, some observations on prices are missing.

The algorithm proposed by Muller (2005b) to estimate nonmonetary consumption in household surveys was used. For each product and for a given geographical area, the missing values were replaced by the median value of all its observed purchase prices. The procedure started with the village level, the lowest geographical level, assuming that households belonging to the same village are likely to face the same purchase prices. At the village level, the median was calculated for a given product using samples of prices with at least 10 observations. If at the village level, there are fewer than 10 observations, one moved to the next higher geographical level, which is the commune, and the same procedure is repeated. When the constraint of the minimal number of price observations was not satisfied, one moved to the next upper geographical level, thus neglecting the price variation at this geographical scale. If, finally, at the highest scale, the regional level, one cannot replace all the missing or zero values, the constraint on the number of observations is relaxed by making it less than 10.

The following table shows the outcome of this algorithm for the products used to compute the price index and for each season. As shown in this table, the percentage of households for which missing price values have been replaced by median values varies between 5 percent and 71 percent depending on the type of product and the season. Moreover, in most cases, missing values have been replaced with median price values at the regional level, a geographical level for which there is a sufficient number of observations. Note that village or communal replacement would often fit the typical practices to generate price data well. However, it seems reasonable to consider that the gaps identified in this paper due to the differences between minimal and maximal prices should be seen as conservative, as some of these differences may be attenuated by the aggregation process used in this algorithm.

Table 11: Percentage of Seasonal Prices Replaced by the Median Values by Area Type for the Minimum and Maximum Prices

Products	Cold and dry season					Hot and dry season					Rainy season				
	V	C	D	R	All	V	C	D	R	All	V	C	D	R	All
Millet	8.08	28.95	11.33	9.17	**57.53**	7.07	23.32	6.5	5.99	**42.88**	6.86	28.01	8.95	6.21	**50.03**
Sorghum	0.86	6.71	5.85	58.3	**71.72**	0.72	17.72	8.80	40.9	**68.14**	1.66	14.3	5.63	42.82	**64.41**
Cowpea	2.02	4.04	1.08	57.25	**64.39**	1.01	10.61	1.15	51.19	**63.96**	1.37	10.83	5.41	45.48	**63.09**
Maize	0.14	0.21	12.27	37.03	**49.65**	0.14	7.5	8.95	42.23	**58.82**	0.5	4.33	13.2	28.88	**46.91**
Groundnut	0	0	0	49.89	**49.89**	0	0	0	50.10	**50.10**	0	0	0	49.89	**49.89**
Butter	0	0	0	19.20	**19.20**	0	0	0	5.04	**5.04**	0	0	0	38.62	**38.62**
Kola nut	0.07	5.41	0	51.33	**56.81**	0.14	5.41	0	51.55	**57.1**	0.14	5.48	0	51.33	**56.95**
Okra	0.72	4.47	2.38	46.42	**53.99**	0.28	4.25	2.45	46.64	**53.62**	0.64	3.97	2.52	33.28	**40.41**
Oil	1.73	5.48	5.34	13.72	**26.27**	2.16	8.23	4.90	7.65	**22.94**	1.66	7.14	4.18	15.88	**28.86**
Fresh milk	0.28	4.25	0	40.57	**45.1**	0.07	4.54	0	22.23	**26.84**	0.36	4.40	0	29.45	**34.21**
Curdled milk	0.86	11.84	2.16	18.98	**33.84**	0.64	8.59	2.31	23.68	**35.22**	0.64	12.12	2.16	18.19	**33.11**
Bread	0	0	0	28.30	**28.30**	0	0	0	28.51	**28.51**	0	0	0	28.51	**28.51**
Pasta	0.5	5.63	1.66	30.32	**38.11**	0.43	6.13	1.44	30.54	**38.54**	0.5	6.42	1.66	30.03	**38.61**
Fish	0	0	0	29.96	**29.96**	0	0	0	10.25	**10.25**	0	0	0	17.54	**17.54**
Sugar	1.73	6.85	2.52	11.55	**22.65**	1.87	5.27	5.19	11.69	**24.02**	1.80	9.09	2.52	8.44	**21.85**
Tobacco	0.144	1.29	0	36.75	**38.18**	0.14	1.29	0	36.67	**38.1**	0.14	1.29	0	36.75	**38.18**
Tea	1.37	5.99	0	19.35	**26.71**	1.22	6.71	0	19.56	**27.49**	1.22	6.71	0	19.13	**27.06**
Condiments	0.64	3.17	6.93	3.68	**14.42**	0.72	3.10	6.85	3.68	**14.35**	0.43	3.97	7.0	3.89	**15.29**
Meat	0.21	5.27	3.46	14.15	**23.09**	0.28	5.12	3.24	15.02	**23.66**	0.36	5.55	3.24	14.22	**23.37**
Poultry	0.28	0	0	24.83	**25.11**	0.07	0	0	6.64	**6.71**	0.14	0	0	14.44	**14.58**

Notes: Values presented in this table are in percent. They represent the proportion of missing values replaced with the median price value at the village (V), communal (C), departmental (D) and regional (R) levels. "All" is the total of these proportions for a given product.

Goods included in the consumption aggregate

All food products are included in the consumption aggregate for each household. For nonfood products, following the recommendations of Deaton and Zaidi (2002), health expenditures are excluded, but expenditures on water, energy, telecommunications, transportation, education, and personal care are included.

Finally, transitory expenses, such as for holidays or ceremonies, are not included in the aggregate.

The food consumption expenditure is evaluated for each season and alternatively with the minimum and maximum prices faced by each household. The nonfood expenses are given for the whole year, and therefore, they were divided by three to estimate their value for each of the three seasons. Finally, the total consumption aggregate for each season is obtained by adding up food consumption expenditure and nonfood expenses. The annual consumption aggregate for a given household is therefore the sum of its three seasonal consumption aggregates. The value of the consumption aggregates, in each case, was calculated using alternatively minimum and maximum food prices. Then, they were deflated with the Laspeyres price index calculated at the household level and with an equivalent scale that reflects the household demographic composition.

The price index and the equivalence scale

Laspeyres price indices were calculated for each of the three seasons as in Muller (2008). In the basket of goods used to calculate them, we kept only those products (mainly food) for which the number of price observations was at least 20, as suggested by Deaton & Tarozzi (2005). The food price index (FPI) was calculated at the household level.

$$FPI_{it} = \sum_g S^g \times (p_{it}^g / P_t^g), \text{ where } \quad S^g = \frac{\sum_t \sum_i w_i \times p_{it}^g \times q_{it}^g}{\sum_t \sum_g \sum_i w_i \times p_{it}^g \times q_{it}^g} \text{ and } P_t^g = \frac{\sum_i w_i \times p_{it}^g}{\sum_i w_i}$$

S^g is the weight of good g in the price index yearly, w_i is the sample weight of household i, p_{it}^g is the price faced by household i in season t for good g, q_{it}^g is the quantity consumed of good g by household i, and P_t^g is a consistent estimate of the mean price for all consumed quantities of good g at the national level in season t. The household annual price for good g is $p_i^g = \frac{\sum_t q_{it}^g \times p_{it}^g}{\sum_t q_{it}^g}$, which is used to compute the annual FPI. In the FPI formula, the prices are weighted by both sampling weights and consumption quantities. These food price indices are calculated using alternatively the minimum and maximum prices faced by each household.

The adult equivalent variable is computed for each household by using the approach proposed by Deaton & Zaidi (2002). We used the following formula: $AE = NA + 0.67 * NYA + 0.33 * NC$, with AE= Adult Equivalent scale, NA: Number of Adults (>20 years old) in the household, NYA= Number of Young Adults (between 17 and 20 years old) and NC= Number of Children (less than 17 years old).

7.2 Estimated absolute poverty line

The poverty line is calculated in five steps that follows a usual method implemented by the World Bank worldwide. These steps are replicated with each of the three seasonal living standards and the annual real living standards to estimate seasonal and chronic poverty measures, respectively. Moreover, these steps in each case are applied alternatively with minimum and maximum prices. A total of 8 poverty lines are therefore estimated.

Defining a reference group of poor households

A reference group was constructed on the basis of the distribution of the real living standard per adult equivalent. This group is used to ensure that the consumption patterns employed for defining the poverty line are not overly influenced by those of wealthy households. This group corresponds to the lowest half of the distribution. This is consistent with nearly 42 percent of the population being considered officially poor (Institut National de la Statistique du Niger and Banque Mondiale, 2013).

We regrouped the seven regions into two categories: the South (formed by Dosso, Tahoua and Tillaberi regions) and the North (formed by Agadez, Diffa, Maradi and Zinder). This distinction allows for better control of the geographical variations in household consumption habits. Thus, the reference groups are constituted separately for the North and the South, and their union represents the reference group for the whole country.

Defining the caloric need for households belonging to the reference group

The caloric intake per capita per day for each household is computed by converting the recorded food quantity consumed by the household over the year into calories. For this conversion, the FAO food composition table for West Africa in 2012 was used (Stadlmayr et al., 2012). Calories requirements for households in this reference group, in each stratum, are specified as 2700 Kcal per day and per adult to account for moderate activity level. The National Institute of Statistics of Niger instead uses an energy requirement of 2400 Kcal/day per individual. However, we want to account for the typically relatively higher activity level of agropastoral households that are not fully sedentary.

The 2700 Kcal requirement per day per adult is then multiplied by the average equivalent scale in the reference group and divided by the corresponding average household size. This adjustment allows us to account for nutritional requirements increasing with the age and gender of household members.

The mean unit price of the calories consumed in each stratum for the reference group is then calculated as the ratio of the average value of food consumption in the reference group to its average calorie intake.

Defining the food poverty line

The food poverty line is the minimum income needed for a household to have access to the calories required for an active life. Based on the unitary price of calories consumed by a household in the reference group and his energy requirement, the calculus of the food poverty line is the value of the calorie requirement. The food poverty line is calculated for each of the two strata (North and South).

Defining the absolute poverty line

The absolute poverty line is obtained by extrapolating the food poverty line to the whole range of consumption. This process allows for the inclusion of nonfood consumption by using a food Engel curve, which is consistent with the quadratic almost ideal demand system. The estimated Engel curve equation is:

$$s_i = a + b \times \ln\left(x_i\right) + c \times \ln\left(x_i\right)^2 + d \times N_i + \varepsilon_i$$

where s_i is the share of food expenditure in the total expenditure of household i, x_i is its daily real total consumption, N_i are household sociodemographic characteristics, and ε_i is an error term. The coefficients a, b, c, and d are estimated by the ordinary least squares method, as is typical in the World Bank methodology. The estimation results are shown below.

Two different equations have been estimated separately for the North and the South. The absolute poverty line z_j for stratum j is obtained by replacing s_i with the ratio of the food poverty line by z_j and solving numerically in z_j the following equation of the estimated Engel curve: $\frac{z_j^f}{z_j} = a_j + b \times \ln\left(z_j\right) + c \times \ln\left(z_j\right)^2$, where z_j^f is the computed food poverty line in stratum j for the whole household (i.e., the previously computed food poverty line is multiplied by the average household size of the corresponding reference group in stratum j). The fixed effects a_j account for the different mean values of other independent variables in the North and the South. The absolute poverty line in stratum j, z_j, is obtained by solving the above equation with the bisection method. The value obtained is then divided by the mean adult equivalent scale of the reference group of stratum j, which makes the poverty line comparable to the specified real living standards.

Table 12: Estimated Engel curve

	s_i					
Variables	National level (N=671)		North (N=284)		South (N=387)	
	Pmin	Pmax	Pmin	Pmax	Pmin	Pmax
$\ln\left(x_i\right)$	.740*** (.201)	.713*** (.186)	.753** (.378)	.773* (.398)	.697*** (.144)	.654*** (.120)
$\left[\ln\left(x_i\right)\right]^2$	-.046*** (.014)	-.043*** (.013)	-.048* (.026)	-.048* (.027)	-.042*** (.009)	-.039*** (.007)
ln(Adult Equivalent)	-.055*** (.015)	-.048*** (.014)	-.033 (.026)	-.035 (.028)	-.068*** (.017)	-.057*** (.016)
Area of living: 1 if in the South and 0 otherwise	.029** (.013)	.035** (.014)	-	-	-	-
Constant	-1.97*** (.695)	-1.92*** (.65)	-2.00 (1.29)	-2.13 (1.39)	-1.82*** (.548)	-1.68*** (.465)

Note: Values in parentheses are standard errors. *, ** and *** indicate significance at the 10%, 5% and 1% levels, respectively.