Are Smallholder Farmers Better or Worse Off from an Increase in the International Price of Cereals[1] ?

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Online Appendix

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Appendix A. Derivations

AppendixA.1. (Equation 2)

For a given commodity i, let be (u_h) the utility of household h, w the wage rate of hired- in and family labor supported by h, A the transfers received, πh the profit function, (pc) consumer price, (pp) producers price, world price v input prices, and pw world price. For the purpose of simplicity, we drop the indices.

Given a farm production technology and an income constraint, by extension of Deaton (1989) household h living standard is represented as follows:

$$u_h = (w \times T + A + \pi_h(v, w, p^p(p^w)), p^c(p^w)) \quad \text{(A.1)}$$

Taking the partial derivative of both sides with respect to p^w , setting household income $I = w \times T + A + \pi_h(v, w, p^p(p^w))$ and by chain rule we have:

$$\frac{\partial u_h}{\partial p^w} = \frac{\partial \psi}{\partial p^c}\frac{\partial p^c}{\partial p^w} + \frac{\partial \psi}{\partial I}\frac{\partial \pi_h}{\partial p^p}\frac{\partial p^p}{\partial p^w} \qquad \text{(A.2)}$$

From Roy's identity household $q = -\frac{\partial \psi}{\partial p^c} \Big/ \frac{\partial \psi}{\partial I}$ hence $\frac{\partial \psi}{\partial p^c} = -q\frac{\partial \psi}{\partial I}$. From Hotelling's Lemma we have the optimal output supply $y = \frac{\partial \pi_h}{\partial p^p}$. Equation A.2 becomes:

$$\frac{\partial u_h}{\partial p^w} = -q\frac{\partial \psi}{\partial I}\frac{\partial p^c}{\partial p^w} + y\frac{\partial \psi}{\partial I}\frac{\partial p^p}{\partial p^w} \qquad \text{(A.3)}$$

Multiplying first term of equation A.3 right hand side by $\frac{p^w}{p^c}\frac{p^c}{p^w}$ and the second term by $\frac{p^w}{p^p}\frac{p^p}{p^w}$ we have :

$$\frac{\partial u_h}{\partial p^w} = -q\frac{\partial \psi}{\partial I}\frac{\partial p^c}{\partial p^w}\frac{p^w}{p^c}\frac{p^c}{p^w} + y\frac{\partial \psi}{\partial I}\frac{\partial p^p}{\partial p^w}\frac{p^w}{p^p}\frac{p^p}{p^w} \qquad \text{(A.4)}$$

As a result:

$$\frac{\partial u_h}{\partial p^w} = \frac{\partial \psi}{\partial I} y_i \varepsilon_{p^w,p^p} - \frac{\partial \psi}{\partial I} q_i \varepsilon_{p^w,p^c} \quad \text{(A.5)}$$

With $\varepsilon_{p^w,p^c} = \frac{\partial p^c}{\partial p^w}\frac{p^w}{p^c}$ and $\varepsilon_{p^w,p^p} = \frac{\partial p^p}{\partial p^w}\frac{p^w}{p^p}$ world price transmission elasticity to consumer and producer price, respectively.

Appendix A.2. Derivation of Equations 4 and 5

The net welfare change (equation 2) is represented by :

$$welfare = e(p^c(p_0^w), u_0) - e(p^c(p_1^w), u_0) + \pi(p^p(p_0^w), u_0, z_0) - \pi(p^c(p_1^w), u_0, z_0) \quad \text{(A.6)}$$

where $e()$ is the household expenditure function, p_0^w and p_1^w are the levels of world cereal price before and after a price shock, respectively. The levels of household utility before the price change is u_0. Notably, we assumed that labor is perfectly inelastic causing input price stickiness.

$$CV = e(p^c(p_0^w), u_0) - e(p^c(p_1^w), u_0)$$

Expanding $e(p^c(p_1^w), u_0)$, which is a composite function of $p^c(p_1^w)$, around the initial world

price (p_0^w) and utility combination by means of a Taylor series, chain rule, and considering only one price change, we obtain:

$$e(p^c(p_1^w),u_0) \cong e(p^c(p_0^w),u_0) + \frac{1}{1!}\sum_{i=1}^{n}\frac{\partial e(p_0^w,u_0)}{\partial p_i}\frac{\partial p_i^c}{\partial p_i^w}\Delta p_i^w$$
$$+\frac{1}{2!}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\partial^2 e(p_0^w,u_0)}{\partial p_i \partial p_j}\frac{\partial p_i^c}{\partial p_i^w}\frac{\partial p_j^c}{\partial p_i^w}\Delta p_i^w \Delta p_j^w$$
$$+R_2$$

R_2 is the remainder term in the series, Δp_i^w and Δp_j^w are commodity i *and* j world price change, respectively.

$$e(p^c(p_1^w),u_0) \cong e(p^c(p_0^w),u_0) + \frac{1}{1!}\sum_{i=1}^{n} h_i(p_0,u_0)p_i^c\frac{\partial p_i^c}{\partial p_i^w}\frac{p_i^w}{p_i^c}\frac{\Delta p_i^w}{p_i^w}$$
$$+\frac{1}{2!}\sum_{i=1}^{n}\sum_{j=1}^{n}\frac{\partial h_i(p_0,u_0)}{\partial p_i^c}\frac{p_i^c}{h_j}h_j p_i^c \frac{p_i^c}{p_i^c}\frac{\partial p_i^c}{\partial p_i^w}\frac{p_i^w}{p_i^c}\frac{\partial p_j^c}{\partial p_j^w}\frac{p_j^w}{p_j^c}\frac{\Delta p_i^w}{p_i^w}\frac{\Delta p_j^w}{p_j^w}$$
$$+R_2$$

$$-CV = e(p^c(p_1^w),u_0) - e(p^c(p_0^w),u_0) \cong \frac{1}{1!}\sum_{i=1}^{n} h_i(p_0,u_0)p_i^c \varepsilon_{p^w,p_i^c}(\zeta_{p_i^w})$$
$$+\frac{1}{2!}\sum_{i=1}^{n}\sum_{j=1}^{n} h_j p_j^c \eta_{ij}\varepsilon_{p^w,p_i^c}\varepsilon_{p^w,p_j^c}(\zeta_{p_i^w})(\zeta_{p_j^w})$$
$$+R_2$$

With $\varepsilon_{p^w,p_i^c} = \frac{\partial p_i^c}{\partial p_i^w}\frac{p_i^w}{p_i^c}$, $\eta_{ij} = \frac{\partial h_i(p_0,u_0)}{\partial p_i^c}\frac{p_i^c}{h_j}$, $\zeta_{p_i^w} = \frac{\Delta p_i^w}{p_i^w}$ and $\zeta_{p_j^w} = \frac{\Delta p_j^w}{p_j^w}$. Since we are considering the world cereal price index for all the commodities and assuming there is no cross price effect, $\zeta_{p_i^w} = \zeta_{p_j^w} = \zeta_{p^w}$ and $\eta_{ij} = 0$ for $i \neq j$. In addition, if the quadratic terms alone form a good approximation, then:

$$CV \cong -\sum_{i=1}^{n} q_i p_i^c \varepsilon_{p^w,p_i^c}(\zeta_{p_i^w}) - \frac{1}{2}\sum_{i=1}^{n} q_i p_i^c \eta_{ii}\varepsilon^2_{p^w,p_i^c}(\zeta_{p^w})^2$$

Similarly,

$$PW \cong \sum_{i=1}^{n} y_i p_i^p \varepsilon_{p^w,p_i^p}(\zeta_{p_i^w}) + \frac{1}{2}\sum_{i=1}^{n} y_i p_i^p \gamma_{ii}\varepsilon^2_{p^w,p_i^p}(\zeta_{p^w})^2$$

With $\varepsilon_{p^w,p_i^p} = \frac{\partial p_i^p}{\partial p_i^w}\frac{p_i^w}{p_i^c}$, $\gamma_{ii} = \frac{\partial h_i(p_0,u_0)}{\partial p_i^p}\frac{p_i^p}{h_i}$, and $\zeta_{p_i^w} = \zeta_{p_j^w} = \zeta_{p^w} = \frac{\Delta p^w}{p^w}$.

Appendix B. Demand estimation using QUAIDS approach

Demand elasticities estimation relies on the quadratic version of Deaton and Muellbauer (1980) Almost Ideal Demand System. The quadratic version is introduced by Banks et al. (1997). It allows the budget share to react more flexibly to the log of expenditure while respecting demand theory restrictions that is adding-up, homogeneity and Slutsky symmetry. Following Ray (1983) and Poi et al. (2012) we also include the demographic characteristics z_k to control for any changes in the consumption pattern not related to price or expenditure. Therefore, in this QUAIDS model, the share of good $i = 1,\ldots,N$ consumed by household $h = 1,\ldots,H$ is defined as:

$$w_i^h = \alpha_i^h + \sum_{j=1}^{n}\gamma_{ij}\ln p_j^h + (\beta_i + \eta_i z)\ln(\frac{m^h}{m_0 a(p^h)}) + \frac{\lambda_i}{b(p^h)c(p,z)}\ln(\frac{m^h}{m_0 a(p^h)})^2 + \mu_i^h$$

Where w_h is the share of total expenditure, m^h is the household total expenditure allocated to i^{th} good by household h, p^h the price of i^{th} good; α_i, γ_{ij} , β_i, η_i, and λ_i are vectors of associated parameters estimated. $m_0(z)$ and $c(p,z)$ are two functions which measure the change in household expenditure as function of z and p. For the full specification of $m_0(z)$ and $c(p,z)$, see Magrini et al. (2017a). We deal with the high proportion of zero expenditure shares registered for commodities not consumed in the year of the survey by consumers. We address the situation using consistent two-step procedure. Following Shonkwiler and Yen (1999) and Zheng and Henneberry (2010), we first estimate a probit to calculate the probability for a given house- hold to consuming a specific commodity. Following Magrini et al. (2017a) the covariates used in the estimations are households demographic characteristics (z_k). Second from the models estimated we compute for each commodity the standard normal Cumulative Distribution Function (CDF) and the standard normal Probability Density Function (PDF) in order to augment the QUAIDS specification as follows:

$$w_i^{h*} = \Phi(\hat{\tau}_i z)w_i + \delta_i\phi(\hat{\tau}_i z) + \xi_i$$

where w^{h*} is the observed share of commodity i, Φ_i and ϕ_i are the (CDF) and (PDF) respectively, $\hat{\tau}_i$ is the vector of associated parameter estimated in the simple probit models. ξ_i is the error term associated to the augmented QUAIDS model. Since the budget shares no longer sum up to one, we adopt Yen et al. (2003) correction, treating the others crops as residual with no specific demand and imposing the following identity:

$$w_k^{h*} = 1 - \sum_{i=1}^{k-1} w_i^{h*}$$

The parameter of QUAIDS model is estimated using an iterated feasible generalized non- linear least square. With the parameters estimated we compute the commodities expenditure and price elasticities, µi and cij as follows:

$$\mu_i = \frac{\partial w_i^*}{\ln m} = 1 + \frac{1}{w_i}[\beta_i + \eta_i z + \frac{2\lambda_i}{b(p)c(p,z)} \ln\{\frac{m}{m_0 a(p)}\}]\Phi(\tau_i z)$$

$$\begin{aligned}\in_{ij} = \frac{\partial w_i^*}{\ln p_j} = \frac{1}{w_i}(\left\{\gamma_{ij} - \left[\beta_i + \eta_i z + \frac{2\lambda_i}{b(p)c(p,z)} \ln\{\frac{m}{m_0 a(p)}\}\right]\right\} \\ \times\left(\alpha_j + \sum_k \gamma_{ik} \ln p_k\right) - \frac{(\beta_i + \eta_i z)\lambda_i}{b(p)c(p,z)}\left[\ln\{\frac{m}{m_0 a(p)}\}\right]^2) \\ \times\ \Phi(\tau_i z) + \varphi_i \tau_{ij}(1 - \frac{\delta_i}{w_i}) - \delta_{ij}\end{aligned}$$

where τ_{ij} represents the coeficient for price for the price j for the commodity i in the stage probit estimation and δ_{ij} is the Kronecker delta, meaning that it takes the value of "1" when j = i and "0" otherwise. We skip the expenditure and price elasticities of other crops because the heterogeneous nature of this group makes it difficult to interpret those elasticities. The compensated price elasticities are calculated as follows:

$$\in_{ij}^H = \in_{ij} + w_i u_i$$

Finally, elasticities from equation B.6 can be directly plugged into equations 4 and 5.

Appendix C. Tables

Table C.1: Summary of estimated demand, supply and world price transmission elasticities

	Demand elasticities	Supply Elasticities	Price transmission (consumer)	Price transmission (Producer)
Millet	0^a	0.120	0^a	0.29
Maize	-0.91	0.247	0.36	0.56
Rice	-0.75	0.00	0.25	0.25
Sorghum	0^a	0.084	0.62	0.41
Peanuts	-1.51	0^a	0^a	0^a
Cowpea	-0.557	0.0925	0^a	0^a

[a] We set the value of the elasticity to zero in our welfare estimation whenever it is not significant at 10%

Table C.2: Summary of some estimates

	Purchases	Sales	CV^a	PW^b	Absolute Net Welfare	Relative Net Welfare
Millet	70.50	103.00	0.00	0.40	0.40	0.56%
Maize	67.30	116.70	0.32	0.86	0.54	0.81%
Rice	91.00	81.70	0.30	0.27	-0.03	-0.03%
Sorghum	231.80	229.50	1.90	1.25	-0.65	-0.28%
Peanuts	17.30	314.60	0.00	0.00	0.00	0.00%
Cowpea	12.20	218.00	0.00	0.00	0.00	0.00%
Total	490.20	1063.60	2.51	2.77	0.26	0.05%

[a] Compensating Variation, [b] Change in Producer Welfare

Table C.3: Food Balance sheet in tons

	Variables	Total Quantity
Consumption	Millet	2.902 e+09***
		(1.944e+06)
	Maize	2.972e+09***
		(2.355e+06)
	Rice	3.805e+08***
		(373,711)
	sorghum	5.581e+09***
		(2.015e+06)
	Peanuts	2.995e+08***
		(256,643)
	Cowpea	5.028e+08***
		(301,155)
Production	Millet	(1.864e+06)
		3.478e+09***
	Maize	(3.231e+06)
		4.747e+08***
	Rice	(773,320)
		5.935e+09***
	sorghum	(2.215e+06)
		9.901e+08***
	Peanuts	(658,632)
		8.705e+08***
	Cowpea	(482,545)
		2.652e+09***
sold	Millet	2.329e+08***
		(320,949)
	Maize	5.940e+08***
		(1.649e+06)
	rice	1.886e+08***
		(487,311)
	sorghum	8.110e+08***
		(701,664)
	Peanuts	5.138e+08***
		(417,700)
	Cowpea	3.389e+08***
		(284,557)

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table C.4: Food Balance sheet in tons (Continued)

	Variables	Total Quantity
Gifts	Millet	8.271e+06***
		(22,714)
	Maize	1.174e+07***
		(31,961)
	Rice	1.547e+06***
		(8,316)
	sorghum	1.676e+07***
		(34,554)
	Peanuts	1.141e+07***
		(33,612)
	Cowpea	2.941e+06***
		(12,569)
Seed	Millet	7.180e+07***
		(48,914)
	Maize	7.340e+07***
		(53,095)
	Rice	2.391e+07***
		(40,758)
	Sorghum	1.387e+08***
		(69,414)
	Peanuts	2.009e+08***
		(136,311)
	Cowpea	4.857e+07***
		(30,287)
Stock	Millet	2.970e+09***
		(2.114e+06)
	Maize	2.944e+09***
		(2.403e+06)
	rice	3.694e+08***
		(371,659)
	sorghum	5.680e+09***
		(2.087e+06)
	Peanuts	2.501e+08***
		(253,647)
	Cowpea	4.858e+08***
		(312,261)

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table C.5: Food Balance sheet in ton (Continued)

Seed	Millet	8.974e+06***
		(19,846)
	Maize	7.512e+06***
		(12,955)
	Rice	23,528***
		(693.7)
	sorghum	2.454e+07***
		(28,135)
	Peanuts	44,495***
		(868.8)
	Cowpea	0
		(0)
Losses	Millet	1.009e+07***
		(22,028)
	Maize	4.869e+06***
		(16,353)
	Rice	1.174e+06***
		(6,415)
	sorghum	7.789e+06***
		(20,007)
	Peanuts	231,583***
		(1,350)
	Cowpea	1.731e+06***
		(5,582)
	Observations	7,025,645

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Table C.6: Expenditure and Hicksian price elasticities for cereals and legumes at population means

	Income Elsticity	Hicksian price elasticities					
		Millet	Maize	Rice	Sorghum	Peanuts	Cowpea
Millet	1.622***	-1.174***	0.211*	-0.271	0.250**	-1.129	0.304**
	(0.248)	(0.157)	(0.0837)	(0.263)	(0.0557)	(0.641)	(0.0611)
Maize	1.203***	0.878*	-0.630***	-0.365	0.337**	0.424***	0.201**
	(0.0520)	(0.281)	(0.0287)	(0.262)	(0.0982)	(0.0586)	(0.0480)
Rice	-1.099	-0.354	-0.0826	1.805	-0.434	-0.257	-0.341**
	(1.038)	(0.253)	(0.149)	(1.534)	(0.314)	(0.262)	(0.103)
Sorghum	2.353**	0.583*	0.164	-0.504	-0.689**	0.710	-0.205
	(0.620)	(0.205)	(0.126)	(0.624)	(0.193)	(0.331)	(0.0875)
Peanuts	0.992***	-0.482	0.112	-0.0369	0.228*	-0.316	0.359***
	(0.00393)	(0.226)	(0.0501)	(0.0172)	(0.0878)	(0.285)	(0.0327)
Cowpea	1.030***	0.279*	0.0424***	-0.241	-0.135	0.611	-0.389***
	(0.0280)	(0.0920)	(0.00509)	(0.150)	(0.0908)	(0.303)	(0.0461)

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table C.7: Marshallian price elasticities for cereals and legumes at population means

	Marshallian oprice elasticities					
	Millet	Maize	Rice	Sorghum	Peanuts	Cowpea
Millet	-1.304***	0.0864**	-0.0266	0.201***	-1.227	0.0665
	(0.111)	(0.0228)	(0.0469)	(0.0191)	(0.673)	(0.0551)
Maize	0.432	-0.944***	-0.206	-0.0706***	0.159	-0.351
	(0.185)	(0.0164)	(0.122)	(0.00602)	(0.0858)	(0.163)
Rice	-0.682	-0.296*	1.843	-0.526***	-0.439	-0.969
	(0.339)	(0.0974)	(1.590)	(0.0691)	(0.237)	(0.601)
Sorghum	0.229	-0.133**	0.0556	-0.454***	0.477	-1.072***
	(0.123)	(0.0246)	(0.152)	(0.0359)	(0.257)	(0.133)
Peanuts	-0.639*	0.00652**	-0.000206	0.266***	-0.406	0.0402
	(0.254)	(0.00199)	(0.00465)	(0.0230)	(0.325)	(0.0198)
Cowpea	0.197*	-0.0183***	-0.194	-0.441***	0.560	-0.257
	(0.0805)	(0.00284)	(0.108)	(0.0501)	(0.307)	(0.123)

Standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table C.8: Estimation results of the QUAIDS model at the second budgeting stage

Price	$\gamma 11$	-0.250***	$\gamma 31$	-0.0105	$\gamma 51$	-0.194***	$\gamma 61$	0.122**
		(0.0857)		(0.0383)		(0.0566)		(0.0575)
	$\gamma 12$	0.176***	$\gamma 32$	-0.130***	$\gamma 52$	-0.0294	$\gamma 62$	-0.213***
		(0.0581)		(0.0419)		(0.0586)		(0.0626)
	$\gamma 13$	-0.0105	$\gamma 33$	0.162***	$\gamma 53$	-0.00471	$\gamma 63$	0.0571
		(0.0383)		(0.0338)		(0.0360)		(0.0421)
	$\gamma 14$	0.157**	$\gamma 34$	-0.0732	$\gamma 54$	0.0898	$\gamma 64$	-0.184***
		(0.0632)		(0.0452)		(0.0665)		(0.0672)
	$\gamma 15$	-0.194***	$\gamma 35$	-0.00471	$\gamma 55$	-0.0386	$\gamma 65$	0.218***
		(0.0566)		(0.0360)		(0.0723)		(0.0729)
	$\gamma 21$	0.176***	$\gamma 41$	0.157**	$\gamma 16$	0.122**		
		(0.0581)		(0.0632)		(0.0575)		
	$\gamma 22$	0.130*	$\gamma 42$	0.0680	$\gamma 26$	-0.213***		
		(0.0747)		(0.0651)		(0.0626)		
	$\gamma 23$	-0.130***	$\gamma 43$	-0.0732	$\gamma 36$	0.0571		
		(0.0419)		(0.0452)		(0.0421)		
	$\gamma 24$	0.0680	$\gamma 44$	-0.0582	$\gamma 46$	-0.184***		
		(0.0651)		(0.0850)		(0.0672)		
	$\gamma 25$	-0.0294	$\gamma 45$	0.0898	$\gamma 56$	0.177***		
		(0.0586)		(0.0665)		(0.0594)		
	Observations	1,274						

Standard errors in parentheses

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

Table C.9: Estimation results of the QUAIDS model at the second budgeting stage(Continued)

Constant	$\alpha 1$	-0.106	Expenditure	$\beta 1$	0.183***	Demographic Characteristics	$\eta 11$	-0.00127
		(0.147)			(0.0316)			(0.00206)
	$\alpha 2$	0.599***		$\beta 2$	0.227***		$\eta 12$	0.00991***
		(0.138)			(0.0419)			(0.00279)
	$\alpha 3$	0.0913		$\beta 3$	-0.413***		$\eta 13$	0.00236
		(0.0983)			(0.0228)			(0.00170)
	$\alpha 4$	0.274*		$\beta 4$	0.554***		$\eta 14$	-0.00102
		(0.159)			(0.0356)			(0.00240)
	$\alpha 5$	-0.0168		$\beta 5$	-0.0878**		$\eta 15$	-4.46e-05
		(0.147)			(0.0414)			(0.00334)
	$\alpha 6$	0.159		$\beta 6$	-0.464***		$\eta 16$	-0.00993***
		(0.152)			(0.0417)			(0.00311)
Expenditure squared	$\eta 21$	-0.00857	Expenditure squared	$\lambda 1$	0.0348***	Probability density	d1	0.434***
		(0.00783)			(0.00758)			(0.104)
	eta22	-0.0183*		$\lambda 2$	0.000386		d2	-0.0121
		(0.0100)			(0.0108)			(0.125)
	$\eta 23$	0.0223***		$\lambda 3$	-0.0417***		d3	0.802***
		(0.00513)			(0.00537)			(0.130)
	$\eta 24$	-0.0231***		$\lambda 4$	0.0514***		d4	0.762***
		(0.00871)			(0.00888)			(0.144)
	$\eta 25$	0.0227**		$\lambda 5$	-0.00631		d5	0.187
		(0.00935)			(0.0108)			(0.126)
	$\eta 26$	0.00486		$\lambda 6$	-0.0386***			
		(0.0102)			(0.0108)			
Observations	1274							

Standard errors in parentheses

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

Table 3b: Summary of regression of two-stage least square model estimates using deviation of household yield from province-level trend as instrument.

	Millet	Maize	Rice	Sorghum	Peanut	Cowpea
Demand						
Elasticity	-0.197	-0.912***	-0.750***	-0.226	-1.513***	-0.557***
	(0.265)	(0.173)	(0.0552)	(0.156)	(0.190)	(0.128)
Province dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	6,666	7,414	5,364	8,145	5,959	6,437
Tests						
1st-stage F-demand	18.68	40.07	58.6	26.87	6.57	19.9
Wu-Hausman F-stat	0.99	7.43	2.24	2.10	0.003	0.006
Supply						
Elasticity	1.104***	1.012***	1.387***	1.326***	0.813***	0.800***
	(0.0913)	(0.325)	(0.128)	(0.137)	(0.120)	(0.0151)
Province dummy	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,813	2,079	1,465	2,237	1,623	1,749
Tests						
1st-stage F-supply	7.16	14.12	13.69	14.49	12.95	17.54
Wu-Hausman F-stat	1.11	5.73	29.80	0.11	18.66	0.007

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' calculations

Table C.11: Summary of regression of ordinary least square model estimates.

	Millet	Maize	Rice	Sorghum	Peanut	Cowpea
Demand						
Elasticity	-0.490***	-0.467***	-0.407***	-0.247***	-0.684***	-0.544***
	(0.0550)	(0.0638)	(0.0274)	(0.0519)	(0.0593)	(0.0641)
Province dummy	Yes	Yes	Yes	Yes	Yes	Yes
Current yield shock	Yes	Yes	Yes	Yes	Yes	Yes
Observations	1,277	1,332	3,713	2,107	909	1,011
Supply						
Elasticity	1.025***	1.202***	0.975***	1.151***	0.799***	0.838***
	(0.00618)	(0.00695)	(0.0126)	(0.00519)	(0.00806)	(0.0106)
Province dummy	Yes	Yes	Yes	Yes	Yes	Yes
Current yield shock	Yes	Yes	Yes	Yes	Yes	Yes
Observations	5,093	6,397	1,454	7,042	4,552	1,752

Standard errors in parentheses.
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. Source: Authors' calculations

Appendix D. METHODOLOGY OF THE SURVEY

The evaluation of the agricultural campaign was carried out by the statistical system of the Ministry in charge of Agriculture through the permanent agricultural survey under the statistical visa No. AP2008002CNSCS4 of October 7, 20 08 by the National Council of Statistics in accordance with the Law on National Statistical Activities.

Appendix D.*1. Objective*

The primary purpose of the scheme is the evaluation of areas, yields and productions of the main crops in the rainy season and in the dry season. This assessment is done in two stages: August and September, for forecasts season, and at the end of harvest for the first results. The specific objectives of the investigation are:

- evaluate areas, yields and final agricultural productions by provinces and country for each crop.

- make forecasts of cereal harvests in September each year to inform the government and its partners early on development in an objective way about the campaign. These forecasts enable a forecast cereal balance to be established;

- make estimates of residual peasant stocks during September;

In addition to these data, the device makes it possible to collect credit information, use of inputs, marketing, the agricultural population, the occupation of the agricultural population, the sources of money income, the livestock attached to agricultural households, the demography of farm households, etc. The data being collected with a sufficiently detailed level, more in-depth analyzes can be done, especially on household food security, the analyzes differentiated by sex, ...

Appendix D.*2. Field of investigation*

The survey covers the entire rural area of the country. It is a random sample survey at two stages, with stratification at each stage. The first stage consists of the list of villages from the 2006 census. At the second stage the frame is obtained in listing the agricultural households in the villages drawn from first stage.

Sample size: At first level, the number of sample villages per province is proportional to the population of the province. The sample of farmers is drawn by province in proportion to the size of the village after order villages by size. The number of sampled villages is 706 in total. In the second stage, in each sampled village, one draws 8 farming households with probability proportional to the size of the village.

Appendix D.*3. Fact Sheet*

- Fact Sheet 1: Census of Household Members

  Section F.1.0: Identification Elements

  Section F.1.1: Census of Household Members

- Fact Sheet 2: Inventory and Characterization of Household Parcels

  Section F.2.0: Identification Elements

  Section F2.1: Inventory and Characterization of Household Parcels

  Section F2 .2: Inventory and Characterization of Abandoned Parcels

- Fact Sheet 3: Measuring Surfaces, Installation and Weights of Yield Squares

  Section F3.0: Identification Elements

  Section F3.1: Surface Measurement, Installation and Weighting of Performance Squares

- Fact Sheet 4: Acquisition and Inputs use

  Section F.4.0: Identification Elements

Section F4.1: Use of Inputs During the Campaign 2011-2012

Section F4.2: Acquisition of Inputs During the Present Campaign 2011-2012

- Fact Sheet 5 And 6: Estimation of Farming Stocks and Forecast of Harvesting

  Section F.5.0: Identification Elements
  Section F5.1: Estimation of Farming Stocks
  Section F6.1: Forecast For 2011/12 Crops and Production of the 2010/2011 Campaign

  Section F6.2: Estimated Production of Cultivated Plots Past and Abandoned Campaign Presents

- Fact Sheet 7: Household Head Section

  F.7.0: Identification Elements Section

  F7.1: Household Head

- Fact Sheet 9: Nutritional Monitoring of Children Under 5 Years

  Section F.9.0: Identification Elements

  Section F9.1: Nutritional Monitoring and Anthropometric Measures for Children Under 5 Years Old

- Fact Sheet 10: Agricultural Equipment and Infrastructure

  Section F10.1: Agricultural Equipment and Household Infrastructure

  Section F10.2: Charges Supported in 2011 In the Operation of Household Equipment and Infrastructure

- Fact Sheet 12: Employment and Labor Section F12.0: Identification Elements

  Section F12.1: Employment and Labor

- Fact Sheet 13: Food Security

  Section F.13.0: Identification Elements Section

F13.1: Food Consumption

Section F13.2: Level of Food Security of Households

- Fact Sheet 14: Trees