Food aid, cash transfers and producer prices in Ethiopia

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Abstract

We measured the producer price impacts of food and cash transfer programmes in Ethiopia using monthly panel data from 37 zones in four major regions over the period January 2007 to December 2010. We studies the independent and joint impacts of Ethiopia's Productive Safety Net Programme (PSNP) and emergency relief programmes on producer prices for teff, wheat and maize. We estimated a series of dynamic, fixed-effects and seemingly unrelated regression (SUR) models. The results indicate that food aid allocated both by the PSNP and emergency relief programmes has either no discernible correlation with subsequent prices, or a weak, negative correlation. This suggests no strong disincentive effect of food aid on agricultural producers. The magnitudes of the correlations between prices and seasonal and time trends are substantially stronger than those associated with cash and grain transfers to local markets.

Key words: emergency relief; Ethiopia; food aid; PSNP; SUR

1. Introduction

This paper studies the effects of food aid and cash transfers on food prices in Ethiopia, one of the most food aid-dependent countries in the world. Food aid has been a popular response to food crises worldwide, and has been a typical response to both transitory and chronic food insecurity in Ethiopia, even during periods when weather and market conditions were generally favourable.[1] Such aid, whether delivered through international humanitarian relief efforts or a national social protection programme, is widely seen as saving lives and protecting the livelihoods of the acutely and chronically food insecure. Nonetheless, potentially deleterious impacts on local markets and producers have been recognised, at least since Schultz (1960).

We analyse the impacts of food aid and cash transfers, delivered as part of the Productive Safety Net Programme (PSNP), on monthly food prices in 37 zones over the period January 2007 to December 2010. Importantly, although both food aid and cash transfers can be viewed as income transfers to the recipients, from a conceptual point of view they affect food markets differently. By increasing local food supplies, food aid may depress prices, thereby discouraging production and job-seeking. Cash transfers, in contrast, may stimulate demand, thereby increasing local prices, with potentially beneficial effects on some producers but generally negative impacts on net buyers, especially those who do not receive cash transfers.

[1] Overall, annual food aid distribution has averaged 500 000 metric tons over the past decades, and the ratio of food aid to cereal production has ranged from 5% to 18%.

Using a dataset of our own construction, we examine three issues. First, we directly test the production disincentive hypothesis, asking whether observed levels of food aid, which are largely delivered in the form of wheat, have been negatively correlated with subsequent grain prices. Since, at various times, some PSNP districts have simultaneously received both regular food aid and emergency food aid (Ministry of Agriculture and Rural Development [MoARD] 2009), we also compare the impact of "predictable" food aid arising from safety net programmes with that of "unpredictable" food aid resulting from emergency relief. Second, we test whether cash transfers have had discernible and differential correlations with grain prices, leveraging the fact that, in some settings, the PSNP transferred cash, in other settings food, and sometimes both. This provides us the opportunity to advance a comparative analysis of the differential impacts of cash transfers and food aid on prices, something that, to our knowledge, has not been attempted in the literature. Third, we test whether the impacts of cash and food aid are sensitive to seasonal considerations and underlying levels of domestic production.

A major challenge confronting many researchers working in this area has been the lack of appropriate spatially and temporally detailed data on food aid deliveries and cash transfers (Awokuse 2011). Tadesse and Shively (2009), for example, used annual World Food Programme ([WFP] 2019) food aid shipment data to approximate monthly food aid allocation in Ethiopia, but were able to examine only three local markets. Tschirley *et al*. (1996) were forced to use data from a period in Mozambique in which prices were highly affected. And, while Garg *et al*. (2013) use spatially- and temporally-disaggregated data from seven countries and several commodities, their results are based on small and short-duration pilot projects that do not represent the full spectrum of interventions.

We overcome previous data-related shortcomings by working from detailed *woreda*-level monthly reports of food and cash transfers. By aggregating up from these data and using a least-squares dummy-variable approach, we account for zonal-level confounders that may be correlated with both food aid and producer prices. We also account for price trends, seasonal price patterns, and crop production. Our results are derived from data that are highly disaggregated across both time and space, and that cover 48 months, 37 zones, and all PSNP districts in four major regions of Ethiopia.

2. Background and framework

Isenman and Singer (1977) suggest that financial aid would be preferable to food aid in many instances to avoid deleterious effects of food shipments on local prices. In contrast, using a highly stylised general equilibrium model, Lavy (1990) argues that the positive effect of food aid on overall economic activity tends to offset the negative price effects that are driven by additional supply in the domestic market. Similarly, Maxwell (1991) argues that, on net, food aid is likely to have a limited disincentive effect on prices and production. Bezuneh *et al*. (2003) used macro- and household-level data for sub-Saharan Africa (SSA) to show how food aid could create growth through income effects. Abdulai *et al*. (2005) show that the disincentive effect of food aid disappeared after controlling for factors correlated with food aid receipt and production. Barrett *et al*. (1999) and Lowder (2004) found that food aid does not affect food production in recipient countries, but instead displaces food imports. Levinsohn and McMillan (2007) found that the net benefit from lower food prices driven by food aid was disproportionately higher for poorer households in Ethiopia, who were also net buyers of wheat compared to those who were net sellers.

In contrast, market-level studies for Ethiopia (Tadesse & Shively 2009) and Mozambique (Tschirley *et al*. 1996) provide support for the hypothesis of a disincentive effect. Tadesse and Shively (2009) found a threshold level of imports beyond which food aid shipments reduced prices. Tschirley *et al*. (1996) found that food aid in the form of yellow maize, provided at prices below import parity, created disincentives to producers and traders in Mozambique, and undermined investments in white maize production and marketing. However, in a more recent study of Malawi, Zant (2012) used simulations to show that, whether the food aid impacts on the production of a staple are positive or negative depends mainly on the share of domestic food production in total staple food demand, and the share of income from sample food production in total household income. Using data from seven countries, Garg *et al*. (2013) found no statistically significant relationship between local food aid procurement and distribution on the one hand, and local price levels or price volatility on the other.

Observers tend to favour cash transfers over food aid for two reasons. One, cash may be more cost-effective to deliver than food aid, since the latter requires delivery and storage (Gelan 2006). Two, cash may more reliably stimulate production and market development.[2] Sabates-Wheeler and Devereux (2010) compare cash to food aid in Ethiopia, concluding that cash transfers are generally favoured, but that food transfers or cash plus food have greater effects on income growth, livestock accumulation and food security.

To provide some structure for assessing these competing forces, we developed a framework to understand the potential supply and demand effects of food and cash transfers on local markets. Impacts depend on the amount of cash or food provided, the own and cross-price elasticities of food demand, income elasticities of demand, and the overall degree of market integration and price transmittal across space (Dercon 1995; Negassa & Jayne 1998; Negassa & Myers 2007; Rashid & Taffesse 2009; Rashid & Negassa 2011; Dillon & Barrett 2016). We introduce food aid and cash transfers into the standard demand and supply functions for food, and show how equilibrium market prices change given a shift in demand, supply or both, as a result of food and cash transfers in the domestic market. We assume that aggregate demand for food (Q^D) is a function of own price (P), income (Y) and demand shifters (Z^D). The latter includes population and the prices of other goods. The aggregate supply of food (Q^S) depends on own price (P), food aid (A) and supply shifters (Z^S). These shifters include rainfall shocks and seasonality. We introduce food aid directly into the supply function, since the additional supply of food to the local food market is translated into net sales of food aid in the market. Food aid may also enter into the income equation because it increases household income. Induced changes in market demand for food arise from induced increases in household food demand due to cash transfers added to income. Thus, cash transfers affect household demand through income, which consists of farm income ($P \times Q^S$), the monetary value of food aid ($P \times A$), cash transfers (C), and other non-farm income (R). The equilibrium system is then formulated as equations (1) to (4):

$$Q^D = D(P, Y, Z^D) \tag{1}$$

$$Q^S = S(P, A, Z^S) \tag{2}$$

$$Y = P \times Q^S + P \times A + C + R \tag{3}$$

$$Q^D = Q^S \tag{4}$$

Total differentiation of the above equations yields:

$$dQ^D = \frac{\partial Q^D}{\partial P} dP + \frac{\partial Q^D}{\partial Y} dY + \frac{\partial Q^D}{\partial Z^D} dZ^D \tag{1'}$$

$$dQ^S = \frac{\partial Q^S}{\partial P} dP + \frac{\partial Q^S}{\partial A} dA + \frac{\partial Q^S}{\partial Z^S} dZ^S \tag{2'}$$

[2] But also see Kebede (2006), who argues that cash-generated price hikes can undermine the welfare of those who do not receive cash transfers.

$$dY = dPQ^S + dQ^S P + dPA + dAP + dC + dR \tag{3'}$$

Log-linearisation provides a set of equations expressed in terms of shares and elasticities:

$$\dot{Q}^D = E_P^D \dot{P} + \eta \dot{Y} + E_Z^D \dot{Z}^D \tag{1''}$$

$$\dot{Q}^S = E_P^S \dot{P} + E_A^D \dot{A} + E_{Z'}^S \dot{Z}^S \tag{2''}$$

$$\dot{Y} = \alpha_Q(\dot{P} + \dot{Q}^S) + \alpha_A(\dot{P} + \dot{A}) + \alpha_C \dot{C} + \alpha_R \dot{R} \tag{3''}$$

$$\dot{Q}^D = \dot{Q}^S \tag{4''}$$

where $\dot{P} = \frac{dP}{P}$; $\dot{C} = \frac{dC}{C}$; $\dot{A} = \frac{dA}{A}$; $\dot{Q}^S = \frac{dQ^S}{Q^S}$; $\dot{Q}^D = \frac{dQ^D}{Q^D}$; and $\dot{Y} = \frac{dY}{Y}$ are rates of change in the respective variables, $E_P^S > 0$, $E_A^S > 0$ and $E_{Z^S}^S > 0$ are supply elasticities with respect to price, food aid and other factors (such as rainfall); $\mathrm{E}_P^D < 0$ and $\mathrm{E}_{Z^D}^D < 0$ are demand elasticities with respect to price and other factors (such as population); and $\eta > 0$ is a food demand (income) elasticity. The terms $\alpha_Q = \frac{PQ^S}{Y}$; $\alpha_C = \frac{C}{Y}$; $\alpha_A = \frac{PA}{Y}$ and $\alpha_R = \frac{R}{Y}$ denote the shares of farm income, cash transfers, monetary value of food aid and other off-farm income in total income respectively.

We are interested in how the rate of change in food aid ($\dot{A}$) and cash transfers ($\dot{C}$) affect the rate of change in the equilibrium price ($\dot{P}$) in the local market. Equations (1″) to (4″) can be used to derive the key relationships, which are:

$$\frac{d\dot{P}}{d\dot{C}} = \frac{\eta \alpha_C}{E_P^S - E_P^D - \eta(\alpha_Q + \alpha_A)} \tag{5}$$

$$\frac{d\dot{P}}{d\dot{A}} = \frac{\eta \alpha_A - E_A^S}{E_P^S - E_P^D - \eta(\alpha_Q + \alpha_A)}. \tag{6}$$

The impact of cash and food transfers on prices depends on the signs and the magnitudes of the elasticity coefficients, and also on the shares through income and substitution effects. In equation (5), the numerator on the right-hand side indicates the impact of cash transfers on prices due to an income effect. A positive cash transfer shifts the demand for food outward and, *ceteris paribus*, leads to an increase in price. The first term in the numerator of equation (6) shows the impact of food aid on prices due to an income effect, which is positive. The second term indicates the responsiveness of local food supply as aid deliveries increase. The denominators in (5) and (6) indicate the effects of cash and food aid, which depend on how responsive prices are to demand, supply and income changes. If one assumes a negative price elasticity of demand and positive supply and income elasticities, then the total impact of changes in the denominators depends on the magnitude of the share of farm income and food aid in the household's total income. If the sum of these shares is sufficiently large, these effects will offset the combined effects of the supply and demand elasticities, leading to a positive denominator. In that case, the total net effect of equation (5) will be positive. And, depending on the magnitude and the signs of food supply responsiveness to change in food aid, the net effect of food aid represented by equation (6) can be positive or negative.

3. Empirical strategy

We estimate the parameters in equations (5) and (6) using reduced-form inverse demand functions for three crops, *teff*, wheat and maize. Our unit of analysis is the price of crop *g* in month *t* in zone *i*. We expect supply and demand shocks to spill across crops, and therefore estimate systems of seemingly unrelated regressions (SUR), one equation per crop, using a least-squares dummy variable (LSDV) estimator. We allow lagged prices to enter the equations, thereby giving rise to a system of three dynamic regressions of the form:

$$\mathbf{P}_{git} = \alpha_g + \mathbf{P}_{git\text{-}l}\boldsymbol{\gamma} + \mathbf{A}_{git}\boldsymbol{\beta} + \mathbf{X}_{git}\boldsymbol{\lambda} + \boldsymbol{\mu}_{gi} + \mathbf{v}_{git} \quad i = 1,\dots,N\text{; } t = 1,\dots,T \text{ and } g = 1,\dots,G \tag{7}$$

In the g^{th} equation, α_g is a scalar intercept; P_g represents a vector of prices; l denotes the lag length, and γ is a vector of parameters to be estimated. A_g denotes a (n x k) matrix of food aid-related variables, where $n = N \times T$ and k is the number of variables. These include monthly per capita PSNP food aid allocation, relief food aid allocation and quarterly cash distribution; and the interactions of each with a measure of production and a binary indicator for season. The primary item of interest for this study is $\boldsymbol{\beta}$, a vector of parameters to be estimated. These measure the marginal impacts of food aid and cash transfers on local prices. X_g is a (n x k) matrix of other exogenous control variables. These include annual population, annual production, monthly rainfall, a binary indicator for the harvest season, and a unit-step time trend; $\boldsymbol{\lambda}$ is a vector of parameters to be estimated; μ is unobserved individual zone-level effects, and V is a white noise disturbance.

Equation (7) constitutes a dynamic panel model. The dependent variable, P_{git} is a function of previous values, P_{git-k}. P_{git-k} is correlated with the unobserved individual effect, μ_i, by construction. Because OLS estimation of the equations in the system produces inconsistent parameter estimates of equation (7), we estimate the system using LSDV. This method requires that we first remove μ_i using individual dummies, as represented by equation (8):

$$\mathbf{P}_{git} = \mathbf{P}_{git\text{-}l}\boldsymbol{\gamma}_g^{'} + \mathbf{A}_{git}\boldsymbol{\beta}_g^{'} + \mathbf{X}_{git}\boldsymbol{\lambda}_g^{'} + \mathbf{D}_{git}\boldsymbol{\eta}_g^{'} + \mathbf{v}_{git}^{'}, \tag{8}$$

where, in the g^{th} equation, $\mathbf{D}_g = \mathbf{I}_{gn} \otimes \boldsymbol{\iota}_{g\mathrm{T}}$ is a matrix of zone-specific dummies; $\mathbf{I}_{gn}$ is an identity matrix of dimensions N; $\boldsymbol{\iota}_{g\mathrm{T}}$ is a vector of ones of dimension T, and $\otimes$ denotes the Kronecker product. All other notation is the same as described in equation (7).

For a panel with large N and small T, a model that combines fixed effects with lagged dependent variables can produce inconsistent estimates. The fixed-effects approach achieves consistency, as $T \to \infty$ (Kiviet 1995; Bun & Kiviet 2001; Baltagi 2005; Bruno 2005). In our case, with $T = 48$ and $N = 37$, we have a somewhat smaller N and substantially larger T than are typically encountered in empirical studies. We therefore rely on the asymptotic properties of the fixed-effect estimator and proceed under the assumption that bias associated with the use of the dynamic panel estimator, if any, is likely to be small. An additional consideration is that LSDV estimators usually suffer from a large loss in degrees of freedom due to the inclusion of extra parameters in the model. However, for the current sample, we employed a large number of observations ($N \times T = 37 \times 48 = 1\,776$), so that the inclusion of individual dummies for zones does not result in a large loss of degrees of freedom. As further confirmation that our approach is statistically sound, we tested for unit roots in all real producer price series using the Im–Pesaran–Shin (IPS) test (Baltagi 2005) and find prices stationary over the period covered.

4. Data and sources

Our panel covers three major cereals, *teff*, wheat and maize. These crops are individually and jointly important in terms of both production and consumption of grains in Ethiopia. For example, in 2010, *teff*, wheat and maize represented 14%, 17% and 25% respectively of grain production in the country. We observed prices for 48 consecutive monthly time steps, extending from January 2007 to December 2010. We focused on 252 PSNP *woredas* from four major regions (Tigray, Amhara, Oromia and the Southern Nations, Nationalities, and People's Region). To overcome missing *woreda*-level prices, we aggregated to 37 zones (see Figure 1) by first computing zonal average prices and rainfall amounts, as well as zonal sums of food aid and other exogenous variables, using the available data observed at the *woreda* level, and then converting quantities to per capita values by dividing by zonal population.

Variables include producer prices, relief food aid, PSNP food aid, PSNP cash transfers, production, rainfall, population, binary indicators for season, and a time trend. We also consider various interactions among season and production variables, and the policy variables of interest, food aid and cash transfers. Nominal monthly producer prices (in *birr*/kg) come from the Ethiopian Central Statistical Agency (CSA).[3] We deflated these using the CSA's regional consumer price index. We include in each regression lags of own price. The Akakie Information Criterion (AIC) suggests a lag length of three months.

The policy variables of interest are monthly per capita relief food aid allocation, monthly per capita PSNP food aid allocation, and quarterly per capita cash transfers to each PSNP *woreda*. We include the current and one-month lag of the food aid variable, and the current and one-quarter lag of the cash transfer. The lags account for delays in delivery and storage. Negative correlations between producer prices and PSNP/relief food aid provide evidence in support of the disincentive hypothesis; positive correlations support the hypothesis that cash injections increase local demand and raise prices. Sources for the food aid data are the Disaster Risk Management and Food Security Sector (DRMFSS), the Food Security Coordination Bureau (FSCB), and the World Food Programme. Cash transfer data come from the Ethiopian Ministry of Finance and Economic Development.

We control for production shocks directly by incorporating both contemporaneous and previous year's average monthly rainfall. We do not instrument production using rainfall, because rainfall does not clearly satisfy the exclusion requirement for IV estimation. For example, rainfall could affect rural incomes or transportation, and hence production, through channels other than prices. Since our concern is with shocks to production or demand that might affect grain prices independently and also be correlated with food aid, we simply control directly for rainfall, accepting that bias might arise from endogeneity. Rainfall data come from the National Meteorological Agency of Ethiopia. We also include variables for current-year annual aggregate production for each crop, as well as one-year lagged values. Including production in the model also controls for other, less easily observed, supply-side factors such as technology adoption.[4] Production data come from Ethiopia's Central Statistical Agency (CSA).

[3] In 2010, 1 USD = 12.58 birr.

[4] Temperature could also be an important supply-side factor in production (see Lobell *et al*. 2011), but we do not have relevant temperature data. Usage rates for chemical fertiliser and improved seeds are relatively modest, whilst irrigation rates have been very low in Ethiopia, at least over the period covered by our data. For example, calculations using data from the Central Statistical Agency ([CSA] 2008, 2009, 2010, 2011) reveal that, on average, only 25%, 16% and 28% of smallholders applied chemical fertilisers and 12%, 1% and 15% of smallholders used improved seeds for *teff*, wheat and maize respectively. Average UREA- and DAP-fertilised area accounted for 28%, 20% and 31% over the same period for *teff*, wheat and maize respectively. Only 1%, 16% and 5% of the total area planted was sown with improved seeds of *teff*, wheat and maize respectively.

To control for demand-side effects on prices, we include annual current population (in 1 000s). Population data come from the country's annual population projection by the CSA, based on regional average population growth rates obtained from recent national population and housing censuses conducted in the country. A unit-step time trend accounts for any underlying price trends during the study period. A binary indicator (= 1 during the primary harvest months, September through March; 0 otherwise) controls for possible seasonal price changes.

To assess potential heterogeneity in the impact of food aid on prices within seasons, or due to production levels, interactions between binary season indicators and the food aid and cash transfer variables, as well interactions between current production levels and food aid and cash transfer variables, are included. Food aid delivered in the lean period or during periods of production shortfall, and cash transfers in the post-harvest seasons or during normal production periods, should exert less influence on prices than at other times.

We note that the endogeneity of food aid in relation to both food prices and factors affecting food prices could be threats to inference from our regressions. In the former case, food price spikes caused by forces other than production failures could induce food aid responses. Historically, however, this has rarely been the case for Ethiopia, where food aid is triggered mainly by rainfall and production failures (Tadesse & Shively 2010). The latter case would occur when common factors, such as production shortfalls in adjacent regions, induce both food price and food aid responses. We cannot address this concern directly, but we expect that, by using proper controls in our models, such as rainfall and production levels, any remaining endogeneity between food aid and food prices is minor. Our parameter estimates likely remain robust and consistent, although they could be less efficient than desired.

5. Results and discussion

Descriptive statistics for the variables used in the regressions are presented in Table 1. Figures 2 to 4 provide graphical representations of the price series under consideration. All prices declined slightly over the interval examined, with the highest prices recorded in mid- to late 2007 (see Figure 2). Gaps between nominal and real prices in Figure 2 reflect general price inflation in Ethiopia during this period. Coefficients of variation in prices indicate that price instability was highest for maize (50%) and lowest for *teff* (30%). Figure 3 further shows that prices fluctuate greatly for all crops. Figure 4 indicates that, on average, all prices follow a similar seasonal pattern. Pre-harvest prices (March through September) are higher than post-harvest prices (October through February).

Data in Table 1 indicate that the average monthly amount of PSNP food aid (0.73 kg/person) was roughly 70% greater than that of relief food aid (0.43 kg/person). The combined average total food aid allocation was approximately 1.2 kg/person in the PSNP area. The average cash transfer is 11.15 *birr*/person/quarter. Per capita annual *teff* production in the PSNP districts average 33 kg, while similar figures for wheat and maize are 31 kg and 47 kg. Average monthly rainfall is about 76 mm, with a monthly maximum of 496 mm. Average population was 839,881 during the study period.

Table 2 contains regression results for three sets of regression systems. Model 1 consists of regressions that include the policy variables of interest, lagged own prices, Model 2 adds to these regressors a set of control variables for rainfall and production, seasonality, the unit-step time trend, and population. Model 3 is a long regression that adds to the control variables of Model 2 a comprehensive set of interaction terms. Table 2 reports point estimates and standard errors, as well as goodness-of-fit measures for each crop-specific regression. No near-perfect multicollinearity problems were observed in any of the models.

Table 1: Descriptive statistics of variables used in the analysis

Variables	Mean	Std. dev.	Min.	Max.
Teff real producer price (*birr*/kg)	4.17	1.25	1.68	10.56
Wheat real producer price (*birr*/kg)	3.00	1.08	0.67	8.33
Maize real producer price (*birr*/kg)	2.21	1.08	0.52	7.32
Monthly per capita PSNP food aid (kg)	0.73	1.60	0.00	13.00
Monthly per capita relief food aid (kg)	0.47	1.02	0.00	7.68
Quarterly per capita cash transfers (*birr*)	11.15	16.09	0.00	130.48
Annual per capita *teff* production (kg)	33.20	29.40	0.00	145.80
Annual per capita wheat production (kg)	31.20	39.20	0.00	319.30
Annual per capita maize production (kg)	47.70	72.70	0.00	452.40
Monthly rainfall (mm)	75.79	79.78	0.00	496.00
Population (1 000s)	839.88	710.38	49.99	3 122.49

Statistics computed for 37 zones covering the period January 2007 to December 2010.

5.1 Do food aid and cash transfers affect the local market?

Model 1 employs the primary policy variables of interest and provides cursory evidence for their importance, although, as we shall argue below, the omission of proper controls surrounding supply and demand shifters means the regression is likely mis-specified. Most of the estimated coefficients indicate strong effects of food aid and cash transfers, both in statistical significance and magnitude. Current period and lagged food aid from relief programmes are negatively correlated with prices. In contrast, current period food aid and PSNP cash transfers are positively correlated with prices.

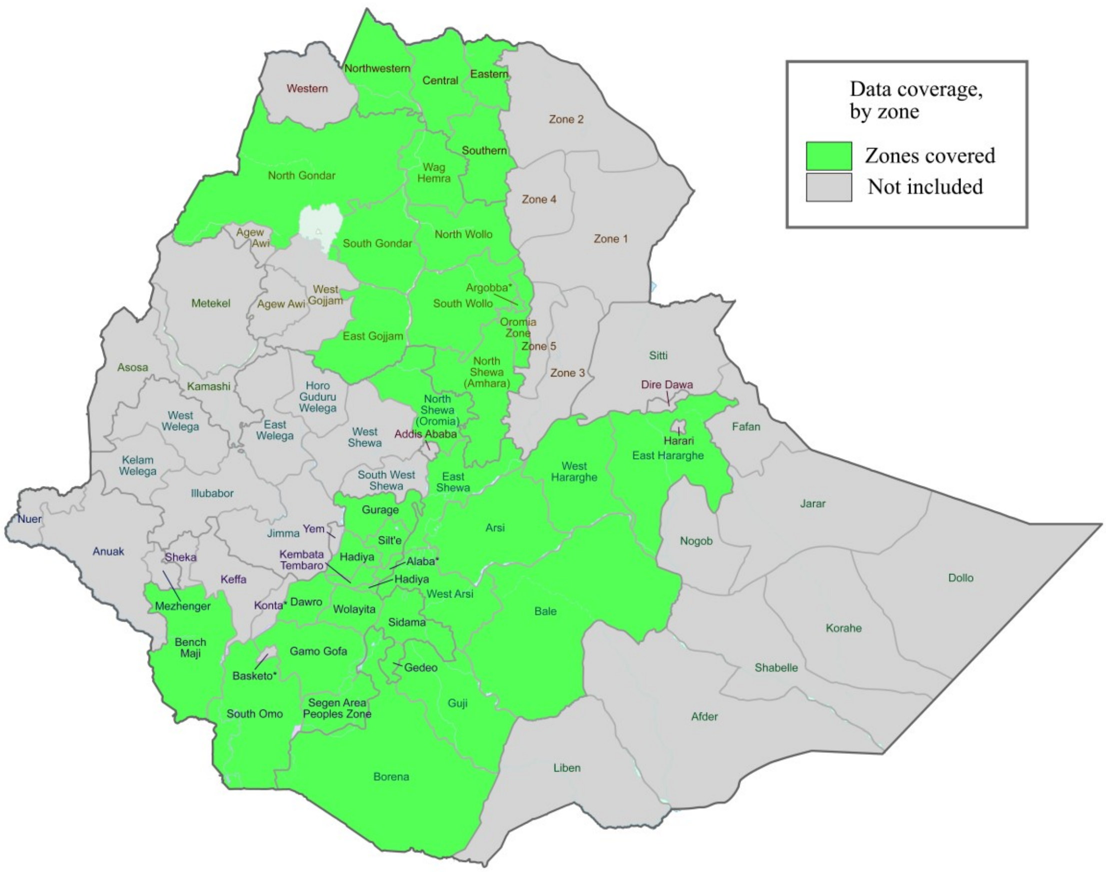

Figure 1: Map of Ethiopia indicating zones covered by the PSNP during the study period

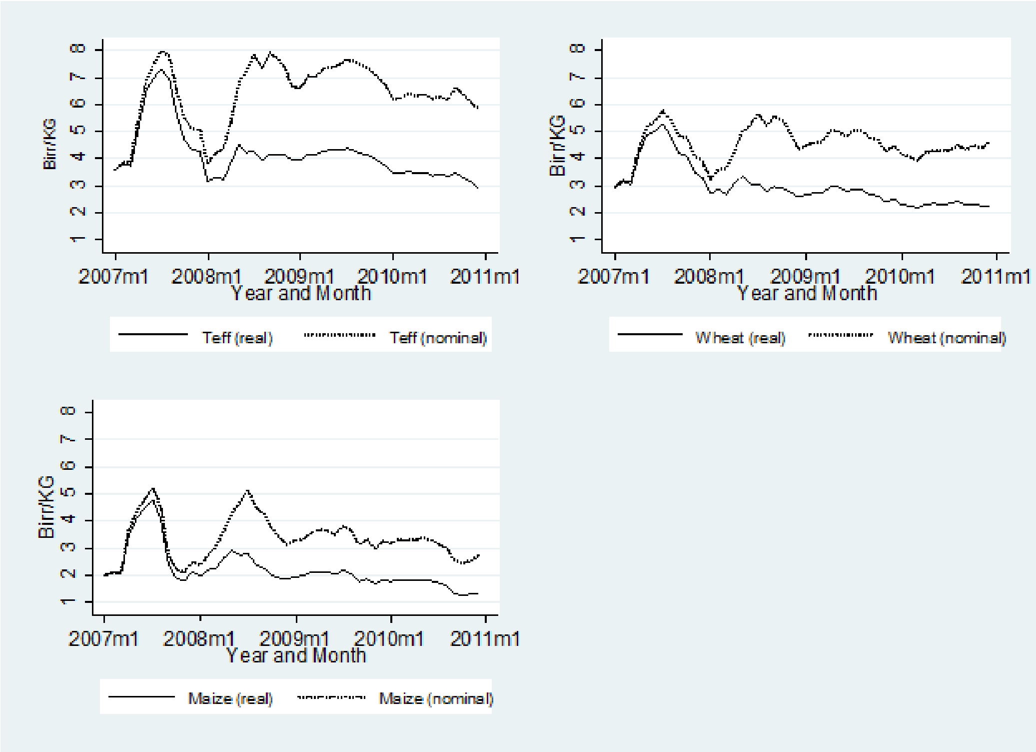

Figure 2: Nominal and real monthly producer prices, by commodity (2007 to 2011)

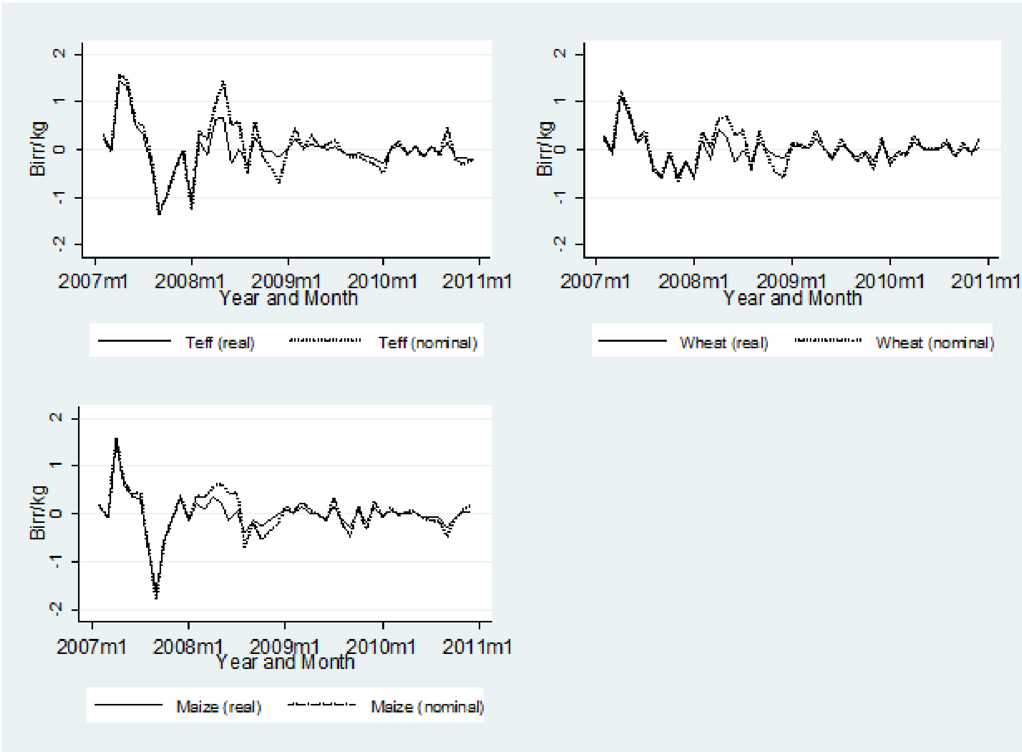

Figure 3: Change in real and nominal prices, by commodity (2007 to 2010)

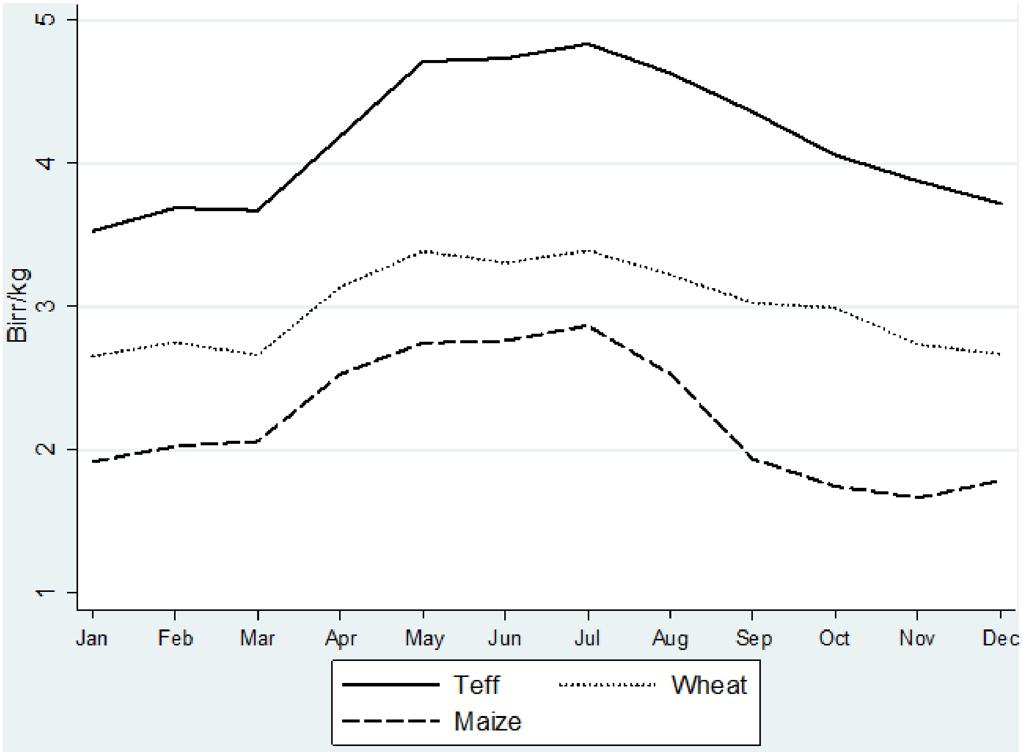

Figure 4: Seasonal patterns in real prices, by commodity (2007 to 2010)

To examine how robust these finding are to the inclusion of important conditioning variables, we turn to Model 2. Note that including 12 months of lagged production results in a loss of observations (from 1 575 to 1 260). Wald tests of the joint significance of PSNP food aid, relief food aid, and PSNP cash transfers in explaining prices produce chi-squared statistics of 8.46, 14.58 and 17.36 for the three crops (*teff*, wheat and maize) respectively. The evidence provided in Model 2 therefore allows one to reject the null hypothesis of no policy effect on prices at least at the 90% confidence level. As expected, the regression results indicate strong negative correlations between the harvest season indicators and price changes. We find evidence of declining prices over the period covered by our data, especially for wheat and maize.

Most important, we find that, once we control for some of these exogenous factors, the policy variables decline in both economic magnitude and statistical significance. For all crops, the point estimates in Model 2 provide evidence of no or a positive statistical link between prices and PSNP food aid, and both weak and mixed evidence regarding a statistical link between prices and relief food aid. Out of six estimated coefficients, two are significant, but of opposite signs: contemporaneous relief aid is positively correlated with the maize price, whilst lagged relief aid is negatively correlated with the *teff* price. In the case of current cash transfers, however, evidence is somewhat more convincing and robust, and points to a positive correlation between current cash transfers and producer prices. This result indicates that grain supply in the local market responds to any increased demand arising from current cash injections. However, the correlation between cash transfers and maize and wheat prices is weakened once we introduce the interaction terms (as shown by the parameter estimates in the last three columns of Table 2).

We conclude that, once we are able to control for the confounding effects that are likely correlated with both food aid distribution and prices, among them rainfall, production, seasonality and underlying price trends, most of the "observed" effects of food aid disappear. We find that neither contemporaneous nor lagged food aid allocations from the PSNP have evident statistically significant negative correlations with producers' grain prices. Relief food aid allocations may potentially be depressing the subsequent price of *teff* with some lag, and levels of food aid may be positively associated with contemporaneous maize prices, but relief food aid does not seem to be correlated with prices in the other cases we consider.

The theoretical model given by equation (6) suggests that, under three plausible scenarios, food aid will have little or no impact on prices: (i) a modest supply response to an increase in food aid (E^S); (ii) a small income effect associated with food aid ($\eta\alpha_A$); and (iii) a relatively large share of food aid and farm income in total income (α_A and α_Q respectively). In the first case, if food aid is delivered in a timely manner and well targeted to beneficiaries who are not in a position to produce, the responsiveness of food supply to an injection of food aid will be small, and will not exert downward pressure on price. The regression results show that, in some cases, relief food aid is negatively and significantly correlated with prices, but that PSNP food aid has either no price effect or a small, positive effect. This is in line with our expectation that PSNP food aid is more predictable and carefully targeted than emergency relief food aid deliveries, and therefore is less influential in the local market. In the second case, it could be that the income effect of food aid, $\eta\alpha_A$, is small, such that food aid does not induce an increase in household food demand sufficient to put upward pressure on prices. Of course, holding constant the income elasticity of food demand (η) of poor households, larger shares of food aid in total income (α_A) will generate larger income effects. Food aid as a percentage of food production has been quite large, reaching 18% for *teff*, maize and wheat combined in 2009. This helps to explain the positive and significant associations between food aid and prices that are observed in some cases. Given an assumption of low supply response to PSNP food aid, demand-side effects will dominate. That is, the demand-side effect of food aid as an addition to income offsets the supply-side effect of food aid as an addition to the local food supply. However, relief food aid shows a negative association with prices in some cases, perhaps when the supply-side effect dominates. In the third case, food aid could have a small (and positive) effect if the share of income from staple food production and the share of food aid in total income are both sufficiently large to offset the price effects of food aid. For food-insecure farmers, one would expect a large share of income to come from staple food production, and the share of food aid in total income to be large.

Table 2: SUR regression results; dependent variable is real producer price (*birr*/kg)

	Model 1			Model 2			Model 3		
Variables	***Teff***	**Wheat**	**Maize**	***Teff***	**Wheat**	**Maize**	***Teff***	**Wheat**	**Maize**
Per capita PSNP food aid (MT)	35.3 (21.63)	35.64** (16.8)	0.611 (17.01)	34.92** (16.35)	24.22* (12.84)	-6.959 (10.96)	17.56 (31.34)	20.40 (23.56)	-5.604 (20.99)
Per capita PSNP food aid, one-month lag (MT)	71.63*** (19.99)	48.3*** (15.56)	61.00*** (15.65)	15.93 (15.35)	2.419 (12.06)	5.689 (10.27)	14.96 (15.72)	-0.394 (12.42)	9.035 (10.51)
Per capita relief food aid (MT)	-47.61* (25.16)	-48.18** (19.73)	-28.33 (19.85)	18.26 (18.13)	-0.484 (14.20)	45.84*** (12.16)	31.60 (38.28)	0.0381 (28.63)	50.24** (25.42)
Per capita relief food aid, one-month lag (MT)	-90.20*** (25.82)	-78.9*** (20.23)	-75.34*** (20.36)	-36.45* (18.85)	-21.60 (14.75)	8.189 (12.66)	-39.10** (19.07)	-23.71 (15.02)	7.710 (12.81)
Per capita cash transfer (*birr*)	0.0037** (0.00161)	0.003** (0.0013)	0.00246* (0.00128)	0.0049*** (0.001)	0.00204* (0.001)	0.00191** (0.0009)	0.00537*** (0.00188)	0.00209 (0.00148)	0.000550 (0.00129)
Per capita cash transfer, one-quarter lag (*birr*)	-0.000182 (0.00149)	-0.00139 (0.0012)	-0.0029** (0.00118)	0.000446 (0.00128)	0.000289 (0.00099)	-0.000868 (0.00086)	0.000829 (0.00129)	0.000279 (0.00101)	-0.000974 (0.000869)
Seasonal indicator (1 = harvest season)				0.0243 (0.0478)	-0.0969** (0.0380)	-0.164*** (0.0332)	0.00153 (0.0567)	-0.0932** (0.0455)	-0.225*** (0.0400)
Time trend (unit time step)				-0.00179 (0.00190)	-0.013*** (0.00187)	-0.020*** (0.00154)	-0.00201 (0.00193)	-0.0131*** (0.00189)	-0.0202*** (0.00154)
Production (MT)				-0.000427 (0.00255)	-0.000666 (0.00067)	-6.37e-05 (0.000677)	-0.000456 (0.00254)	-0.000689 (0.000676)	-0.000108 (0.000676)
Production, one-year lag (MT)				-0.000593 (0.000837)	-0.000745 (0.00078)	-0.000231 (0.000763)	-0.000674 (0.000837)	-0.000700 (0.000790)	-0.000432 (0.000768)
Rainfall (mm)				0.0011*** (0.000377)	0.000434 (0.00029)	-0.000173 (0.000253)	0.00110*** (0.000378)	0.000436 (0.000298)	-0.000214 (0.000253)
Rainfall, one-year lag (mm)				0.000375 (0.000348)	-3.90e-05 (0.00027)	0.00046** (0.000233)	0.000432 (0.000349)	-2.12e-05 (0.000275)	0.000452* (0.000233)
Population (in thousands)				6.79e-05 (0.000500)	8.35e-05 (0.00032)	0.000246 (0.000279)	3.85e-05 (0.00050)	7.35e-05 (0.00032)	0.000185 (0.00027)
Season × PSNP food aid							-36.53 (26.32)	-10.16 (20.61)	23.72 (17.54)
Season × Relief food aid							0.00293 (0.00314)	0.00104 (0.00246)	0.00412* (0.00211)
Season × PSNP cash							52.45 (34.52)	-12.70 (27.27)	8.509 (23.19)
Production × PSNP food aid							0.974 (0.760)	0.239 (0.475)	-0.239 (0.440)
Production × Relief food aid							-1.189 (0.903)	0.168 (0.541)	-0.366 (0.502)

	Model 1			Model 2			Model 3		
Variables	***Teff***	**Wheat**	**Maize**	***Teff***	**Wheat**	**Maize**	***Teff***	**Wheat**	**Maize**
Production × PSNP cash							-4.19e-05 (5.39e-05)	-1.00e-05 (3.17e-05)	2.41e-05 (2.94e-05)
Observations	1 575	1 575	1 575	1 260	1 260	1 260	1 260	1 260	1 260
R-squared	0.96	0.96	0.92	0.976	0.971	0.964	0.977	0.971	0.964

Standard errors in parentheses. Single, double and triple asterisks represent statistical significance at the 10%, 5% and 1% test levels respectively. All regressions estimated with zonal level fixed effects.

Comparing the importance of cash transfers to that of food aid suggests that food aid may be a more neutral policy tool than cash transfers, since it does not appear to distort prices.[5] Comparing results across crops, we would expect food aid correlations with prices to be the strongest in the case of wheat, since it is the food aid crop. However, we find the associations in our regressions to be nearly uniform across all the crops we consider.

5.2 Does conditioning on seasonality and domestic production alter the price effects?

Tadesse and Shively (2009) argue that the timing of food aid deliveries and cash transfers can exert a strong influence on how these interventions play out in local markets. In principle, if food aid and cash transfers occur in response to production shocks, caused by either seasonal changes or production shortfalls, they will stabilise prices and the food supply in the market. Thus, seasonality and the level of domestic production are some of the factors that influence the timing of food aid and cash deliveries to beneficiaries. Under normal conditions, hunger prevails in the pre-harvest season, when markets are slow or unable to respond to demand, as compared to in the post-harvest period. Thus, the price effects of food aid and cash transfers may be less pronounced if food aid deliveries occur during lean periods, and if cash transfers occur during the post-harvest season. In the same way, domestic food production shortfalls should motivate food aid deliveries that augment rather than supplant local supply. And cash transfers should be sensitive to the domestic food production situation, so that cash infusions do not put too much upward pressure on prices by stimulating demand that cannot be satisfied out of domestic production. Unfortunately, the poor timing of food aid deliveries and cash transfers is often unavoidable, largely due to administrative dysfunction, lags in food aid delivery from donors, or complex procurement and transportation bottlenecks.

Model 3 (the final columns of Table 2) examines this issue. Model 3 adds a set of six interaction terms to Model 2 to measure sensitivities in the effects of food aid and cash transfers to season and production levels. Most of the results from Model 2 carry over into Model 3, although positive correlations between cash transfers and prices are weaker. We find no strong evidence that price effects are particularly sensitive to seasonality or production levels. From the entire set of eighteen point estimates for interactions, only one is statistically significant. Moreover, a Wald test of the joint significance of the six interaction terms fails for every crop.

To check the robustness of our results, we estimated Model 3 for the four regions separately. Most of the results replicate Model 3 in sign, magnitude and significance, with the exception of the coefficient on PSNP food aid, which is positively correlated with prices and with some statistical significance in Amhara and Oromia.

6. Conclusions

We studied one of the largest safety net programmes in SSA, Ethiopia's PSNP. We used data on monthly prices from January 2007 to December 2010, and food aid allocations observed at the zonal level, to estimate a series of fixed-effects seemingly unrelated regression (SUR) models. Using data that correspond to the period after the introduction of PSNP, and contemporaneous with the recent food price crisis, enabled us to carry out a wider assessment of these longstanding issues than has been possible in the past. An additional strength of the analysis is that it is based on more highly disaggregated data across space and time than many past studies. The analysis controlled for supply-side drivers such as rainfall and seasonality. We also examined the differential price effects arising from food aid distributed through predictable channels, such as the PSNP, and through emergency relief programmes. We compared the price impacts of cash transfers to those of food aid. We also

[5] This result could change if a variant of this model were estimated using food aid data disaggregated between donor transfers and local procurement.

examined whether conditioning these policy interventions on seasonality or production levels would alter the observed price effects. We furthermore also checked the robustness of our results by repeating the analysis for each of the four regions separately, which confirmed the basic findings.

Overall, we find no compelling statistical support for the hypothesis that PSNP and relief food aid have affected food grain prices. Once we control for possible factors contributing to food price changes, such as seasonality and rainfall, we are left with patterns that do not point strongly to disincentives at the household level, either for crop production or the provision of labour. We find some evidence that cash transfers have exerted upward pressure on prices, especially for *teff*. Furthermore, conditioning food aid and cash transfers either on seasonality or on production levels does not alter the basic patterns observed here. Revealed correlations between prices on the one hand, and seasonal changes and time trends on the other, are larger and stronger than those observed between prices and policy interventions.

7. Policy implications

A major objective of the PSNP has been to bring predictable and timely food and cash transfers that closely track known seasonal variability in local production. Our results imply that food and cash transfers have been sufficiently well targeted and well timed in the PSNP *woredas* that any effects on local prices have been negligible. This is in line with the expectation that PSNP food aid is more predictable, timely and carefully targeted than past emergency relief deliveries. Theoretically, food aid and cash transfers may not necessarily disrupt markets and undermine production incentives if well designed and properly implemented, especially since the unintended consequences of such policy interventions likely arise from problems related to the timeliness and successful targeting of the food and cash transfers. Furthermore, food and cash-for-work under the PSNP are carried out outside the main agricultural season. In addition, the PSNP uses traditional community-based targeting systems, refining these to include more criteria that enable the programme to identify chronically food-insecure households within each food-insecure *woreda*. All of these efforts may combine to mute any price pressures arising from food/cash transfers.

Tadesse and Shively (2009) concluded that food aid shipments reduce prices in producer and consumer markets in Ethiopia. They used annual emergency food aid shipments and monthly food prices for three markets over the period 1996 to 2006. We observe prices over a different period that post-dates a major policy shift in food aid delivery that began with the introduction of Ethiopia's PSNP in 2005. This policy shift, and the different periods covered by these two studies, likely lie at the heart of the divergence in results.

One caveat to the current study is that we have conducted this analysis at the zonal level. Although this provides a broad perspective on patterns associated with food aid and PSNP activities, and a more detailed analysis than offered by past studies, it may nevertheless mask important effects that may be occurring at the *woreda* level that we fail to discern. Future researchers may want to approach this task using spatial econometric methods to account for spatial correlations or spill-overs.

Another possible limitation is that our analysis does not control for the possible effects of local and regional procurement of food aid grains at market prices. These modes of food aid delivery to Ethiopia have become increasingly important over the past decade. However, during the time period covered by our data, local procurement of food aid was relatively small in quantity, in large part because the government suspended donors from purchasing food aid grains locally as part of its price stabilisation response during the price spikes from 2007 to 2010. Uncovering sufficient data to conduct an analysis that overcomes these limitations is left for future efforts.

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