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Trading in Turbulent Times

Smallholder Maize Marketing in the Southern Highlands, Tanzania

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ABSTRACT

The short-run effects of the 2007/2008 global food crisis on semisubsistence farmers' well-being in low-income countries depends on whether they are net sellers or net buyers of the affected commodities. Realizing that farmers face volatile prices over the course of an agricultural year, we analyze the timing of sales and purchases of maize. In addition, in our analysis, we depart from the oft-made assumption that farmers in rural villages are perfectly integrated within the wider economy. Comparing our results with a static analysis, we find that especially-poor farmers face greater losses from the maize food price crisis than others. The welfare impact is likely to be even more severe than previously thought, as the crisis hurts large households with relatively large numbers of children and women most. We also analyze the effects of factors that are likely to affect potential benefits from intertemporal and spatial price dispersion, such as means of transport, access to price information, and credit.

Keywords: market participation, food prices, intertemporal arbitrage, spatial price dispersion, Tanzania

1. INTRODUCTION

The answer to the question of whether rising food prices is beneficial for the well-being of semisubsistence farmers in developing countries crucially depends on the household's net position. If households are net sellers of the product under consideration, an increase in its price will increase household income. The reverse holds if a household is a net buyer. This simple fact partly explains why some nongovernmental organizations (NGOs) and international organizations have opposing views on the effects of changes in prices for farmers in low-income countries, or why their views seem to have changed in the light of the global food crisis (Swinnen 2010).

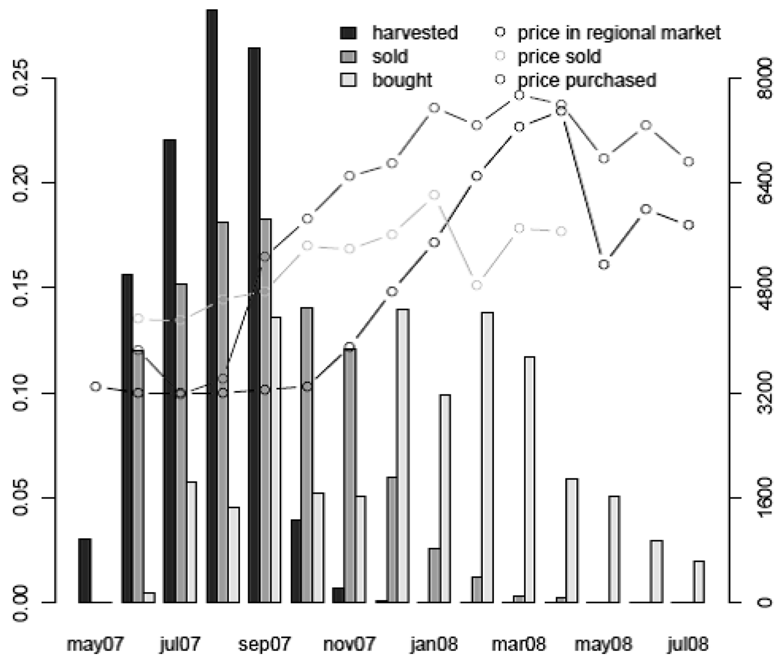
A popular way to estimate the first-order impact of changes in food prices is the one used by Deaton (1989). Central to such studies is the concept of net benefit ratio (NBR), which is defined as the value of net food sales (that is, production minus consumption) as a share of total consumption. By multiplying the change in the price by the NBR of a particular product, we obtain the change in welfare as a percentage of total consumption for a particular household. This model has been used widely to assess first-order welfare effects of changes in food prices (Simler 2010; Benson, Mugarura, and Wanda 2008; Ivanic and Martin 2008).

Yet one should ask if these models are appropriate for describing actual farmer behavior in times of high price volatility. These models are fairly static. They calculate each household's NBR on the basis of a cross-sectional survey and then simulate welfare effects by multiplying these ratios by actual or projected changes in prices. However, throughout an agricultural year, prices vary significantly. In addition, households may be net sellers at one point in time but become net buyers at another point in time. Hence, the actual welfare effects for a farmer that, for example, sells part of the harvest when prices are low and buys the product at another point in time when prices are high may be quite different from those found by just multiplying the average price change by the cumulative net position over time.

An additional concern relates to how rural farmers are connected to the wider economy. While market integration has been studied at a regional level, less is known on how rural farmers are connected to regional market centers. As is well established, the existence of transaction costs drives a wedge between the prices at which producers sell their products and prices at which consumers buy the product. In the light of seasonal market participation, this may mean farmers lose out twice. When farmers want to sell their product, a substantial part of the transaction cost may be passed to them. If farmers want to buy food, again, the bulk of the transaction cost may be borne by the farmer. The share of the transaction cost that is passed to the farmer will depend on his bargaining power. This in turn is dependent on a range of things, such as asymmetric price information, collusive middlemen, the farmer's impatience, the availability of substitutes for him to purchase and sell, and so on.

Figure 1.1 gives an overview of the main points we want to make in this paper. The data used to produce this graph come from a household level survey done in the Southern Highlands of Tanzania in 2007/2008. The left axis refers to the bar chart. As amounts harvested were much higher than amounts sold and bought, we express each as a percentage of the total. For example, the figure shows that 100 percent of maize in our sample was harvested before January 1, 2008, and about 28 percent was harvested in August 2007. We overlay the bar chart with time series of the prices of maize. Prices are expressed in Tanzanian shillings (TZS) per *debe* (20 liters; see right axis). We differentiate among three different prices. First, we recorded for each month the average price registered on the market in Mafinga, which serves as the regional market for the households in our sample. Second and third, we also calculated average prices in each month for purchases and sales of maize as reported by the farmers.

Figure 1.1—Maize harvested, sold, and bought



Source: Authors.

The first interesting feature shown in this figure is that amounts harvested, sold, and purchased varied significantly over time. The bulk of the harvesting occurred in August 2007. At this point in time, sales also started to pick up, but farmers kept selling up to January 2008. The bulk of purchases by farmers happened in February, March, and April 2008. If we look at the evolution of prices over this period, it becomes clear that the largest quantities of maize were sold in months when prices were low while the largest purchases occurred when prices were high.

A second interesting observation relates to the evolution of prices over time. Clearly, prices increased dramatically during the period under consideration, especially the regional market prices and local prices at which farmers bought maize. In the regional market, the food price crisis seems to have started in November 2007. Prices increased by 135 percent between August 2007 and April 2008, the times of the lowest and highest prices respectively. From May 2008 onward, beans started to get harvested, which took some of the pressure off maize prices. Over the entire agricultural year, the regional price increased by 80 percent. The mean price over this period was 5,020 TZS per *debe*, with a standard deviation of 1,560.

At the village level, the food crisis had an impact even earlier. In particular, local purchase prices started to go up from the point when harvested quantities started to decelerate and the first villagers started buying maize. The increase between the lowest (July 2007) and highest (January 2008) prices is even higher than in the regional market, at almost 140 percent. Both the mean and the standard deviation of the local purchase price are also higher than in Mafinga, respectively 6,120 and 1,590 TZS. On the other hand, while initially the price at which farmers sold was higher than both the central market price and the local price at which farmers bought, this quickly changed for the worse. From September 2007 onward, as maize purchases started to pick up, the price at which farmers bought was always highest. The price at which farmers sold did not seem to follow the upward trend as much. From February onward, it fell below the regional market price. Here the maximum increase, between July 2007 and January 2008, was only 44 percent. While the mean over the agricultural year was slightly higher than the mean price in Mafinga, the standard deviation was only 630 TZS.

A third interesting fact is that, although the village-level prices moved broadly in the same direction as the prices in the regional market, they were by no means equal. Clearly, the law of one price does not hold, hinting at the existence of substantial transaction costs between rural markets and the regional market of Mafinga. The fact that the prices at which farmers bought were higher than the regional market price may indicate that maize flowed from the regional market to the villages and farmers incurred the transaction cost. The fact that the average seller's price was for a large part of the agricultural year between the regional market price and the purchase price may be due to transactions that took place within the village. For instance, fellow villagers may know the regional price and how much it costs to transport, and adjust their reservation price accordingly.

Our main findings are in line with those of previous studies on the impact of surging commodity prices, in that especially the poorest farmers lost substantially from the food crisis. More importantly, we find that the losses to these poor farmers appear to be even higher when we explicitly model the timing of transactions and recognize that farmers may face different prices than the ones prevailing at a regional or national level. We also find that households vulnerable to intrahousehold inequality are likely to feel the crisis most. We also find that access to information and transport is inversely related to the loss from the maize price spikes in 2007 and 2008.

The remainder of this article is organized as follows. In the next section, we take a look at studies that are related to the present one in different ways. First, we review the literature that focuses on the impact of the 2007/2008 food crisis. Next, we look at studies that investigate smallholder farmers' behavior in terms of sales and purchases within a single agricultural year. Finally, we look at the literature on market integration. While going over these studies, we also explain why they are relevant in the context of our study. The next section presents our data and explains why we chose to concentrate on households within the Mufindi district. Next, we carry out a simple analysis to study the impact of the food crisis on the households in our sample and comment on how the results differ from approaches that disregard intraseasonal heterogeneity in buying and selling behavior and local market interconnectedness. Finally, we summarize our main findings and reflect on the importance of the results.

2. RELATED STUDIES

While global food prices have been increasing since 2003, there was a dramatic acceleration in 2007 and 2008. Among the factors primarily responsible for this were higher oil prices, the use of food crops for biofuel, increased meat consumption, poor harvests in certain agricultural regions, a depreciating dollar, export bans by key wheat and rice producers, and underinvestment in the agricultural sector in the past (Benson, Mugarura, and Wanda 2008; Mitchell 2008). From mid-2008 prices started to move downward, but in general they remain high and volatile. Currently, global food prices are near record highs again,[1] making studies that aim to assess the impact of high food prices particularly relevant.

Probably the first study on the impact of the 2007/2008 food crisis at the micro level is that of Benson, Mugarura, and Wanda (2008).[2] Using data from more than 7,000 Ugandan households surveyed over a 12-month period from the nationally representative 2005/2006 Uganda National Household Survey (UNHS), they determine whether households are net buyers or sellers to gauge the likely impact of the food crisis. They find that the poor only purchase small quantities of food from the market. This, coupled with the fact that Ugandans have a varied diet with prominent places for traditionally nontraded crops and a poor pass-through of world to local prices, leads the researchers to conclude that the impact should be small. As a follow-up to this study, Simler (2010) disaggregates by regions and individual food items, uses more recent price data, and estimates the impact on consumption poverty. He finds that both incidence and depth of poverty increased, by 2.6 and 2.2 percentage points respectively.

Wodon and Zaman (2009) show that rising food prices are likely to lead to higher poverty in Sub-Saharan Africa as the negative impact on net consumers outweighs the benefits to producers. However, most of their evidence is based on West African countries.

Stephens and Barrett (2011) look at seasonal variability in commodity marketing behavior. More in particular, they investigate the *sell low, buy high* puzzle. Realizing the large potential gains that can be made from intertemporal price movements, they argue that incomplete credit markets are to blame for this lack of arbitrage. Also, a recent study by Aksoy, Beverinotti, and Isik-Dikmelik (2010) recognizes that the net buyer/seller status may change over time. However, they track the net buyer/seller status using two points of a panel covering several years, while we want to specifically focus on the seasonal price variations.

A second feature often ignored by studies that aim to assess the welfare impact of price changes relates to market integration[3]. The NBR is often multiplied by a price change based on (an average of) prices collected in regional markets. For example, Simler (2010) uses prices based on six regional markets. However, these prices may be poor proxies for the prices that are actually used by the farmers.

These days, there are many studies on market integration in developing countries. This is due to the increasing availability of price series data in different markets at ever-higher frequency. Market information systems and famine early warning systems are the main providers for this data. Recent progress in econometric models appropriate for modeling spatial interconnectedness, like threshold autoregressive models and the parity bounds model, have also contributed to the increased attention to measuring market integration. Most of these studies in developing countries find that markets are integrated but that significant transaction costs are involved.

One limitation of these studies is that they concern regional market integration. The nature of the price series only allows integration to be judged between regional markets. Often, these regional markets are better endowed in terms of infrastructure than markets in rural villages. For example, most markets

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[1] For instance, in February 2011, the FAO food price index was at an all-time record high (236 points), while its cereal price index was at the highest level since July 2008 (FAO 2011).

[2] This study refers to an earlier multicountry study (Ivanic and Martin 2008). However, that study does not cover the climax of the crisis.

[3] In this study, market integration refers to how well spatially separated locations are connected to each other by arbitrage. In other words, market integration refers to the process where commodities from an excess supply location are shipped to an excess demand region. If markets are well integrated, prices will adjust to each other. If this is not the case, large price differences for the same commodity may persist.

studied by Van Campenhout (2007) are connected by paved roads. Much less is known about how well rural communities are connected to regional markets.

But why is this important? Because even if markets are integrated, the existence of transaction costs makes seasonal market participation costly for the farmer.

Assume the price of an agricultural crop in a village is p_R and the price of this same crop in the regional market is p_C. We will start by assuming excess supply in the rural market and excess demand in the regional market, such that $p_R < p_C$, and so profit can be made by shipping the crop from the village to the regional market. The increased demand by the traders in the village will drive up p_R, while the increased supply in the regional market will increase supply, reducing p_C. The traders will keep trading until no profits can be made, that is, until $p_R = p_C$.

With seasonal market participation, it is possible that the direction of trade reverses. For instance, during the lean season, stocks may be depleted and farmers may need to buy agricultural produce to meet their basic needs. If there are no transaction costs between the two locations, the equilibrium condition will remain the same. The farmer will be able to buy at $p_R = p_C$. In other words, the farmer only faces a price risk, in that the price may have changed over time.

Now we introduce a positive transaction cost for moving one unit of the crop from the village to the regional market, T. We know from the literature on regional market integration that the existence of transaction costs results in a region of price differences where no trade is taking place. Now, traders will only make a profit if $p_R + T < p_C$. In other words, farmers that want to sell are forced to sell below $p_C - T$.

We now also assume seasonal market participation. We assume that farmers sell immediately after harvest and buy back later. Because of the transaction cost, the farmer cannot buy at price p_C but also incurs the transaction cost ($p_C + T$). One may argue that the farmer need not incur the transaction cost, as he can decide to buy from the local market p_R. However, one has to keep in mind that a rational seller will only sell at $p_R \geq p_C + T$. In sum, apart from the price risk, the farmer now also faces transaction costs.

3. CONTEXT AND DATA

We interviewed 1,134 small-scale farmers on their maize production and maize-related transactions over the entire 2007/2008 agricultural year. We decided to draw our sample from the Mufindi district. Rural households living in the semiarid lowlands of Mufindi district mainly depend on semisubsistence smallholder farming to provide for their livelihood. Most households keep small livestock to supplement their diet or for trade. Some keep small herds of cattle as savings, for milk, or for trade. Other activities include crop trade, petty trade, brick or charcoal production, seasonal labor, and beer brewing. Agricultural production is primordially based on rainfed cultivation with the use of rudimentary technology and minimal inputs.

Mufindi district is located in Iringa region in the Southern Highlands of Tanzania. The area is known as an important maize-producing area. Mufindi is mountainous, with one of the coolest and rainiest climates in Tanzania. The district capital is Mafinga, which lies on the Tanzam Highway, an important tarmac road that runs from Dar es Salaam to Zambia and Malawi. About 70 kilometers to the east of Mafinga along the Tanzam is the regional capital, Iringa. At about the same distance in the other direction lays Makambako, a small trading town where the railway passes.

Within the district, we chose seven villages such that our sample would be representative for the region. More in particular, to reflect the geographic diversity of the region, we chose some villages in lower, dryer areas; some on the Mufindi plateau; and some in areas marked by high hills and narrow valleys. In addition, we also selected on distance to the regional market (Mafinga) as well as on the quality of the road connecting the villages to this market. Within each of these villages, we sampled farmers randomly, the number of individuals proportional to the share of farmers in the village in the total sample. The villages were Ibwanzi, Ikongosi, Ipilimo, Kwatwanga, Mtambula, Mtili, and Nundwe. Table 3.1 below presents summary statistics for the continuous variables we will use in the analysis in the next section.

Table 3.1—Summary statistics

		mean	standard dev	min	max
Net benfit	agg - MI	43600	157144	-917400	2036000
Net benfit	disagg - MI	27200	134739	-746800	1502000
Net benfit	agg - no MI	47260	177319	-1086000	2272000
Net benfit	disagg - no MI	40840	176198	-874500	1950000
NBR	agg - MI	-0.06	0.76	-9.18	1.36
NBR	disagg - MI	-0.14	0.74	-7.26	1.33
NBR	agg - no MI	-0.08	0.89	-10.86	1.51
NBR	disagg - no MI	-0.15	0.95	-10.39	2.42
	log value harvested per capita	10.17	0.97	7.68	14.48
	log farmsize per capita	-0.35	0.71	-2.64	2.57
	log cattle per capita (TLU)	-3.15	2.09	-8.39	1.57
	education (years)	5.18	3.02	0.00	13.00
	household size	5.60	2.59	1.00	22.00
	children/hhsize	0.45	0.21	0.00	0.88
	women/hhsize	0.30	0.17	0.00	1.00
	(women+children)/hhsize	0.75	0.17	0.00	1.00

Source: Authors.

4. ANALYSIS

Total maize production in our sample over the 2007/2008 agricultural year amounted to about 1,068 tons. Of this, only about 200 tons entered the market. About 61 tons of maize was bought by farmers over the entire period. Most farmers who reported sales only sold once (88 percent). This is remarkable, given the high seasonal variation of prices as well as the high variability in amounts produced (mean 0.9 tons and a standard error of 1 ton) and sold (mean 0.17 tons and a standard error of 0.53 tons). In addition, most sales occurred immediately after the harvest. By the end of October, before the price in Mafinga started to go up, 77 percent of the quantity of maize sold was already put on the market. In contrast, in October 2007, only 30 percent of total quantity bought had been purchased already.

Let us now look at the data more closely. First, we find that the majority of farmers in our sample, about 35 percent, appear to be self-sufficient for maize. These farmers reported not a single transaction. In comparison with what is usually found in similar studies, this is very high.[4] About 31 percent of the households bought only; they reported at least one transaction. This is also different from the usual finding, as most studies find that the majority of households are likely to be only buying maize. A further 27 percent of our households reported only selling maize. A remaining 6 percent reported both sales and purchases of maize.

Summing over the entire sample, we find that the food crisis benefited farmers in Mufindi district. If we multiply the net position in quantities of maize of each household at the end of the agricultural year (July 2008) by the average price over this period, and then sum over all households in our sample, we obtain a figure of about TZS 32 million. This amounts to net exports of about 400 tons of maize grain. If we disaggregate net positions over the different months and evaluate them at market prices, the gains are much smaller: only about TZS 20 million.

To get an idea of how gains and losses are correlated with other continuous variables, we followed standard practice in the literature and ran nonparametric regressions between NBRs and various continuous variables. However, we use a slightly different definition of the NBR. We decided to express net benefit as a share of the total value of maize harvested by the farmer instead of total consumption expenditure[5]. We decided also to only include farmers that participated in the market.[6]

Figure 4.1 shows four panels. The first panel plots out the NBR against the log of the value of the amount of maize harvested per household member. The second plots the same against the log of acres of land per capita, while the third looks at correlation with total livestock units per capita. Finally, the fourth panel plots the NBR as a function of the number of years of education attained by the farmer who does the transaction.

Each panel shows four nonparametric regression lines,[7] corresponding to the different assumptions made when calculating the net position of the farmer. The solid line is the most restrictive

[4] For instance, Benson, Mugarura, and Wanda (2008) find that for staple foods in Uganda two years earlier, only 14 percent of households had sales similar to purchases. Note that our definition is narrower than theirs, as we only consider situations where purchases are equal to sales and zero. Minten and Barrett (2008) find only 7 percent of households in Madagascar are self-sufficient for rice. Jayne, Zulu, and Nijhoff (2006) find that in Kenya only 8 percent of households do not participate in the maize market. However, these percentages are much higher in Mozambique (24 percent) and Zambia (39 percent). The authors attribute this to the fact that in these regions, cassava is the main staple.

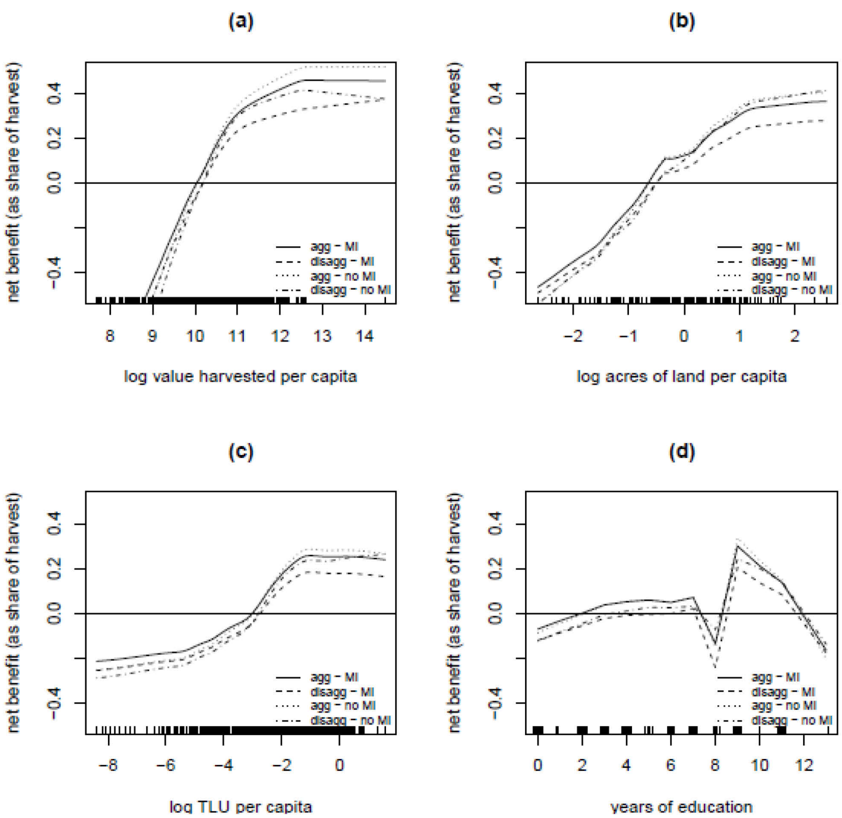
[5] The fact that net benefit is usually scaled by total consumption expenditure is due Deaton (1989). In his data, he did not have records of sales and purchases. Instead, he interpreted all production in excess of consumption as sales and all consumption in excess of production as purchases. Hence, in his equation, total consumption and total production of the commodity under investigation appeared. Dividing these by total household consumption led to a familiar concept, namely the budget share of the commodity under study. Since have data on sales and purchases of maize, we do not need total consumption in our equation. We thus thought it would be more informative to express net benefit as a share of the value of maize at the time of harvest.

[6] Deaton (1989) notes that in his case, adding or deleting the farmers with an NBR of zero does not influence the results. In our case, since we have a substantial share of farmers that do not participate, including them will make the lines flatter. However, it will not affect the relative position of the different lines within each graph.

[7] More in particular, we use locally weighted polynomial regression as implemented by the R lowess function (Cleveland 1981). The reason why we deviate from standard practice to use a kernel average smoother is that locally weighted

one, which we will call the *aggregated—market integration* case. Here we simply calculate the net position at the end of the agricultural year and multiply this by the percent change of the central market price in Mafinga over that year. The dashed line disaggregates the net position over time but still assumes local farmers buy and sell at central market prices. We call this the *disaggregated—market integration* case. Here, we calculate the net position of the household for each month and evaluate it at that month's central market price. The dotted line again shows the cumulated net position, but this time we multiply by the percent change of the average local price. As there is a considerable gap between prices at which maize is sold and at which it is bought at the village level, we differentiate between sellers and buyers prices. We multiply cumulated sales by the increase in the price farmers report for their sales prices and multiply cumulated purchases by the percent change farmers report for their purchases. The net value of this calculation is called the *aggregated—no market integration* case. Finally, the dash-dot line represents the least restricted scenario, the *disaggregated—no market integration* case. Here, we calculate the NBR by evaluating the amounts sold or bought at reported prices received or paid by the farmer in the respective month.

Figure 4.1—Net benefit ratios and welfare



Source: Authors.

The first panel, (a), in Figure 4.1 shows the correlation between the logarithm of the value of the maize harvest per capita and the NBRs. We learn that the households at the bottom end of the distribution are likely to be hurt more by the food price crisis. For instance, for households that harvest little maize per capita, say less than TZS 22,000—log(10)—the NBR becomes negative. The amounts are substantial: For a household that harvests about TZS 8,000 per capita—log(9)—the loss is equivalent to more than 40

regressions are better at estimating functions at the boundaries. Since we are especially interested in the effect for the poorest and the richest, we believe locally weighted regressions are more useful.

percent of the value of maize harvested. For households at the upper end of the distribution, those that harvest more than TZS 170,000 per capita—log(12)—the NBRs appear to level out at about 40 percent of the value of maize harvested. It is also interesting to note that the aggregated—market integration case is always higher than the other scenarios for farmers that lose from the food price crisis. As such, this scenario underestimates the losses incurred by net selling households from the food crisis and overestimates the gains to net sellers. The one exception is when we use the aggregated—no market integration case. For farmers who are net sellers of maize, the gains are higher in this scenario, as the local price for maize sales is higher than the market price. In sum, especially for the poorest farmers in terms of maize production, the losses incurred increase substantially when one considers local prices and allows for differences in timing of maize transactions.

In panel (b), we consider a measure of wealth based on land access. As in panel (a), we take logs after controlling for household size. We again find an upward-sloping pattern of the net benefits, but this time it is less steep. For households that have only about 0.13 acres of land per capita, the loss is also equivalent to about 40 percent of the value of maize harvested. While as in the previous panel, the least restrictive way to calculate the NBRs shows larger losses when farmers are net buyers, we now observe that the restrictive measure underestimates the gains for net sellers. Put differently, our analysis suggests that the food crisis will increase inequality more than what is suggested by studies that only look at aggregated marketing behavior and prices.

Panel (c) assesses wealth in terms of livestock holdings. One self-insurance strategy often observed in the face of a covariate shock like the food crisis is to use savings as a buffer stock (Deaton 1991). Livestock may be an obvious asset to use for this purpose, since it has a positive return (Verpoorten 2009). We aggregate livestock assets in tropical livestock units (TLUs). For a household of average size (5.6 members), the NBRs become positive at about 0.5 TLU. This is interesting, as a value lower than this would be typical for a household that only has small animals. In the last panel, (d), we also look at the correlation between years of schooling and the NBR. While the pattern is not monotonous, farmers with no education seem to lose out from the 2007/2008 maize price increase. For both of these last panels, the restrictive method to calculate the benefit ratios again underestimates the losses we find when we disaggregate over time and space.

It is argued that the welfare impact of a food crisis may differ across members within the household. Although the degree varies across countries and regions and by household characteristics (Quisumbing 2003, 118), often children and women are most at risk. While conclusive evidence on the individual impact is impossible with household-level data such as what we have, we can get a sense of this impact by looking at household demographics. If we find that it is particularly households with relatively more women, children, or both that have lower benefit ratios, this should alert us that the impact of the crisis may be particularly bad for some.

In Figure 4.2 we plot net benefit as a share of total maize production against different measures of dependency. In the first panel, we simply correlate net benefit with total household size. It is clear that the impact of the food crisis becomes negative if households exceed seven members. As in Figure 4.1, we plot four regression lines corresponding to our four cases. Also here, we see that the aggregated case that assumes full integration between rural areas and the regional market center underestimates the negative impact on large households. The impact in terms of the share of total maize produced almost doubles if one allows for disaggregation of sales and purchases over the agricultural year and accounts for price differences between rural areas and regional trade centers.

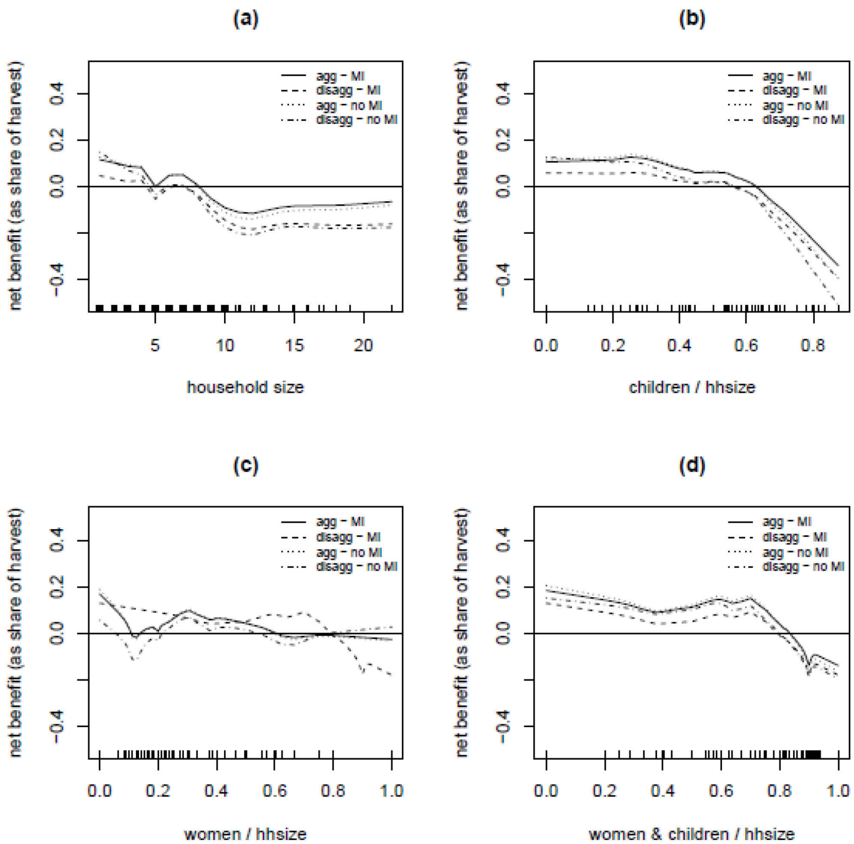
The second panel, panel (b), plots benefit ratios against the share of children within total household size. This can be thought of as a child dependency ratio.[8] When more than 60 percent of the household members are children, we see that the impact of the food crisis becomes negative. Also here, we see that the aggregated—full market integration scenario substantially underestimates this negative impact. Households composed of something between 20 and 60 percent children, on average, benefit

[8] In fact, child dependency ratios are defined as the ratio of the number of children over the active members within the household, which can become larger than one.

from a price increase, but the effects are overestimated by the aggregated—full market integration method. When households move in the direction of childless, the aggregated—full market integration case underestimates the impact.

The third panel, (c), plots benefit ratios against the share of women within total household size. This gives us an idea of whether households with relatively more female members are more or less likely to benefit from high food prices. While the pattern is less clear than in the previous case, there seems to be a slight downward trend, indicating falling benefits from a price rise as the number of women as a share of total household size increases. The last panel, (d), combines the latter two assessments.

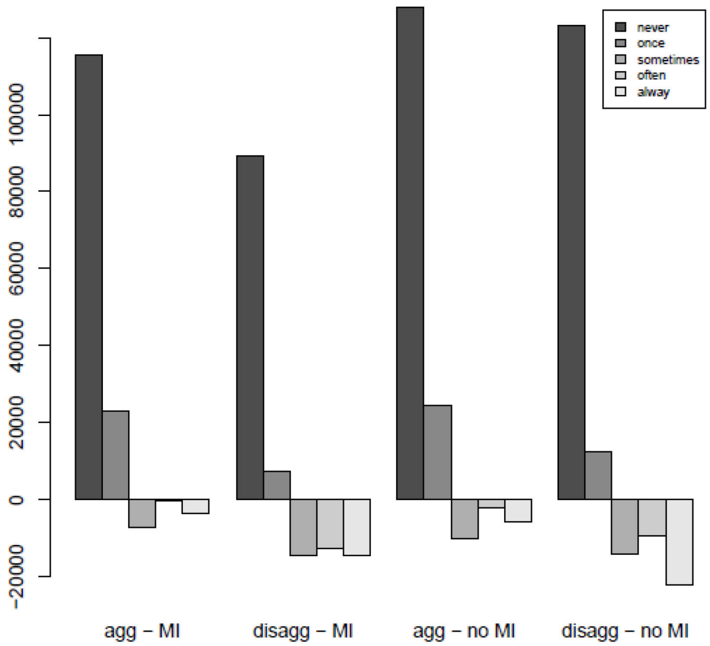
Figure 4.2—Net benefit ratio and household composition



Source: Authors.

Let us now have a look at average losses and gains by a qualitative variable. Figure 4.3 splits up the households into different categories depending on their food security status. There were five possible answers to the question on how often the household experienced food problems over the last agricultural year, ranging from *never* to *always*. We see that for households never experiencing food problems, about 260, the average gain from market participation is large and positive. These farmers seem to gain most from exploiting the price difference between their location and the regional market. The fact that the disaggregated—no market integration scenario shows a slightly lower gain means that, on average, farmers lose some of the potential gains from beneficial local prices because of their inability to take advantage of intertemporal arbitrage. This loss of potential benefits becomes much larger for farmers reporting a food problem once during the last year. When farmers report being sometimes insecure, the benefit turns into a loss. Most of this loss stems from seasonal price variation (that is, sell low, buy high, or both). Farmers that are always food insecure suffer from both seasonal price variation and adverse local prices.

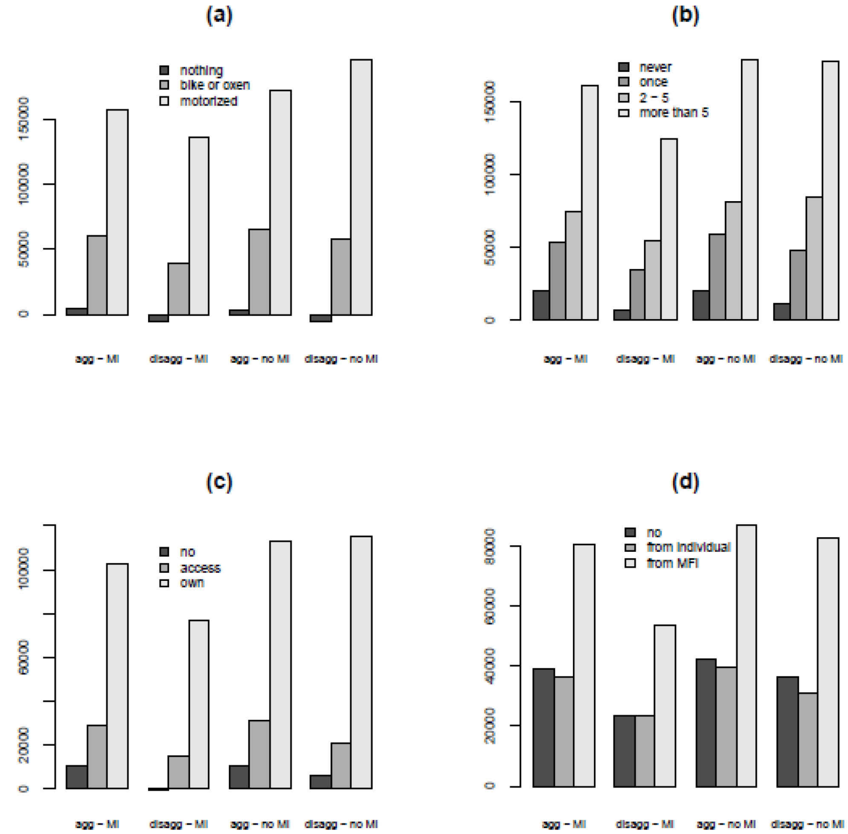
Figure 4.3—Average gain or loss by food insecurity category



Source: Authors.

Figure 4.4 presents average net gains or losses by some other interesting categorical variables. For instance, one factor that will affect a farmer's potential to exploit spatial and temporal price variation to his advantage is his access to transport. We therefore grouped the households into three categories: those that own no means of transport, those that own at least one bicycle or an ox and a cart (nonmotorized), and those that own a car (sedan, pickup, or truck). Panel (a) of Figure 4.4 gives mean net benefits or losses from the food crisis for the four different ways of calculating the impact. For those that can only walk, it seems that the average loss should be mainly attributed to their inability to sell, buy, or both at the right time. Those who have at least a bicycle or an ox and cart win from the food crisis. While they, on average, win from intertemporal arbitrage, they seem to exploit spatial price variations even better. The ones with motorized transport seem to be able to exploit both spatial and intertemporal price differences.

Figure 4.4—Average gain or loss by selected categorical variables



Source: Authors.

Information, and especially price information, is also an important factor that will affect losses or benefits from price changes over time and space. We correlate NBRs with two proxies: the number of visits to a town (categorized) and mobile telephone access (no telephone, access to a telephone, ownership of a telephone). Panel (b) shows that every household wins on average, but the gains increase with the number of trips made to town during the last month. Those who stayed in the village seem to be able to profit from spatial price variation, but this profit is reduced by the inability to sell or buy at the right time. The more farmers visit the market, the less this adverse effect seems to matter. Panel (c) shows that people who don’t have access to a mobile telephone cannot exploit seasonal price variability, although eventually they also profit from the food crisis. Those who only have access to a mobile telephone are able to engage in some profitable intertemporal arbitrage, but overall the gains would be bigger if we disregard intertemporal price variation. Farmers that own a mobile telephone profit from both intertemporal and spatial price variation.

Finally, access to credit may also be important, especially for intertemporal arbitrage. Panel (d) divides the farmers into those that received no loan, those that received a loan from another institution, and those that received a loan from a microfinance institution. Overall, farmers do not seem to use their loans to engage in intertemporal arbitrage. In fact, the evidence suggests that poor timing of sales, purchases, or both reduces the potential gain from local prices, regardless of receiving a loan and from whom this loan came.

5. CONCLUSION, SIGNIFICANCE, AND POLICY RECOMMENDATIONS

In this study, we look at how the 2007/2008 food crisis affected a sample of semisubsistence farmers in a maize-producing area in the Southern Highlands of Tanzania throughout the agricultural year. Unlike other studies that try to assess the impact of the food crisis, we pay specific attention to the timing of households' sales and purchases over time. In addition, we depart from the implicit assumption made in most studies that rural households face the same prices as the prices prevailing at more aggregate levels (regional, national).

We find that poorer households lost substantially from the 2007/2008 food crisis. More important, we find that studies that do not properly account for seasonal price variability and differences between regional market prices and local prices tend to underestimate the negative impact of rising food prices. We also find that larger households tend to benefit less from price increases than do smaller ones. Especially households with lots of children and few adults experienced sizable costs due to the increased food prices during the 2007/2008 crisis. Since women and children are likely to be most at risk from adverse price shocks, this indicates substantial problems in terms of food and nutrient intake that are not reflected in household-level analysis.

While this paper is limited in geographical scope and only looks at first-order effects, we feel it is nevertheless important. Recently, food prices have been reported to be on the rise again, reaching levels reminiscent of the 2007/2008 crisis. Therefore, studies that aim to assess the impact of these price crises continue to remain relevant. These studies underline that it is important to look beyond the average effects, as some households will gain from higher food prices and some will lose from them.

With respect to the narrow geographical focus of this study, we strongly feel that the points made in this paper are relevant in other areas as well. There is no reason to believe that the reported large seasonal price variations do not occur in other regions. Indeed, Sahn (1989) reports that regular, sharp seasonal price fluctuations are a common characteristic in many developing countries. Likewise, there is no reason to believe that rural markets are better integrated in the wider regional economy in other areas. The factors that affect market integration are shared throughout the developing world, and various other studies report sluggish market interconnectedness in several regions and countries (for a review, see Minot 2011).

Another limitation concerns the fact that we only study first-order effects. For instance, one could argue that the effects would be less dramatic in the long run due to the increase in the price elasticity of the wage rate to the price of staples (Ravallion 1990). However, Rashid (2002) argues that this elasticity is low. Even more, Christiaensen and Demery (2007) also estimate the second-round effects of a price change on agricultural productivity. They find that this effect is negligible and conclude that higher food prices are likely to increase poverty, even after taking wage and productivity adjustments into account.

As these sharp seasonal price fluctuations seem to be a regularity, consumption credit would seem to have a key role to play here. Although we do not observe the *sell low, buy high* strategy very often, it is striking that most households sell at a price that is very low compared with what they could get in a not-so-distant future. Given these substantial forgone benefits, microfinance institutions should be less hesitant to approve consumption loans.

In addition, in time of a food crisis, the inability to smooth consumption may have lasting impacts. If households start to deplete productive assets to assure meeting their consumption needs, this may take them to a point where productive assets are too low to recover from this shock. This suggests that having appropriate insurance mechanisms in place might be a more efficient way to ensure food safety in the long run than imposing export bans.

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