The Effect of Refugee Inflows on Host Communities: Evidence from Tanzania

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Despite the large and growing number of humanitarian emergencies, there is little economic research on the impact of refugees and internally displaced people on the communities that receive them. This analysis of the impact of the refugee inflows from Burundi and Rwanda in 1993 and 1994 on host populations in western Tanzania shows large increases in the prices of nonaid food items and more modest price effects for aid-related food items. Food aid is shown to mitigate these effects, though its impact is smaller than that of the increases in the refugee population. Examination of household assets suggests positive wealth effects of refugee camps on nearby rural households and negative wealth effects on households in urban areas. JEL codes: O12, O13, F22, R23, R12

Each week seems to bring news of more humanitarian crises. In 1980, there were 5.7 million refugees and internally displaced persons worldwide; at the beginning of 2005, there were 9 million. The burden of refugees and internally displaced persons falls on the poorest countries. Almost 3 million refugees were in Sub-Saharan Africa in 2005, home to 23 percent of the world's internally displaced persons (UNHCR 2004). This article turns the spotlight on the millions uncounted in statistics: the hosts.

In addition to hosting more refugee camps than any other country, Tanzania has been the destination of two very large population flows: Burundian refugees in 1993 and Rwandan refugees in 1994. The unexpected nature and size of these population movements generate a natural experiment that allows their effects on prices and household wealth in the western Tanzanian regions hosting the refugees to be examined.

Despite the prevalence of humanitarian crises, little research has been conducted on their impact on local economies. Williamson and Hatton's (2004) literature review reveals considerable work on the determinants of population displacement—usually civil wars (Collier and Hoeffler 1998; Hatton and Williamson 2002)—as well as on how policies in Europe and the United States have affected the direction of human flight from conflicts in developing economies. There is little mention of the effects of these crises on the refugees and internally displaced persons directly or on the communities that receive them. The exception to this trend is a recent paper by Baez (2008) that shows a substantial negative impact on health outcomes of residents living close to refugee camps in the Tanzanian region that hosted most of the refugees from the Burundian and Rwandan crises.

This article focuses on one facet of this complicated issue: the impact of refugee camps on prices in nearby markets. This interaction has received attention from development practitioners and other social scientists, with contradictory conclusions. Borton, Brusset, and Hallam (1996) and Whitaker (1999) discuss large price spikes and suggest that local populations suffer from these events. On the other hand, Landau (2002) compares a market near the refugee camps in Tanzania with one in the central part of country and finds little evidence of any impact on prices.

Two strains of literature inform the design of this study. The first is the incentive effects of food aid, and the second is the impact of immigrant flows on prices in recipient countries. Barrett (2001) thoroughly reviews the effects of food aid on local prices. The empirical results have been mixed, with much of the research focused on food for work programs rather than on free food, which is the situation in humanitarian emergencies.

Early research has shown that effectively targeted food aid, as in India, has increased consumption by the targeted population, with little or no effect on domestic food prices (Maxwell and Singer 1979; Singer, Wood, and Jennings 1987; Ruttan 1993; Insenman and Singer 1997). More recent work by Dercon and Krishnan (2004) finds food aid targeting in Ethiopia quite imperfect. Abdulai, Barrett, and Hoddinott (2005), also using data from Ethiopian households, present no evidence that households lower food production in the presence of food aid and find suggestive evidence that they increase it.

The source of the aid—foreign or domestic—is key in determining its effects on the market. Theory suggests that foreign-supplied aid is likely to depress prices, while increases in domestically produced aid could increase prices. Simulated effects of different food policy approaches in India by Binswanger and Quizon (1988) confirm this intuition. In sum, research finds that whether the supply side shock of food aid in developing economies results in local price effects depends on how the aid is targeted and where it comes from.

Food aid is only one possible impact of refugee flows. Another—the population increase—can change local prices through increased demand for goods and increased supply of inexpensive labor. Immigrant movements and their

subsequent effects on host countries are topics of considerable research, usually related to labor market outcomes (Borjas 1987; Card 1990; Cortes 2005), which are not analyzed directly here. The research has shown that immigrant inflows can have either positive or negative impacts on local populations, depending on the context. Recent work by Lach (2007) finds that the movement of refugees from the former Soviet Union to Israel in the 1990s resulted in falling prices and attributes this effect to greater price sensitivity among immigrants, who have not established the store and brand allegiance of the native population and are likely to search more intensively for lower prices.

This article uses variations in refugee population and food aid over time to examine the impact of proximity to refugee camps and aid on prices of Tanzanian agricultural goods. The estimates show increases in the prices of most goods in markets closer to refugee camps as a result of the refugee inflows, though the effect is much larger for Rwandan refugees than for Burundian refugees. The differences in the effects are explained by variations in the diets of the two groups as well as by the nature and magnitude of the two crises. Food aid in the form of maize and legumes depresses the prices of these crops but does not appear to affect nonaid crops. This result is particularly strong in the short run. Suggestive evidence that rural residents living near the refugee camps may have benefited from selling home-produced agricultural products is also discussed. On the other hand, because urban households are more likely to be purchasing agricultural goods for consumption, they experience negative wealth effects.

The article is organized as follows. Section I provides background on the Tanzanian situation in 1993–94. Section II presents a framework for understanding the effects of the refugee inflow on prices. Section III describes the data. Section IV details the identification strategy and gives results from the analysis of agricultural prices. Section V discusses potential welfare effects. And section VI discusses the implications of the findings and suggests directions for future research.

I. Tanzania in 1993–94

With a GDP per capita in 2007 of about $350, Tanzania is wealthier than Burundi ($101) and Rwanda ($271) (World Bank 2009). Tanzania has a long history of accepting migrants from across Africa, and its population is known to be friendly and accepting of foreigners. Though refugee flight to Tanzania, largely from Burundi, has occurred since the 1970s, this study focuses on the largest of the recent arrivals, those in 1993 and 1994. Kagera and Kigoma, the Tanzanian regions hosting most of the refugees, have high rates of poverty, with 35–40 percent of residents living below the poverty line. In 2000, out of the 20 mainland regions, Kagera ranked 11th and Kigoma ranked 7th in poverty (Mkenda and others 2004). Both regions heavily depend on

MAP 1. Camps and Markets in Tanzania, 1993–94
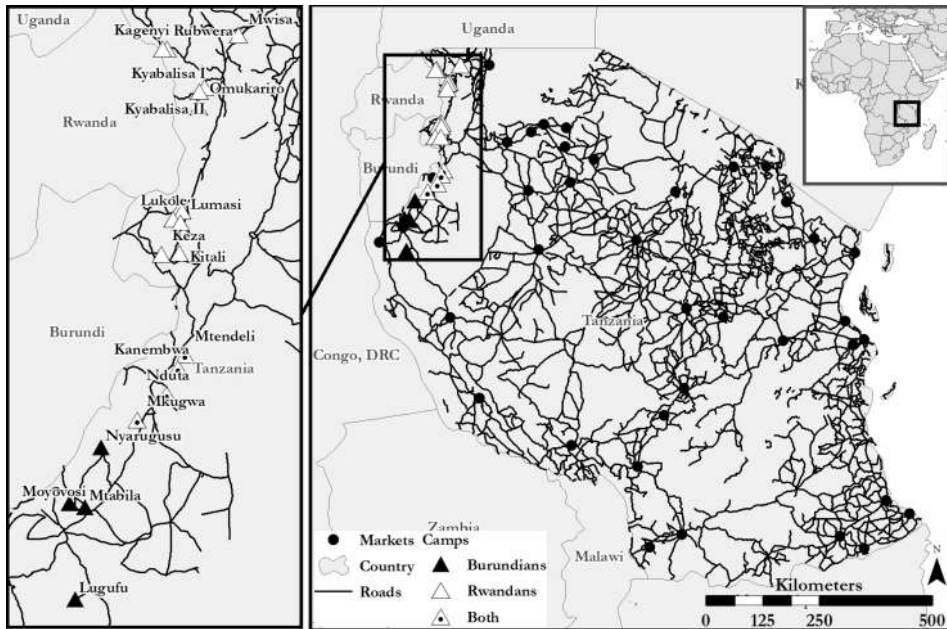
Source: UNHCR Environmental Database 1996; Reliefweb 2005; USAID 2004.

agricultural income, with about 80 percent of their regional GDP from agriculture (Tanzania Ministry of Agriculture and Food Security 2006).

The timeline of events is as follows. On October 21, 1993, the first elected president of Burundi, Melchior Ndadaye, a Hutu, was assassinated in a bloody coup led by Tutsi soldiers. Some 700,000 Hutus fled the country, many to western Tanzania. The initial influx of Burundians into Kagera and Kigoma, reported at 245,000, rose to more than 300,000 within a month (SCN 1993–98). Until 1993, refugees had largely been assimilated into Tanzanian villages. The 1993 and 1994 crises led to the construction of large refugee camps, a network of food distribution facilities, the sudden presence of multiple international agencies, and the beginning of the Tanzanian government's policy of separating the refugees from the local population (Landau 2002). Map 1 shows the road networks, location of refugee camps, and major markets in Tanzania. According to Jaspers (1994), the location of the camps was dictated by the Tanzanian government in cooperation with the International Committee of the Red Cross and the United Nations World Food Programme. Camp locations were likely chosen to facilitate the provision of food aid but were also determined by the ability of the refugees to reach them; all were within 40 kilometers of the border (Whitaker 1999).

On April 6, 1994, just as many of the Burundian refugees were preparing to return home, the presidents of Burundi and Rwanda died in an airplane crash,

FIGURE 1. Refugees in Western Tanzania, 1993–99
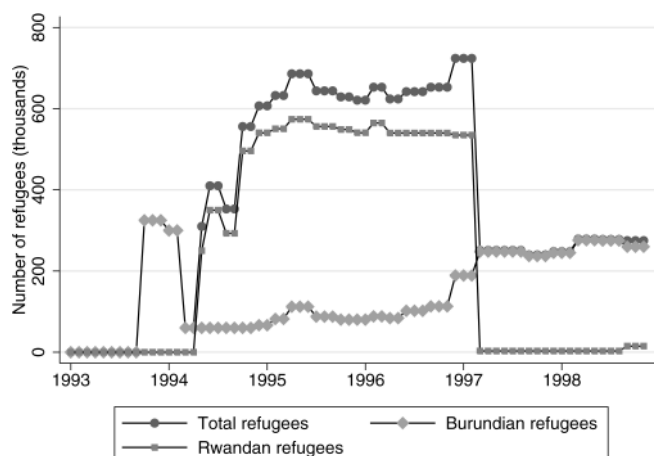
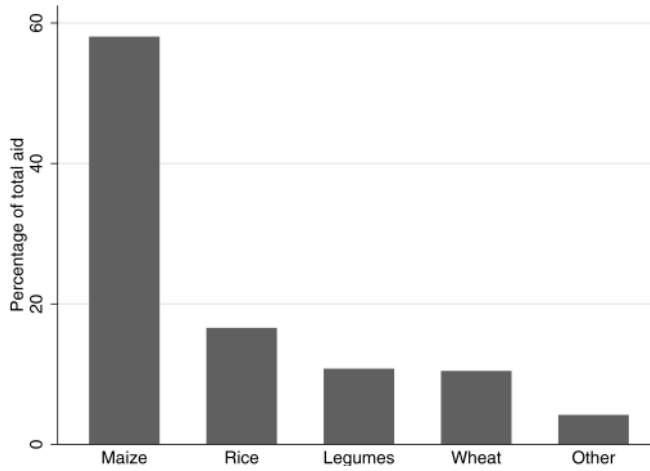
Note: Data are reported every three to four months.
Source: SCN issues 1–25.

sparking genocide in Rwanda, with 500,000–1 million people slaughtered. In a 24-hour period on April 28, nearly a quarter of a million Rwandans flooded into northwestern Tanzania's Ngara district in Kagera (UNHCR 2000). The UN Refugee Agency has called the Rwandan influx the largest and fastest movement of refugees in modern history. In 1998, the UN Office for the Coordination of Humanitarian Affairs estimated the local population of the refugee-affected regions at about 1.3 million (UNOCHA 1998). According to the United Nations Children's Fund, refugees totaled as much as 39 percent of the population in Ngara district in Kagera and Kibondo district in Kigoma (UNICEF 2000).

UN estimates of the total refugee load in western Tanzania are produced every three to four months (figure 1), based on estimates by the managers of the refugee camps used for calculating food requirements. Although data quality is uncertain, the population counts are usually revised downward, suggesting that estimates exceed the actual number of refugees.

Anecdotal evidence suggests that the Rwandan refugees were relatively wealthy, especially compared with the Burundian refugees, having brought cash and other assets used to trade (Borton, Brusset, and Hallam 1996). The main source of food in the camps was maize or maize flour, which generally constituted 83 percent of the cereal distributed to refugees, with sorghum or rice making up the other 17 percent. The World Food Programme supplied 75 percent of the aid, the International Committee of the Red Cross, 22 percent. Most of the food was imported through Mombasa or Dar es Salaam, but 23,000 tons of maize and legumes given to refugees were produced in Tanzania (of the country's 270,000 tons total) from April through the end of

Figure 2. Food Aid to Tanzania, by Type, 1992–98

Source: SCN issues 1–25; WFP/INTERFAIS 2008.

Figure 3. Number of Refugees and Total Food Aid to Tanzania, 1992–98
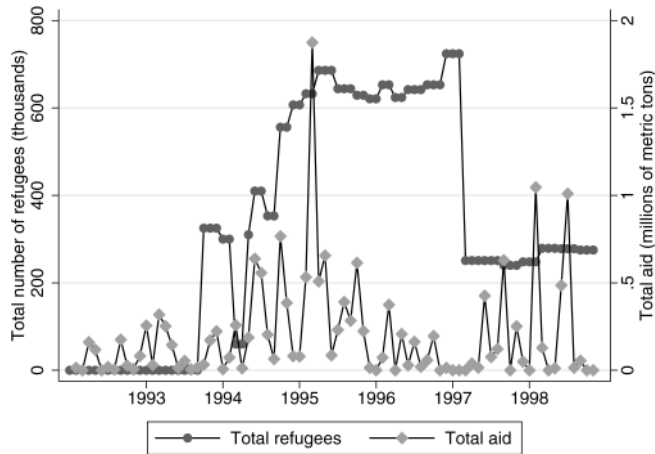
Note: Data are reported every three to four months.
Source: SCN issues 1–25; WFP/INTERFAIS 2008.

1994. Tanzania's 1994–95 National Agricultural Census shows total production of maize in Kagera and Kigoma at 68,400 tons (Tanzania Ministry of Agriculture and Food Security 2006).

Most aid sent to Tanzania came as maize or maize products and legumes (beans, lentils, and peas), although rice and wheat deliveries were not insubstantial (figure 2). Food aid was arriving in Tanzania before the Burundian and Rwandan crises (figure 3). Its destination is unclear, but the lack of refugee camps in western Tanzania suggests that the most likely destination was food

for work programs or camps on the southern border. The aid clearly increased in response to the Rwandan crisis and stayed high even after many refugees had returned home. Other forces were likely determining the flow of aid, and potential sources of endogeneity to local prices are investigated below.

According to Whitaker (1999), refugees typically sold about 75 percent of their food rations. Jaspers (1994) found that maize was a particularly popular food for Rwandan refugees to sell in order to purchase plantains, cassava, and sweet potatoes. They "generally preferred their own staples of cassava, cooking bananas, and sweet potatoes, which were also produced by local farmers. Refugees therefore used a variety of strategies to gain access to these foods, including trading, purchasing, and stealing. With this huge increase in the market for local crops, the prices of foods such as cassava and especially cooking bananas [plantains] skyrocketed (p. 3)."

II. Theoretical Framework

This section presents a simple framework for analyzing the local price effects of population displacement and of the subsequent flows of aid. A large inflow of refugees and aid implies both supply side and demand side effects on the market. On the supply side, food aid increases the amount of aid-related goods available, which may put downward pressure on prices if the food aid is imported and upward pressure if it is provided locally. The percentage of food aid purchased in Tanzania is small relative to the total aid provided (10 percent of World Food Programme provisions), but the amount is substantial given local production capacity.

The population increase results in increased demand for all goods. These pressures can substantially change the prices of tradable goods only when trade with areas outside affected regions is limited. The model below assumes that transaction costs prohibit immediate price adjustment through the inflow of goods from other regions or countries—not unreasonable in western Tanzania, with its limited range of substitute goods and high transaction costs that may result in much more localized price effects. Kahkonen and Leathers (1999) indicate that such costs in Tanzania are due to "movement restrictions, infra-structural impediments, limited access to credit, lack of storage capacity, and contract enforcement problems" (p. page 57). They cite a 1990 World Bank study that concluded that only 24 percent of Tanzania's paved roads were in good condition, with the remaining poor or fair. Only 16 percent of maize farmers live within 5 kilometers of a market where they can sell their product, and prices of maize and cotton (the two crops considered in the study) vary considerably by city. Some 30–40 percent of maize produced in Tanzania is lost due to a lack of on-farm storage every year, and only one farmer of the 139 interviewed by Kahkonen and Leathers reported having obtained credit.

The inflow of refugees may also depress wages, which may result in falling prices where labor is an important agricultural input. Although the government

of Tanzania has restricted refugees' ability to seek employment, there is substantial anecdotal evidence that they do so nonetheless (Jacobsen 2005).

The model is formalized as follows. Suppose that households have concave utility functions dependent on their consumption of aid goods, x_a, and nonaid goods, x_n. They also have simplified budget constraints, with the sum of spending on consumption of all goods equal to income: $p_a x_a + p_n x_n = m$.[1] Refugee population income, m_r, is assumed to be different from that of the host population, m_h: $m_r \neq m_h$.

The maximization of $u(x_a, x_n)$, subject to $p_a x_{ak} + p_n x_{nk} = m_k$ with $k = r, h$, yields household demand functions of

$$(1) \qquad\qquad x_{ik}^d(p_i, p_j, m_k)$$

where $i, j \in a, n$ and $j \neq i$.

The concavity of the utility function produces demand functions that are decreasing in own price and increasing in the price of the other good and in income: $\partial x_i^d / \partial p_i < 0$, $\partial x_i^d / \partial p_i \geq 0$, $\partial x_i^d / \partial m_k > 0$. With the total number of refugee households denoted by R and the total number of host households by H, market demand for goods yields

$$(2) \qquad\qquad H x_{ih}^d(p_i, p_j, m_h) + R x_{ir}^d(p_i, p_j, m_r).$$

Both refugee and host populations may participate as laborers in the production of all goods, whose main input is labor. A concave production function will yield supply functions of the form

$$(3) \qquad\qquad x_i^s(p_i, w; \alpha_i)$$

where α_i is a parameter indicating the productivity of labor, p_i is the price of good $i \in a, n$, and w is the wage. The supply function increases in own price and decreases in the wage: $\partial x_i^s / \partial p_i > 0$, $\partial x_i^s / \partial w < 0$. Aggregate supply is the sum of supply for P, individual producers. It is assumed that, in the short run, P does not depend directly on R—which is not unreasonable given the restrictions on refugee land ownership in Tanzania.

For aid-supplied goods, there is an additional component to the supply function—the aid itself, which depends on the number of refugees. Imported aid is denoted by $a_f(R)$, a function that increases in R. The quantity of aid purchased locally, $a_d(R)$, affects the market on the demand side. Equilibrium in the

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1. The simple framework here assumes that household production can be separated from consumption. There is clear evidence in countries like Tanzania that such decisions are, in fact, nonseparable. However, the complications of nonseparability yield little payoff in this situation, where the predictions regarding price changes are equivalent in either case and where there is no information on household production choices that would allow causes or effects of nonseparability to be identified at the household level.

aid-related markets is then determined by

$$(4) \quad Hx_{ih}^d(p_a, p_n, m_h) + Hx_{ir}^d(p_a, p_n, m_r) + a_d(R) = Px_a^s(p_a, w; \alpha_a) + a_f(R).$$

Rearranging and totally differentiating this expression by price and the number of refugees yields

$$(5) \qquad \frac{\partial p_a}{\partial R} = \frac{\frac{\partial a_f}{\partial R} - \frac{\partial a_d}{\partial R} - x_{ar}^d}{H \frac{\partial x_{ah}^d}{\partial p_a} + R \frac{\partial x_{ar}^d}{\partial p_a} - P \frac{\partial x_a^s}{\partial p_a}}.$$

The denominator of equation (5) is always negative, while the numerator's sign is ambiguous. Domestically produced aid and foreign-supplied aid move prices in opposite directions, and the additional demand from refugees puts upward pressure on prices in the same way that domestically produced food aid might. If the foreign aid effect ($\partial a_f / \partial R$) exceeds the other two effects, the price will decrease. The price might also increase—if, for example, the aid were not sufficient to satisfy refugee demand and refugees began to purchase these products on local markets. A positive price effect could be exacerbated by local procurement of aid. In nonaid markets, the effect of the refugees occurs without the buffer of aid and is therefore unambiguously positive.

In this framework, labor is demanded in the production of both aid-related and nonaid goods. Assuming substitutability between refugee and host labor, and a concave production function, the increase in the labor supply caused by the refugees is easily shown to depress the wage. This model ignores other factors likely to be associated with the refugees, most notably changes in the local economy as a result of the aid infrastructure itself: increases in demand, especially for luxury goods purchased by aid workers; changes in transportation costs as a result of the presence of more cars and trucks on highways delivering aid; and subsequent pressures for road improvements that might affect transactions costs. In addition, individual household responses to price changes are not explored in terms of their decision to market their home production.

However, this model generates reasonable predictions for the available data—agricultural prices in markets throughout Tanzania. None of the goods included in the analysis is likely to be strongly preferred by aid workers. There are three predictions of interest. First, the price of aid-related goods will be affected by both the increase in population caused by the refugee inflow and the availability of food aid. The net effect will be the sum of these two, and these effects move in opposite directions when food aid is foreign supplied and in the same direction when food aid is purchased locally. Second, nonaid goods are likely to experience price increases because there is no mitigating effect from foreign-supplied aid. Third, wages may decrease, although this effect is not formally tested here (section V presents suggestive evidence regarding household wealth).

TABLE 1. Percentage of Calories from Maize, Legumes, Bananas and
Plantains, and Milk, by Country, 2004

Country	Maize	Legumes	Bananas and plantains	Milk
Tanzania	34.9	3.4	1.9	2.1
Burundi	11.8	22.6	13.2	0.8
Rwanda	10.8	11.9	30.4	1.8

Source: FAO 2005.

III. DATA

The data in this study come from various sources. The Famine Early Warning
System set up by the U.S. Agency of International Development provides monthly
prices from 44 urban markets in Tanzania, beginning in 1985 and ending in 1998
(USAID 2004; see map 1 for these markets). The data report a single price for each
market every month. Until 1991, the prices of major commodities were controlled
by the government, so data from before January 1992 have been discarded.
Although the data contain prices for numerous crops, many of the series have large
gaps. The six markets with the most serious data omissions—those without com-
plete data during the major refugee influx (late 1993 and early 1994)—have been
dropped in favor of the more complete time series for maize, legumes, bananas,
plantains, and milk.[2] The first four are staple crops that are both grown and eaten
in the regions of interest, though maize is preferred more by Tanzanians than by
the refugee groups. Maize and legumes, unlike bananas, are also part of the stan-
dard food aid package. Milk is included because it is often supplied to refugee
camps for supplemental feeding programs targeting mothers and small children.

In Kagera, the two most common agricultural systems are banana/coffee/horticul-
ture and maize/legume. In Kigoma banana/coffee/horticulture is also common, as are
cotton/maize and sweet potato/sorghum/groundnuts (Tanzania Ministry of
Agriculture and Food Security 2006). These regions are not major suppliers of aid
goods. In the 1994–95 growing season, Kagera and Kigoma produced only 2.4
percent of the total maize in the country, but significantly more of the legumes (15.9
percent) and bananas (28.2 percent). In Kagera, bananas and plantains make up 60
percent of agricultural production, while in Kigoma, they constitute 26 percent. Milk
production in Tanzania is generally on a very small scale, and production in Kagera
and Kigoma is of a traditional, low-input variety (Muriuki and Thorpe 2006).

The share of legumes, bananas, and plantains in the diet is much higher for
the typical refugee than for the typical Tanzanian (table 1). However, consider-
able regional variation in food preferences is likely, and given the region's high
production of plantains and bananas, local consumption of these products may
be higher than the national average.

2. These series are complete for only 38 markets.

The dates and quantities of food aid deliveries to Tanzania were provided by the World Food Programme, which provided 75 percent of the aid to Tanzania (WFP/ INTERFAIS 2008). To combine these data with the other data, total aid for each month was summed, giving monthly deliveries in hundreds of metric tons. Deliveries of maize and legumes were separated to analyze these commodities' impact on their respective market prices. The data do not contain the deliveries supplied by the International Committee of the Red Cross, the other main source of aid.

Monthly normalized difference vegetation index readings for each market were also taken from the Famine Early Warning System. The index measures vegetation vigor using satellite images and is a good proxy for agricultural productivity. The readings were extracted from geographical data with a pixel size of 8 square kilometers and were merged with price data using the reading from the pixel in which the markets are located.

Household data come from two Demographic and Health Surveys conducted in 1991–92 and 1996 (Macro International 2004). These surveys contain information on basic household characteristics, including assets and type of employment. The data have the disadvantage of not containing observations on income or expenditures, but they do cover more than 12,000 households over the two years, including more than 1,000 households in the refugee-affected regions. The two surveys were combined to make a pooled cross section that was used to analyze changes in welfare indicators across the period of interest (see section V).

IV. Impact of Refugees and Aid on Prices

The estimation of the effects of refugees and aid on prices exploits the variation in the number of refugees in Tanzania across time as well as the fact that they were present in specific parts of the country. The natural log of prices, $\log(p_{i,t})$, in market i at time t depends on the number of refugees from Burundi and Rwanda as a percentage of the population of Kagera and Kigoma, where they were located at time t. In other words, for the Burundian refugees, $B_t = \left(\dfrac{\text{Burundian refugees}}{\text{Kigoma population} + \text{Burundian refugees}} \right) \times 100$. A similar expression[3] is included for the Rwandan refugees (R_t).

The refugee impact is given by the interaction of these terms with a variable that is the inverse of the distance to the closest refugee camp (D_i) from market i.[4]

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3. The number of refugees was divided by the population of the province to which the majority of each group went. Regressions using the refugees divided by the total population in the two provinces together were also run, with similar qualitative results and patterns of significance.

4. The inverse of distance is used rather than distance itself to reflect the isolated nature of markets in Tanzania. A quadratic form of the distance measures was also tested, with similar results, as was absolute distance. The model's R^2 was highest using the inverse of distance, the results presented here. A simpler difference-in-difference estimator, where treatment equaled 1 if the market was in Kagera or Kigoma and 0 otherwise, showed a post-treatment interaction that differed for the Burundian and Rwandan crises. The results were very consistent with those using the distance specification shown here.

D_i represents proximity to camps, and the interaction terms $R_t D_i$ and $B_t D_i$ allow the effect of the refugee inflows to vary according to the distance from the camps. The distances used to generate this variable were measured using the information in map 1 by calculating the length of the road network from the markets to the camps using geographic information system software.

Food aid, F_t, is a vector that includes total aid, and, where the price of interest is an aid product, the amount of that product. Aid's impact is given by the interaction of F_t with camp proximity D_i.

It is impossible to rule out all other events that could cause spurious results, but the normalized difference vegetation index, which varies over time and space, controls for one of the main competing sources of agricultural price shocks: weather. The index measures vegetation "greenness" and thus picks up variation in both temperature and rainfall. It is included for the current period for every market along with a previous growing season average of the index to control for stocks of the crop from the previous year. These weather controls are indicated by $X_{i,t}$. Market-level fixed effects M_i capture time-invariant market characteristics. Year-month fixed effects ψ_t are also included to control for shocks common to all markets in a given time period.

The full estimated equation is:

$$(6) \qquad \log(p_{i,t}) = \alpha + \delta_1 B_t D_i + \delta_2 R_t D_i + \delta_3 F_t D_i$$
$$+ X_{i,t}\Gamma + \sum_{i=1}^{38} M_i + \sum_{t=1}^{84} \psi_t + u_{i,t}.$$

For this estimation to give reasonable estimates of the effect of refugees on the local markets, the location of the refugee camps must not be affected by the markets themselves. As mentioned, the camps are likely to be have been located to facilitate the provision of food aid. But the location of the camps is random in a larger sense: the refugees entered Tanzania, rather than other border countries, as a result of directional pushes of internal conflict within their own countries, which is unlikely to have been affected by markets in Tanzania.

An additional concern with this estimation is the potential endogeneity of food aid to local food prices. Significant flows of food aid followed the refugees (see figure 3). If the influx of refugees led to increases in local food prices and donors reacted to these prices, adding aid to the regression could yield biased estimates. Conversations with World Food Programme representatives suggest that the magnitude of aid shipments is determined by the population censuses conducted in the refugee camps rather than by local prices. To test whether prices independently determine aid quantities, a simple ordinary least squares regression of total aid in a given month was run on average maize prices in Tanzania, total number of refugees in that month, and the price of maize in the United States. Despite the small number of observations ($n = 84$), the coefficients are significant for refugees (0.42, standard deviation of 0.14) and the

U.S. price of maize ($-3,848$, standard deviation of 1,687). The coefficient on local maize price is negative and insignificant (-14, standard deviation of 65). While an imperfect test, it clearly gives no evidence that local maize prices are important in determining the amount of aid sent to Tanzania.

Equation (6) is estimated using fixed effects ordinary least squares with robust clustered standard errors, which allows for arbitrary correlation across time within clusters and for correlation across markets. Kezdi (2004) has shown this adjustment to produce consistent standard errors in the presence of serial correlation, even in finite samples. Standard errors were also calculated using Driscoll and Kraay's (1998) method, which produced smaller estimates. The more conservative, clustered robust results are presented here.

The main results of the regression on equation (6) are as the model predicts (table 2).[5] In general, the arrival of more refugees leads to price increases that are greater the closer a market is to the refugee camps. An increase in the number of Burundian refugees affects prices of maize, maize flour, legumes, and plantains, while an increase in the number of Rwandan refugees affects all prices except for maize and maize flour. In the context of the model, these price increases are explained by the increase in demand for these products by the incoming refugees. The effect of food aid is limited to aid-related goods. Increases in the amount of maize generates an increase in both total aid, which raises price, and in the amount of maize, which lowers the price of maize. The marginal effect is 0.032–0.040, a net change of zero in the maize price. For legumes, the net effect is negative and large. This implies that changing the composition of aid can strongly affect food prices. No effect of aid on nonaid goods is observed, somewhat surprising given the anecdotal accounts of refugees trading food aid for nonaid products.

One concern with this analysis is that some of the estimated price effects could result from the longer term influence of the refugee populations on migration of Tanzanians wishing to take advantage of jobs provided by nongovernmental organizations or from interactions on the local labor market rather than from the direct impact of the refugees on demand. In addition, the price increases could also reflect income effects if a substantial number of Tanzanians experience higher incomes as a result of the refugee presence.

To examine the immediate impact of the establishment of the camps, regressions were run with data through December 1994 only, when the largest part of the Rwandan inflow had just finished (table 3). These shorter run estimates show similar impacts to the full sample results, except for maize flour, where increases in Burundian or Rwandan refugees result in price decreases. In contrast to the full sample estimates, there is no short-run effect of the Rwandan refugees on banana prices. Where the effects are significant in both the long and the short run, they are generally of similar magnitudes—except

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5. A more parsimonious specification that excludes the weather controls produced nearly identical results and is available from the authors on request.

TABLE 2. Impact of Refugee Camps and Aid on Agricultural Prices, 1992–1998

Independent variable	Maize	Maize flour	Legumes	Plantains	Bananas	Milk
(Burundian refugees/ Kigoma population) × camp proximity	0.088 (0.053)*	0.128 (0.057)**	0.150 (0.034)***	0.398 (0.299)*	0.018 (0.180)	0.019 (0.073)
(Rwandan refugees/ Kigoma population) × camp proximity	−0.038 (0.065)	−0.050 (0.045)	0.081 (0.028)***	0.625 (0.182)***	0.239 (0.043)***	0.156 (0.031)***
Total aid × camp proximity	0.040 (0.005)***	0.015 (0.011)	−0.009 (0.007)	−0.037 (0.023)	−0.007 (0.006)	0.001 (0.003)
Maize aid × camp proximity	−0.032 (0.007)***	−0.013 (0.012)				
Legume aid × camp proximity			−0.078 (0.035)**			
Weather controls	Yes	Yes	Yes	Yes	Yes	Yes
Market fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year/month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	2,335	2,183	2,417	1,849	2,255	2,285
R-squared	0.641	0.684	0.843	0.489	0.573	0.800

*Significant at the 10 percent level; **significant at the 5 percent level; ***significant at the 1 percent level.

Note: Numbers in parentheses are standard errors. Standard errors are robust and clustered. These are results from ordinary least squares regressions. The dependent variable is the natural log of the food price.

Source: Authors' calculations based on data discussed in the text.

TABLE 3. Impact of Refugee Camps and Aid on Agricultural Prices, 1992–1994

Independent variable	Maize	Maize flour	Legumes	Plantains	Bananas	Milk
(Burundian refugees/Kigoma population) × camp proximity	0.026 (0.057)	−0.183 (0.026)***	0.130 (0.049)***	−0.050 (0.066)	0.104 (0.092)	−0.043 (0.045)
(Rwandan refugees/Kigoma population) × camp proximity	−0.294 (0.161)*	−0.479 (0.103)***	0.205 (0.066)***	0.620 (0.198)***	0.076 (0.051)	0.149 (0.038)***
Total aid × camp proximity	0.089 (0.014)***	0.043 (0.027)	0.005 (0.009)	−0.044 (0.046)	0.017 (0.013)	−0.003 (0.004)
Maize aid × camp proximity	−0.087 (0.013)***	−0.044 (0.032)				
Legume aid × camp proximity			−0.466 (0.111)***			
Weather controls	Yes	Yes	Yes	Yes	Yes	Yes
Market fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Year/month fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	1,060	969	1,088	953	1,020	1,004
R-squared	0.424	0.456	0.773	0.333	0.310	0.549

*Significant at the 10 percent level; **significant at the 5 percent level; ***significant at the 1 percent level.

Note: Numbers in parentheses are standard errors. Standard errors are robust and clustered. These are results from ordinary least squares regressions. The dependent variable is the natural log of the food price.

Source: Authors' calculations based on data discussed in the text.

FIGURE 4. Impact of Refugees and Aid on Prices, by Distance from Refugee Camps
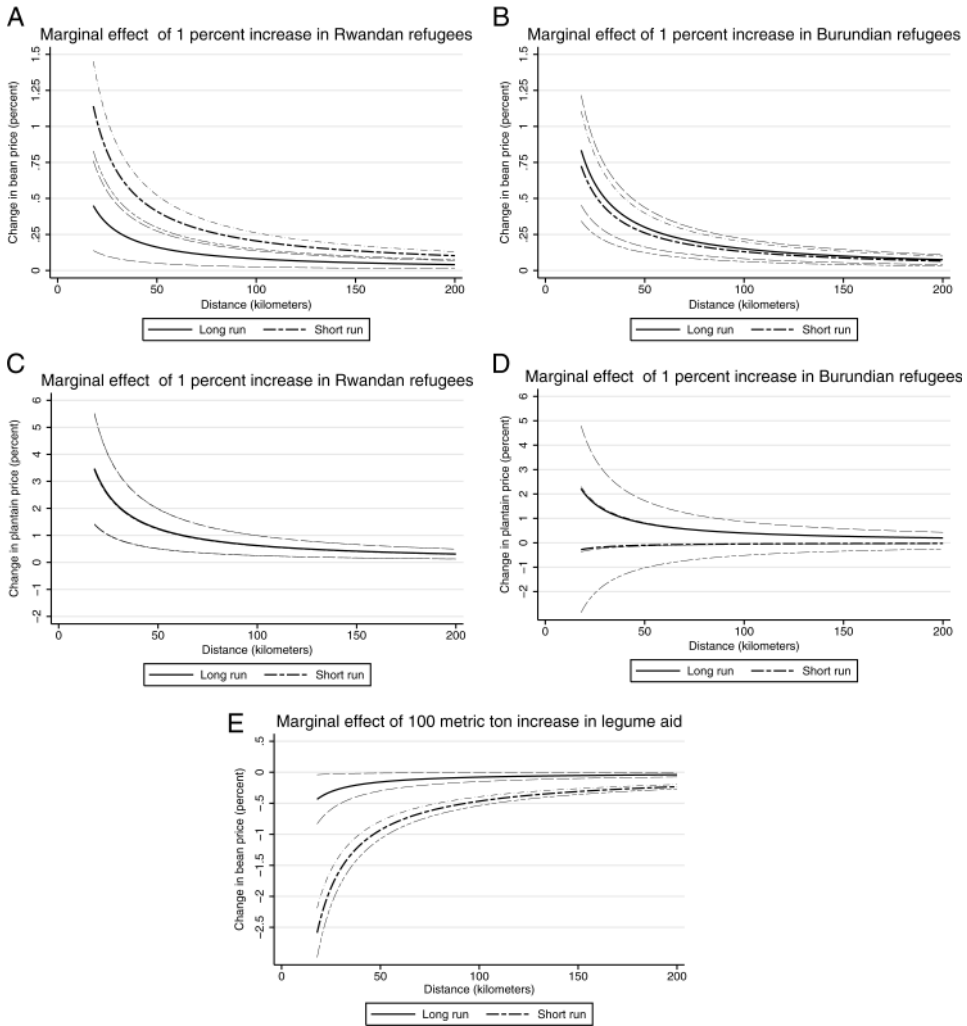
Source: Authors' calculations based on SCN issues 1–25 and WFP INTERFAIS 2008.

for legumes, for which the short-run effect of refugees is much larger than that for the full sample estimates. The estimates of the effect of specific aid—maize and legumes—are considerably larger in the truncated sample.

Because the impact of the refugee inflow is given by the interaction between two continuous variables, it is instructive to graph the marginal effect of increases in the refugee population and food aid according to distance from camps (figure 4). This highlights the change in price effects as a result of the difference in refugee inflows and aid according to distance of the market from the camps.

The impact of both refugees and aid decreases quickly with distance from camps. The largest impact of growth in the number of Rwandan refugees in Kagera is on plantains, where a 1 percentage point increase leads to a nearly 4 percent increase in price in the closest market, which quickly diminishes as distance increases. The impact of the refugees on legumes, an aid good, is smaller than it is on plaintains, a nonaid and more perishable good. Rwandan refugees have a larger impact on both types of goods than Burundian refugees do. There are three possible explanations for this. First, the Burundian refugee group was not nearly as large as the Rwandan group, and most did not stay as long. Second, the Rwandan refugees arrived with considerably more income, enhancing their ability to trade on local markets rather than relying exclusively on food aid. Third, the two groups had different food preferences (see table 1).

In sum, increases in the number of refugees generally pushed prices upward, with especially large effects for nonaid goods. These effects were generally similar in the short and long run, with the effect on legumes somewhat greater in the immediate aftermath of the crises. Food aid generated smaller and short-lived negative effects on prices, with no effect for the main aid product, maize. These results do not indicate how local Tanzanians may have fared as a result of these changes in their local economy. Section V discusses the potential welfare impacts of the price changes.

V. POTENTIAL EFFECTS ON HOUSEHOLD WELFARE

The increase in the refugee population in Tanzania resulted in large increases in prices in some markets—legumes, bananas, plantains, and milk—while the aid inflows put downward pressure on prices in legume markets. Assuming that the demand for staples is inelastic, price declines in these markets must result in lower revenues for producers (and increases must result in higher revenues). Therefore, the shift in demand caused by the refugee population is likely to benefit producers. The effects are the opposite for consumers in these markets—net consumers of legumes, plantains, bananas, and milk will suffer a decrease in surplus, while those purchasing maize may enjoy positive effects from the lower prices, at least temporarily. In both Kagera and Kigoma, the most common agricultural systems include both plantains and legumes, so if the loss in revenue from the food aid effect is smaller than the gain from the refugee effect, the net effect for producers is positive.

It is possible, however, that production from other regions could have been brought to the refugee-affected parts of the country to take advantage of the high prices. No data are available from before the Burundian crisis, but there are interesting trends in production in Kagera and Kigoma compared with total production in Tanzania (figure 5). In the post-refugee period, the share of Kagera and Kigoma's banana and plantain production in total production increased, while the total level of production nationwide remained relatively flat. The increase happened two years after the initial refugee inflows; bananas

FIGURE 5. Production of Maize, Legumes, and Bananas, 1994–1999

Percent production from Kagera and Kigoma and total production Tanzania, 1994–1999
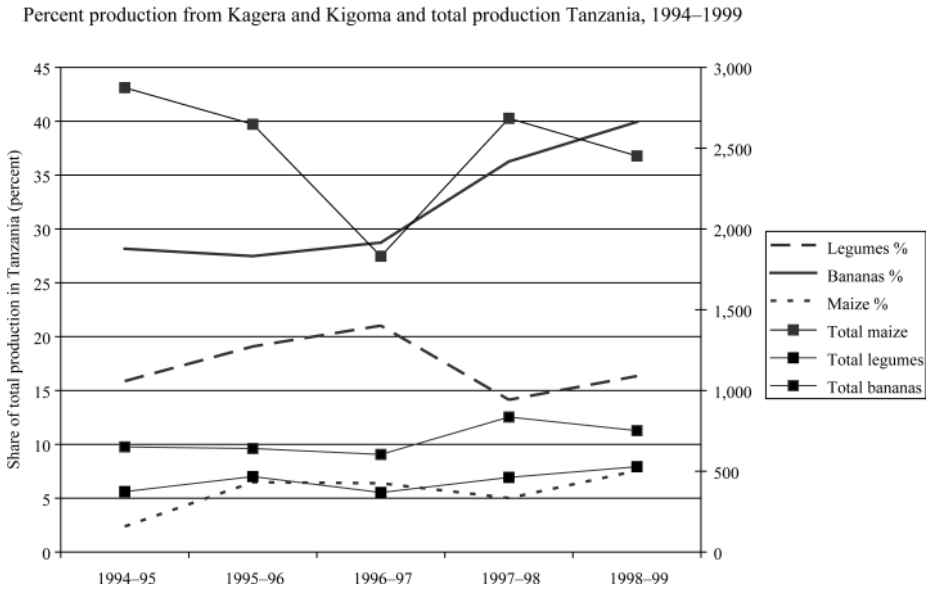
Source: Tanzania Ministry of Agriculture and Food Security 2006.

typically produce fruit 10–15 months from planting. Legume production in the western regions increased in the years just after the refugee inflows and then decreased. Part of this decrease can be explained by a decrease in productivity per hectare planted, from 1,487 Tanzania shillings in 1996–97 to 800 in 1997–98.

Although it is difficult to draw firm conclusions given the scarcity of the production data, the data provide some insight into producer decisions. First, the western regions are not the major producers of legumes in the country; the bulk of legume production comes from the more central regions, Iringa and Rukwa. But the western regions are important banana and plantain producers, more so after the refugee inflow. These simple production statistics suggest a producer reaction to the higher prices offered for these goods as a result of the crises in the region. Assessing the welfare effects on local residents requires knowing which individuals are net buyers or sellers in the markets and who receives wages or employs labor. These data are not available. However, in the 1992 Demographic and Health Survey, 77 percent of the men in rural areas of Kagera and Kigoma listed their primary occupation as farmer, whereas only 23 percent of men in urban areas did.

To investigate whether there are differential effects on net buyers and net sellers, data from the Demographic and Health Surveys as well as the fact that most rural households are agricultural producers were exploited. Using a pooled cross section constructed from the 1991 and 1996 surveys, a fixed effects estimator with effects at the regional level was applied to a regression of

the presence of wealth indicators on the effect of an interaction between proximity to the refugee camps and a dummy variable equal to 1 for observations in the 1996 survey.[6] The same proximity metric applied in section IV is applied here: the inverse of distance to the nearest refugee camp. Because the exact coordinates of each sampled cluster are not available, the estimated center point of the ward in which each sample cluster was proxied.

The results of the regressions show positive and significant effects on the presence of radios and bicycles in rural households closer to the refugee camps in the 1996 sample than in the 1991 sample (table 4). The point estimate for cement floors is positive but not significant. For urban households, proximity to the refugee camps has a negative and significant effect on the change in bike and cement floor ownership. The interpretation is that while urban households farther from camps were installing more cement floors over this period, those closer to camps were not installing any. Using a much smaller sample, the impact on households that identify farming as their primary source of income compared with nonfarm sources was analyzed.[7] The results are qualitatively similar: nonfarm households experience a negative impact of proximity to refugee camp, while farm households show increased presence of wealth indicators the closer they are to refugee camps.

These results, while consistent with the observed price changes, are merely suggestive. The Demographic and Health Survey samples are chosen to allow comparisons across regions, not necessarily on the fine scale that the distance analysis demands of the data.[8] So bias could be introduced into the estimates through the different samples in different years. In addition, household location within a ward cannot be precisely measured, and the number of households in close proximity to the refugee camps is small.[9]

These results concord with the story suggested above. Rural, farming households are likely to be net sellers of agricultural goods and thus to benefit from higher prices in key markets. The agricultural production statistics confirm that banana production, which experienced positive price shocks, increased in the post-refugee period. The increase in legume production, a small but important part of regional output, also could have benefited rural producers. Urban, non-farming households, by contrast, lose from the higher prices, because they are

6. Controls included number of household members, number of women and children, gender and age of the household head, and the highest grade of schooling attained by the household head.

7. The smaller sample size is due to the structure of the survey; only a subsample of households was asked to respond to detailed questions regarding individual occupations.

8. An estimate that replaces the proximity variable with a dummy variable equal to 1 when a household is in Kagera or Kigoma yielded similar impact results.

9. It was impossible to match every cluster with a ward, but the final sample includes 8,687 rural households whose wards are known: 1,170 are in wards within 200 kilometers of the closest refugee camp, with 522 within 200 kilometers of the nearest camp in the 1996 sample. The closest rural ward in this sample is 2 kilometers from the nearest refugee camp, and the closest urban ward 20 kilometers.

TABLE 4. Effect of Proximity on Household Wealth Indicators

	Dependent variable		
Independent variable	Radio	Bicycle	Cement floor
Rural sample			
1996	0.091 (0.013)***	0.130 (0.015)***	−0.001 (0.007)
1996 × camp proximity	0.511 (0.195)***	0.459 (0.069)***	0.040 (0.065)
Observations	8,634	8,636	8,687
R^2	0.073	0.095	0.036
Urban sample			
1996	0.074 (0.031)**	0.071 (0.018)***	0.098 (0.035)***
1996 × camp proximity	0.482 (20.205)	−50.673 (10.208)***	−60.056 (20.633)**
Observations	2,040	2,037	2,053
R^2	0.085	0.081	0.061
Farm sample			
1996	0.095 (0.027)***	0.157 (0.023)***	0.001 (0.012)
1996 × camp proximity	−0.523 (0.481)	0.660 (0.264)**	0.092 (0.108)
Observations	1,520	1,523	1,531
R^2	0.057	0.039	0.028
Nonfarm sample			
1996	0.145 (0.038)***	0.124 (0.035)***	−0.025 (0.030)
1996 × camp proximity	−10.392 (0.424)***	−0.584 (0.296)**	0.107 (0.162)
Number of observations	605	605	608
R^2	0.081	0.075	0.051

*Significant at the 10 percent level; **significant at the 5 percent level; ***significant at the 1 percent level.

Note: Numbers in parentheses are standard errors. Standard errors are robust and clustered at the district level. These are partial results from fixed effects ordinary least squares regressions with the effect at the district level. Other included variables are proximity to camps, the number of household members, number of women and children, gender and age of the household head, and the highest grade of schooling attained by the household head.

Source: Authors' calculations based on data discussed in the text.

net buyers of food. Urban households may also be affected by changes in the urban housing and labor markets as a result of the population influx.

To the extent that the impacts are relatively isolated—they are much larger the closer a ward is to the refugee camps—it is possible that they balance out regional disparities that leave western Tanzania poorer than much of the country. In addition, the crises may also disproportionately benefit rural residents and potentially redress long-standing rural–urban inequalities. While the price effects may positively affect some households in refugee-hosting regions, there are still many households——any that purchase items whose price has increased—vulnerable to the negative welfare effects of the humanitarian crises.

VI. Conclusion

Refugee situations are not likely to disappear, and understanding the impacts of refugee camps on poor host populations is imperative. This article presents

evidence that the refugee inflows into western Tanzania from 1993 to 1998 resulted in increases in the prices of agricultural goods that are consumed and produced by local populations in Tanzania. Prices in the same markets showed less impact from refugee crises from Burundi than from those from Rwanda, perhaps because of differences in the diets of these groups or because of the relatively smaller and slower nature of the first of the two crises. Food aid is shown to have a depressive effect on legume prices, but not maize prices. The magnitude of the aid effects is considerably smaller than that of the refugee effects. Household data produce suggestive evidence of increased incidence of wealth indicators in rural areas and decreases in urban areas. This is consistent with a scenario where producer households benefit from higher prices for agricultural goods and then invest that money in durable goods.

Clearly the analysis is imperfect. The price results depend on the impact of the camps on a very limited number of markets. In addition, the number of wealth indicators available for analysis was small. Despite these limitations, food aid does the job that it was intended to do: it offsets, at least partially, the impacts of increased demand created by refugee populations. Evidence is also presented that the demand side effects of refugee populations are substantial and affect markets in a way that may benefit local producers and hurt local consumers. This suggests that policy-makers should be concerned with net buyers of agricultural goods in refugee-hosting regions because they are likely to be adversely affected by the price shocks resulting from refugee demand. Although both host governments and aid agencies are often stretched to their budgetary limits, investment in mitigating negative impacts on host villages is warranted—one humanitarian crisis need not cascade into another.

This article gives insight into the effect of humanitarian emergencies on food prices. It is not able to shed light on the effects of these catastrophes on health, environmental, or labor market outcomes and has not touched on the economy internal to the camps themselves. These and other important questions—such as price volatility and coping strategies, including support from the government or from neighbors—are left for future analysis. Further research is essential for informing the policies of international agencies whose missions include supporting refugees and for the many countries that find themselves hosting refugees from other countries or large populations displaced within their own borders.

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