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# CATPRN

Canadian Agricultural Trade Policy And Competitiveness Research Network

## HIGH FOOD PRICES AND INTERNATIONAL FOOD ASSISTANCE

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**Ryan Cardwell**

Department of Agribusiness and Agricultural Economics  
University of Manitoba

<http://www.catrade.org>

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## **Abstract**

High food prices in 2008 and 2010 generated concern about food security in developing countries. The number of food insecure people was estimated to have jumped significantly and food assistance donors were faced with unexpectedly high procurement bills. This paper discusses how high food prices affect the delivery of food assistance, focusing on recipient effects and on procurement decisions. Recent changes in Canadian food assistance policies are discussed in the context of high commodity prices, and food assistance flows during recent periods of high prices are reviewed. Two empirical investigations relating to high food prices are undertaken. First, the degree of price transmission from world markets to local and regional markets, where a growing share of food assistance is being purchased, is shown to vary widely across countries and provides some insulation for food assistance against world price shocks. Second, the degree to which donors substitute between important food assistance commodities when relative commodity prices change is examined. There is significant substitution between protein sources in food assistance baskets, but not between cereals.

*JEL* Classification Codes: Q18, O13, O19

Keywords: food security, food assistance, food assistance, price volatility

## **1.0 Introduction**

Two periods of high food prices in recent years have brought renewed public awareness to food insecurity in developing countries. Media reports, political instability and food riots prompted governments to respond to high prices by implementing new export restrictions, initiating domestic food policies and calling for increased food assistance shipments.

High food prices can affect food assistance in two important ways. Indirectly by expanding the population of food insecure people, thereby increasing calls for food assistance, and directly by increasing procurement bills for food assistance donors. Donors' commitments quickly became much more expensive during recent periods of high prices, as important food assistance commodities experienced price increases of as much as 100% in one year.

This paper provides an overview of recent periods of high food prices and food assistance shipments through descriptive statistics and analysis, and presents econometric analyses of two factors that determine how food price changes affect food assistance. The first analyses how international price shocks pass through to local and regional markets where an increasing share of food assistance is being purchased. The second analysis investigates whether donors take advantage of relative price discounts in determining the commodity make-up of food assistance baskets. The paper closes with a discussion of future events that will affect food assistance's vulnerability to price movements.

## **2.0 High Prices**

### **2.1 Recent Price Movements**

Food prices have experienced two remarkable peaks over the past four years. The FAO's food price index reached 185 (2002-2004 = 100) in June 2008 and 209 in February 2011 (figure 1). A number of confluent factors led to high commodity prices that were passed through to food prices, particularly dairy, oils and cereals.<sup>1</sup> Higher cereal prices are of particular concern for food assistance donors and recipients because cereals account for approximately 90% of food assistance shipments in most years (WFP INTERFAIS).

Figure 2 presents cereal prices over the past ten years and highlights the sharp increases in maize, rice and wheat<sup>2</sup> (the primary food assistance commodities) prices in 2008 and again in 2010. The prices in figure 2 are world reference prices and do not necessarily represent food assistance procurement prices<sup>3</sup>, but are representative of grain price trends over these periods. Grain prices have come down in recent months, but remain high in a historical context.

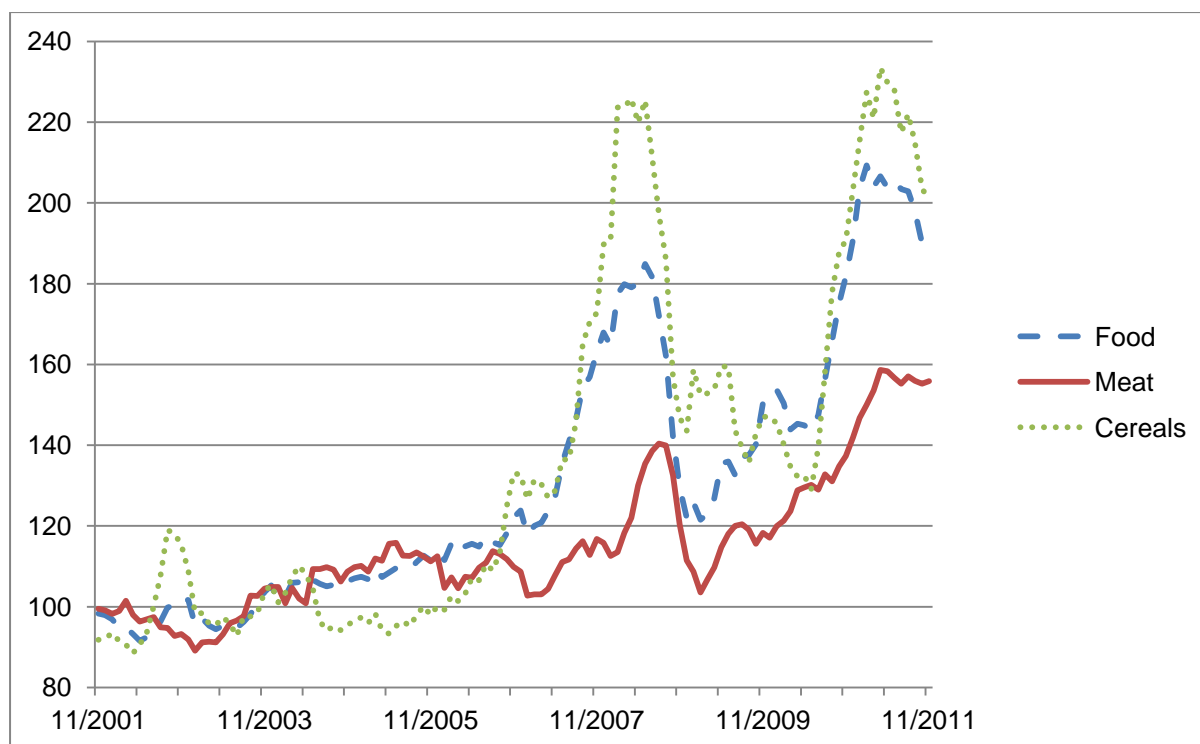
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<sup>1</sup> This paper does not investigate the causes of high and volatile commodity and food prices. See Mitchell (2008), Abbott, Hurt and Tyner (2009) and Meyers and Meyer (2008) for discussions of the causes of high commodity and food prices; and Hailu and Weersink (2010) and Sanders and Irwin (2011) for a discussion of volatility.

<sup>2</sup> Maize, rice and wheat account for approximately 90% of cereal food assistance shipments (WFP INTERFAIS).

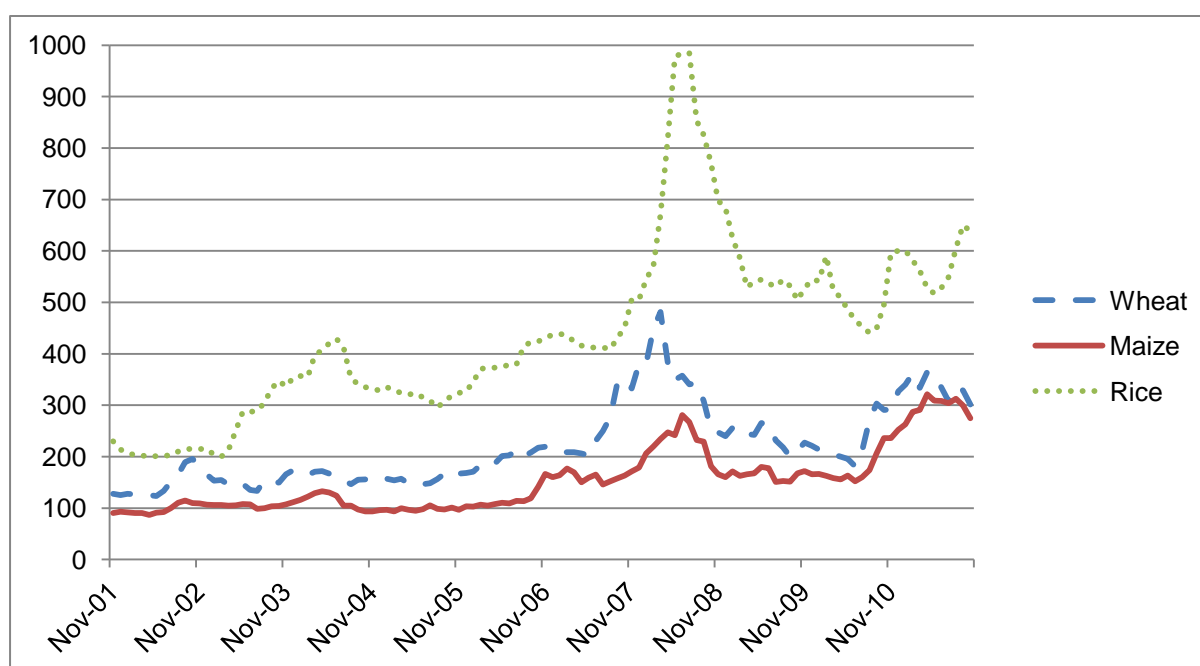
<sup>3</sup> The topic of procurement location is analysed in section four.

**Figure 1. FAO Food Price Index (real, 2002-2004=100)**



Source: OECD-FAO Agricultural Outlook Database

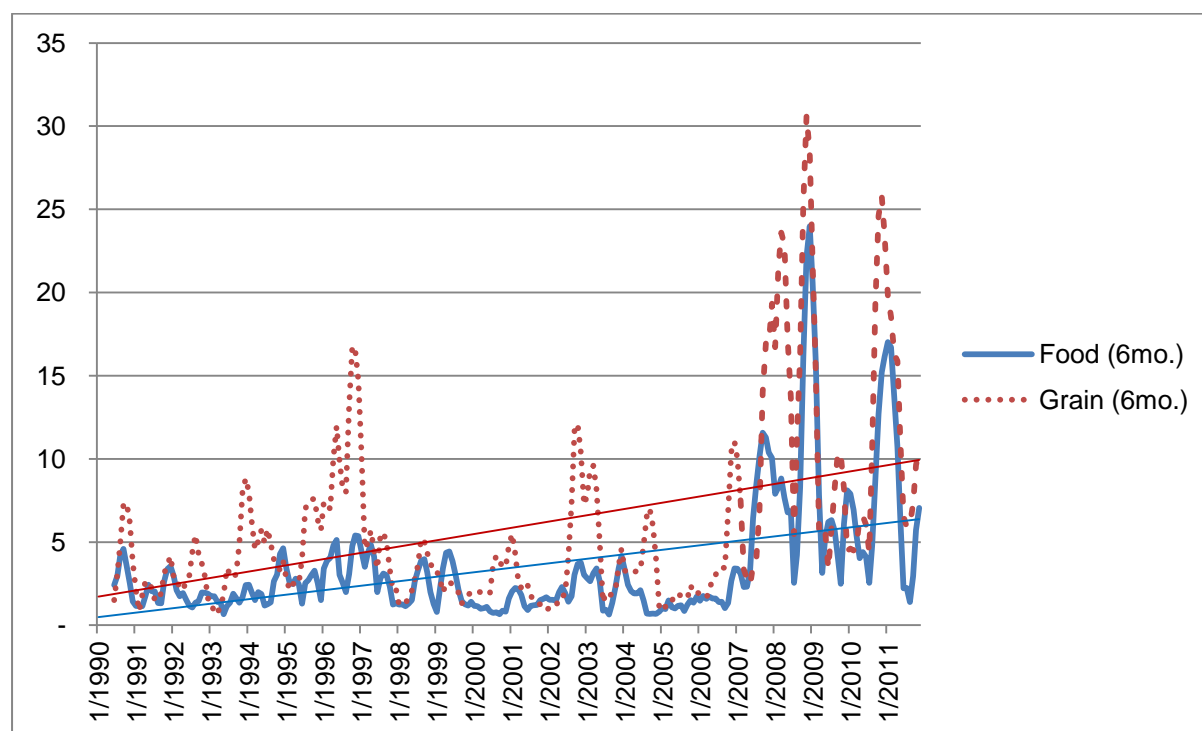
**Figure 2. Grain Prices (\$US/mt, US prices)**



Source: FAO GIEWS database

Food prices have also become more volatile in recent years. Figure 3 displays moving six-month standard deviations of the FAO's food price indices for all food and for grains. The fitted lines through each series indicate an upward trend over the past twenty years. The market's perception of food price volatility is also rising. Figure 4 presents the implied volatility<sup>4</sup> of selected food commodities, as calculated by the FAO (2010). Higher implied volatility indicates both higher current volatility and a market perception of future increased price volatility.

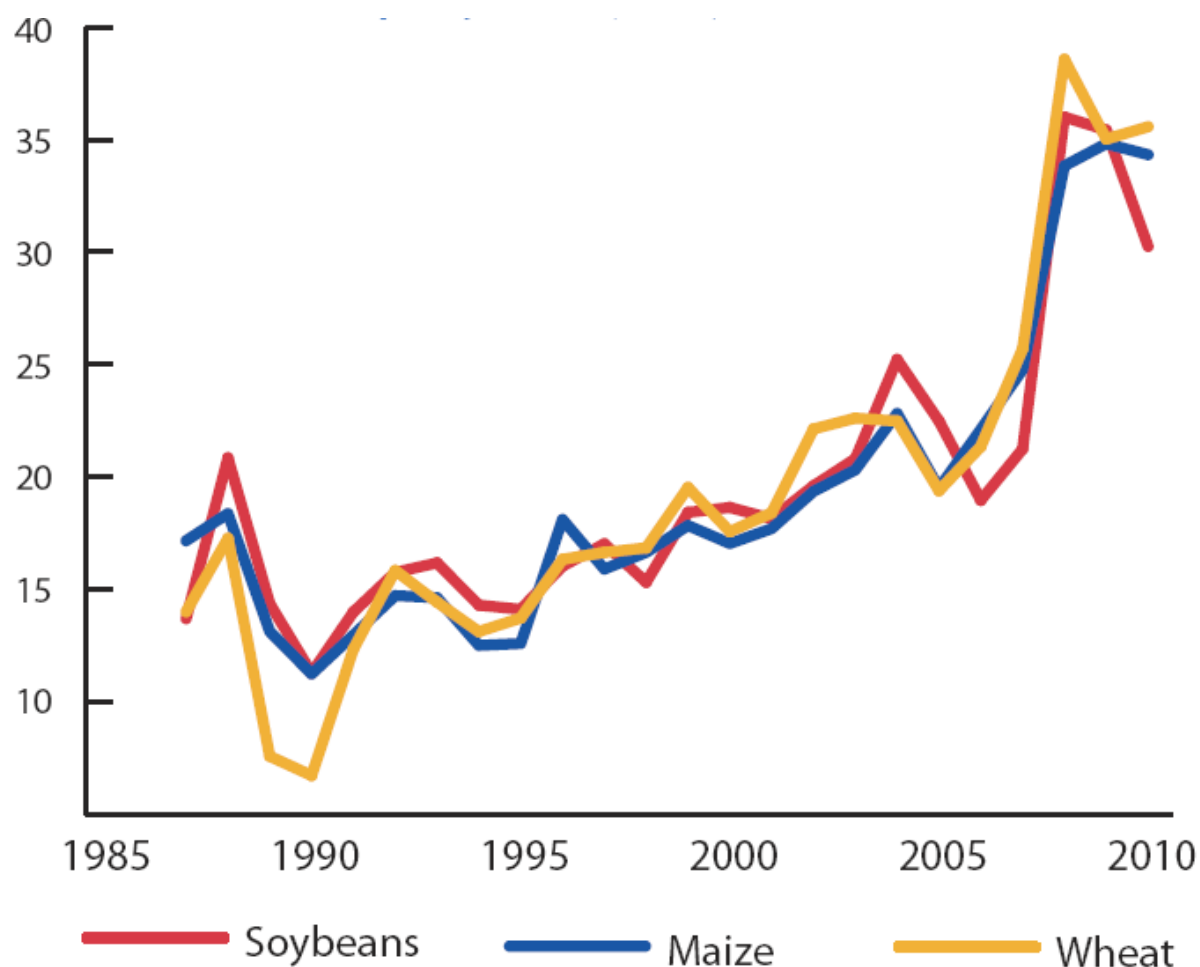
**Figure 3. Price Volatility is Increasing, Six-Month Moving Standard Deviations of FAO Price Indices (\$US/mt)**



Sources: OECD-FAO Agricultural Outlook Database, authors' calculations

<sup>4</sup> Implied volatility is calculated from option pricing models. Instead of computing the price of an option from observed historical volatility (and other variables), implied volatility is the level of volatility that would be generated in such a pricing model from observed prices.

**Figure 4. Implied Volatility**



Source: FAO (2010)

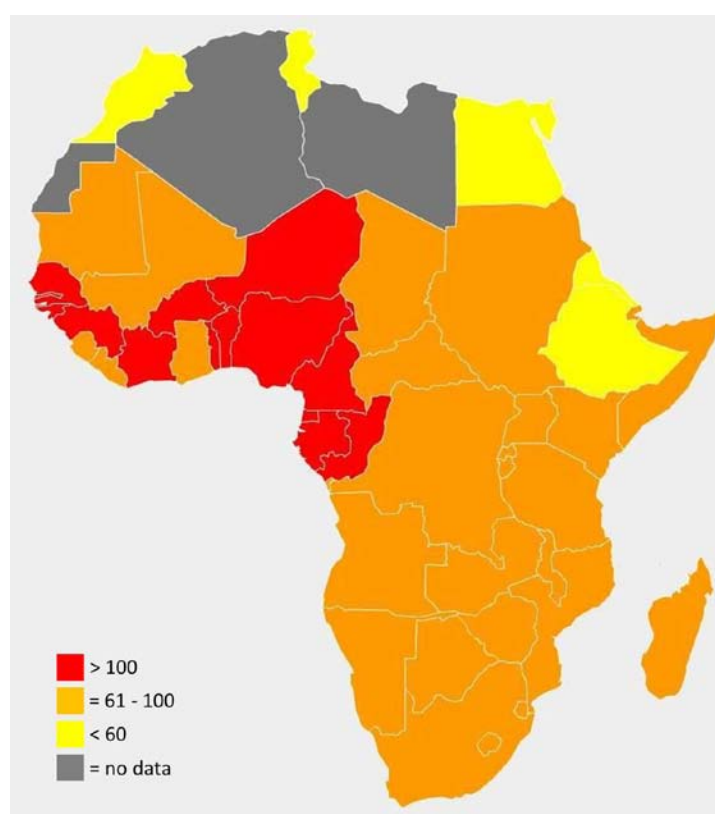
## **2.2 Variation Across Recipient Countries**

High food prices affect food assistance shipments both directly and indirectly. On a simple level, higher food prices increase the cost of food assistance baskets, *ceteris paribus*.<sup>5</sup> Maize, rice and wheat, in unprocessed and processed forms, account for most food assistance shipments and recent price spikes for those goods have heightened concern about meeting existing and new food assistance commitments. High prices have likely also affected the willingness of donors to make future commitments in the food assistance treaty negotiations (discussed below) currently underway.

Figure 5 illustrates a comparative static snapshot of how much the price of African countries' representative food assistance baskets increased from July 2007 to July 2008; a period that was characterised by rapid price increases for important food assistance commodities. Representative food assistance baskets are calculated using five-year average shares of each country's food assistance basket comprised of maize, rice and wheat.

<sup>5</sup> The *ceteris paribus* condition is relaxed in the analytical section of this paper.

Figure 5. Price Changes for Representative Food Assistance Baskets - Africa



Sources: WFP INTERFAIS, OECD-FAO Agricultural Outlook Database, authors' calculations

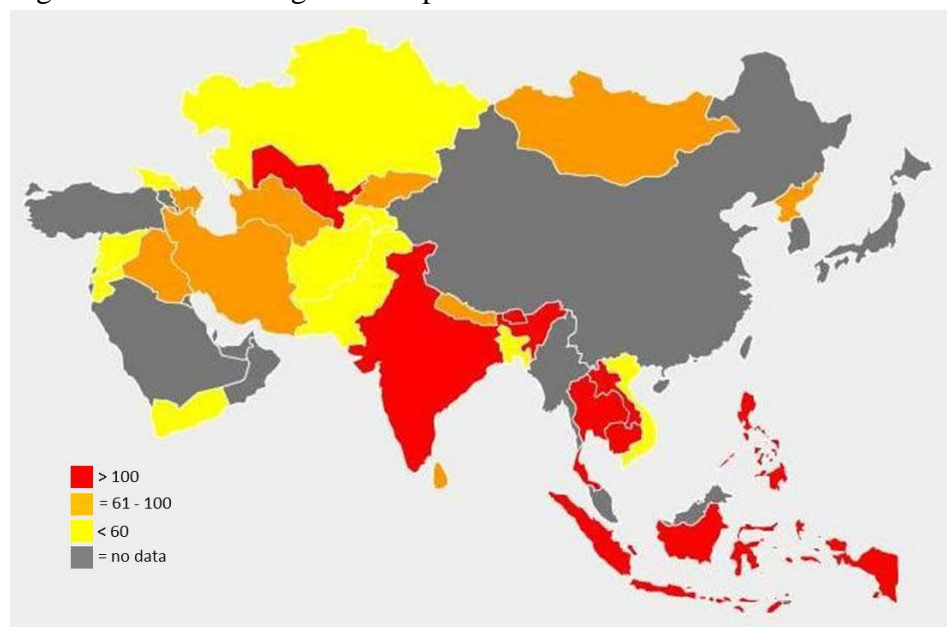
World price changes from 2007 to 2008 (FAOSTAT) are applied to these baskets to calculate the price increase for each country's food assistance basket. The calculations used to generate figure 5 are simplifications for several reasons. First, the calculations only consider maize, rice and wheat. Second, food assistance donors do not necessarily pay world prices for food assistance commodities, and third, the figures do not allow for substitution of relatively cheap commodities for relatively expensive commodities. This point is discussed in detail in section four. A fourth consideration is that the price increases do not consider fortification, processing or transportation costs. Such factors are significant portions of food assistance programme costs. The salient point of differential price effects across countries remains, however.

Those countries whose food baskets are primarily comprised of wheat would have experienced the smallest price effects, and those countries who primarily received rice, the largest increases. Many countries along the coast of the Gulf of Guinea saw costs rise by more than 100% over the course of one year.

Figure 6 presents the same calculations for Asian food assistance recipients. These countries were hardest hit because the price of rice more than doubled from 2007 to 2008. Thailand, Indonesia and the Philippines receive primarily rice as food assistance, while Afghanistan and Pakistan (both large recipients of food assistance in recent years) receive primarily wheat.



Figure 6. Price Changes for Representative Food Assistance Baskets – Asia



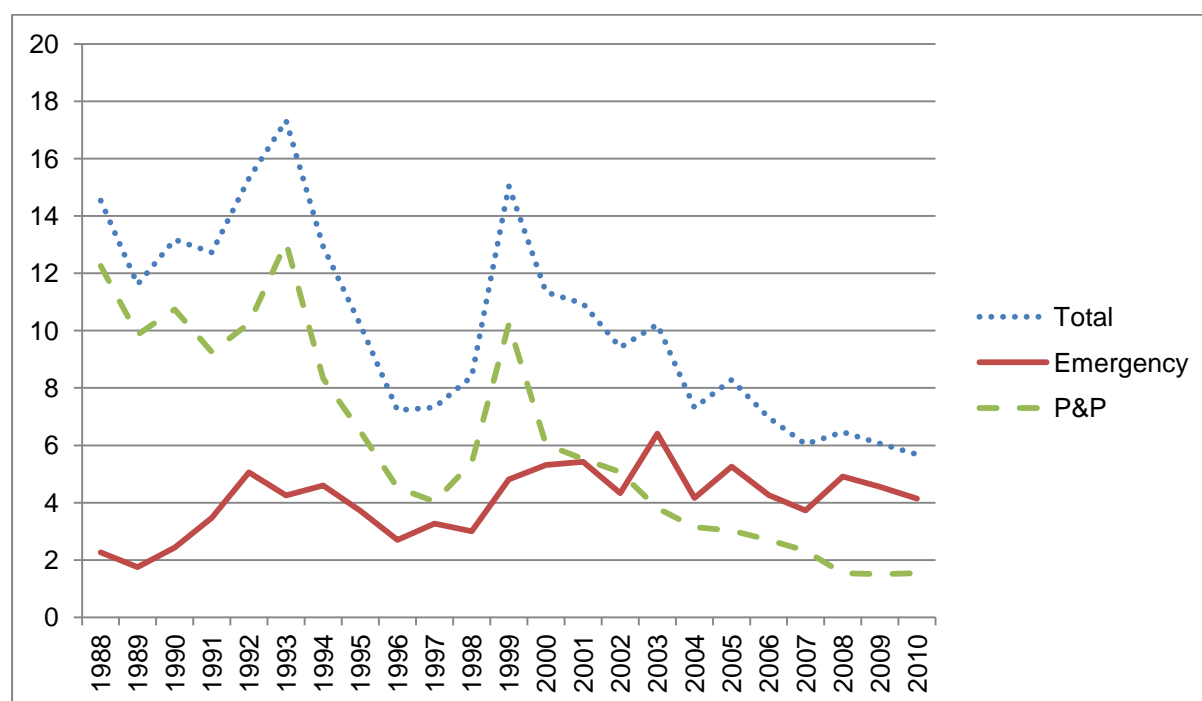
Sources: WFP INTERFAIS, OECD-FAO Agricultural Outlook Database, authors' calculations

### 3.0 Recent Food Assistance Trends

#### 3.1 *Global Food Assistance*

Global food assistance volumes have been trending downwards for the past twenty years, and periods of high prices in 2008 and 2010 were not significant departures from this downward trend. Figure 7 illustrates food assistance flows from 1998 to 2010. Though this research does not attempt to formally identify (in an econometric sense) the causes of falling food assistance shipments, the decline in total shipments closely mirrors the long-term secular decline in programme and project (P&P) food assistance. The decline in P&P food assistance over the past twenty years has been remarkable and is due to several factors. First, programme aid was a frequently-used foreign policy tool during and shortly after the Cold War. Donor countries provided balance-of-payments support to political allies through in-kind aid that was sold in open markets. Perhaps the most striking example of this is the United States' (US) donation of over three million metric tonnes (mt) of food assistance (grain equivalent) to Russia in both 1993 and 1999 to develop and strengthen strategic ties with the evolving leadership and to encourage political stability (Barrett and Maxwell, 2005). Programme food assistance has largely fallen out of favour in the past twenty years, and P&P food assistance's share of total shipments has fallen from near 85% in the 1980s to approximately 25% in the last few years.

**Figure 7. Global Food Assistance Shipments (grain equivalent millions of mt)**



Source: WFP INTERFAIS

The use of programme food assistance has also declined in response to the perception that donor countries channeled surplus agricultural commodities into food assistance as a veiled support programme for domestic farmers, processors and shippers. Programme food assistance shipments are delivered in kind (instead of cash-based aid) and some major donors still donate commodities instead of cash. The Food and Agricultural Organisation's (FAO) Consultative Subcommittee on Surplus Disposal (CSSD) was established in an attempt to monitor the use of food assistance for surplus disposal. The CSSD is governed by two principles: 1) donors report all shipments to the CSSD, and 2) Usual Marketing Requirements<sup>6</sup> are to be maintained in recipient countries. However, as the CSSD's principles are non-binding and unenforceable, there have been no consequences for violating these principles and most donors no longer make reports to the CSSD.

Finally, donors of all types of aid have moved towards the provision of untied aid. This has been in response to a steady stream of research that points out the cost inefficiency of sending in-kind, tied aid (Tschriley and del Castillo (2007), US GAO (2009)). Many donor countries have eliminated requirements to use domestically-procured commodities and increased their use of local and triangular sources for food assistance commodities.

The decline in P&P food assistance has meant an increase in emergency food assistance's share of total shipments over the past twenty years. Though the volume of emergency food assistance has not increased to fill the void left by falling P&P shipments, emergency food assistance's share has increased from 15% in 1988 to approximately 75% in recent years.

<sup>6</sup> Current year imports must not fall below a five-year historical average in the recipient country for usual marketing requirements to be met.

High commodity prices in recent years are thought to have increased both the severity of, and the number of people subject to, food insecurity by reducing the real incomes of net food buyers. The FAO estimates that the number of undernourished people in Africa jumped from approximately 220 million in 2007 to almost 240 million in 2008 (FAO, 2011).<sup>7</sup> The FAO also estimates that the number of undernourished people in Asia remained steady over that same period. One would expect that food assistance shipments to regions where food security worsened would receive more food assistance, *ceteris paribus*.

Establishing the counterfactual level of food assistance shipments, had food prices not increased by such large amounts, during 2008 and 2010 is a fool's errand that is not attempted here. However several observations can be made regarding food assistance data over the past several years. First, total food assistance shipments did not spike upwards in 2008 or 2010 (figure 7). Even after accounting for the steady decline in P&P food assistance, emergency aid shipments increased to a level just above the ten-year average in 2008 and fell below that average in both 2009 and 2010. Shipments to Africa, where undernourishment is estimated to have increased substantially over this period, increased only marginally from 2007 and remained near or below the ten-year average in 2009 and 2010. Food assistance to Latin America and the Caribbean, where undernourishment was estimated to have increased over this period (FAO, 2011), actually decreased in 2008 and remained below historical levels through 2010.

General observations of the food assistance data mask several confounding factors that could affect assistance shipments. First, higher prices are expected to reduce shipment volumes if donors operate on fixed budgets. This point is examined for Canada and the US below. Second, such observations do not control for factors such as changes in regional distribution of assistance from, for example, net food exporting countries (that might have benefited from higher prices) to net food importing countries in the same region. However most developing net food exporters are considered food insecure and receive food assistance in most years. Further, the total number of undernourished people in developing regions is estimated to have increased by almost 19 million people through FAO's most recent estimate (FAO, 2011) and total food assistance shipments have not responded in concert.

Numerous unobserved factors, other than commodity price changes, also contribute to variable demand for, and supply of, food assistance. Such factors include positive demand shocks (for example, flooding in Vietnam in 2008 and cyclones in Burma) and positive supply shocks (for example, Saudi Arabia donated more than US\$500 million to the WFP in 2008 – more than ten times what they had donated in any year before 2008).

Though global food assistance demand from recipients' perspectives cannot be explained in an empirical model, we can observe the number of new appeals issued by the WFP. These appeals can be interpreted as proxies for new situations calling for food assistance responses. The WFP's Emergency Operations (EMOPs) are drawn up by WFP staff in disaster situations before appealing to international donors for funding and for food. EMOPs last from three to twelve months, after which longer-term programmes are implemented. Figure 8 displays the number of EMOPs issued over the past ten years. The number of EMOPs in 2008, though above the ten-year average, was not above the 2007 level even though food prices spiked in 2008.<sup>8</sup> The WFP did, however, issue an appeal in April of

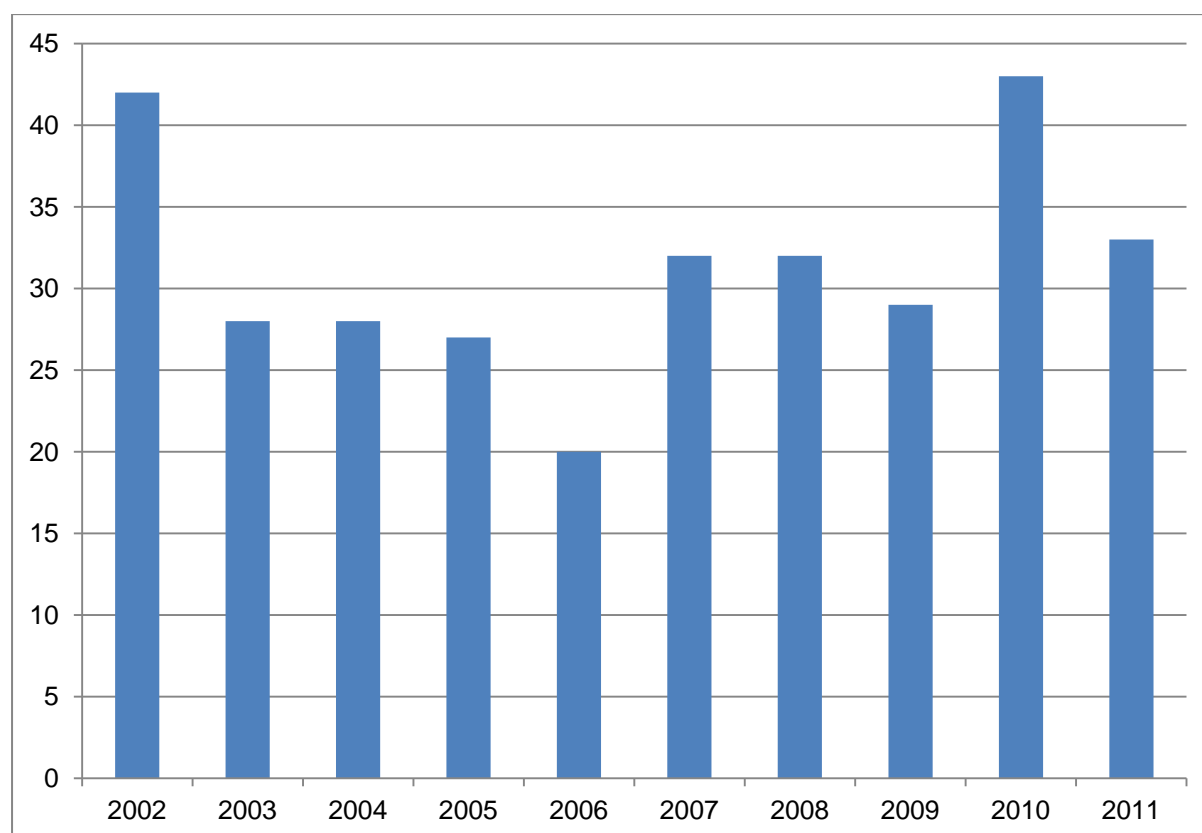
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<sup>7</sup> These estimates are based on models that contain several controversial assumptions, and are subject to criticism (see Easterly, 2010).

<sup>8</sup> It is worth noting that EMOPs have become a larger share of WFP's total budget over the past ten years.

2008 for an additional US\$775 million after “recosting” their planned programmes in light of higher prices and a depreciated US dollar.

**Figure 8. Emergency Operations of the World Food Programme**



Source: World Food Programme Executive Documents, various issues

### **3.2 Canadian Food Assistance**

The Canadian International Development Agency (CIDA) is responsible for dispensing Canadian federal funds for international food assistance. CIDA does not undertake its own food assistance projects, but allocates the majority of its funds between two agencies; the WFP receives approximately 90 percent of CIDA’s food assistance budget and the remainder goes to the Canadian Foodgrains Bank (CFGB).<sup>9</sup> Most of the funds channeled to the WFP are granted in response to appeals throughout the year.

The CFGB is a private voluntary organisation (PVO) that is comprised of a partnership between Canadian churches, and undertakes a range of projects that are aimed at increasing food security in developing countries. The CFGB is financed through private donations and an annual matching grant from CIDA of up to \$25 million. Approximately 35% of the budget is spent on food security projects (agronomic and investment projects) and 60% on food assistance.

Canadian food assistance funding policies have undergone significant changes over the past few years. Federal guidelines required that ninety percent of food activities (by value) whose commodities were procured with federal funds be tied to domestic sources prior

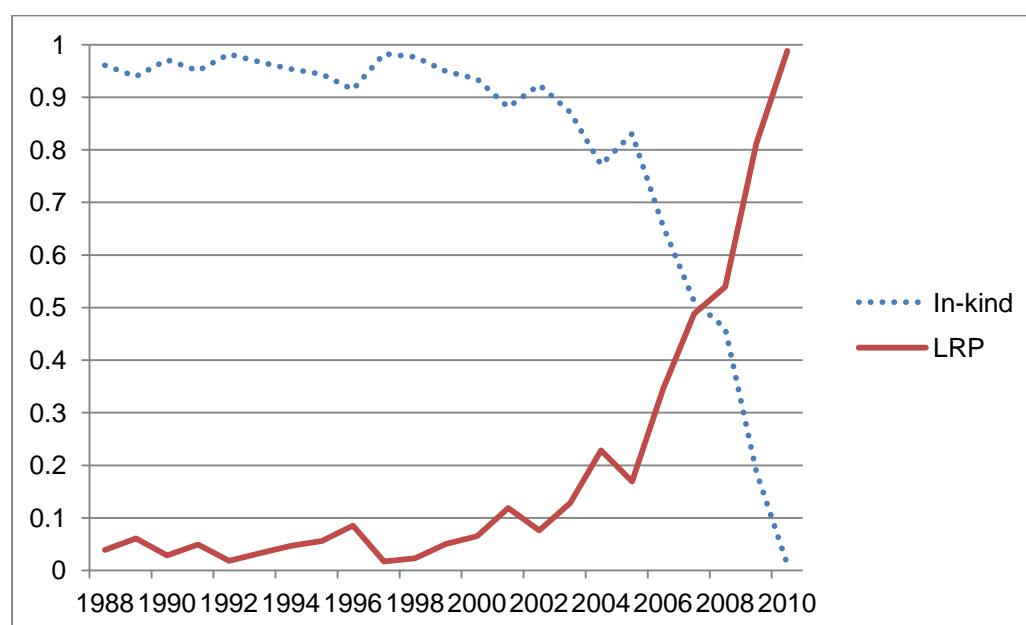
<sup>9</sup> A small number of other organisations receive small allocations from CIDA each year.

to 1996. This was a controversial policy because requiring domestic procurement reduces implementing agencies' flexibility on choice of commodities, location of procurement and price competition. Domestically-procured food assistance is generally thought to be more expensive, less culturally appropriate for recipients and slower to deliver in many cases than locally- or regionally-procured (LRP) assistance (Barrett and Maxwell, 2005). Canadian implementation agencies also felt that buying from the Canadian Wheat Board forced them to buy a higher quality of grain than was necessary, thereby reducing the cost effectiveness of assistance programmes. A CIDA (2006) study estimated that CIDA paid approximately \$200 million above market prices over a 13 year period during which 90% of wheat was procured from the Canadian Wheat Board.

The requirements for tying expenditures to Canadian products were reduced in late 2005 to 50%. Half the money donated to the WFP and the CFGF could be used to purchase commodities in or near recipient countries, or in third countries where prices were lower and/or transportation costs were lower. This requirement was relaxed entirely in 2008 and there are now no formal restrictions on procurement source for federally-funded food assistance. CIDA is encouraged, however, to not procure commodities from countries that have not untied their food assistance procurement processes (particularly Japan and the US).

Figure 9 illustrates that the tying requirements on Canadian food assistance were binding. Implementing agencies took advantage of increased flexibility quickly in 2006 and again in 2008. Almost all federally-funded Canadian food assistance is now procured outside of Canada. The revealed preference of implementing agencies to procure commodities outside of Canada strongly suggests that untied assistance is a more effective method of implementing assistance projects.

**Figure 9. Shares of Canadian Food Assistance Delivered In-Kind and Purchased Abroad**



Source: WFP INTERFAIS

Canadian food assistance donations have hovered just below 250 000 mt (grain equivalent)<sup>10</sup> for the past ten years, and the volume of donations did not jump up during recent price spikes. However a closer look at the data reveals that increasing emergency assistance donations (emergency food assistance's share of total shipments has increased from 17% to 85% over the past ten years) are masked by persistently declining project assistance shipments. Canada's emergency food assistance donations reached their highest point in 2008 since 1994 and have remained near 200 000 mt for the past three years. Much of this assistance has been sent to Eastern Africa (Ethiopia, Sudan and Somalia) in response to persistent shortages and to Haiti in response to tropical storms and a major earthquake in 2010.

Federal funding for Canadian food assistance has increased markedly in the past four years. Federal government outlays jumped by 70 percent from 2007 to 2008 and have remained near \$300 million through 2011 (CIDA, 2012). The increase in funding is a function of several factors, most importantly higher prices for purchased commodities and a ramping up of emergency food assistance shipments in response to WFP appeals. Canada remains one of the largest donor countries by volume (the largest *per capita* donor), ranking fourth (behind the US, EU and Japan) in most years.

### **3.3 US Food Assistance**

The US is the largest donor of food assistance, accounting for more than half of global donations in most years. Legislators in the US have bucked the recent trend of untying assistance shipments, however; almost all US donations are sourced and processed in the US and shipped on US-flagged vessels. These tying policies are widely believed to reduce the efficiency of US food assistance (US GAO, 2009), but a recent effort by President Bush to allow up to one-quarter of US funded food assistance to be purchased abroad in 2008 was defeated by Congress.

The US has transitioned towards providing emergency, instead of programme, food assistance over the past several years.<sup>11</sup> This transition has been particularly dramatic since 2008; emergency food assistance has accounted for more than two-thirds of shipments from the US for the past three years. US emergency food assistance shipments did not jump significantly in 2008 or 2010. The US has delivered an average of approximately 2.3 million mt (grain equivalent) of emergency food assistance over the past ten years, and delivered 2.5 million mt in 2008. Donations have fallen from that level in each of the last two years.

## **4.0 Empirical Investigations**

The discussions in section 2.2 about the cost of food assistance baskets across countries simplify the effects of rising food prices in two important ways. First, figures 5 and 6 do not allow for substitution of food assistance commodities as relative prices change. Second, the price changes on which figures 5 and 6 are based are taken from FAO reference world prices, which may not be representative of the prices paid for food assistance commodities. This is particularly true as the share of food assistance that is procured in, or

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<sup>10</sup> All Canadian assistance shipments reported in this paper are from WFP INTERFAIS, and may not match data reported directly from CIDA.

<sup>11</sup> The US has committed to provide a minimum value of project food assistance in response to pressure from NGOs that monetise food assistance as a source of revenues.

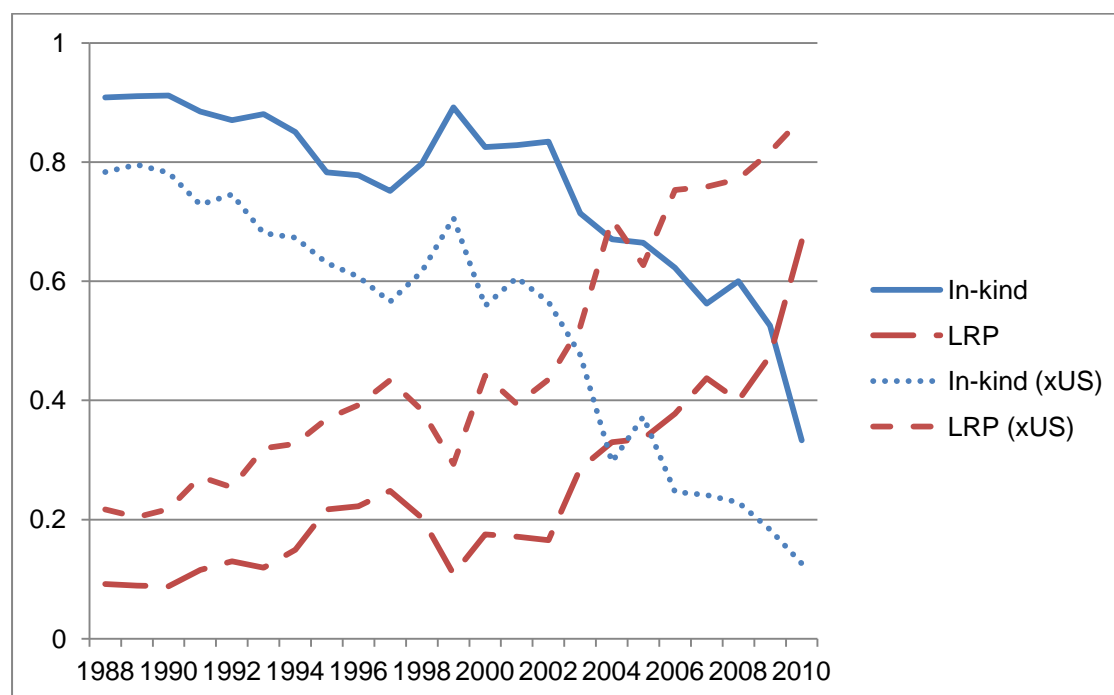
near, recipient markets increases. A more rigorous analysis of these two points is presented below.

#### 4.1 *International Price Pass-through*

The price comparisons in figures 1 through 6 are based on world reference prices, as reported by the FAO. These values typically represent prices at major exporting points or trade-weighted average prices and do not necessarily reflect the cost of commodities that practitioners face when procuring food assistance. This is particularly true when commodities are purchased in locations that are not closely integrated with world markets. Price transmission from world markets to local markets can be muted by trade and domestic policy interventions.

The importance of price transmission from world markets into procurement locations increases as the share of food assistance that is procured outside of donor countries increases. The degree of transmission into the home markets for the group of traditionally-important food assistance donors is presumed to be very high, and world price movements accurately reflect the cost of food assistance commodities in these locations. However in-kind food assistance deliveries are becoming rarer as most donor countries now allow their cash donations to be used to buy food outside their domestic markets. Figure 10 illustrates the shares of food assistance that are delivered as direct transfers from donor countries (in-kind assistance) and assistance that is purchased outside the donor country (LRP). Local and regionally-procured food's share of total shipments has increased from below 10% to approximately 67% over the past thirty years. This trend is even more pronounced when the US, which still procures most of its food assistance domestically, is eliminated from the dataset.

**Figure 10. Shares of Global Food Assistance Delivered In-Kind and Purchased Abroad**



Source: WFP INTERFAIS

Price transmission from world markets into regional markets depends on several factors, including trade policy, domestic price programmes, exchange rate movements and high transaction/transportation costs. Trade policies that limit imports or exports can create wedges between domestic autarkic prices and landed prices for imports and exports. Domestic policy interventions that create price ceilings and floors truncate price transmission from global to local markets. Price ceilings prevent world price movements above the ceiling from affecting local markets and price floors prevent low price movements from passing through.

Exchange rate movements can also affect the degree of price transmission to national markets. Most global food commodity transactions are conducted in US dollars, while local prices are in domestic currencies. A depreciation of the US dollar can, *ceteris paribus*, dampen the effects of rising food prices in a country where the currency has appreciated. However, a significant share of LRP contracts is conducted in US dollars, which limits this effect for food assistance donors.

High transaction costs and shoddy trading infrastructures (in land-locked African countries, for example) also generate wedges between domestic prices and import- or export-parity prices. These factors can have similar effects as price ceilings; global price movements that do not move outside of the parity bands are not transmitted to local markets.

Another consideration in understanding the degree of price transmission from global markets to LRP markets is that most food assistance donors conduct business with relatively large traders, even in developing countries. Most food assistance projects require delivery of large quantities of a specified quality on schedule. Small-scale traders and local markets are generally unable to meet such requirements, so food assistance agencies deal with commercial traders. These commercial traders are more closely integrated with world markets (some may even maintain export operations) than local markets, so the degree of price transmission to LRP markets is higher than to local markets in recipient and surrounding countries.

Several countries where food assistance is now procured have long-standing policies of the types described above, and several pursued new policies during periods of high prices in recent years (see FAO, undated, for an up-to-date list of such policies). Given the growing importance of LRP, the degree and speed of price transmission from world markets to regional markets for important food assistance commodities is investigated. If world price transmission from global to regional markets is slow or incomplete then fixed-value food assistance budgets may buy more food inside recipient or nearby countries. The converse would be true when global prices are falling. Price transmission is investigated in an attempt to determine if movements toward LRP will insulate food assistance procurement from world price shocks.

Project-level procurement data from the CFGB is used to test for price transmission. The speed and degree of price transmission from world markets to LRP markets is tested between pairs of prices for the three important food assistance grains. World prices are from FAO's Global Information and Early Warning System (GIEWS) database and prices for LRP locations are determined by finding commodity- and country-level matches between CFGB procurement locations and available price observations in the GIEWS database. Observations are monthly and the sample runs from 2000 to 2011, except for the Pakistani



rice price that begins in 2006. Table 1 contains the matched locations used in transmission tests.

**Table 1. Location and Commodity Matches for Price Transmission Tests**

Commodity	CFGB Procurement Source	GIEWS survey location
Maize	South Africa	Randfontein
Rice	Pakistan	Peshawar
Wheat	Ethiopia	Addis Ababa

Sources: CFGB, FAO GIEWS

#### **4.1.1 Methodology**

The wide literature on spatial price analysis ranges from tests of international/interregional competitive market equilibrium to closeness of market integration. The presence of competitive market equilibrium is distinct in that competitive pressures eliminate extraordinary profits even if physical trade does not occur (Barrett and Li, 2002). Market integration refers to the trade links between two distinct markets.

This paper investigates a related, but different, concept. The focus here is the degree and speed at which unidirectional price signals are transmitted from world commodity markets to important LRP markets. Time-series analyses can provide speed-of-adjustment coefficients that convey the rate at which departures from an equilibrium relationship are corrected through movements in one of the endogenous variables.

Price vector error-correction models (VECMs) are estimated to observe the speed at which world price signals are passed through to LRP markets. This involves three steps: 1) testing for the order of integration of each price series, 2) testing for the presence of cointegration between price series and 3) estimating VECMs for relevant pairs of price series and interpreting resultant speed-of-adjustment coefficients. These steps are followed for the price series in table 1.

#### **4.1.2 Estimation and Results**

Summary statistics for all price series are presented in table 2. All series are tested for order of integration using the augmented Dickey-Fuller test and all series are I(1) at the 1% significance level. The Johansen (1988) procedure is used to test for cointegrating relationships between each pair of prices. The null hypotheses of no cointegrating vectors are rejected for all price pairs, and one long-term equilibrium relationship is revealed between each matched price pair.<sup>12</sup>

<sup>12</sup> Results for ADF and Johansen tests are available on request.

**Table 2. Summary Statistics - Price Vector Error-Correction Models**

Variable	Mean	Std. Dev.	Maximum	Minimum
Maize price, South Africa	208.06	44.07	298.44	144.43
Maize price, World	189.36	59.08	321.49	103.05
Rice Price, Pakistan	473.57	136.53	820.00	270.00
Rice Price, World	769.56	216.87	1208.00	485.00
Wheat Price, Ethiopia	405.36	111.34	708.69	256.19
Wheat Price, World	268.82	70.97	481.50	170.60

Note: all prices in \$US/mt

Sources: FAO GIEWS, authors' calculations

The following VECMs are estimated

$$(1) \quad \begin{pmatrix} \Delta p_{i,t} \\ \Delta p_{j,t} \end{pmatrix} = \begin{pmatrix} \mu_i \\ \mu_j \end{pmatrix} + \begin{pmatrix} \alpha_i \\ \alpha_j \end{pmatrix} (p_{i,t-1} - \beta p_{j,t-1}) + \sum_{k=1}^n A_k \begin{pmatrix} \Delta p_{i,t-k} \\ \Delta p_{j,t-k} \end{pmatrix} + \begin{pmatrix} u_{i,t} \\ u_{j,t} \end{pmatrix}$$

for all cointegrated price pairs. Prices in location  $i$  at time  $t$  are  $p_{i,t}$ ,  $\begin{pmatrix} \mu_i \\ \mu_j \end{pmatrix}$  and  $\begin{pmatrix} \alpha_i \\ \alpha_j \end{pmatrix}$  are parameters to be estimated,  $A_k$  is a vector of estimated coefficients on lagged price terms, where  $k$  is chosen by minimum Akaike Information Criteria. The error terms  $\begin{pmatrix} u_{i,t} \\ u_{j,t} \end{pmatrix}$  are assumed to be *iid* disturbances and  $\beta$  is the error correction parameter that is estimated using the Johansen procedure.

The  $(p_{i,t-1} - \beta p_{j,t-1})$  portion of equation (1) represents last period's deviation from the long-run relationship between the two price series. Coefficients  $\begin{pmatrix} \alpha_i \\ \alpha_j \end{pmatrix}$  describe how current prices change in response to previous deviations from long-run equilibrium. These coefficients range from negative one to positive one, with small values indicating slow responses and high values representing fast responses. Parameter estimates are reported in table 3. Note that error-correction terms ( $EC_{t-1}$ ) are specified as  $(p_{w,t-1} - \beta p_{j,t-1})$  in estimation, where  $p_w$  is the world reference price and  $p_j$  is the LRP market price.

The parameters on the lagged disequilibrium term,  $EC_{t-1}$ , are of primary interest in this analysis. These coefficients convey the speed at which prices respond to lagged deviations from long-run relationships. The VECM for maize in South Africa generates a speed-of-adjustment estimate of approximately 6%, which is highly significant. This suggests that only 6% of a disequilibrium in period  $(t - 1)$  is corrected each month in South Africa. The direction of Granger causality between cointegrated prices can be determined by the significance of the speed-of-adjustment coefficients in each equation (Rapsomanikis, *et al.*, 2003). This coefficient is highly significant in the equation for the South African price, suggesting that Granger causality runs from world prices to South African prices. The speed-of-adjustment coefficient is insignificant in the world price equation. South African maize prices are contemporaneously correlated with world prices, but the adjustment to shocks is slow.

**Table 3. Parameter Estimates for Price Vector Error-Correction Model**

	Maize - South Africa		Rice - Pakistan		Wheat - Ethiopia	
Variable	$P_w$	$P_i$	$P_w$	$P_i$	$P_w$	$P_i$
Intercept	0.7881 (0.8294)	0.7170 (0.6687)	3.3222 (0.8235)	6.3106 (1.1833)	1.5929 (0.98)	2.3170 (1.1424)
$EC_{t-1}$	-0.0166 (-0.7052)	0.0559 (2.0997)	-0.1378 (-3.3155)	-0.0723 (-1.3154)	0.0364 (1.0709)	0.2497 (5.8823)
$\Delta p_{w,t-1}$	0.2768 (2.7296)	0.0721 (0.6299)	0.4469 (3.3436)	-0.2066 (-1.1695)	0.1727 (1.8621)	-0.4191 (-3.6211)
$\Delta p_{i,t-1}$	-0.1243 (-1.414)	0.2195 (2.2122)	0.0950 (0.7491)	0.1457 (0.8692)	-0.0529 (-0.8502)	0.1864 (2.4014)
$\Delta p_{w,t-2}$	0.1337 (1.3101)	-0.0056 (-0.049)	0.0122 (0.0802)	0.0785 (0.389)	-0.2031 (-2.072)	-0.0629 (-0.5138)
$\Delta p_{i,t-2}$	0.0249 (0.2775)	0.1021 (1.0063)	-0.2356 (-2.2338)	0.0696 (0.4992)	-0.0490 (-0.8077)	-0.0512 (-0.6751)
$\Delta p_{w,t-3}$	-	-	-0.0154 (-0.1079)	0.0153 (0.0812)	-	-
$\Delta p_{i,t-3}$	-	-	-0.0252 (-0.2567)	-0.1768 (-1.3595)	-	-
$\Delta p_{w,t-4}$	-	-	-0.0038 (-0.0326)	-0.1585 (-1.0289)	-	-
$\Delta p_{i,t-4}$	-	-	-0.0481 (-0.5122)	-0.0769 (-0.6195)	-	-

Notes:  $P_w$  is reference world price for each commodity and  $P_i$  is commodity price in the surveyed location.  $EC_{t-1}$  is the lagged error term. Autoregressive lag lengths determined by minimum AIC.  $t$ -ratios in parentheses.

Ethiopian wheat prices respond fast and significantly to changes in their relationship with world wheat prices. Approximately 25% of a lagged disequilibrium is corrected each month in the Ethiopian market. Again, Granger causality runs from the world market to the Ethiopian market as the error correction coefficient is highly significant in the Ethiopian wheat price equation.

The error-correction coefficient in the Pakistani price equation in the rice model is insignificant and the coefficient in the world price equation is significant. This suggests that Granger causality runs from the Pakistani market to the world market. The coefficient on the  $EC_{t-1}$  in the world price equation is negative, which is consistent with the specification of the error-correction term (*i.e.* using the US price as the reference price that appears first in the error term). This result can be explained by the GIEWS database's use of a California export price as its reference world price. Pakistan has become a major rice exporter and has exported more than the US (almost twice as much in some years) over the past 17 years. Approximately 14% of a deviation from long-run equilibrium is corrected each month through changes to world (US, in this case) prices.

### 4.1.3 Discussion

The markets analysed above exhibit varying degrees and speed of price transmission. The South African maize market is relatively isolated from shocks to world prices, suggesting that LRP food assistance purchased in South Africa is well insulated from global maize price shocks. This phenomenon may be partly due to the moving-average maize tariffs implemented at the South African border. Note that this does not mean that prices will necessarily be lower in South Africa; a negative shock to the world reference price will not be quickly transmitted to South Africa and prices may remain above world prices.<sup>13</sup>

The contemporaneous pass through of price shocks from world wheat markets to Ethiopian markets is not complete (*i.e.* not equal to one), but occurs much faster than for maize in South Africa. One-quarter of the previous month's disequilibrium is corrected each month, reducing potential cost savings for food assistance donors that procure wheat in Ethiopia. Ethiopia's wheat market is relatively unfettered by border measures, thereby allowing price signals to move quickly into the country. Locally and regionally procured rice assistance in Pakistan appears not to be insulated from world price shocks. It is possible that world rice price shocks may originate in Pakistan (the direction of causality, in the traditional context, cannot be deduced from Granger causality tests), thus changing the incentives for purchasing organisations.

The data suggest that LRP maize and wheat is partially insulated from world price shocks, and that upward world price shocks will only gradually pass through to procurement markets. The movement from in-kind food assistance shipments to LRP assistance has therefore lessened the effects of rising world commodity prices on food assistance purchases, at least for maize and wheat in the markets analysed above. It is important to note, however, that the rates of price transmission differ across countries and commodities.<sup>14</sup> Domestic food policies in LRP locations can have significant effects on the prices paid for food assistance commodities, and these policies can be very fluid during periods of high food prices.<sup>15</sup>

## 4.2 Do Donors Take Advantage of Relative Price Changes?

Figures 5 and 6 provide insightful static snapshots of the effects of relative price changes, however it may be unrealistic to expect that (for example) Zimbabwe will receive 60% fewer food-assistance calories as a result of a 66% increase in the cost of its historically-representative food-assistance basket. If cereals are substitutable food assistance commodities, then demand theory (with those making procurement decisions as consumers) suggests that food-assistance baskets will be altered to contain larger shares of the commodities whose relative prices fall. Using the example of Zimbabwe, one would expect that as the price of maize increases more than the price of wheat, the share of wheat in Zimbabwe's food-assistance basket would rise. That is, the own-price elasticity for delivered food-assistance commodities should be negative and cross-price elasticities positive.

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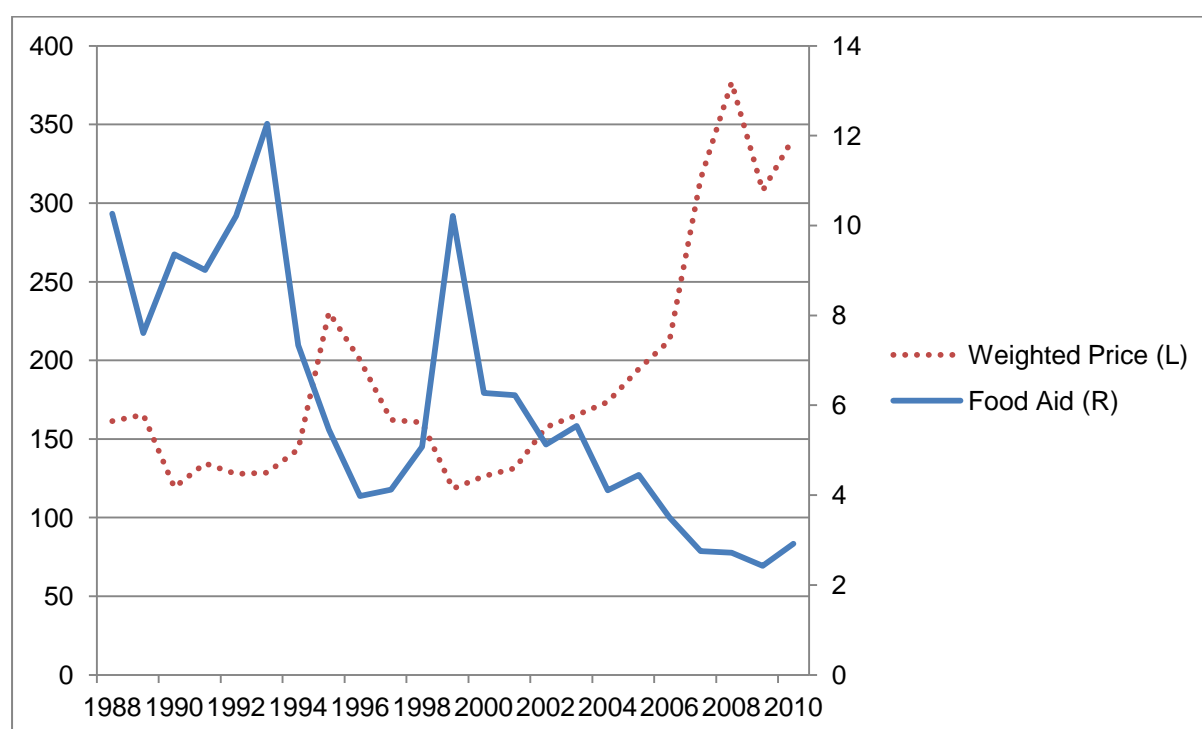
<sup>13</sup> An extension of this research would be to estimate asymmetric VECMs to determine if positive and negative shocks are corrected at different speeds. For example, South Africa's maize tariff is zero when the international price is above the tariff reference price. This is not investigated here.

<sup>14</sup> Note that the analysis considers different commodities for each country, so the range of effects could be commodity specific, country specific, or a combination of both.

<sup>15</sup> The future of some of these policies is discussed in section five.

There is a negative correlation between cereal prices and the volume of cereal food assistance shipments (figure 11). This negative correlation alone does not identify causal price effects on food assistance, but is consistent with two general observations. First, fixed-value food assistance budgets generate negative correlations – higher prices lead to lower quantities. Second, several commentators have criticized food assistance policies as being veiled tools for disposing of surplus agricultural commodities. As market prices fall, there may be more pressure to remove supply from the home market and dispose of commodities in markets that are not integrated (in terms of price transmission) with the donor market.

**Figure 11. Food Assistance Flows and Commodity Prices (prices in \$US/mt; shipments in grain equivalent millions of mt)**



Sources: WFP INTERFAIS, OECD-FAO Agricultural Outlook Database

Note: The weighted price is generated using each commodity's share of total food assistance.

This paper investigates whether food assistance organisations change the commodity composition of their donated baskets in response to relative price changes. The lower volume of shipments in response to higher prices is somewhat trivial, and identification of price effects on food assistance volumes on a global level is not feasible, as discussed in section three.

A naïve hypothesis about price effects is that donors respond to relative price changes by shopping for relatively cheap substitutes. Maize, rice and wheat are the primary commodities that are used as sources of carbohydrates and calories in food assistance baskets. It is sensible, then, to presume that donors who are unable to meet commitments (through fewer beneficiaries, smaller rations or shorter project duration) due to the higher price of a component of their food assistance basket would buy a relatively cheap commodity to lessen the effects on the project's outcomes. The response of wheat's share in a food-assistance

basket to wheat prices should be negative and significant, *ceteris paribus*. There are, however, two confounding factors that may mitigate this response.

First, most food-assistance organisations make concerted efforts to provide “culturally appropriate” food-assistance baskets. Procuring commodities that match local tastes and preparation customs is foremost among donor organisations’ policy objectives, and conversations with staff at the World Food Programme and the Canadian Foodgrains Bank reinforce this point. Many donor organisations follow regional FAO guidelines that provide recommended ingredients for food assistance baskets. The strong efforts to procure specific commodities, even at high prices, suggest that selection of some potentially substitutable commodities within food-assistance baskets may be quite price inelastic. Food assistance practitioners that were consulted during this research were unwilling to speculate on the sign or significance of price effects. A second confounding factor is that some donor countries provide a large share of their food assistance donations as in kind commodities, and domestic production and trade policies<sup>16</sup> are important determinants of commodity selection regardless of relative prices.

#### **4.2.1 Empirical Model**

The empirical model and identification strategy are shaped by the acknowledgement that the conditions under which countries receive food assistance vary widely across recipients. Studies that have tried to explain food assistance shipments typically measure aggregate flows of all commodities (or a subgroup - *i.e.* maize, rice and wheat) as functions of several factors, including donor/recipient stocks (Nunn and Qian, 2010), recipient need (Kuhlgatz, Abdulai and Barrett, 2010) and political economy variables (Neumayer, 2005). We are primarily interested in price effects between commodities, however, and take a different approach.

An empirical model that adequately controlled for determinants of commodity flows on a global level, even in a model with fixed effects that treats price changes as exogenous, would be intractable. The primary interest here is the identification of substitution effects between commodities, however, and that does not require estimating the effects of price changes on assistance basket sizes. Instead, the model estimates how the share of a specific commodity in a food assistance basket changes when prices change.

One of the difficulties in modelling food assistance shipments is identifying who “demands” the commodities. Recipients who consume the commodities cannot be modelled as demanding food assistance in the traditional sense because they typically don’t pay (except in cases of concessional or monetised food assistance). Food assistance organisations (WFP, CFGB, etc.) or donor countries (in the case of tied assistance) typically procure and distribute commodities, however donors’ decisions on commodity selection is not always observable from available data. Consider, for example, donations of 235,116 mt of wheat from Canada in 2000, as reported by WFP INTERFAIS. This donation measures the quantity of wheat received by all recipients as the result of Canadian food assistance operations, and can be separated into at least three components: 1) in-kind commodities sent from Canada to recipient countries or implementing organisations, 2) cash-based assistance from Canada to implementing organisations that was used to buy wheat and 3) cash-based assistance that was used for vouchers in recipient regions and redeemed for wheat in the recipient area. The

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<sup>16</sup> For example, a large share of Japan’s imported rice (as mandated by WTO minimum access commitments) is shipped back out of the country as food assistance before entering the Japanese food system (OECD, 2009).

important point is that it is not possible to identify Canadian policy makers as having made the decision to select wheat (instead of maize or rice) as the carbohydrate component of the recipient's food assistance basket. The challenge of identifying who selects the components of a basket varies across donors (easier for donors who contribute a large share of assistance as in-kind commodities, more difficult for donors that use a range of modalities).

Our strategy for dealing with this challenge is to use WFP INTERFAIS shipment data from recipients' perspectives. Each data point represents the volume of a commodity that country-based recipients receive from all donors, regardless of who made the commodity procurement decision. This allows the identification of price effects on commodity selection averaged across all donor countries and implementation organisations. The focus is placed on the effects of relative price changes on the recipients of food assistance.

Food assistance rations typically contain four components: 1) cereals for carbohydrates and calories, 2) pulses for protein, 3) oils and 4) salt. Each component serves different dietary objectives, and a shortage of (for example) cereals cannot be made up for with more (for example) salt. We therefore treat each component group of a food aid ration as being a separable group of commodities<sup>17</sup> and model price effects within these groups.

We propose an *ad hoc* empirical specification to estimate price effects on food assistance shipments. The estimated equation is

$$(2) \quad s_{ki,t} = \alpha_{ki} + \sum_{j=1}^n \gamma_{ij} P_{j,t} + \beta_i X_{k,t} + \varepsilon_{ki,t}$$

where the share (by volume<sup>18</sup>) of country  $k$ 's food assistance basket that is comprised of commodity  $i$  in period  $t$  is  $s_{ki,t}$ , prices for commodity  $j$  are  $P_{j,t}$ ,  $X_{k,t}$  is the total volume a recipient's food assistance basket and  $\varepsilon_{ki,t}$  is an error term. Parameters  $\alpha_{ki}$ ,  $\gamma_{ij}$  and  $\beta_i$  are estimated, where  $\gamma_{ij}$  is an estimate of the average price effect once country fixed-effects are considered.

Equation (2) is *ad hoc* in that it is not derived from the optimisation of an agent who demands food assistance, as would be the case in estimating demand functions. We are not able to identify who is selecting the specific commodities for each country's assistance basket, and instead estimate the effect of relative price changes on the make-up of recipients' baskets.

Observed assistance volumes for each commodity group are taken as exogenous (for example, specific projects may call for the feeding of a predetermined number of people). Donors determine the size of their food assistance baskets, and then allocate spending across commodities in response to relative prices and the size of the basket. This allows us to derive price effects (*i.e.* elasticities) without having to explain the volume of food assistance.

The parameters  $\gamma_{ij}$  are estimates of how commodity  $i$ 's share of food assistance baskets change in response to a change in the price of commodity  $j$ , averaged across all observations

<sup>17</sup> There are not sufficiently complete data to formally test for separability between food aid commodities.

<sup>18</sup> Volume shares are used instead of expenditure shares because observations on food assistance expenditures are not available from INTERFAIS. Food assistance expenditure data are available for select projects, but we believe that there are substantial benefits to estimating the model over a large number of countries and many years, as are available from the INTERFAIS dataset in volumes.

in the panel data set. Parameter  $\beta_i$  estimates how commodity  $i$ 's share of food assistance baskets changes in response to a changes in the size of the basket.

Food assistance data come from the WFP's INTERFAIS database which provides annual recipient-level food assistance shipments by commodity from 1988 to 2010. Data are collected for two commodity groups: cereals (maize, rice and wheat) and pulses (bean, lentil, pea and soybean). All data are converted to grain equivalent<sup>19</sup> measures so that volumes can be compared across commodities. Measuring in grain equivalent units is important in this context so that donors are selecting between nutritionally-equivalent products once the size of the basket is determined.

Price data are from the OECD-FAO Agricultural Outlook database and represent reference world prices. Donors do not necessarily pay world prices for food assistance commodities, as discussed in section 4.1, however the variation in the world prices from this database should be representative of price movements facing donors. Table 4 presents summary statistics for the data.

**Table 4. Summary Statistics - Grain Model**

Variable	Mean	Std. Dev.	Maximum	Minimum
Maize share	0.20	0.34	1	0
Rice share	0.45	0.44	1	0
Wheat share	0.36	0.42	1	0
Maize price (\$US/mt)	124.06	38.54	230.62	87.82
Rice price (\$US/mt)	312.78	115.09	695.00	184.17
Wheat price (\$US/mt)	164.84	59.08	340.02	103.52
Food assistance (mt, grain equivalent)	69,254.31	175,888.90	3,263,272.00	0.32

Note: 114 countries

Sources: FAO GIEWS, authors' calculations

#### 4.2.2 Estimation and Results

A Hausman test reveals no significant difference between the random and fixed effects models, so random effects estimates are biased upwards and the investigation proceeds with country-fixed effects in the panel model. Panel-corrected standard errors (PCSE) are used because contemporaneous correlation across panels is expected; regional dietary customs often permeate national borders. This is especially true in trans-border refugee situations. Country-level fixed effects control for unobserved time-invariant determinants of each commodity's share in a food assistance basket.

Table 5 presents the baseline empirical results.<sup>20</sup> The coefficients on the constants do not have meaningful economic interpretations, but sum to one because the system is singular. Estimated coefficients on price terms are mostly insignificant and their signs are often

<sup>19</sup> This conversion is made using pairwise commodity-specific rates based on nutritional comparisons.

<sup>20</sup> Woolridge's (2002) test for serial correlation in panel models does not reveal serial correlation in any of the system equations.



counterintuitive. Own-price effects are generally insignificant, with the exception of rice which is positive and significant only at 10%. Cross-price effects are also mostly insignificant.

**Table 5. Parameter Estimates - Price Effects on Commodity Shares – Grains**

	Wheat	Rice	Maize
Constant	0.487677 <sup>a</sup> (0.041385)	0.377342 <sup>a</sup> (0.029608)	0.134981 <sup>a</sup> (0.028322)
$P^{\text{wheat}}$	-0.000594 (0.000514)	0.000874 <sup>b</sup> (0.000366)	-0.000280 (0.000372)
$P^{\text{rice}}$	-0.000220 (0.000144)	0.000178 <sup>c</sup> (0.000103)	0.000043 (0.000104)
$P^{\text{maize}}$	0.000173 (0.000860)	-0.000857 (0.000611)	0.000684 (0.000612)
Total	0.0000002 <sup>a</sup> (0.0000001)	-0.0000003 <sup>a</sup> (0.0000001)	0.0000001 <sup>a</sup> (0.0000000)
Observations	2026		
System R <sup>2</sup>	0.628		

Notes: Dependent variable is commodity share in food assistance basket. Equations are estimated with panel-corrected standard errors to account for contemporaneous correlation across panels. Superscripts “a”, “b”, and “c” denote significance at the 1%, 5% and 10% levels, respectively.

Estimated coefficients on the size of food assistance baskets are all significant at 1%. The coefficients for wheat and maize shares are positive and the coefficient for rice is negative. This suggests that the share of wheat and maize in baskets increases with basket size while the share of rice declines.

It is useful to look at elasticities to determine the economic significance of estimated parameters. Table 6 provides price elasticities of share that are derived from the parameter estimates in table 5. Price elasticities<sup>21</sup> can be shown to equal:

$$(3) \quad \eta_{ij} = \gamma_{ij} \cdot \frac{\bar{P}_j}{\bar{s}_i}$$

where  $\eta_{ij}$  is commodity  $i$ 's share elasticity with respect to price  $j$ , or with respect to size of food assistance basket. All elasticities are partial elasticities that assume other right-hand side variables are constant, and are calculated at sample means ( $\bar{P}_j$  and  $\bar{s}_i$ ). Basket-size elasticities of share<sup>22</sup> are:

$$(4) \quad \eta_{iX} = \beta_i \cdot \frac{\bar{P}_i}{\bar{X}}$$

<sup>21</sup> Price elasticities of share are reported instead of elasticities of quantity because of the wide range of observed shipment volumes across panels and over time in the database. Elasticities of quantity evaluated at the sample means would not be informative.

<sup>22</sup> Basket-size elasticities of commodity volume are different than elasticities of commodity share, and are always positive when calculated using the parameters in table 5. Commodity share may decline with increased basket size (as is the case with rice), even though commodity volume increases.

**Table 6. Share Elasticities – Grains**

	Wheat	Rice	Maize
$p^{\text{wheat}}$	-0.275	0.322 <sup>b</sup>	-0.235
$p^{\text{rice}}$	-0.193	0.125 <sup>c</sup>	0.068
$p^{\text{maize}}$	0.060	-0.238	0.109
Total	0.040 <sup>a</sup>	-0.054 <sup>a</sup>	0.048 <sup>a</sup>

Notes: Dependent variable is commodity share in food assistance basket. Superscripts “a”, “b”, and “c” denote significance at the 1%, 5% and 10% levels, respectively.

All share price elasticities are small in magnitude. For example a 10% increase in the price of wheat generates a decrease of wheat’s share in food assistance baskets of approximately 3%. The standard deviation of wheat prices over the sample period is US\$59, which would generate a decline in wheat’s share of approximately 10%. Similarly small results are observed across other own- and cross-price elasticities, however rice’s share is more responsive to relative price changes. Note, however, that these elasticities are statistically insignificant, so economic interpretations must be made with caution.

Basket-size elasticities of commodity share are all highly significant, but the economic significance of these elasticities is small. A 10% increase in the size of a food assistance basket leads to a decline in rice’s share of less than 1%. The standard deviation of assistance basket size<sup>23</sup> over the sample period is 175,889 mt, which would generate a decline in rice’s share of approximately 14%. Wheat and maize’s shares increase as basket size expands.

Cereal grains account for a large share of food assistance deliveries, particularly bulk, in-kind deliveries. However food assistance interventions often provide rations that contain a variety of ingredients in an effort to provide more nutritionally-balanced diets. For example, a typical WFP ration in emergency and refugee events includes staple grains, pulses or beans, vegetable oil, sugar and salt.

The degree of substitutability among these peripheral commodities may be different than for cereal grains because preparation methods are more similar across commodities and it is possible that none these products are part of recipients’ traditional diets. Donors may therefore be more willing to alter the components that make up the non-staple part of food assistance baskets in response to price changes. Relative price changes on pulses and beans (referred to as the bean model hereafter) in food assistance baskets are investigated.

The investigation for beans is similar to the approach taken for cereal grains, however the important commodities in this category for which there are data available from INTERFAIS consider are considered; beans, lentils, peas and soybeans. The estimating equation is the same as equation (2), with relevant world prices included from the OECD-FAO Agricultural Outlook database. Summary statistics are in table 7.

<sup>23</sup> This standard deviation is calculated from all observations across all panels. It is much larger than the mean because of the wide range of volumes across recipient countries in the dataset.

**Table 7. Summary Statistics - Bean Model**

Variable	Mean	Std. Dev.	Maximum	Minimum
Bean share	0.52	0.42	1.00	0.00
Lentil share	0.17	0.31	1.00	0.00
Pea share	0.27	0.36	1.00	0.00
Soybean share	0.04	0.18	1.00	0.00
Bean price (\$US/mt)	490.19	113.29	763.00	342.00
Lentil price (\$US/mt)	335.75	134.26	745.00	184.00
Pea price (\$US/mt)	171.50	55.84	295.00	42.00
Soybean price (\$US/mt)	233.75	58.41	371.00	161.00
Food assistance (mt, grain equivalent)	5,538.07	13,132.30	259,320.00	1.00

Note: 114 countries

Source: FAO GIEWS, authors' calculations

Table 8 presents parameter estimates from the bean model. Several estimated price effects for bean commodities exhibit high levels of statistical significance. Own-price effects for lentils and peas are negative and significant, however the own-price effect for soybeans is positive and significant. Several cross-price effects are also significant at varying levels of significance.

**Table 8. Parameter Estimates - Price Effects on Commodity Shares – Beans**

	Beans	Lentils	Peas	Soybeans
Constant	0.762244 <sup>a</sup> (0.126634)	0.09255 <sup>b</sup> (0.043429)	0.152298 (0.094851)	-0.007092 (0.019325)
P <sup>beans</sup>	0.000037 (0.000333)	0.000017 (0.000109)	-0.000067 (0.000249)	0.000013 (0.000052)
P <sup>lentils</sup>	-0.000096 (0.00041)	-0.000372 <sup>a</sup> (0.000139)	0.000588 <sup>c</sup> (0.000307)	-0.00012 <sup>c</sup> (0.00007)
P <sup>peas</sup>	0.000277 (0.000772)	0.000800 <sup>a</sup> (0.000257)	-0.000954 <sup>c</sup> (0.000573)	-0.000124 (0.000107)
P <sup>soybeans</sup>	-0.001101 (0.000954)	0.000277 (0.00032)	0.000495 (0.000706)	0.000329 <sup>b</sup> (0.000147)
Total	-0.000003 <sup>a</sup> (0.000001)	-0.000001 (0.000001)	0.000000 (0.000001)	0.000004 <sup>a</sup> (0.000001)
Observations	1559			
System R <sup>2</sup>	0.41			

Notes: Dependent variable is commodity share in food assistance basket. Equations are estimated with panel-corrected standard errors to account for contemporaneous correlation across panels. Superscripts “a”, “b”, and “c” denote significance at the 1%, 5% and 10% levels, respectively.

Elasticities for the bean model are in table 9. Lentil, pea and soybean shares are economically and statistically significantly responsive to relative price changes. A 10% increase in the price of lentils generates a decline in lentil's share in food assistance baskets of 7.2%. The standard deviation of lentil prices over the sample is US\$134.26, which would generate a change in lentil's share of approximately 29%. The share of peas in food assistance baskets is similarly sensitive to price changes. Soybeans' share in food assistance baskets appears very sensitive to prices changes, with an own-price elasticity of two. This result is difficult to explain, particularly because soybeans are difficult to prepare and require more firewood for cooking than peas or lentils. Food assistance practitioners report that peas and lentils are preferred unless soybeans are markedly cheaper. Some cross-price elasticities are positive, suggesting substitutability between commodities that make up the bean component of food assistance baskets.

**Table 9. Share Elasticities – Beans**

	Beans	Lentils	Peas	Soybeans
$P^{\text{beans}}$	0.035	0.047	-0.122	0.163
$P^{\text{lentils}}$	-0.062	-0.719 <sup>a</sup>	0.738 <sup>c</sup>	-1.043 <sup>c</sup>
$P^{\text{peas}}$	0.091	0.789 <sup>a</sup>	-0.612 <sup>c</sup>	-0.551
$P^{\text{soybeans}}$	-0.495	0.372	0.433	1.997 <sup>b</sup>
Total	-0.035 <sup>a</sup>	-0.022	-0.007	0.618 <sup>a</sup>

Notes: Dependent variable is commodity share in food assistance basket. Superscripts “a”, “b”, and “c” denote significance at the 1%, 5% and 10% levels, respectively.

### 4.2.3 Discussion

Barrett and Bellemare (2011) argue that volatile food prices do not necessarily have negative effects on food insecure populations. Two conditions are central to this being the case: 1) food commodities can be stored and 2) there exist available substitutes that can be purchased at relative discounts when the price of one product rises. Cereal food assistance satisfies the first condition, but the empirical model above suggests that donors do not substitute between cereals in food assistance baskets. This means that food assistance donors do not take advantage of relative discounts and substitute, for example, cheap maize for expensive rice. Furthermore, the prospects for such substitution are not good even if donors change behaviour. Substituting for relatively cheap commodities requires the existence of commodities whose prices are uncorrelated, or negatively correlated, with each other. Prices for important food assistance cereals (maize, rice and wheat) are all correlated at levels above 0.9 (Cardwell and Barichello, 2009). Price volatility, *per se*, may not be a problem, but when the price of one of these commodities increases, all shortly follow suit.

Donors appear to be taking advantage of opportunities for substitution among peripheral components of food assistance rations in the case of beans. Several of the estimated own- and cross-price elasticities are economically and statistically significant. The observed willingness of donors to make these substitutions may be due to the fact that cultural dietary traditions are not as pervasive for these protein sources as for cereal grains.

The empirical results suggest that the shares of some food assistance commodities are affected by basket size. The share of rice in food assistance baskets declines when the sizes

of donations increase, and the shares of wheat and maize increase. Bean share also falls with basket size, while the share of soybeans increases when basket sizes expand. These results are highly significant and robust, but are difficult to explain. It's possible that the wider global availability of maize and wheat, particularly in net-food exporting countries where food assistance commodities are often sourced, mean that donors are forced to move towards maize and wheat purchases as total donations exceed a certain level.

Assistance organisations may also have the opportunity to substitute for lower quality products when faced with binding budget constraints. For example, lower-quality and cheaper soft wheat may be substituted for higher-protein hard wheat when selecting the cereal component of a food assistance basket. There are a few important constraints on organisations' ability to make such substitutions, however. First, assistance agencies already tend to use the lowest grade that will meet their project requirements in most instances - this allows for larger and/or more assistance baskets. Second, assistance that is received from donors that tie their donations are available only as provided. This created obstacles for organisations that received Canadian funding prior to the untying of Canadian food assistance. Organisations were required to purchase wheat of a higher quality than was required, thereby increasing procurement costs. Current data on food assistance are not disaggregated by quality, so a formal analysis of this possibility is not feasible at this time.<sup>24</sup>

## **5.0 Future**

Prognosticating on the direction of food prices in the future is beyond the scope of this paper, and no such attempt is made here. Instead, a few important developments that will affect food assistance's vulnerability to food price swings in the future are discussed.

The 1999 Food Aid Convention (FAC) is an international treaty that, among other things, commits member countries to minimum quantity donations of food assistance commodities. The convention has been renewed several times and is currently being renegotiated. One current proposal is to allow member countries to commit to cash value donations instead of volume donations. This could generate broader use of LRP food assistance and provide greater flexibility to donor agencies. Fixed-value donations would increase price risk, however and result in countercyclical donations as prices vary. One possible solution to this problem is to index cash-based commitments to food prices to ensure more stable volumes (Gaus, *et al.*, 2011).

There are also suggestions to provide more room in donors' commitments to allow for donations of fortified food products. Such products are widely used in emergency responses and the current FAC allows only 15% of a country's donations to be fortified and nutritional products. Such products are more expensive than unprocessed cereal commodities, however volatile commodity prices would have less significant effects on final donations because raw commodities account for only a portion of the final cost.

Export restrictions in countries that are becoming important sources for LRP food assistance are spectres hanging over donors' decisions to move away from in-kind assistance. Several net food exporting countries introduced new, or tightened existing, export disciplines on food commodities during periods of high prices in 2008 and 2010. These policies not only

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<sup>24</sup> It is possible that different categories of food assistance (emergency, programme and project) exhibit different degrees of substitutability. As donors have moved towards relatively more emergency assistance, this possibility may become more relevant over time. We do not investigate this here.

applied upward pressure on world food prices, but also interfered with donors' ability to source food. For example, the WFP reported difficulties securing enough grain to implement programmes in Somalia and Afghanistan in 2008 because of Pakistani export controls on rice (Mitra and Josling, 2009).

Several commentators have proposed an agreement between countries that food assistance purchases be exempt from export controls. Such an agreement would maintain donors' flexibility on procurement location, though it would not significantly reduce the effects of export restrictions on world prices.

Current WTO negotiations include new proposed disciplines on food assistance shipments that would limit the circumstances under which food assistance could be provided without being disciplined. The most recent proposals attempt to define a "safe box" (akin to the URAA's "green box" for domestic support) for food assistance - donations that meet the requirements of "safe box" assistance would be allowed and all other shipments would be subject to disciplines on export subsidies and credit guarantees. It is not clear what effect such disciplines would have on the vulnerability of food assistance to price shocks. Much of the debate over food assistance rules stems from the EU's attempts to reduce what many negotiators view as the US' use of food assistance as a domestic agricultural support policy. As long as the US continues to provide most of its food assistance in kind, then such rules may be relevant to US shipments (though the ability of such rules to modify US behaviour is highly suspect). However as most other donors move toward LRP, concerns over surplus disposal diminish and these rules would be less relevant.

## **6.0 Conclusions**

The only long-term solution to food security is income growth. However, food assistance will remain an important piece of the toolbox for addressing short-term instances of entitlement failures. The need for food assistance tends to rise during periods of high commodity prices and the supply of food assistance is typically countercyclical to prices. These opposing forces generated a flurry of debates over food assistance policy and practice in recent years. Recent periods of high commodity prices strained food assistance resources by pushing more people into states of food insecurity and by increasing the costs of existing food assistance programmes. Food security, and food assistance's role in providing it, is again at the fore of international development debates.

Several developments in food assistance policy over the past several years have enhanced the usefulness of food assistance in periods of high prices. Canadian food assistance policies have become more responsive and efficient by eliminating tying requirements and allowing procurement in more strategic locations. Most other donors, with the notable exception of the US, have made similar adjustments to their policies.

The movement towards local and regional procurement provides potential benefits beyond shorter delivery lags and more culturally appropriate foods. Price shocks in international food markets may be slow to pass through to local markets where a growing share of food assistance is purchased. This can partially and temporarily insulate food assistance shipments from global price spikes. The flipside of this is that falling international prices are slower to pass through and prices may remain high longer in local and regional markets. However the increased flexibility that local and regional procurement provides to

donors allows them to change source locations in response to international price differentials.<sup>25</sup>

Donors' efforts to provide culturally-appropriate foods to recipients appear to trump the opportunity to substitute away from relatively expensive commodities for the cereal component of food assistance baskets. This is unlikely to change given most donors' strong commitment to this principle. However there do appear to be price effects for the protein component of food assistance baskets.

A new Food Assistance Convention may help to further insulate food assistance from rising prices in the future by committing donor countries to minimum value donations that are indexed to food prices. There are also proposals for countries to exempt food assistance purchase from export restrictions that are erected during periods of high prices. Any new agreement will be voluntary, however, and their success will have to be evaluated after being tested.

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<sup>25</sup> The WFP has been shown to successfully shop for low prices across borders when buying food assistance commodities (Tschirley and del Castillo, 2007).

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