Methodological Note:

Estimating the Effects of the Food Price Surge on the Welfare of the Poor

Alain de Janvry and Elisabeth Sadoulet[1]
UC Berkeley
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I. The food crisis and research questions

The main symptom of the world food crisis has been a large upsurge in international prices for the main staples foods, principally corn, wheat, rice, and soybeans over the last three years. However, this general effect is transmitted into domestic food prices in highly uneven ways across countries depending on the way markets work and on government price policies. It has highly differentiated impacts across categories of poor people depending on their sources of income, their consumption patterns, and their participation to markets. There are also short-term effects whereby a price movement is a mere change in the monetary value for what people were doing in production and consumption before the shock. But there are longer-term effects when opportunities are seized through supply response in production and negative impacts are mitigated through substitutions in consumption. In order to design policy responses, it is important to measure these effects. We need to know who is gaining and who is losing, and by how much. We need to know what are the channels through which these effects are occurring. And we need to know both the short term and the longer-term effects.

The objective of this note is to review the methodological approaches that have been used to analyze the impact of the food crisis on the poor. Note that we are not addressing here the macro-economic effects of the food crisis on such issues as overall inflation, fiscal revenues, balance of trade, and GDP growth. Neither are we looking at the policy responses to the food crisis such as changes in import tariffs and export taxes, consumer subsidies, social safety nets to provide access to food, and assistance to agriculture to respond. Our focus is on poverty. Choice of a methodological approach depends on the research question that is being asked. A major issue of concern for researchers has been to measure the impact of rising food prices on the overall incidence of poverty. Of concern also is what is the magnitude of the loss in consumption by the poor that would need compensation. Finally, we know that there is considerable heterogeneity across poor households, with the implication that policy responses need to be differentiated in correspondence to this heterogeneity. Of concern as well is consequently to trace the impact of the food crisis on the well-being of particular subsets of the poor population, identifying in each case the causal channels involved, the magnitude of the impacts on welfare, and the policy entry points that could be used to respond.

In this paper, we start by asking what price increase should be simulated in terms of impact on the poor. We then look at the methodologies that have been used to measure impacts on poverty and on specific categories of poor using a partial equilibrium framework, both for short and medium run analyses. We also look at approaches used to track general equilibrium effects. We conclude by making a pragmatic proposal regarding a suggested approach to analyze the impact of the food crisis on poverty

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stressing heterogeneity and differentiated policy responses. This approach could be applied to a number of countries in the region in order to guide policy responses.

II. What price increase should be simulated?

International food prices have increased sharply, but transmission to domestic prices varies greatly, in part due to the nature of policies. The effects on domestic prices for these commodities are thus specific to each country. The prices of other foods also increase domestically due to substitutions in production and consumption. Prices also change due to other unrelated phenomena that affect the different food and non-food items. It is also likely that incomes, profits, wages, and transfers change.

In analyzing the impact of price movements on poverty, it is consequently important to first decide what it is that we are interested in simulating. Options varies along several dimensions:

(i) Simulate the actual vector of observed price changes vs. a subset of prices of interest?

The first option is to simulate the effect of the actual vector of observed price changes (including incomes) over a given period of time, whatever the origin of these changes. The reason for doing this is to infer the changes in welfare and poverty that are presumed to have taken place during the period as a consequence of the observed price/income changes, and to decompose effects coming from different price changes. Results are important for actual welfare analysis, but do not give a clear message on the role of the food crisis because many other changes in prices and incomes have occurred during the period.

The other option is to simulate the increase in only some key food prices of interest. To do this, one should specify the group of food items of interest, namely internationally traded cereals and domestic foods that are close substitutes. But to simulate the observed increases while keeping constant all other prices may exaggerate the relative movement of prices and hence the welfare effects of the food price increase.

(ii) If focusing on a subset of prices, what to assume for all the other prices?

The question is then how to neutralize the other idiosyncratic price movements. One possibility is to set all other goods and incomes to increase as the overall CPI. This is equivalent to analyzing the impact of the relative price increase (relative to CPI) of the food items of interest and not changes in other prices and incomes.

Other papers have chosen to simply look at an artificial price increase of 10, 25, or 50% of specific commodities, keeping all other prices constant. These simulations serve the purpose of illustrating the mechanism of transmission of key relative price increases to welfare, but do not relate to the actual price increases observed in specific countries.

Recent papers on the impact of the food prices have taken different options. Specifically:

- Analyze arbitrary changes in the prices of food, keeping all other price constant

  - Wodon (2008): 25 and 50% increase in the prices of all foods of interest, which include cereals in all countries, and milk, sugar, or oil and butter in some countries.
  - Coady, Dorosh, and Minten (2008): 33% increase in the price of rice.
  - Wodon, Tsimpo, and Coulombe (2008): -30% to +30% increase in successive 5% increments for the prices of cereals one at a time and all together.
  - Dessus, Herrera, and de Hoyos (2008): 10, 20, and 30% increase in price for the food aggregate (urban population only).

- Robles, Cuesta, Dureya, Enamorado, Gonzales, and Rodriguez (2008): 30% increase in the relative price of the food aggregate, calibrated as the international average price increase.
- Ivanic and Martin (2008): 10% increase in the price of beef, dairy, maize, poultry, rice, sugar, and wheat, one at a time. They also added simulations with the unskilled labor wage increase given by running the 10% price shock in the GTAP model for each country (values not reported in the paper).

- Analyze the vector of key international prices, assuming all other prices constant

- Ivanic and Martin (2008). The observed 2005-07 international price increases from FAO statistics (beef 0%, dairy 90%, maize 80%, poultry 15%, rice 25%, sugar 0%, and wheat 70%).

- Analyze the observed vector of all prices (at some level of aggregation)

- Friedman and Levinsohn (2002) in the context of the 1997 Indonesian financial crisis.
- Robles, Cuesta, Dureya, Enamorado, Gonzales, and Rodriguez (2008) simulate the aggregate food and non-food price observed in each country. The observed 2006-08 CPI and aggregate food price in each country give the relative food price increase as the difference between the food price increase and the non-food price increase. Other simulation scenarios use the international relative price of food.
- IADB (2008) as above, using (i) the country's relative price of food and non-food, (ii) the regional average of the relative price of food, and (iii) the relative price increase that corresponds to the country of Latin America with the highest pass-trough from international prices.
- Busjeet, Demombynes, and Sobrado (2008): Observed changes over the last 3 years for the CPI and the aggregate food price in each country.
- Chen and Ravallion (2003): In the context of anticipating the effect of China's entry into the WTO, they use a predicted vector of price changes from GTAP simulations, including three categories of wages, and the prices of land and capital.

What price increase to simulate thus depends on the research question. But results from different options must be interpreted with caution. Analysis of international price increases is only meaningful if indeed there is almost full transmission to domestic markets. Analysis of changes in the relative prices of food items miss many price changes that have occurred as part of the crisis itself, such as energy prices and effects on food items that are close complements or substitutes. Analysis of change in the observed full vector of prices (and incomes) includes many events that occurred during the period, but are not part of the food crisis per se. Recommendation may be that several simulations should be done, but that results from each should be interpreted as informing clearly different aspects of the impact of the food crisis on poverty. In all cases where only a subset of prices or income components are adjusted it is important that these be *real* price changes, so that there is no money illusion, i.e, properly deflated by an overall price index.

III. Methodology for the partial equilibrium analysis of effects on welfare

There are two clearly different objectives in this analysis. One, that has dominated the question asked in research papers that followed immediately after the food crisis, is to measure the impact of the food

crisis on different poverty indicators. The other, which is more concerned with the design of policy responses, is to measure the differential welfare effects of the crisis on particular categories of households, both gainers and losers. We describe each in turn, and then compare them in section 3.

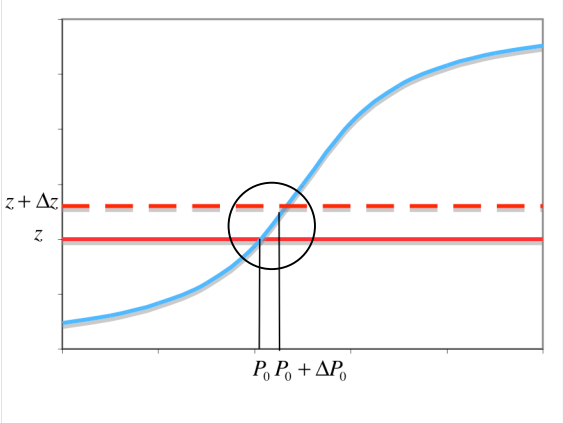
1. Adjusting the poverty line to compute poverty indicators

We first consider methods that essentially adjust the poverty line to take into account the increase in the cost of living due to rising prices, while keeping household total expenditures constant. The adjustment of the poverty line thus needs to reflect the effect of the changes in *real* consumer prices, i.e., relative to possible changes in total expenditures (or income). Papers vary in their definition of the real price changes, assuming that total expenditures (or income) vary either with the aggregate CPI or with the non-food price. We then describe in section 1.3 how to additionally adjust for total expenditures of the (agricultural) households, in order to include the impact of the changes in producer prices.

The underlying theory for adjusting the poverty line is to compute the increase in total expenditures that would be necessary to maintain the marginal poor at the same level of welfare after the price increase, i.e., the compensating variation. A first order linear approximation simply gives a value equal to the share of food consumption times the increase in its relative price. This is the increase in household budget that would be necessary were there no change in the structure of consumption. A second order approximation adds a substitution effect between food and non-food, leading to a small reduction in the initial impact of the price shock.

Note that the adjustment of the poverty line is the correct measure of the welfare effect of price changes on the marginal poor, but does not reflect the welfare effects on the poorest households. It is however sufficient to compute the traditional poverty measures P_0, P_1, and P_2, which are solely based on comparing total expenditures (or nominal income) of households to poverty lines. Furthermore, measuring the effect on P_0 and P_1 needs only focus on the households that are just above the poverty line, as illustrated on Figure 1. This suggests a quick back of the envelope method based on assumptions on the density of households just above the poverty line as proposed by Busjeet et al. (2008). The other analyses described in this section use the observed pre-crisis distribution of household expenditures to compute new poverty indices.

Figure 1. Adjusting the poverty line to the increase in food price



The compensating variation interpretation of the adjustment to the poverty line can be formalized as follows. Define the poverty line as the expenditure function for attaining the "poverty" utility level u^0 with real price p^* :

$$z = z\left(u^0, p^*\right).$$

A first-order Taylor expansion of the change in z due to a change in the real prices of food and non-food items goods gives:

$$dz = c_F^z dp_F^* + c_{NF}^z dp_{NF}^*,$$

or
$$\boxed{d\ln z = \omega_F^z d\ln p_F^* + \omega_{NF}^z d\ln p_{NF}^*}, \quad (1)$$

where c_F^z and c_{NF}^z are consumption of food and non-food measured at the poverty line z, ω_F^z and ω_{NF}^z are corresponding shares of food and non-food in expenditures, and p_F^* and p_{NF}^* are real food and non-food prices. The change in poverty line, $d\ln z$, is thus equal to the change in real expenditures (or real income) of households at the poverty line.

The second-order Taylor expansion is written as:

$$d\ln z = \sum_{i=F,NF} \omega_i^z d\ln p_i^* + \frac{1}{2}\sum_{i=F,NF}\sum_{j=F,NF} \omega_i^z \varepsilon_{ij} d\ln p_i^* d\ln p_j^*, \quad (2)$$

where ε_{ij} is the elasticity of consumption c_i^z with respect to price p_j^*.

1.1. A simple aggregate calculation around the poverty line

If the only purpose of the study is to measure the impact of the increase in relative food prices on the poverty rate, a simple analysis can focus on the households that are around the poverty line.

Busjeet et al. (2008) develop a method based on strong assumptions on the poverty profile to obtain a measure of the increase in poverty rate without micro data information on household income. The idea is to measure the change in real expenditures of the households just above the poverty line by computing their specific consumer price index, while assuming that their nominal expenditures varies with the overall CPI.[2]

In the notations defined above, this is equivalent to specifying:

$$\boxed{\begin{aligned} d\ln p_F^* &= d\ln p_F - d\ln CPI \\ d\ln p_{NF}^* &= d\ln p_{NF} - d\ln CPI \end{aligned}}$$

which leads to:

$$d\ln z = \omega_F^z d\ln p_F + \omega_{NF}^z d\ln p_{NF} - d\ln CPI \equiv d\ln PPPI - d\ln CPI$$

where *PPPI* is the consumer price index at the poverty line, named the Poor People Price Index.

The computation of the non-food price index is derived from the knowledge of the food share ω_F in the CPI: $p_{NF} = \left(CPI - \omega_F p_F\right)/\left(1-\omega_F\right)$.

Assuming that the semi-elasticity of the poverty rate to the poverty line is -1 gives a change of poverty rate equal to:

[2] We acknowledge that this is a reinterpretation of the method described by the authors. They claim to measure the change in real income of the poor in general by *CPI – PPPI*, where *PPPI* is the consumer price index of the poor, and assume a semi-elasticity of the poverty rate to this real income. The underlying theory of the link between poverty rate and real income of all poor is however not clear, thus our re-interpretation.

$$dP_0 = -d\ln z = d\ln CPI - d\ln PPPI \approx CPI - PPPI \ .$$

Whether this value of -1 is a good approximation is an empirical question. This would need to be verified across many countries before the method can be used.

A measure of the change in poverty gap can easily be obtained:

$$dP_1 = \left(P_0 + 0.5dP_0\right)dz \ .$$

The advantage of this method is that its implementation only requires the observation of *CPI* and p_F, the overall consumer price index and the food price, and the expenditure shares of food, ω_F and ω_F^z in the CPI and in the budget of the poor.

1.2. Changing the poverty line, but using the observed household expenditure distribution

If information on individual households' total expenditure per capita is available, then one does not need to assume a value for the elasticity of the poverty rate with respect to the poverty line. Computing the change in the poverty rate is done empirically by measuring P_0 or any other poverty indicator, notably P_1 and P_2, with the new poverty line, keeping household total expenditures constant.

This is for example done by IADB (2008) for Guatemala, and by Robles et al. (2008) for 19 Latin American countries. In these studies, the adjustment to the poverty line is done as follows. The extreme poverty line, which is the cost of the minimum food basket, is adjusted by the price of food relative to other goods, while the moderate poverty line is adjusted for the increase in food expenditures.

In the notation defined above:

$$\boxed{\begin{aligned} d\ln p_F^* &= d\ln p_F - d\ln p_{NF} \\ d\ln p_{NF}^* &= 0 \end{aligned}}$$

This is equivalent to assuming that nominal incomes vary with the non-food price index.

For the extreme poverty line, defined as $z^{ext} = c_F^z p_F^*$,

$$d\ln z^{ext} = d\ln p_F - d\ln p_{NF} \ .$$

For the moderate poverty line, we obtain:

$$d\ln z = \omega_F^* d\ln p_F^* \text{, or } dz = dz^{ext} \ .$$

One can take into account the substitutability between food and non-food in computing the adjustment in the poverty line, as given in (2) above. Using the relative price change of food vis-à-vis the non-food price leads to a simplification of necessary adjustment in the poverty line as:

$$d\ln z = \omega_F^z d\ln p_F^* + \frac{1}{2}\omega_F^z \varepsilon_{FF} d\ln p_F^* d\ln p_F^* \ ,$$

where ε_{FF} is the direct price elasticity of demand for food in response to the change in its relative price.

Note that, while getting shares is relatively straightforward from household surveys, estimating elasticities is far more demanding since, with a cross section of households, one does not observe behavioral changes in demand patterns. Friedman and Levinsohn (2002) use a technique proposed by Deaton (1990) to estimate the cross price elasticities from cross sectional data, and apply the framework to analyze the impact of the 1997 Indonesian economic crisis on household welfare. In the context of the

food price surge, Dessus et al. (2008) use plausible values for the food share, price elasticity, and relative price change to obtain a plausible poverty line change, which they apply to various countries income distribution.

1.3. Adjusting for the agricultural income of each household

Households' agricultural incomes also change as a consequence of price movements, which will affect total expenditures of households with agricultural income. If the household survey includes an income module, one may thus also consider taking this income effect into account in assessing the poverty impact. A very approximate adjustment in household income is proposed by Robles et al. (2008). It consists in adjusting agricultural income by the increase in food crop prices, which gives an adjustment to total income y_h for each household *h* proportional to its share of agricultural income s_h^A:

$$d \ln y_h = s_h^A d \ln p_F .$$

This assumes that all agricultural profits and wages (for agricultural workers) increase proportionately to the food crop price. It also assumes that consumer and producer food prices vary proportionately. It may imply an over-estimation of the increase in household income, since other crop prices may not follow food crop prices, depending on substitutabilities in production and consumption. On the other hand, it may underestimate the profit in food production if input prices do not increase proportionately to food prices.

Applying the calculated percentage change in income to total expenditures (which is used in poverty rate calculations), poverty indicators are computed with the adjustment in the poverty line as described above.

2. Welfare impacts for individual households

With household surveys giving detailed information on the consumption structure and on the production structure, it is possible to actually compute a welfare effect at the household level, imputing changes in relative food prices to the household's production and consumption of the corresponding food crops. The theoretical foundation to use the change in real income as a first approximation to the change in welfare is based on a concept similar to that of compensating variation, which is the money-metric loss in welfare due to changes in consumption prices and income. Its expression is best derived from the indirect utility function.

Consider a household that produces and consumes food and non-food items (the non-food items in production and consumption are not usually the same), and receives income from wage labor and transfers. Its indirect utility function can be written as:

$$V = V\left(p, y = p_F q_F + p_{NF} q_{NF} + wL + T\right),$$

where q_F and q_{NF} are production of food and non-food (this can include inputs, with a negative sign), labor income *Lw* as the product of employment *L* and wage *w*, and *T* other incomes such as transfers. Production and labor supply are set at the levels that maximize utility. Taking first derivatives and using Roy's theorem gives:

$$dV = \frac{dV}{dy}\left[p_F \left(q_F - c_F\right) d \ln p_F + p_{NF} \left(q_{NF} - c_{NF}\right) d \ln p_{NF} + Lw \; d \ln w \; \right].$$

In this expression, one should think of non-food as a vector of items, some of them solely consumed, $q_{NF} = 0$, others solely produced, $c_{NF} = 0$. The expression in square brackets is a measure of the change

in real income induced by changes in prices and wage, which is equal to the change in utility in money-equivalent.[3] An increase in the food price p_F has therefore a positive welfare effect if the household is a net seller of food and a negative effect if it is net buyer. Note that the effect is proportional to the net sale/purchase of the product. If changes in producer prices are different from change in consumer prices, this expression requires the use of consumer (purchase) price for net purchases and the producer (sale) price for net sales. This derives from the standard household model with transactions costs on markets, in which the opportunity cost of consumption for a net seller is the sale price, while the opportunity cost of production for a net buyer is the purchase price.

The welfare effect of price increases is therefore measured by:

$$\boxed{dW = p_F\left(q_F - c_F\right)d\ln p_F + p_{NF}\left(q_{NF} - c_{NF}\right)d\ln p_{NF} + Lw\,d\ln w} \quad . \tag{3}$$

This expression assumes that other incomes (noted as transfers *T*) remain constant. Hence price and wage changes have to be measured relative to all other sources of income. It is a money-metric measure of welfare changes. For the effect of food price increase only, it simplifies to $dW = -c_F dp_F$, which is equivalent to a loss in total expenditures.

This method was used by Chen and Ravallion (2003) to measure the impact of changes in prices anticipated to follow the entry of China in the WTO. In the context of the current food crisis, it is used by Cai et al. (2008a and b) for India and Guatemala, by Coady et al. (2008) for Madagascar, by a team from the World Bank African region for a number of African countries, as summarized in Wodon (2008), and by Ivanovic and Martin (2008) for a sample of 10 countries.

Note that the essence of the method is to measure a welfare effect for each household as a function of its own income and consumption structures. It is therefore particularly well suited to analyze heterogeneity of impacts across different types of households. This can be done in different ways, by showing the distribution of impacts, or the average effect by household category, or in a regression framework (Chen and Ravallion, 2003).

A second order Taylor expansion of *V* gives a more nuanced welfare effect by accounting for the demand and supply responses to price changes. This becomes all the more relevant as producers and consumers have the time to adjust what they produce and what they consume in response to price movements. A medium-term response to the food crisis, even in a partial equilibrium framework, should thus allow for these responses. Assuming that the marginal utility of income remains constant, the welfare effect is:

$$\boxed{\begin{aligned} dW = \frac{dV}{dV/dy} &= \sum_{i=F,NF} p_i\left(q_i - c_i\right)d\ln p_i + wLd\ln w + \frac{1}{2}\sum_{i=F,NF}\sum_{j=F,NF} p_i\left(q_i\varepsilon_{ij}^q - c_i\varepsilon_{ij}^c\right)d\ln p_i d\ln p_j \\ &= \sum_{i=F,NF} p_i q_i\left(1 + \frac{1}{2}\sum_{j=F,NF}\varepsilon_{ij}^q d\ln p_j\right)d\ln p_i - \sum_{i=F,NF} p_i c_i\left(1 + \frac{1}{2}\sum_{j=F,NF}\varepsilon_{ij}^c d\ln p_j\right)d\ln p_i + wLd\ln w \end{aligned}} \tag{4}$$

[3] This is equivalent to a generalization of the compensating variation measure given by the change in:

$$B = e\left(u_0, p, w\right) - y\left(p, w\right),$$

where *e* is the expenditure function and *y* the profit function, i.e., the maximum income a household can obtain given prices and wages. Total differentiation gives *dB* equal to the negative of the term in brackets in equation (3), noted *dW* below.

Comparing this expression to (3) shows the role of the production and consumption adjustments. Positive direct and negative cross price elasticities in production imply a larger positive welfare effect than initially estimated. Negative direct and positive cross price elasticities in consumption imply a lower welfare loss than initially estimated. Both types of substitution effects combine in offsetting some of the losses (or increasing some of the gains) estimated by the first-order calculation. Note, however, that these effects are generally small in comparison to the first-order effects that remain valid even in the medium term.

3. Measuring the impact on household welfare to compute the change in poverty rate

The question here is whether one could measure the changes in poverty rates by keeping the poverty line constant but adjusting expenditures for the consumption price increases, instead of what has been described in section 1 above.[4] Doing this is, however, not well suited to compute aggregate poverty indicators. This is because the essence of the poverty indicators is the comparison of household total expenditures to a minimum value necessary to reach a threshold welfare level. Poverty gaps, for example, are strictly measured by the difference between total expenditures and the poverty line, and not adjusted for each household as a function of its own consumption structure. When poverty rates are computed for different years, one adjusts the poverty line to take into account the changes in prices, and then calculates each household's poverty status, gap, or severity of poverty by comparing its expenditures to the new poverty line. One does not adjust each household's poverty gap, for example, according to its own consumption basket. The same reasoning applies to a simulation exercise of price changes.

One reason invoked for adjusting individual expenditures is that the weights used for the computation of poverty lines may be outdated (or unknown). If this is the case, one can use the average consumption pattern of households close to the poverty line to define those weights and perform the adjustment to the poverty line. This is consistent with the poverty line being the total expenditure needed to be out of poverty.

On the other hand, what is consistent with theory is to compute adjustments to total expenditures for income changes (which is a more detailed specification of the adjustment presented in 1.3. above) and then compute poverty indicators based on comparing these total expenditures (adjusted for changes in production prices and wage) with the poverty line (adjusted for changes in consumption prices).

Whether using one or the other method affects the estimated effect on the poverty rate is an empirical question. There will likely be little difference because the main difference between the two methods is on the measured impact on those close to the poverty line that may become poor with the food price increase (or become non-poor if their income effect is larger than the consumption effect). It would however affect measures of change in the other poverty indicators such as the poverty gap and the severity of poverty. And for these measures, the individual welfare adjustment is not consistent with the basic concept used in the definition of the indicators.

4. Heterogeneity by household types: what typology?

We showed that calculating the welfare effects of changes in prices and wages on household welfare through direct (short run) and behavioral (medium term) effects allows characterizing the heterogeneity of impacts of the food crisis across different segments of the population. This is important as knowing the heterogeneity of impacts is needed to design and target differentiated policies aimed at assisting different

[4] Valero-Gil and Valero (2008), Wodon, Tsimpo, and Coulombe (2008), Wodon (2008), and Ivanovic and Martin (2008).

segments of the population. What social disaggregation to use thus depends on how to best identify contrasts in impacts and the possibility of designing group-specific policy interventions.

It is tempting to use a typology of rural households that reflects the net-buyer net-seller dichotomy. Use of household survey data to implement this typology is, however, problematic because of the importance of production shocks at the time of the survey. Weather shocks imply that many normally net-seller farm households (including very large farmers) would be classified among the net-buyers because expenditures on inputs were not matched by subsequent output sales in that particular year. If the net-buyer net-seller dichotomy is to be used to construct a household typology it should be based not on observed market participation but on predictions from an estimated equation that correlates market participation to a set of household and contextual observables.

In the India and Guatemala studies (Cai et al., 2008 a and b), we used a household typology based on the rural-urban contrast and on access to land by farm size for the landed households, including among urban households where we see many peri-urban farmers. This gives a way of constructing social categories with a differential incidence of net buyer and net seller households. Urban households are disaggregated between poor and non-poor. However, choice of a household typology to identify differentiated welfare impacts of the food crisis and to design differentiated policy responses very much depends on each particular country and the intended policy instruments. In the India and Guatemala studies, we wanted to put emphasis on what a quick "next harvest" land productivity boost could do to help reduce the hunger cost of the food crisis on poor rural households, the vast majority of the poor. For this reason, it was useful to put emphasis on the marginal and small farmer categories where many will be found to be net buyers of food and negatively affected by the crisis. Access to land gives the possibility of differentiated policy responses to increase land productivity in these classes of farms, likely through rapid access to subsidized fertilizers, seeds, and tools complemented by technical assistance. If the policy instrument is targeted cash (or conditional cash) transfers, then the poor-non-poor dichotomy or correlates of poverty such as geographical location, demographic structure, and occupation would be more useful variables to construct a policy-relevant typology.

5. Recap on the differences in methods for partial equilibrium analysis

Consider first the consumption side (i.e., ignoring possible changes in production prices or wages). Methods based on adjusting the poverty line are sufficient to measure a change in the poverty rate. Like any poverty calculation, these methods do not presume of the consumption structure, and only measure individual households' welfare by the difference between their total expenditures and the poverty line. All poor households loose the same amount relative to the poverty line by definition, since it is the poverty line itself that is adjusted. In dealing with the welfare effects of a surge in food prices, this method does not capture the potentially higher welfare losses for very poor people whose share of food in expenditures is larger than that of the households closer to the poverty line.

On the other hand the method that consists in applying price changes to the consumption structure of each individual household may exaggerate net welfare losses. This is because it does not account for the possibility of substitutions in consumption in response to price changes (note that this is also the case for the marginal poor in the poverty line adjustment). While using marginal analysis techniques is adequate for small changes in prices, it may not be sufficient for an analysis of larger price changes as currently contemplated in the food crisis.

Similarly, on the income side, there is a clear distinction between methods that keep aggregate income of all households in line with either the non-food price or the overall CPI (thus falling back on the *real* consumption price framework), and those that recognize heterogeneity in the structure of income. For urban and non-agricultural households, the homogeneity across households may be an adequate assumption. But for households that produce some of these crops whose prices rise, neglecting the

income effect leads to potentially large and heterogeneous overestimation of the negative welfare effect. Such an analysis however requires the availability of information on crop production. Including effect of input price changes (such as fertilizer, fuel costs, or feed) is an integral part of the income effect. As noted above they are easily conceptualized as negative output in these expressions.

Like for the consumption side, using marginal analysis techniques, i.e., assuming that the structure of income and crop production is unaffected by the relative price changes, ignores possible substitutions in income generation decisions. This underestimates the possible positive effects that a response to relative output prices can induce, and overestimates the negative effect that the increased cost of an input can induce.

All welfare measures dW presented above in equations (1) – (4) provide money metric welfare effects of the contemplated price increases. They provide a monetary value of the transfer that would be needed for the household to maintain its original consumption pattern. When substitution in production and consumption are ignored (in (1) and (3)), welfare effects can be computed from the observations of values of purchase and sale of the goods (consumption goods, production commodities and inputs) whose price are affected. Taking into account substitutions in consumption and production requires the observation of consumption and production, separately, and the knowledge of the substitution elasticities. Note that one needs not a full account of all income or all expenditures or consumption to perform this welfare analysis. It is however common to report welfare effect relative to some aggregate pre-crisis welfare level, using for example total expenditures.

III. General equilibrium effects in SAM and CGE models

Constructing an economy-wide model such as a Social Accounting Matrix (SAM) or a Computable General Equilibrium (CGE) is appealing since the price shock is large and macro-effects are expected to transmit throughout the economy. These models help track the impact of the border price shock in cereal (and oil) prices on prices at the producer and consumer levels, quantities produced and consumed, exports, imports, and balance of trade, and government budget balance. The models can be constructed to reflect a household typology based on the rural-urban contrast (Parra Osorio and Wodon (2008) using a SAM for Ghana) or the structure of occupations (Nouve and Wodon (2008) using a CGE for Mali).

There are two ways these models have been used. The first is essentially to predict changes in the domestic price vector (including wages) induced by the food crisis. The most common use of the SAM framework is to keep all prices constant and simulate how the quantities adjust to an external demand shock in exports. In the context of the analysis of the impact of external food prices, it is used in its dual form, i.e., to compute the transmission of an external price shock to a commodity that comes in as an input in production on the other prices in the economy, assuming no changes of behavior in production and consumption. In the CGE model, on the other hand, there are substitutions in production and in consumption and prices are determined by market clearing conditions. Key assumptions though are the rules that balance the government budget, labor market, and international trade. Critical also are the different elasticities in production and consumption, and between foreign and domestic goods. The predicted changes in prices can then be used in the micro-economic framework discussed in the previous section. This is what is done by Chen and Ravallion (2003) and by Ivanic and Martin (2008) using the GTAP general equilibrium models for the countries they analyze. Alternatively, Osorio and Wodon (2008) derive from the consumption structure imbedded in the SAM the aggregate cost of living for urban and rural households in Ghana.

The second application of CGE modeling has been to use these models to predict changes in the real income of the typology of households imbedded in the model. These group average changes in real income are then applied to each individual household in a household survey. This provides an overall

income distribution, which keeps unchanged the distribution of incomes within each group, while adjusting their real incomes to reflect the impact of the changes in the economy. This is the micro-simulation approach used by Nouve and Wodon (2008) for Mali.

These general equilibrium models are appealing as they take into account all the indirect effects of the price shocks. The approach is, as we well know, taxing to use and dependent on many crucial yet fairly arbitrary assumptions such as the closure rule used (unlimited indebtedness in the Mali model) and the value assigned to crucial elasticities that are not estimated.

IV. Conclusion and recommendations

The food crisis is a major shock on the welfare of the poor that deserves a better understanding of the mechanisms involved in order to design effective policy responses. In a first phase, research was directed at measuring the short run effect of price movements on poverty indicators. This was done by adjusting the poverty line or by predicting changes in real expenditures. Concern was also given to taking into account changes in wages that would accompany changes in relative prices, usually using general equilibrium modeling to establish the price-wage relation. In just a few cases, effort was made to allow for responses in production and consumption to price changes, introducing direct and cross-price elasticities in linearized income equations. General equilibrium models were also used to track second-round effects throughout the economy, and use impacts on households' real incomes to calculate changes in the poverty indicators.

With the food crisis impacting poor households now for almost three years, attention should shift from measuring impacts on poverty to understanding processes through which these welfare effects occur, including behavioral responses in production and consumption. The objective is to design policy responses that can help reduce negative welfare impacts and amplify positive ones. Given the high degree of heterogeneity in the income and expenditure patterns of the poor, these policies need to be differentiated across categories of households. Because we are beyond the very short run, behavioral responses also need to be taken into account. The proposition is consequently to focus on country and household heterogeneity and to correspondingly identify policy entry points. Useful country-level analyses would consequently consist in the following:

- Give a detailed characterization of the country's exposure to the food crisis and of price transmission.
- Give a characterization of the degree of exposure of different types of households to price movements, both in consumption and production.
- Construct typologies of households that can capture this heterogeneity of impacts and anticipates analyzing the value of the policy instruments to be used.
- Conduct an empirical analysis of impact of the food crisis on household welfare in either partial or general equilibrium, including behavioral responses. It is our opinion that partial equilibrium effects with behavioral responses will capture most of the large effects that we want to measure.
- Use these results to discuss the design of differentiated policy responses, such as productivity gains in production for home consumption and a food marketed surplus, and the targeting of social safety nets.

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