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High Food and Oil Prices and Their Impact on the Achievement of MDG 1 in Asia and the Pacific*

by Clovis Freire[1] and Alberto E. Isgut[2]

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Abstract

This paper estimates the impact of the high food prices of 2010 on income poverty and the achievement of MDG 1 in Asia and the Pacific. It also estimates the impacts of high price during 2011 under various scenarios for the prices of food and oil. We find that although the high food prices of 2010 have not caused an increase in poverty in the region, they slowed down the rate of poverty reduction - the estimated number of poor decreased by 24.5 million people between 2009 and 2010, compared with 43.8 million people if staple food prices had not increased above domestic rates of inflation. By detailing the methodology and assumptions used to produce our estimates, the paper also highlights the need for broader and more open discussion on methodological issues to provide policymakers and poverty data users with a better understanding of the limitations of any such exercise.

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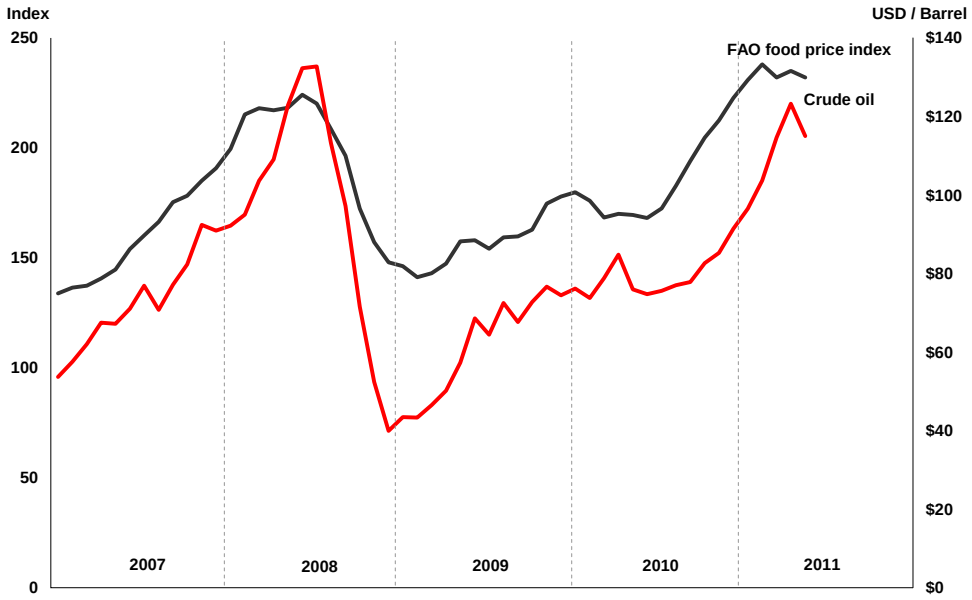
High food and oil prices and their impact on the achievement of MDG 1 in Asia and the Pacific

Clovis Freire and Alberto Isgut

I. Introduction

International food prices increased steeply from mid-2010 to early 2011, raising alarm bells across the developing world about a repetition of the food price crisis of 2007-2008. Increases in food prices are worrisome because of their impact on headline inflation and because they hurt poor and low middle class households, which allocate a large share of their income to buy food. Food prices had increased dramatically during 2007 and the first half of 2008, but decreased sharply afterwards, as a result of the deflationary impact of the global financial crisis. However, as shown in figure 1, the food price index of the Food and Agriculture Organization (FAO) recovered part of its lost ground since the crisis during 2009, increasing 27 percent between February of that year and January 2010. After a lull between January and June of 2010, in which it retreated 7 percent, the index surged 40 percent between June 2010 and February 2011, reaching a record high value of 237.2 in the latter month.

Figure 1 International food and crude oil prices 2007-2011



Source: Authors based on FAO, World Food Situation, http://www.fao.org/worldfoodsituation/FoodPrices Index/en/ and United States Energy Information Administration, http://www.eia.doe.gov/dnav/pet/pet_pri_ spt_s1_d.htm (accessed 13-June-2011).

While these price increases are worrisome, their impact on individual countries varies according to the share of specific components of the index in countries' total staple foods consumption and to various transportation, logistic, and regulatory factor that affect the transmission from international prices to domestic prices. As shown in table 1, increases in rice prices were less than half as high as increases in wheat prices, and there is a lot of variation across countries for both wheat and rice price increases. However, in all the cases shown in the table, the increases in staple food prices exceeded, often significantly, each country's inflation rates.

Table 1 Price change of staple foods in major cities of selected Asia-Pacific countries

	Wheat		Rice	
Country	% price change (in real terms)	% of dietary energy supply	% price change (in real terms)	% of dietary energy supply
Armenia	14	48		
Bangladesh			17	71
China			6	27
Georgia	69	50		
Indonesia			16	51
India	6	21	6	30
Kyrgyzstan	31	49		
Lao PDR			20	64
Mongolia	38	42		
Nepal			11	34
Tajikistan	107	58		
Viet Nam			34	62
Median	35	49	16	51
Average	43	45	16	49

Source: Authors based on data from FAO, Global Information and Early Warning System, available from www.fao.org/giews/pricetool (accessed February 2011).

Note: The second and fourth columns show the percentage changes in the prices of wheat and rice, respectively, deflated by the national consumer price index (CPI) between May 2010 and January 2011.

There is little argument that staple foods inflation can have detrimental impacts on food security and poverty in developing countries. However, such impacts on specific households depend on whether they are net buyers or net sellers of staple foods. When food prices increase, net food buyers are forced to spend a larger share of their income on essential food and less on other food items – which are important as complementary sources of energy and nutrients – and on non-food items including health and education. Net food sellers, however, see their monetary income increase, allowing them to consume more goods and services. Thus, unexpected rises of staple food prices have clearly negative effects on poor urban households, the great majority of which are net buyers, and on poor rural households in countries such as Bangladesh, where 81 percent of these households were net buyers of the country's main staple foods in year 2000 (FAO, 2008, table 13). While in counties with a high proportion of poor households that are net sellers of food, such as Viet Nam, an increase in food prices may not be as detrimental, the recent literature has found that poor rural households are likely to be adversely impacted from increases in food prices in many countries.

Despite the overall consensus that high food prices affect the dynamics of people moving in and out of poverty, quantitative estimates vary widely. In February 2011, the World Bank estimated a net increase in extreme poverty of about 44 million people in low- and middle-income countries considering both those who fell into poverty and those who moved out of poverty as a result of food price rises since June 2010.[3] In March 2011, Asian Development Bank (2011) estimated that the 30 percent hike in international food prices in 2010 increased average domestic food price inflation in developing Asia by about 10 percentage points and pushed an additional 64.4 million people into poverty in Asia alone. In May 2011, ESCAP (2011) estimated that, as a result of the higher food prices, 15.6 million people were prevented to climb out of poverty and 3.7 million were pushed into poverty. And also in May 2011, Headey

[3] For details see World Bank's website:
http://www.worldbank.org/foodcrisis/food_price_watch_report_feb2011.html

(2011) reported evidence of a significant *reduction* in self-reported food insecurity between 2005 and 2008, which is difficult to square with the large increases of poverty and hunger resulting from the food price crisis of 2007/08 estimated by the World Bank, the FAO and other international agencies.

The large variations in quantitative estimates of the poverty impact of the food price crisis can be explained by differences in methodologies and assumptions – which often are not clearly understood by policymakers and users of poverty data. The main purpose of this paper is to discuss in detail the methodology that ESCAP (2011) utilized to estimate the poverty impact in Asia and the Pacific of the increase in staple food prices in 2010. Poverty impacts of increases in staple food and oil prices during 2011 under various scenarios are also considered. The results show that the poverty impact estimates depends critically on a number of quantitative assumptions for key parameter values, such as the share of net buyers and net sellers in rural and urban areas, the share of staple foods expenditure in total expenditure of the average net buyer and the share of net gains in the case of net sellers. Given this dependence and the need to count with accurate estimates of the poverty impact of staple food prices, the paper argues that more resources should be devoted to conduct surveys and studies on the pattern of food consumption of poor urban and rural households in countries of the region.

II. Literature review

A number of studies have examined the impact of the 2007-2008 food price crisis on poverty. Ivanic and Martin (2008) pointed out that while increasing food prices hurt net buyers of food, they increase the incomes of net sellers of food, many of whom are poor. Therefore, the impact on poverty depends on the balance between these two effects. Examining household data for nine low-income countries, they find that the poverty impacts vary by commodity and country but that poverty increases are much larger and frequent than poverty reduction. The average increase in the poverty rate from their 9-country sample is 4.5 percent which, if applied to all the low income countries, would represent an increase of 105 million in the global number of poor and a loss of almost seven years of past poverty reduction gains.

Dessus et al. (2008) estimate the extra monetary cost of alleviating urban poverty as a result of the increase in food prices since 2005 in a sample of 73 developing countries. The main pieces of information needed for this estimation consists on the change in the domestic relative price of food, the share of the total household budget allocated to food by households below or close to the poverty line, and the elasticity of substitution between food and nonfood items for poor and vulnerable households. The results show that while the extra costs are small for most countries, they can exceed 3 percent of the GDP in the most severely affected ones.

Aksoy and Isik-Dikmelik (2008) argue that the vulnerability of households that are net food buyers to increases in food prices varies across countries. In nine countries they examine, they find that about half of the poor households that are net buyers of food are only marginal net food buyers – defined as households that spend less than 10 percent of their expenditures on food – and thus less vulnerable to increases in food prices. However, they find that some countries have large proportions of vulnerable net buyers of food – defined as households that allocate more than 30 percent of their total expenditures to food. In Bangladesh, for example, close to 20 percent of the net food buyers are vulnerable. The authors also find that most of the net food buyers in rural areas are laborers or businessmen whose income depends on the demand from net food sellers – suggesting the need to consider second round effects of food price increases in rural areas.

Wodon et al. (2008) evaluate the impact of a 50 percent increase in prices for selected food items on poverty in a dozen West and Central African countries. The analysis focuses on the prices of rice, flour and bread, vegetable oil, sugar and milk, which tend to be imported in the countries considered. They find an average increase in the poverty headcount ratio of between 3.7 and 5.2 percentage points in urban areas and between 2.2 and 4.1 percentage points in rural areas. The impacts are even larger when considering other measures of poverty such as the poverty gap, the increase of which is mostly attributed to the current poor becoming poorer.

De Janvry and Sadoulet (2009) use simulations to examine the potential impact of rises in the prices of cereals and edible oils on various types of households in India. The results show, contrary to conventional wisdom, that most losers from the price increase are in rural areas. Although large farmers, with farm size of one hectare or more, would gain as a group, 59 percent of them would, in fact, lose. Moreover, of all the poor households that would lose from the price increase, 77 percent are rural households, both farmers and non-farmers. In their view, these results highlight "how important it is to respond to a food crisis by raising the productivity of land and labor in smallholder farming and facilitating access to even tiny plots of land for landless rural households to produce more of their own food needs" (p. 7).

Zezza et al. (2008) study the differential impact of food price increases across households that differ in their access to assets and market and livelihood strategies. Among the characteristics of poor rural households that benefit from the increase in food prices, access to land and modern farming inputs, such as fertilizers and pesticides, are key. Their data confirms that even in rural areas, most households are net buyers of food and therefore vulnerable to increases in food prices. As a result, they find that increases in staple prices lead to decreases in the welfare of rural households in all countries except Viet Nam. The reason for this exception is given by the high proportion of poor households that are net sellers of food in this country. According to Vu and Glewwe (2010) while in the poorest quintile 90 percent of the households are farmers and 76 percent rice farmers, in the highest quintile only 40 percent are farmers and 18 percent rice farmers.

Ortiz et al. (2011) construct a local staple food price index based on price data from the FAO's Global Information and Early Warning System (GIEWS). The price of each staple foods included in the index is weighted by the staple's percentage in the average dietary energy supply (DES) of each country. The number of foodstuffs per country ranges between two and six, which represent an average of about 45 percent of the DES of the included countries. Although the limited number of food products fall short of representative food baskets for each country, the quick availability of their price information allows the preparation of rapid assessments of vulnerability of the poor to sudden increases in food prices. This index allows the authors to study the transmission of international to local food prices in various regions and the differential incidence of food price increases in high- and low-income countries, as well as in major urban centers and vulnerable areas within countries.

III. Data and methodology

This paper uses data from the Global Income Distribution Dynamics (GIDD) database compiled by the World Bank. The GIDD dataset, which includes 116 countries representing 91 percent of the world population, is based on individual records for 1.2 million households in 84 developing countries and additional aggregate information for countries where direct access to

surveys was not available at the time the data was compiled by the World Bank.[4] The analysis presented in this paper focuses on 27 Asian and Pacific developing countries for which data is available in the GIDD database: Armenia, Azerbaijan, Bangladesh, Bhutan, Cambodia, China, Georgia, India, Indonesia, Iran (Islamic Republic of), Kazakhstan, Kyrgyzstan, Lao People's Democratic Republic, Malaysia, Mongolia, Nepal, Pakistan, Papua New Guinea, Philippines, Russian Federation, Sri Lanka, Tajikistan, Thailand, Turkey, Turkmenistan, Uzbekistan, and Viet Nam. These countries are home of 96 percent of the total population of developing Asia-Pacific.

Data in the GIDD database is organized by country and vigintile of average household consumption per capita.[5] The GIDD database is available for one year for each country, and such year is not the same for all countries. The years available for the Asian and Pacific countries in the GIDD range between 1996 and 2005. For countries where household survey data is available, the GIDD dataset contains data on population size, average per capita household consumption or income,[6] average age of the head of the household, proportion of households where the head of the household has no formal education, proportions of households where the head of the household has some (or complete) primary, secondary and post-secondary education, average household size, proportion of households in urban areas, proportion of households where the head's main occupation is in agricultural activities, average food expenditure as a proportion of total consumption, and proportion of household headed by a male. For 6 of the 27 developing countries (Bhutan, Islamic Republic of Iran, Mongolia, Malaysia, Papua New Guinea, and Turkmenistan), we estimated the proportion of households in urban areas per vigintile – which was not available in the GIDD – as the median of such proportion for the remaining Asian and Pacific countries included in the analysis.

For each country in the GIDD dataset and using various assumptions regarding the distribution pattern and level of consumption by net sellers and net buyers of staple foods in urban and rural areas, the methodology adopted to estimate the impact of high prices of staple foods in 2010 on poverty comprises the following four main steps:

1) Estimate the number of people living below the poverty line of $1.25 a-day in 2009;
2) Estimate the number of people living below the poverty line of $1.25 a-day in 2010 considering the counterfactual scenario of no rise in staple food prices;
3) Estimate the number of people living below the poverty line of $1.25 a-day in 2010 considering that the rise in staple food prices has changed the purchasing power of the population;
4) Estimate the impact of the rise in staple food prices on poverty as the number of poor estimated in step 3 minus the number of poor estimated in step 2. Estimate the number of people pushed into poverty in one of the following two ways: i) as the number of poor estimated in step 3 minus the number of poor estimated in step 1, if poverty increases from 2009 to 2010 under the scenario of high prices but decreases under the counter factual scenario, or ii) as the number of poor estimated in step 3 minus

[4] For more information on the GIDD dataset see Bussolo et al. (2007). The GIDD dataset is available at: http://go.worldbank.org/YY8H2EGYZ0.
[5] In theory each vigintile should contain 5 percent of a country's population, with the first vigintile capturing the lowest-consumption households and the 20th vigintile capturing the highest-consumption households, but for the majority of the countries in the GIDD dataset the share of the population of each vigintile differs from 5 percent.
[6] The majority of the countries report consumption instead of income. For simplicity we will refer to this variable in the paper as household consumption per capita.

the number of poor estimated in step 2, if poverty increases from 2009 to 2010 under both scenarios. In addition, estimate the number of people prevented to get out of poverty as the number of poor accounted for the impact of the rise in staple food prices minus the number of people pushed into poverty.

Details of each of these steps are provided below.

1. Number of poor in 2009

The first procedure is to update the GIDD data on population and average per capita household consumption to 2009 following the steps listed below:

Estimate population per vigintile in 2009. For each country *j*, the population of vigintile *i* in 2009 is estimated as follows:

$$pop^{i}_{j2009} = \left(\frac{pop^{i}_{jT}}{\sum_{i} pop^{i}_{jT}} \right) \times pop_{j2009}, \quad (1)$$

where pop^{i}_{jT} is the population in vigintile *i* of country *j* in year *T*, the latest available for this country in the GIDD database, and $pop_{j\,2009}$ is the total population in 2009 in country *j* based on data from the *United Nations Population Prospects: The 2008 Revision Population Database*.

Estimate the average per capita household consumption per vigintile in 2009. The first step is to estimate the following regression of household consumption per capita on GDP per capita for each country *j* and year *t*, controlling for changes in inequality and remittances:

$$\ln(c_{jt}) = \beta_{0j} + \beta_{1j} \ln\left(GDPpc_{jt}\right) + \beta_2 R_{jt} + \beta_3 G_{jt} + \varepsilon_{jt}, \quad (2)$$

where c_{jt}, $GDPpc_{jt}$, R_{jt} and G_{jt} are, respectively, monthly average household consumption per capita, GDP per capita, labor remittances received as percentage of the GDP and the Gini coefficient of country *j* in year *t*. Notice that the intercept and the slope coefficient on the GDP per capita vary across countries. The data source for remittances as percentage of GDP and for the GDP per capita data is the World Bank's World Development Indicators, and the data source for the monthly average household consumption per capita and the Gini coefficient is the World Bank's PovcalNet database.[7] Both c_{jt} and $GDPpc_{jt}$ are expressed in USD of 2005 adjusted by purchasing power parity, and all the data was accessed on February 2011. The regression was estimated using all the country-year observations of consumption-type survey available in the World Bank's PovcalNet dataset for the 27 Asian and Pacific included in this study.

Next, we estimate the annual growth rate of average household consumption per capita of country *j* between year *T*, the latest available for this country in the PovcalNet database, and 2009 as

$$\frac{\Delta_T^{2009} c_j}{c_T} = \hat{\beta}_{1j} \times \frac{\Delta_T^{2009} GDPpc_j}{GDPpc_j}, \quad (3)$$

where $\hat{\beta}_{1j}$ are the estimated coefficient of β_{1j} in equation (2).

[8] The vigintiles below and above these two vigintiles are not included in the calculations.

It should be pointed out that the degrees of freedom available in data to estimate β_{1j} are rather low. As a result the estimates $\hat{\beta}_{1j}$ could be largely affected by potential errors in the data. To prevent these potential errors from unduly influencing the results, we imposed boundaries to the values of $\hat{\beta}_{1j}$ use in the estimation of the rate of growth of average household consumption per capita in equation (3). First, $\hat{\beta}_{1j}$ was negative for Georgia, the Islamic Republic of Iran and Kazakhstan, meaning that an increase in GDP per capita was associated with a *decrease* in the average household consumption per capita. For these three countries we set $\hat{\beta}_{1j}$ as the minimum positive estimate of this coefficient amongst the other countries in the sample. Second, in the case of Azerbaijan, Pakistan, Tajikistan and Viet Nam, the estimates of $\hat{\beta}_{1j}$ was higher than 1, meaning that a 1 percent increase in GDP per capita was associated with more than 1 percent increase in the average household consumption per capita. While this possibility is not unlikely, we preferred to take a more conservative approach with these countries by setting $\hat{\beta}_{1j} = 1$.

Finally, we estimate household consumption per capita for each vigintile *i* of each country *j* in 2009 as follows:

$$c^i_{j2009} = c^i_{jT}\left(1 + \frac{\Delta^{2009}_T c_j}{c_j}\right) \quad (4)$$

where c^i_{jT} is the average household consumption per capita of vigintile *i* of country *j* in year *T*, which represents the only year available in the GIDD dataset or data from a more recent year available in the PovcalNet dataset. An important assumption in this estimation is that the association between the rate of growth of average household consumption per capita to the rate of growth of GDP per capita in country *j* is the same for all vigintiles, which is not necessarily the case. However, as shown below, this assumption will only be relevant for the two vigintiles of the average household consumption per capita that encompass the poverty line.[8]

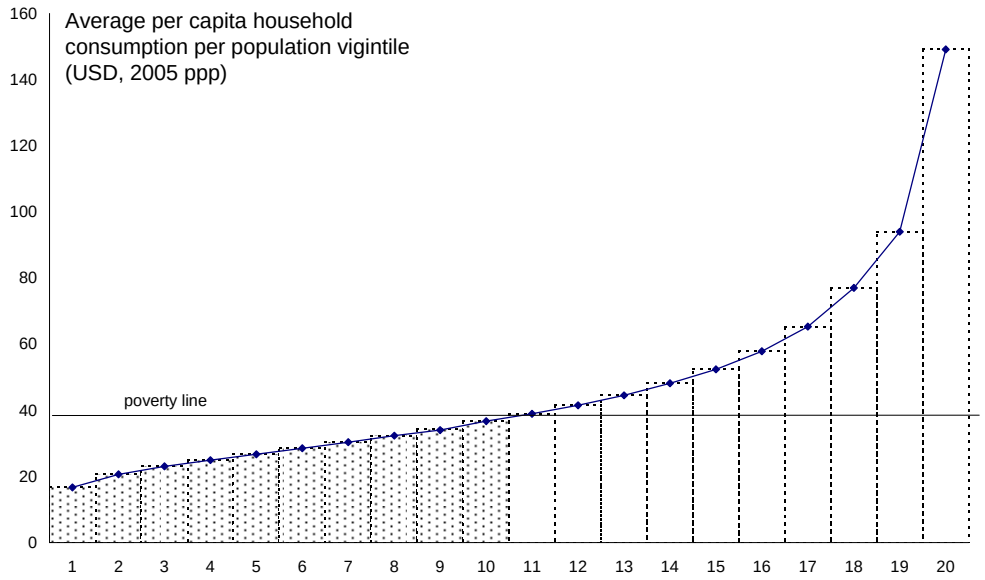
Estimate the number of people living below the poverty line in 2009. The number of poor in 2009 was estimated by adding up the population of all vigintiles for which the monthly average household consumption per capita is less than the monthly international poverty line of $38 (or $1.25 per day), expressed in US dollars of 2005 adjusted by purchasing power parity. To perform this calculation, we assume that the cumulative distribution of average household consumption per capita is piece-wise linear, with linear segments joining the values of this variable at each vigintile (c^i_{j2009}), as illustrated in figure 2.

In this example, the $38 poverty line is located between c^{10}_{j2009} and c^{11}_{j2009}. However, estimating the number of poor as the shaded area in the figure, that is assuming that only the individuals between the 1st and the 10th vigintile are poor, may result in large errors by ignoring the part of 11th vigintile that is below the poverty line. In a large country like India, where each vigintile includes approximately 60 million people, the error can be as high as 30 million. To refine the estimate of number of people living in poverty we include part of the population in the vigintile in which the average household consumption per capita is immediately higher than the poverty line (c^{11}_{j2009}) – or exclude part of the population in the vigintile in which the average

[8] The vigintiles below and above these two vigintiles are not included in the calculations.

household consumption per capita is immediately lower than the poverty line (c^{10}_{j2009}).

Figure 2 Example of piece-wise linear cumulative distribution function of average household consumption per capita



Source: Authors

The refinement in the calculation of the number of poor uses a linear interpolation method, which is illustrated in figure 3. The figure shows a segment of the cumulative distribution function of average household consumption per capita which includes only the two vigintiles that encompass the poverty line. Define

$$a = c^{i+1} - c^{i}, \tag{5}$$

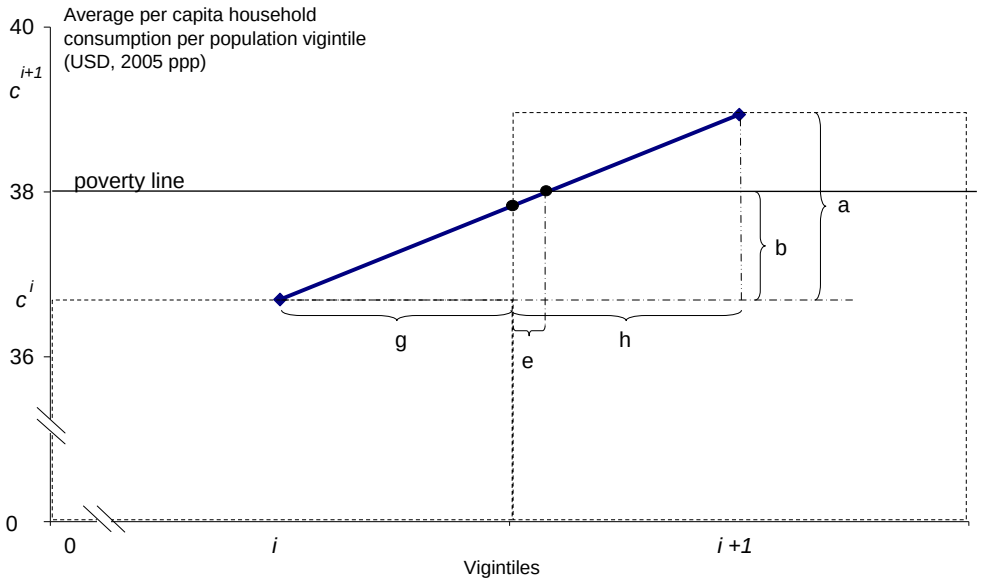
$$b = 38 - c^{i} \text{ and} \tag{6}$$

$$x = b/a, \tag{7}$$

where c^{i} is the average household consumption per capita in vigintile *i* such that $c^{i} < 38$ and $c^{i+1} \geq 38$. Also, define *g* as half of the population of vigintile *i* and *h* is half of population of vigintile *i+1* for $c^{i} < 38$ and $c^{i+1} \geq 38$, and let

$$z = g/(g+h) \tag{8}$$

Figure 3 Adjustment of estimate of number of people living below the poverty line



Source: Authors

From figure 3 it is straightforward to obtain the following relationship:

$$\left(\frac{e+g}{g+h}\right)=\frac{b}{a}, \tag{9}$$

from which, taking into account equations (7) and (8), we obtain

$$e=(x-z)\times(g+h). \tag{10}$$

Therefore, the number of people living in poverty can be estimated as follows:

$$poor=\sum_{k-1}^{i} pop^k+(x-z)\times(\mathrm{g}+\mathrm{h}), \tag{11}$$

where pop^k is the number of people in vigintile k. If $x > z$, as in the example, the number of poor includes people in the vigintile in which the average household consumption per capita is immediately higher than the poverty line. Conversely, if $x < z$, some of the people in the vigintile in which the average household consumption per capita is immediately lower than the poverty line will be considered non-poor. From the definitions of x, z, g and h above, the estimated number of poor for country j in 2009 would be

$$poor_{j2009}=\sum_{k-1}^{i} pop^k_{j2009}+\left(x_{j2009}-z_{k2009}\right)\mathrm{x}\,\frac{pop^i_{j2009}+pop^{i+1}_{j2009}}{2}, \tag{12}$$

where $x_{j2009}=\left(38-c^i_{j2009}\right)/\left(c^{i+1}_{j2009}-c^i_{j2009}\right)$, $z_{j2009}=pop^i_{j2009}/\left(pop^i_{j2009}+pop^{i+1}_{j2009}\right)$, and where the i^{th} and $(i+1)^{\text{th}}$ vigintiles of average household consumption per capita of country j in 2009 encompass the \$38 poverty line, i.e. $c^i_{j2009}<38\le c^{i+1}_{j2009}$.

2. Number of poor in 2010 considering the counterfactual scenario of no rise in staple food prices

The procedure to estimate the number of people living below the poverty line in 2010 under the counterfactual scenario of no food inflation is very similar to the procedure to estimate the

number of poor in 2009. First, the population per vigintile for each country in 2010 was estimated by multiplying the population per vigintile in 2009 by the growth rate of the entire population between 2009 and 2010. Second, for each country, the average consumption per capita of each vigintile *i* was estimated for the year 2010 as follows:

$$c^i_{j2010} = c^i_{j2009} \text{ x} \left(1 + \frac{\Delta^{2010}_{2009} c_j}{c_j}\right) \quad (13)$$

where $\Delta^{2010}_{2009} c_j / c_j$ is the growth rate of the average household consumption per capita of country *j* from 2009 to 2010, which was calculated similarly to $\Delta^{2009}_{T} c_j / c_j$ in equation (3):

$$\frac{\Delta^{2010}_{2009} c_j}{c_T} = \hat{\beta}_{1j} \times \frac{\Delta^{2010}_{2009} GDPpc_j}{GDPpc_j} \quad (14)$$

where $\hat{\beta}_{1j}$ are the estimated coefficient of β_{1j} in equation (2).

After obtaining these 2010 values of population and average household consumption per capita per vigintile, the number of people living in poverty in country *j* in 2010 can be estimated using equation (12).

3. Number of poor in 2010 considering the rise in staple food prices

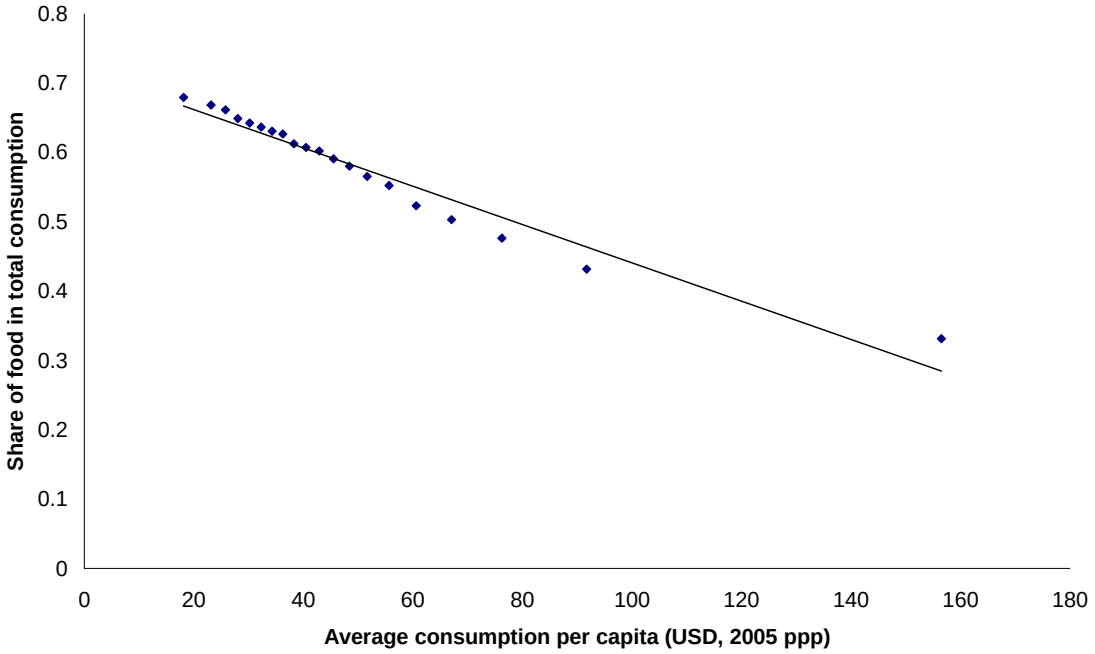
Given the average consumption per capita and population per vigintile for each country in 2010 obtained as described above, the procedure to estimate the number of people living below the poverty line in 2010 considering the high prices of staple foods follows the steps below.

Estimate share of food expenditure on total expenditure in 2010. The GIDD database has information on the average share of food expenditures in total consumption per vigintile of the average household consumption per capita (F^i_{jt}). To estimate such share for 2010, we use the following regression model:

$$F^i_j = \beta_{0j} + \beta_{2j} c^i_j + \varepsilon_j, \text{ if } c^i_j \leq 400 \quad (15)$$

This model assumes that there is a decreasing linear relation between the share of food expenditures in total consumption and average household consumption per capita. This relation is assumed to hold for levels of average household consumption per capita of up to $400, and it is illustrated in figure 4 for the case of India. This restriction was imposed because it was observed in the data that a linear relationship did not hold for households in the top vigintiles. The cutoff was set at $400 to be able to include all the countries in the regression. Recalling that countries in the GIDD dataset have data available for different years during the last decade, another assumption that is implicit in the estimation of the regression in equation (15) is that is that the coefficients have not changed during the past decade.

Figure 4 Linear association between average household consumption per capita and share of food expenditure in total expenditure, India (2000)



Source: Authors

Calculate the impact of high staple food prices on net buyers. As discussed above, the effect of high staple food prices on the poor depend on their condition as net sellers or net buyers of staple foods. Unfortunately, the share of net buyers and net sellers is available for only a few of the countries considered in the analysis, and as average shares for country as a whole rather than by vigintile. Therefore, based on the results shown in table 2 below, we assume that the average share of net buyers of staple foods is 0.69 in rural areas and 0.94 in urban areas. The share of net sellers is one minus the share of net buyers: 0.31 in rural areas and 0.06 in urban areas. Letting $share_h$ represent the share of households of type h that are net buyers of food, where h can be either urban or rural, we can state these assumptions as follows:

$$share_h = \begin{cases} 0.69 & \text{if } h = \text{rural} \\ 0.94 & \text{if } h = \text{urban.} \end{cases} \quad (16)$$

Table 2 Share of net buyers of staple foods

Country	Urban	Rural
Bangladesh	.97	.81
Cambodia	.85	.56
Nepal	.89	.65
Pakistan	.97	.73
Tajikistan	1.00	.89
Viet Nam	.93	.49
Unweighted average	**.94**	**.69**

Source: Authors based on FAO (2008)

If a household is net buyer of staple food, the effect of the high prices also depends on the share of its net purchase of staple foods in total expenditure. For example, the impact would be

higher in a household whose net purchase of staple foods represents 30 percent of its total expenditure than if it represents 10 percent. To account for the intensity of net staple food purchases of net buyers we have used data for Bangladesh, Cambodia and Viet Nam from Aksoy and Isik-Dikmelik (2008) reported in table 3. It is important to keep in mind that the intensity of net staple food purchases of net buyers differs across households located in urban and rural areas. The data in this table represent two points in the cumulative distribution functions of the share of net staple food purchases in total consumption of the three countries, for both urban and rural households. The last line of the table shows the unweighted averages of these two points for the three countries, for both urban and rural households.

Table 3 Intensity of net staple foods purchases (percentage of population)

Country	< 10 % of expenditure		< 30 % of expenditure	
	urban	rural	urban	rural
Bangladesh	28.2	11.6	90.4	77.9
Cambodia	40.9	22.1	95.1	96.2
Viet Nam	39.4	22.0	96.6	95.6
Unweighted average	**36.2**	**18.6**	**94.0**	**89.9**

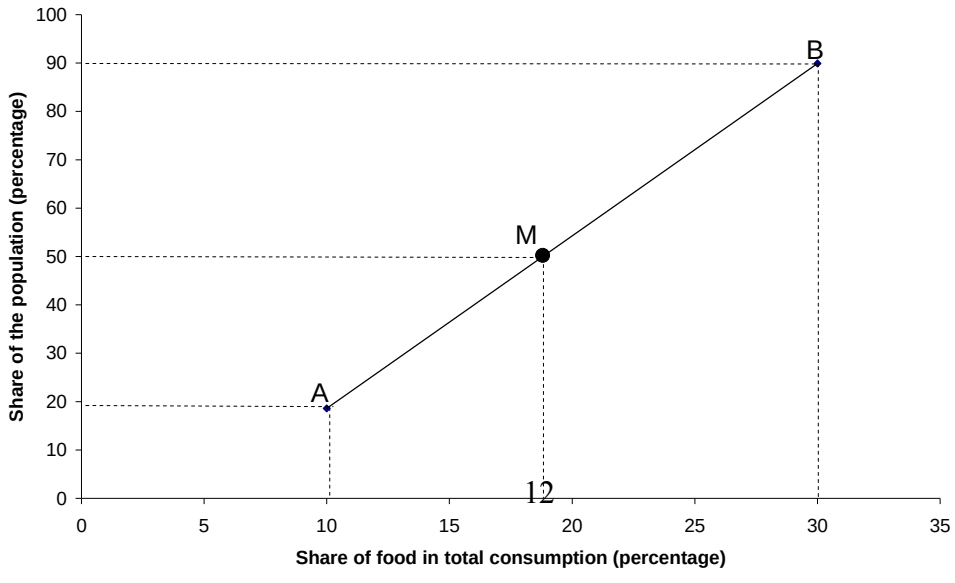
Source: Authors based on Aksoy and Isik-Dikmelik (2008)

We assume that the cumulative distribution functions are linear between the two points shown in the table (10 percent and 30 percent). Figure 5 illustrates this function for the case of rural households, using the unweighted averages for the three countries. It shows that between 18.6 percent and 89.9 percent of the rural households that are net buyers of staple food allocate between 10 percent and 30 percent of their total consumption expenditures to purchases of staple food. Given the assumption of linearity in the cumulative distribution function, the median rural household that is a net buyer of staple food would allocate 19 percent of its consumption to staple food. A similar calculation shows that the median urban household that is a net buyer of staple food would allocate 13 percent of its consumption to staple food. Therefore, letting $netpurchase_h$ represent the share of net staple food expenses in consumption of household of type h, where h can be either urban or rural, we assume that

$$netpurchases_h = \begin{cases} 0.19 & \text{if } h = \text{rural} \\ 0.13 & \text{if } h = \text{urban.} \end{cases} \tag{17}$$

Figure 5 Estimating the average share of the net purchases of staple foods in total expenditure in rural areas

Source: Authors



Notice that the GIDD database includes the share of all food expenditures in consumption, without distinguishing between rural and urban households. Because of the differences in net staple food purchases across both kinds of households and because we are interesting in estimating the impact of staple food price increases on poverty, we adjust the GIDD data on the average share of food expenditures in total consumption per vigintile as follows:

$$f_{j2010}^{ih} = F_{j2010}^{i} \times \left(\frac{netpurchases_h}{(1/20) \times \sum_{k=1}^{20} F_{j2010}^{k}} \right), \tag{18}$$

where the denominator of the ratio in the parenthesis is the average share of food expenditures in total consumption of the country.

Based on that information, we estimate for each country *j* the effective average household consumption per capita of net buyers per vigintile *i* in urban and rural areas as follows:

$$Cb_{j2010}^{ih} = c_{j2010}^{i} \times \left(1 - \frac{\Delta p_j}{p_j} \times f_{j2010}^{ih} \right), \tag{19}$$

where $\Delta p_j / p_j$ is the staple foods inflation in country *j* above the CPI inflation in the period from May 2010 to December 2010 shown in table 1. Notice that these estimates differ across rural and urban households and apply only to those that are net buyers of staple food. Estimates for net sellers of staple food are shown below. Also notice that we have used information on the share of imports of staple foods to estimate the impact of the transmission of the increase in international prices in countries for which staple price data was not available.[9]

To estimate the number of poor in 2010 among rural and urban households that are net buyers of staple food we modify equation (12) as follows:

$$bpoor_{j2010}^{h} = share_h \times \left[\sum_{k-1}^{i} pop_{j2010}^{kh} + \left(x_{j2010}^{h} - z_{j\,k\,2010}^{h} \right) \times \frac{pop_{j2010}^{ih} + pop_{j2010}^{i+1,h}}{2} \right], \tag{20}$$

where pop_{j2010}^{ih} is the population of the i^{th} vigintile of country *j* in 2010 for households of type *h*, $x_{j2010}^{h} = \left(38 - Cb_{j2010}^{ih}\right) / \left(Cb_{j2010}^{i+1,h} - Cb_{j2010}^{ih}\right)$, $z_{j2010}^{h} = pop_{j2010}^{ih} / \left(pop_{j2010}^{ih} + pop_{j2010}^{i+1,h}\right)$, and where the i^{th} and $(i+1)^{th}$ vigintiles of average household consumption per capita of country *j* in 2009 encompass the \$38 poverty line, i.e. $Cb_{j2010}^{ih} < 38 \leq Cb_{j2010}^{i+1,h}$.

Calculate the impact of high staple food prices on net sellers. To estimate the impact of high staple food prices on households that are net sellers of staple food we would need data on their average net sales as a share of their total consumption expenditures, which is not easily available in the literature. For this calculation we have adopted the rather conservative assumption that net sales of staple food gains represent, on average, 5 percent of the total consumption expenditures of net sellers of staple food, and that such share is the same in all countries and all vigintiles, both in rural and in urban areas:

$$netsales = 0.05 \tag{21}$$

[9] The estimate is made by multiplying the staple food inflation in the international market by the share of imports of the staple food in total consumption, using data from FAO's GIEWS country briefs available from http://www.fao.org/giews/countrybrief/index.jsp (assessed March 2011).

We discuss how such assumption affects the aggregate results of the impact of high staple food prices in the poverty reduction in the region in a robustness section below. Given this assumption, we estimate for each country *j* the effective average household consumption per capita of net staple food sellers per vigintile *i* as follows:

$$Cs^{i}_{j2010} = c^{i}_{j2010} \times \left(1 + \frac{\Delta p_j}{p_j} \times netsales \right). \quad (22)$$

And we estimate the number of poor in 2010 among rural and urban households that are net sellers of staple food as

$$spoor^{h}_{j2010} = (1 - share_h) \times \left[\sum_{k-1}^{i} pop^{kh}_{j2010} + (x_{j2010} - z_{j2010}) \times \frac{pop^{ih}_{j2010} + pop^{i+1,h}_{j2010}}{2} \right], \quad (23)$$

where pop^{ih}_{j2010} is the population of the i^{th} vigintile of country *j* in 2010 for households of type h, $x_{j2010} = (38 - Cs^{i}_{j2010}) / (Cs^{i+1}_{j2010} - Cs^{i}_{j2010})$, $z_{j2010} = pop^{i}_{j2010} / (pop^{i}_{j2010} + pop^{i+1}_{j2010})$, and where the i^{th} and $(i+1)^{th}$ vigintiles of average household consumption per capita of country *j* in 2009 encompass the \$38 poverty line, i.e. $Cs^{i}_{j2010} < 38 \leq Cs^{i+1}_{j2010}$.[10]

Calculate the impact of high staple food prices by country and by urban and rural. The final calculation is to sum up the results of (20) and (23) using both urban and rural data to estimate the total number of people living in poverty as a result of the high staple food prices in each country in 2010:

$$fpoor_{j2010} = bpoor^{rural}_{j2010} + bpoor^{urban}_{j2010} + spoor^{rural}_{j2010} + spoor^{urban}_{j2010}. \quad (24)$$

4) Calculate the impact of high staple food prices on poverty in 2010

For each country, including both urban and rural areas, we calculate the counterfactual increase in the number of poor between 2009 and 2010 if staple food prices had not increased faster than the consumer price index (*counter*) and the impact of high staple food prices on poverty (*impact*). The latter number can be decomposed into the number of people who, as a result of the higher prices, were either pushed into poverty (*push*) or prevented to step out of poverty (*prev*):

$$counter_j = poor_{j2010} - poor_{j2009} \quad (25)$$

$$impact_j = fpoor_{j2010} - poor_{j2010} \quad (26)$$

$$push_j = \begin{cases} impact_j & \text{if } fpoor_{j2010} > poor_{j2009} \text{ and } poor_{j2010} \geq poor_{j2009} \\ fpoor_{j2010} - poor_{j2009} & \text{if } fpoor_{j2010} > poor_{j2009} \text{ and } poor_{j2010} < poor_{j2009} \\ 0 & \text{otherwise} \end{cases} \quad (27)$$

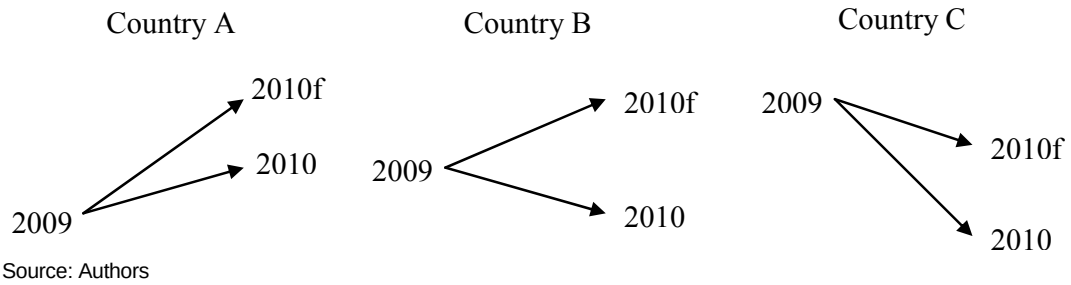
$$prev_j = impact_j - push_j. \quad (28)$$

Given these numbers, three situations illustrated in figure 6 are possible in countries where higher staple food prices led to an increase in poverty. In the figure arrows pointing up represent an increase in the number of poor between *2009* and *2010*, and the adverse impact of high staple food prices in 2010 is represented by the vertical difference between *2010f* and *2010*. The three

[10] Notice that in this case x_{j2010} and z_{j2010} are the same for rural and urban households.

possible situations for a country are the following: (i) *impact = push* (Country A), (ii) *impact = push + prev* (Country B), or (iii) *impact = prev* (Country C).

Figure 6 Possible impacts of higher staple food prices on poverty



Source: Authors

IV. Additional estimations for 2011

The analysis of the potential impact of high staple foods and oil prices in 2011 on poverty in ESCAP (2011) considers three scenarios against the counterfactual scenario of no staple food inflation in 2011 and average oil prices at $105, which was the price level in January 2011:

i) Scenario 1 - 2011 staple food prices rise above CPI inflation at half of 2010 rate and average oil price maintains at the $105 level

ii) Scenario 2 - 2011 staple food prices rise above CPI inflation at same rate as in 2010 and average oil price reaches $115

iii) Scenario 3 - 2011 staple food prices rise above CPI inflation at twice the 2010 rate and average oil price reaches $130

The procedure to undertake these estimations is similar to the one described in the previous section. In all cases, the data is updated to 2011 using the various scenarios for the increase in staple food prices. A new element of these estimations is the impact on poverty of various scenarios for oil prices. In the case of the estimates of the impact on poverty in 2010, the increase in oil prices was already captured in the GDP per capita growth for 2010, which was used to estimate the growth in average household consumption per capita using equation (2). But for 2011, the effect of the increase in price of oil on GDP growth needed to be estimated. For that purpose, we used the average elasticity of a change in oil prices on GDP growth estimated by ESCAP (2011) for six countries (China, India, Indonesia, Malaysia, Philippines and Thailand) to estimate the effect of the different scenarios on the GDP growth of the other countries considered in the analysis. The source of the baseline GDP growth estimates for 2011 used in the analysis was ESCAP (2011).[11]

In addition to estimates on the number of people affected by the high staple foods and oil prices, the analysis also considered the impact on the achievement of the Millennium Development Goal 1 on poverty reduction. The procedure adopted is based on ESCAP(2010, pp.87-89), as follows:

[11] Although the increase in price of oil is expected to contribute to the increase in food prices, we estimate their effects as mutually exclusive. Such assumption is not expected to create large distortions in the results given the estimates that the increase of 1 percent in the average oil price affect the world prices of wheat and rice by less than 0.16 percent (OECD, FAO 2011), and that is expected to affect the domestic prices by less than 0.05 percent if we use estimates by ADB (2011) of the transmission of average increase in international prices on domestic food prices.

For each scenario above, given the estimates of average household consumption per capita and the total number of people living below the poverty line in 2011, we estimate the poverty headcount for each country in 2011. We also have estimated the gini *G* for each country in 2011 using the simplified gini calculation method proposed in Deaton (1997).

We estimate the impact of growth of average household consumption per capita by calculating the semi-elasticity of poverty reduction with respect to per capita consumption growth k_y following Klasen and Misselhorn (2008, p. 8-9) as

$$k_y = \frac{1}{\sigma}\Phi\left[\frac{\log(z/\bar{c}_t)}{\sigma} + \frac{1}{2}\sigma\right], \tag{27}$$

where Φ is the cumulative distribution function of the standard normal and σ is the standard deviation of the lognormal distribution, which was calculated from the Gini coefficient using the following:

$$\sigma = \sqrt{2}\left[\Phi^{-1}\left(\frac{G+1}{2}\right)\right], \tag{28}$$

For each country and each scenario, we then calculate the poverty gap that would need to be closed as follows:

$$\Delta H^T = H_{2011} - H_{2015}, \tag{29}$$

where H_{2011} is the estimated poverty headcount in 2011and H_{2015} is the target to be reached by 2015 to achieve MDG 1, which is calculated as half of the poverty headcount in 1990 (or the nearest year for which data is available in the World Bank's PovCalnet dataset).

Given the semi-elasticity of poverty reduction with respect to household consumption per capita (k_y), the growth rate in average household consumption per capita between 2012 and 2015 ($\Delta c/c$) that would be necessary to close the gap in poverty headcount was calculated as:

$$\Delta c/c = \Delta H^T / k_y. \tag{30}$$

This equation assumes that inequality will remain constant at the 2011 levels. To estimate the required GDP per capita growth that would support the growth in per capita consumption of $\Delta y/y$ estimated in (34), the relationship between the growth rate of average household consumption per capita ($\Delta y/y$) and the growth rate in GDP per capita was estimated using the following regression model presented in (4).

Based on the required GDP per capita growth between 2012 and 2015 and on the estimated population growth in the same period, the required GDP growth to achieve the MGD 1 was estimated. Based on the forecasts of yearly average GDP growth between 2012 and 2015 and on the required GDP growth to achieve the MGD 1, the estimated year of achievement was calculated. The data source for the GDP and population forecasts is IMF, *World Economic Outlook*, October 2010.

V. Results

The analysis suggest that high food prices in 2010 kept 19.4 million people on poverty in Asia and the Pacific; they prevented 15.6 million people in the region from emerging from poverty and have pushed another 3.7 million below the poverty line. Nevertheless, given the economic dynamism of the region, the actual number of poor decreased by 24.5 million people between 2009 and 2010. And yet, if staple food prices had not increased above domestic rates of inflation, the number of poor would have decreased by 43.8 million people. Thus the main effect of the high staple food prices in 2010 was a significant slowdown of the pace of poverty reduction in Asia and the Pacific.

The share of the burden has varied across the region. People in 7 of the 27 countries considered were spared of further hardship and poverty because increases in domestic staple food prices were not significant. On the other hand, in the worst affected countries in relative terms, Georgia and Tajikistan, the high prices of food pushed up the poverty rate to 2.6 percent. Of the three types of countries described in figure 6 above, there were three in which the impact consisted only of people pushed into poverty (type A), seven in which the impact was a combination of people pushed into poverty and people prevented to step out it (type B), and 10 in which the impact consisted only of people prevented to step out of poverty (type C).

The country in which most people were pushed into poverty was Bangladesh: 2.9 million people out of the 3.7 million for the whole region mentioned above. The country were most people were prevented from stepping out of poverty was India, where 8.0 million people were affected, slightly above half of the total for the region (15.6 million). Other countries were many people were prevented from stepping out of poverty were Indonesia (2.9 million), China (2.1 million), Viet Nam (0.9 million) and Bangladesh (0.8 million).

In countries in which the impact consisted only of people prevented to step out of poverty (type C), the effect of high staple food prices was to slowdown the pace of poverty reduction. Such effect was higher in India, Indonesia and Viet Nam, where the number of people affected represented 53 percent to 62 percent of the number of people who would have stepped out of poverty if there had been no increase in staple food prices.[12] In contrast, such effect was smaller for China (13 percent).

Given the onset of high oil prices and the continued increase in food prices in 2011, estimates of further impacts on poverty were produced using three scenarios (see ESCAP, 2011, pp. 29). In the first scenario, if the rise in prices of staple food, above the CPI inflation, continues in 2011 at half the rate of 2010 and the average oil price reaches $105 per barrel, there would be a slowdown in the rate of poverty reduction in the region, with 9.8 million people being adversely affected. Of that number, 8.3 million people would be prevented from rising out of poverty, while an additional 1.5 million people would be pushed into poverty. If prices in 2011 rise above the CPI inflation at the same rate as in 2010 and the average oil price reaches $115 per barrel – a more pessimistic scenario – the resulting slowdown in poverty reduction would be expected to adversely affect 20.2 million people. Of that number, 15.1 million people would be prevented from getting out of poverty, while an additional 5.1 million people would be pushed into poverty. In an alternative scenario in which there are further increases in food inflation and oil prices, with staple food prices in 2011 rising above the CPI inflation at twice the 2010 rate and the average oil price reaching $130 per barrel, the total number of poor in the region would be expected to actually increase, with 42.4 million people being affected. Of that number, 24.6

[12] Formally expressed as 100 x *prev / counter*. See equations 25 and 28 above.

million people would be prevented from getting out of poverty and 17.8 million would be pushed into poverty. In all three scenarios, the strongest effect is expected to be in preventing people from rising out of poverty and the impact would be more severe in rural areas where the majority of the poor live.

As mentioned above, the main effect on poverty of the rise in prices of staple foods items in 2010 was not an increase in the total number of poor, but a slowdown in the rate of poverty reduction. We have estimated that such slowdown may result in a one-year delay in the achievement of the Millennium Development Goal on eradicating extreme poverty and hunger for countries in the region. Furthermore, under the worst case scenario described above (scenario 3), the achievement of the Millennium Development Goal on eradicating extreme poverty and hunger may be postponed by half a decade in many countries of the region, including Bangladesh, India, the Lao People's Democratic Republic and Nepal.

VI. Robustness checks

In the analysis presented in this paper, we have tried to address many of the problems identified in Headey (2011) related to simulation techniques based on Living Standards Measurement Study (LSMS) datasets, which is the case of the GIDD dataset. The first critique is the coverage of such simulations, which is usually very limited in terms of number of countries. In the analysis presented here we have covered 27 countries that are home of 96 percent of the developing Asia-Pacific population, and the final estimates were extrapolated to account for the remaining 4 percent. That makes this analysis broader than those previously reported in the literature.

Another critique is that such studies are not able to account for possible flexibilities that many rural households have in engaging in both farm and nonfarm activities, suggesting that rural households could be able to move quickly from one activity from another to benefit from the terms of trade in agricultural products. Another point is that these simulations are static and do not consider the effects of farm-based economic growth on rural non-farm incomes. Such critique is valid to the analysis presented in this paper as well. The model used here does not consider second-round effects of increase of income of net buyers of staple foods owing to increases in income of net sellers. It also does not consider the expected substitution effect between food items and between food and non food items, which may mitigate the effect of high staple food prices on the consumption of the people living near the poverty line. The expected effect of not considering such second-round effects is an increase in the estimates of people affected by the price shocks.

Another assumption made in this paper is that wages and staple food prices have not increased in tandem. This assumption is somewhat less problematic given that the majority of the population in developing Asia-Pacific is not part of the formal sector, and even those that are part of the formal sector may not have the protection of a cost of living trigger mechanisms to adjust wages to mitigate the impact of rising prices.

Still another critique to simulation technique studies is that the majority of these exercises incorporate price shocks that are an assumed proportion of international price increases rather than the actual price increases observed in domestic markets. Such critique is not particularly relevant to this paper given that we have used the actual price increases of staple foods in the domestic markets as the price shocks. Nevertheless, we had to make some choices in terms of the selection of particular cities or regions within the countries for which data was used for the

analysis. In this paper, we have selected the markets of the capital cities of each country considered in the analysis to estimate the price shock. That choice may not properly reflect the change in prices in the rural areas and may result in estimates of rural poverty that are less reliable than the estimates for urban areas.

A common challenge in such simulation-based analysis is the strong reliance on generalizing assumptions that are made based on the very few available data points. In the case of the analysis presented in this paper, these assumption are in particular related to the share of net buyers (*share*) and net sellers in rural and urban areas, the share of staple foods expenditure in total expenditure of the average net buyer (*netpurchases*) and the share of net sales in the case of net sellers (*netsales*).

To assess the effect of such assumption in the results of the estimates of the impact of high prices on poverty, we have conducted a robustness check in which we have ran 10,000 times the calculations of the impact of high staple food prices in 2010 on poverty considering different sets of values related to those assumption that were chosen randomly from uniform distributions for the following ranges of values:

$$share_h = \begin{cases} [0.49, 0.89] & \text{if } h = \text{rural} \\ [0.85, 1.00] & \text{if } h = \text{urban.} \end{cases} \quad (16')$$

$$netpurchases_h = \begin{cases} [0.16, 0.22] & \text{if } h = \text{rural} \\ [0.10, 0.16] & \text{if } h = \text{urban.} \end{cases} \quad (17')$$

$$netsales = [0.05, 0.11] \quad (21')$$

Such ranges of values were based on the higher and lower values for these variables reported in FAO (2008) and Aksoy and Isik-Dikmelik (2008). The result of those simulations, summarized in table 4, suggest that the estimates presented in this paper are in the average range of values of estimates for the impact in poverty in both urban and rural areas. Nevertheless, the variation of estimates based on the different set of assumption is large. The impact of high prices on poverty, within the 90 percent confidence interval, range from 12 Million to almost 24 Million, which highlights the need for better data regarding the assumptions.

Table 4 Number of people affected by high staple food prices: result of simulations with different set of values for assumptions (million of people)

	Mean	Standard Deviation	Minimum	Maximum
Urban	3.4	0.5	2.1	4.7
Rural	14.4	3.3	6.0	22.9
Total	17.7	3.8	8.2	27.6

Source: Authors.

Another important assumption in any simulation-based exercise, such the one presented in this paper, is related to the association between growth of GDP and growth of household consumption per capita. As discussed in section III, in this paper we use a regression model to estimate that association. In contrast, another assumption, which is often used, simply considers that 1 percent increase in GDP per capita would result in 1 percent increase in household consumption per capita. By applying such assumption to the methodology used in this paper, we found that the estimates of impact of high prices on poverty in 2010 is somewhat lower - 14.5

Million people affect in the Asia-Pacific region – mainly because the total number of poor for all scenarios under that assumption is about half of the currently generally accepted estimates.

VII. Conclusions

This paper presents estimates of the impact on poverty in developing countries of Asia and the Pacific of the increase in staple food prices in 2010 as well as estimates of the impact under various scenarios for 2011. The results suggest that while the rise in food prices has not caused an increase in poverty in the region, there has been a slowdown in the rate of poverty reduction which may cause a delay in the achievement in the MDG 1 in many countries of the region.

The paper has also highlighted the need for better data related to the main assumptions of such impact assessment studies, as well the need for a broader and more open discussion of the its impact on the resulting estimates. In that connection, areas for future work include: production of better estimates of share of net buyers and net sellers of the main staple foods and the associated share of net purchase or net sales in total expenditure and further studies on the relationship between the effect of growth, as measured by GDP growth, on inequality and growth of average household consumption per capita.

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