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WAS THE GLOBAL FOOD CRISIS REALLY A CRISIS? SIMULATIONS VERSUS SELF-REPORTING

Abstract

FAO, USDA and World Bank estimates of the welfare impact of the 2007/2008 global food crisis conclude that between 75 and 160 million people were thrown into hunger or poverty. However, these simulation-based approaches suffer from inherent deficiencies as well as insufficient coverage of the largest developing countries, especially China and India. This paper therefore assesses the usefulness of an alternative to simulation-based approaches, self-reported food insecurity data from the Gallup World Poll (GWP), a survey conducted before, during and after the 2008 crisis. While these data are still less than ideal, we show that trends in self-reported food insecurity are statistically explained by both food inflation (positively) and economic growth (negatively). This validation motivates us to employ the GWP data as a barometer for the welfare impacts of the global food crisis. Our findings suggest that while there was tremendous variation in trends across countries, global self-reported food insecurity fell from 2005 to 2008, with the most plausible lower and upper bound estimates ranging from 60 to 250 million fewer food insecure people. These results are clearly driven by rapid economic growth and very limited food price inflation in the world's most populous countries, particularly China and India. Hence, self-reported indicators of food insecurity reveal an opposite trend to simulation-based approaches.

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Key words:

Global food crisis; Hunger/poverty; self-reported indicators.

JEL: O100; O110; F010.

1. Introduction

In approximate terms, the global food crisis of 2007–2008 involved a doubling of international wheat and maize prices in the space of two years, and a tripling of international rice prices in the space of just a few months. Such rapid increases in the international prices of staple foods understandably raised concern about the impacts on the world's poor. Surveys suggest that poor households spend at least half of their budget on food. If such a household does not earn income from producing or selling food, then a doubling of food prices would-all else equal – equate to at least a 25% loss of disposable income. And while that situation is most relevant to the urban poor-who by definition produce little or no food – a large body of evidence suggests that even the rural poor are often net consumers of food (The-World-Bank 2008c). Consistent with these stylized facts, many simulation exercises of the impact of higher food prices on poverty suggest that poverty often rises in both rural and urban areas (Arndt, et al. 2008, Ivanic and Martin 2008, Robles and Torero 2010, Warr 2008, Zezza, et al. 2008). The earliest such exercise was used by the World Bank to estimate that as much as 100 million were thrown into poverty (The-World-Bank 2008b). A subsequent 73-country World Bank study estimated that global poverty rose by around 160 million people, 90 million of which were rural (de Hoyos and Medvedev 2009). The FAO (2009) and USDA (2009)-using a rather different methodology and the concept of calorie insufficiency rather than poverty-estimated that around 75–80 million people were thrown into hunger during the 2008 food crisis and another 97 million during the 2009 financial crisis. Another World Bank study using an FAO-type methodology also estimated that 63 million people were thrown into hunger by the two crises (Tiwari and Zaman 2010).

Despite an apparent consensus among international organizations that rising food prices are bad for the world's poor, that conclusion has been challenged by other academics. Some criticisms are conceptual whilst others focus on deficiencies in data and methods. Conceptually, Swinnen (2010) emphasizes that whenever a price changes, some benefit and some lose. Whether the poor are likely to benefit or lose depends largely on their occupational status (whether they get their income from agriculture or nonagriculture) but also on the depth of their poverty (i. e. their total household budget and the proportion of that budget that they must devote to food expenditures). While the poor by definition have

lower household budgets and large food expenditure shares, it is also well documented that around three fifths of the world's poor primarily work in agriculture, with another one-fifth working in rural nonfarm sectors often dependent on agriculture (The-World-Bank 2008c). So if rising agricultural prices also lead to rises in farm and nonfarm wages and income, then the net impacts might be positive. Aksoy and Dik-melik (2008) also demonstrate that even when the rural poor are net food consumers, they are often only marginally so. Hence one could be forgiven for believing that higher food prices involve a redistribution of income from richer urban areas to poorer rural areas. Indeed, as Dani Rodrik noted early on in the crisis, [1] pre-crisis trade liberalization studies suggested that higher agricultural prices (food and nonfood) would *reduce* poverty in the developing world.

With regard to empirics, the World Bank, USDA and FAO poverty and hunger estimates have also been questioned. There is a laundry list of potential problems. The widely cited FAO numbers – that 75 million were thrown into hunger during the crisis – are in fact based on USDA estimates because the FAO's «food availability» model has no capacity to model the impact of «food access» shocks (i. e. price changes). The USDA model specifies access shocks based on trade channels, but incorporates very little data on domestic price changes. That «global» model also excludes a number of large middle income countries, including China, Brazil and Mexico. More sophisticated simulations based on the approach pioneered by Deaton (1989) are better at conceptualizing and measuring the vulnerability of households to higher food prices (i. e. whether they are net food producers or net food consumers), but these simulations have other weaknesses. More often than not the shock to the model is an assumed price increase rather than an observed one, and the shock pertains only to food prices, rather than other prices that were also increasing over 2005–2008, such as fuel and nonfood commodities (Headey and Fan 2008). The models are almost invariably partial equilibrium at best, and at least one general equilibrium model (for India; (Polaski, et al. 2008) and several econometric papers indirectly suggests that rising food prices could raise unskilled wages (Lasco et al., 2008), which benefits the poor. And finally, like the USDA model, simulation-based approaches invariably exclude fast-growing China, and mostly omit other large countries like India, Indonesia and Brazil.

Another key feature of all types of simulations is that they incorporate very little real time data from the food crisis period, be it food prices, national income trends or household survey data. In this paper we therefore propose an alternative assessment of global trends in food insecurity based on World Gallup Poll (GWP) survey data collected both before, during and after the 2007/2008 food crisis in well over 100 countries. These surveys are at least superficially well suited to assessing global food security trends for several reasons. First, the GWP has been conducted since 2005/06-i. e. before the global food crisis-to

[1] See Rodrik's weblog: rodrik.typepad.com/dani_rodriks_weblog/.../are-high-food-prices-good-or-bad-for-poverty.html

2010 in well over 100 countries, including the most populous developing countries. Second, the vast majority of GWP surveys contain two questions that capture different dimensions of food security. One question relates to whether the household has had any problems affording food over the last 12 months, while the second asks whether the household has experienced episodes of hunger in the last 12 months. Third, Deaton (2010) has shown that the GWP indicator of food insecurity is closely correlated with GDP per capita and other welfare measures. And fourth, these surveys were conducted in the space of a month, with the month in question recorded. The significance of this last point is that we can match changes in self reported food insecurity to monthly food inflation data, and – more approximately-to annual data on economic growth. Hence we can test whether changes in self-reported food insecurity are explained by changes in mean income and food inflation, and thereby provide some validation for trends in this data.

Whilst these characteristics suggest that the GWP data may provide a suitable means of assessing trends in global food security during the food and financial crises, there are obviously caveats. First, our research question is conceptually different to those posed in simulation analyses. The latter generally try to gauge the impact of rising food prices, all else equal. In the real world, however, all else was not equal: oil and nonfood commodity prices were also rising, often to the benefit of developing countries, and nearly all poor countries experienced rapid economic growth over 2005–2008, especially the largest, such as China and India. Moreover, the rise in food prices was not causally independent from strong economic growth and fuel inflation. The weak US dollar, the impacts of oil prices on biofuels demand, and strong economic growth in developing countries, are all factors related to both economic growth and food inflation. This suggests that simulation studies typically impose unrealistic scenarios on their models.

A second caveat is that there are well known flaws in self-reported indicators, including possible biases, as well as problems specific to the GWP. Hence, much of the working paper version of this paper is devoted to the specific characteristics of the GWP surveys and the two measures involved, and to exploring possible biases in the cross-sectional variation in the GWP indicators. In this version of the paper we restrict ourselves to exploring the plausibility of within-country trends in the data (Section 2). A key finding is that changes in self-reported food insecurity are very desirably explained by economic growth (positively) and inflation (negatively), especially in low income countries. Taking this finding as at least a partial validation of trends in self-reported food insecurity, Section 3 goes on to estimate global and regional food insecurity trends, while Section 4 conducts some critically important sensitivity analyses. Our findings are spectacular for how different they are to simulation-based estimates. In contrast to the various USDA, FAO and World Bank global simulation estimates, we find that global self-reported food insecurity went down from 2005/2006 to 2007/2008, not up. Moreover, most of our estimates suggest that it went down by a huge margin. Our upper bound estimate puts the decrease at about

340 million, while our lower bound puts the decrease at about 60 million. It also quite transparent what explains this trend: very rapid economic growth and very modest inflation in China, India and other large developing countries.

Section 5 concludes with a reiteration of the caveats of this self-reported indicator, as well as some other words of caution and some lessons learned. Two important lessons are that economic growth appears to have been a major driver of trends in food insecurity, and that focusing on the largest countries is obviously essential for any plausible estimate of global food insecurity. A final word of caution pertains to the fact that the impacts of the 2008 crisis are not necessarily a good guide to the current (2010/2011) crisis. The pattern of food inflation this time around may be quite different, with inflation in China, India and other large countries currently much higher than it was in 2008.

2. An overview of the World Gallup Poll surveys and specific indicators of food security

Since 2005/2006 the World Gallup Poll has interviewed households in around 150 countries, although not always on an annual basis. Most questions are constructed to have yes/no answers so as to minimize translation errors. In developing countries all but one of the GWP surveys are face-to-face rather than telephone (China 2009 being the exception) and most take around one hour. The general characteristics of the GWP surveys are reviewed in detail in the working paper version of this paper. Here we concentrate on the phrasing of the question, and whether trends in this variable are explained by changes in GDP per capita and changes in food price levels. The phrasing of the GWP indicator that we are interested in is as follows: «*Have there had been times in the past 12 months when you did not have enough money to buy the food that you or your family needed?*» A simple yes/no answer recorded. For shorthand we refer to this as the «food insecurity» indicator, rather than a more cumbersome term such as food «unaffordability». Of course, there are generic problems with self-reported indicators, and there are some indications of measurement error (especially in the first round fo the GWP – 2005/06) and possible biases related to differing definitions of food. However, biases in levels do not necessarily mean that there are biases in trends.

To see whether trends in this indicator are plausible we test whether they are explained by economic growth and food inflation. Growth rates are measured on annual basis, but in the case of food inflation we match monthly food CPI data to the months of the GWP surveys, using 12 month lags that match the recall period. The results are reported in Table 1 below, where we find strong evidence that self-reported food insecurity is indeed explained by changes in mean incomes and food prices, with the effects generally varying by income levels. For example, in regression 1 we observe that if mean per capita income in a low income economy were to grow by 10% then the country could expect the

prevalence of food insecurity to go down by 4.4 percentage points. However, the interactions with income brackets suggest that growth effects in middle and upper income countries are significantly smaller. In the case of middle income countries the impact of economic growth is insignificantly different from zero. In upper income countries growth's impact is significantly different from zero, but the point estimate is about 60% lower than is the case in low income countries. In regression 2 in Table 1 we measure the change in food insecurity as a percentage change in order to derive a conventional elasticity that is comparable to other elasticities in the poverty-growth literature. The elasticity of food insecurity with respect to economic growth is -0.99 in low income countries (regression 2 in Table 1), which is certainly commensurate to the poverty-growth elasticities obtained in that literature (Loayza and Raddatz 2010).

Food inflation also has larger impacts in lower and middle income countries than in upper income countries. In low/middle income countries a 10 percent increase in food prices is predicted to increase food insecurity by around 2 percentage points. In regression 2 in Table 1 we see that the elasticity of food insecurity with respect to changes in inflation is around +0.54. It is also pertinent to compare the point estimates of the growth and food inflation coefficients. In both regressions 1 and 2 Wald tests confirm that the coefficients on food inflation are significantly smaller in absolute size than the coefficients on growth for low income countries, although the variation in food inflation rates is also somewhat larger (a standard deviation of 8.4 percentage points relative to 6.2 for economic growth).[2] Even so, it is interesting to observe such a strong impact of economic growth on food insecurity, particularly as the relevant GWP question does not specifically ask about disposable income. And given that the developing countries generally grew very quickly both before and during the food crisis-especially the most populous ones-this should give readers an inkling that global trends in self-reported food insecurity may not be so dire.

In regressions 3 and 4 we exclude upper income countries and pool lower and middle income countries together, but add time trends that are interacted with income levels. Relative to the omitted base of (2007), we do not find strong time period effects, although for low income countries all trend effects were positive from 2008 to 2010, but only significant for 2010 (and marginally insignificant for 2009). Interestingly the opposite results hold for middle income countries, which again suggests that their vulnerability to global economic shocks might be quite different. Another point of note is that the addition of time trends seems to reduce the statistical significance of the coefficient attached to food inflation, although it leaves the growth coefficient unharmed. Hence the time trend effects could indeed be picking up the effect of the global food crisis, but less so economic growth effects since growth rates vary more across countries within any given time period. In the working paper version we also show that the results in Table 1 are robust to alternative measures of inflation based on overall inflation and staples food inflation only. The results are also robust to the inclusion of fixed effects.

[2] If one conducts a Wald test of the null hypothesis that the low income growth coefficient is equal to 8.6/6.2 times the inflation coefficient, the null hypothesis is rejected at the 14% level.

Table 1

Are changes in self-reported food insecurity explained by economic growth and food inflation?

Regression	1	2	3	4
Dependent Variable[a]	Change in food insecurity	Percent change in food insecurity	Change in food insecurity	Percent change in food insecurity
Number of Countries	107	109	74	74
Number of Observations	254	257	185	185
Sample	All	All	Upper income excluded	Upper income excluded
Constant	0.06	2.42	-1.06***	3.43
Economic Growth[b]	-0.44***	-0.99**	-0.41**	-1.17**
Food inflation[c]	0.22***	0.54***	0.12	0.27
Growth*upper income	0.26#	-0.16		
□nflation*upper income	-0.18**	-0.30		
Growth*middle income	0.37#	0.87	0.35*	0.84#
□nflation* middle income	-0.10	-0.19		
2008 dummy			3.68	4.95
2009 dummy			2.97#	5.70
2010 dummy			3.60**	5.79
2008 dummy*middle income			-0.37	2.92
2009 dummy*middle income			-3.79**	-12.18*
2010 dummy*middle income			-2.74	-7.62
R-squared	0.09	0.06	0.13	0.08

Notes: These are OLS regressions. *, **, *** indicate significant at the 10%, 5% and 1% levels, respectively, and # indicates marginal insignificance at the 10% level. a. The dependent variable is measured as the between month M in year Y and the previous survey (M_{t-1} and Y_{t-1}). b. Economic growth is the percentage change in GDP per capita between the two years in which the GWP surveys were conducted. c. Food inflation is the percentage change in the food CPI between the month of the GWP survey and the month of the previous GWP survey, where the food CPI in any given month is actually the maximum food CPI in the previous 12 months. d. Low income as defined as a 2005 GDP per capita of less than $5000 PPP, middle income as $5000–13000, and upper income as greater than $13000. Note that by this definition China is defined as a low income country.

Sources: Dependent variables are from the Gallup World Poll (Gallup 2011). Independent variables are sourced as follows: Economic growth = World Bank (2010); Food inflation = ILO (2011).

In summary, what can we take from all of these results? First, the fact that changes in self-reported food insecurity are strongly explained by both economic growth (negatively) and domestic inflation (positively) suggests that changes in self-reported food insecurity are measuring precisely want we want them to: changes in disposable income. The only significant caveat is that because of measurement error and other omitted variables, the coefficients of determination for these regressions are quite low. Without fixed effects, the economic growth and food inflation explain about 10% of the variation in self-reported food insecurity trends over time.

3. Estimating basic trends in self-reported food insecurity at the global and regional level during the food, fuel and financial crises

Although we have noted potential problems with the GWP indicators in previous section, in this section we take a first cut at estimating trends in self-reported food insecurity without making any allowances for possible errors. In the subsequent section, however, we conduct a range of sensitivity analyses on the assumption that there are possible measurement errors in the 2005/06 round, particularly in China.

As for the measurement of basic trends, this is complicated slightly by two issues. First, the GWP surveys are not conducted in the same months in all countries. Some surveys are conducted in the beginning of a calendar year, others towards the end. This is important because the food crisis covered the second half of 2007 and at least the first half of 2008, so some surveys in 2007 may not be picking up the effects of the crisis. Hence we ignore 2007 data on the grounds that it is ambiguous vis-à-vis picking the effects of rising food and fuel prices. Another timing issue is that the first wave of the GWP some surveys were conducted in 2005 and others in 2006. In order to pick up the effects of the food-fuel and financial crises, three periods were therefore selected: (1) a pre-crisis period covering surveys conducted in 2005 *or* 2006 (the first wave of the GWP); (2) a food-fuel crisis period of surveys conducted in 2008, mostly the latter half (the third wave of the GWP);[3] and (3) a financial crisis period (2009) which may pick up some of the early effects of the financial crisis, as well as late effects of food crisis (the fourth wave of the GWP). Note that since the GWP food security question is retrospective over a 12-month period, we denote these three periods as 2005/06, 2007/08 and 2008/09.

[3] In 2008 only one sampled survey was conducted before April 2008 (Indonesia, where the survey finished on the 25th of March, when international food prices were already very high). Hence all the 2008 values for the food insecurity – which are 12-month retrospective answers – cover the first half of 2008, and most cover the last few months of 2007 as well.

A second issue is that our sample of countries is large but not universal. After excluding high income countries,[4] our sample of 70 developing countries over 2005/06–2007/08 covers 79% of the population of the developing world (and 67% of the total world population), including China, India, Indonesia, Brazil, Pakistan, Nigeria and many other large developing countries. We also use a sub-sample of 57 developing countries for which data for 2008/2009 are also available, which covers 77% of the developing world population. However, there are also important exclusions from both samples because on lack of data for one or more time periods. These include: all five North African countries (Morocco, Tunisia, Algeria, Libya, Egypt); Ethiopia, the Democratic Republic of Congo and Sudan (the second, third and fifth largest sub-Saharan African countries); and the Philippines (a country of around 85 million). The exclusion of these countries is unfortunate not only because they are populous, but also because there are strong reasons to suspect that many of them suffered considerably from rising prices. Hence in a sensitivity analysis below we will estimate some food insecurity trends in these countries in order to gauge how important their exclusion is from the present sample.

Turning now to our core results, Table 2 reports trends in food security in the 70 country sample and the 57 country sub-sample. For both samples we report unweighted means and population-weighted means. The results for these two means are very different. In an «average» developing country self-reported food insecurity rose slightly from 2005/06 to 2007/08 in all 7 countries, and fell very slightly in the sub-sample of 57 countries. However, the population-weighted mean dropped very sharply over these two periods, from 35.3% to 26.2% in the 70 country sample, and from 34.7% to 25.3% in the 57 country sub-sample. The latter sample does show, however, that food insecurity increased slightly from 2007/08 to 2008/09 (25.3% to 27.5%). Yet the overall trend in global self-reported food insecurity is undoubtedly very favorable over the entire period. Specifically, Table 3 shows that there was a huge decline in the numbers of self-reported food insecure from 2006/06 to 2008: around 400 million people are estimated to fallen out of this type of food insecurity, although 100 million fell into food insecurity in 2008/2009.

What could explain this remarkable result? One means of accounting for the change is to break up developing countries by regions, and also to examine the largest countries separately. In the top row of Table 4, for example, we group the largest nine developing countries together: China, India, Indonesia, Brazil, Pakistan, Bangladesh, Nigeria, Mexico and Vietnam. Together these countries account 57% of the total population of the 70 country sample, so what happens in these countries largely determines the overall trends observed in Tables 2 and 3.

[4] The exclusion of high income countries is based on the grounds that: (a) self-reported food insecurity in these countries is more likely to pertain to more exigent definitions of «food»; and (b) these countries show little change in food insecurity and are less likely to be influenced by rising international prices because of the greater consumption of processed foods in which raw materials are only a small component of total cost.

Table 2

Trends in self-reported food insecurity in the developing world: weighted and unweighted means

	2005/06	2007/08	2008/09
Total sample (70 countries)			
Unweighted mean	39.1%	39.8%	
Population-weighted mean	35.3%	26.2%	
All three years (57 countries)			
Unweighted mean	36.9%	36.6%	38.3%
Population-weighted mean	34.7%	25.3%	27.5%

Source: Author's calculations from GWP (Gallup 2011) self-reported food insecurity prevalence rates and 2006 World Bank (2010) population numbers.

Table 3

Estimated trends in the numbers of food insecure people (millions) in 58 developing countries

	2005/06	**2007/08**	**2008/09**
Estimated «food insecure» population	1502.1	1094.2	1191.3
Change in «food insecure» population		-407.9	97.1

Source: Author's calculations from GWP (Gallup 2011) self-reported food insecurity prevalence rates and 2006 World Bank (2010) population numbers.

Table 4

Regional trends in self-reported food insecurity (% prevalence)

Developing region	# obs.	2005/06	2007/08	2008/09
Big and fast growing*	9	33.1	26.7	29.1
Sub-Saharan Africa	14	55.8	54.6	57.2
West Africa coastal	4	48.5	51.3	58.0
West Africa, Sahel	5	59.6	49.2	55.2
Eastern & Southern Africa	5	57.8	62.8	58.6
Latin America & Caribbean	15	33.2	36.4	35.7
Central America, Caribbean	7	38.4	41.4	40.3
South America	8	28.6	32.0	31.6
Middle East	3	19.7	26.0	21.3
Transition countries	13	31.9	30.2	34.6
Eastern Europe	6	21.8	19.7	25.8
Central Asia	7	40.6	39.1	42.1
Asia	12	30.6	28.3	29.7
East Asia	7	33.3	29.3	30.4
South Asia	5	26.8	26.8	28.6

Source: Author's calculations from GWP (Gallup 2011) self-reported food insecurity prevalence rates. * «Big and fast growing» includes China, India, Indonesia, Brazil, Pakistan, Bangladesh, Nigeria, Mexico and Vietnam.

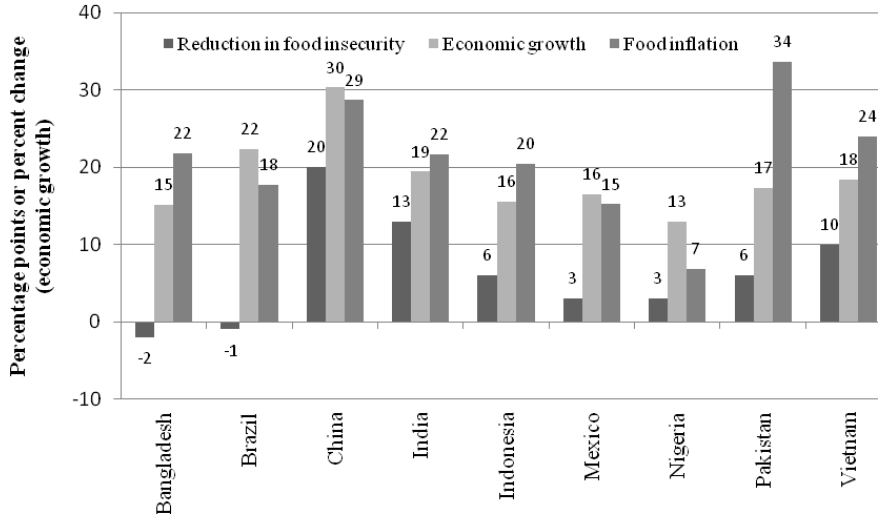
This is indeed evident in Table 4, where average (unweighted) self-reported food insecurity among these countries fell from 33.1% in 2005/06 to 26.7% in 2008, before rising again to 29.1% in 2009. Country details are also interesting. We observe huge reductions in self-reported food insecurity in China and India are perhaps the most striking results, given that these countries contain about 40% of the population of our 70 country sample. In India the trend of declining insecurity was reversed somewhat from 2007/08 to 2008/09, and similar patterns hold for Pakistan, Nigeria and Vietnam. In the other large countries there are no major changes. In China self-reported food insecurity fell by a scarcely credible 20 percentage points (an issue we take up in the next section).

Are the results for these large countries plausible? In Figure 1 we plot trends in three statistics for these countries for the period from 2005/06 to 2007/08: the reduction in self-reported food insecurity, the annual per capita economic growth rate over that period, and the change in CPI inflation over that period. There are several striking features of Figure 1. First, all nine countries experienced per capita annual economic growth rates of over 5 percent, and China and India experienced growth rates of around 15% and 10% respectively. Second, no country saw an increase in CPI inflation of more than 5 percentage points, and Indonesia and Nigeria saw huge reductions in CPI inflation. Third, looking at the relationships between the three variables on observes a very strong correlation between economic growth rates and reductions in food insecurity (the red and blue lines, respectively). The correlation between the two variables for all nine countries is 0.82, but if one excludes Bangladesh and Brazil (two countries where food insecurity rose slightly), the correlation rises to an astonishing 0.96. In other words, it looks like the main driver of reduced food insecurity in the developing world's largest countries was rapid economic growth. Changes in inflation, however, are perversely positively correlated with reductions in food insecurity, and indeed, with economic growth (although not strongly so -both correlations are around 0.40).

We will further explore the plausibility of these trends in China and India below, but for now we turn back to the trends within other developing regions reported in Table 4. Previous research showed that much of sub-Saharan Africa experienced relatively rapid food inflation in 2008 (Headey and Fan 2010, Minot 2010). Our results show very diverse patterns across African regions, however. West African countries saw some increase in food insecurity, which is perhaps unsurprising given that many import substantial amounts of rice, and in some cases other cereals as well. The inland Sahelian/Saharan countries in West Africa actually saw substantial declines in food insecurity, on average, while Eastern and Southern African countries saw substantial increases in food insecurity. If Ethiopia were added to this last group, the increase might be even more pronounced since 2005 and 2006 GWP data report rising self-reported food insecurity, while the unsurveyed years of 2007 and 2008 constitute a period of very rapid food inflation in that country (see our sensitivity analysis below).

Figure 1

Trends in food insecurity, economic growth, and inflation in the developing world's ten most populous countries: 2005/06 to 2007/08



Sources: Reduction in food insecurity is from the Gallup World Poll (Gallup 2011). Economic growth is total growth in GDP per capita between 2005/06 and 2007/08, and is sourced from World Bank (2010). Change in inflation is the total change in the inflation rate between 2005/06 and 2007/08 from World Bank (2008a).

In Latin America, self-reported food insecurity rose by around 4 percentage points, a result broadly consistent with survey-based simulation analyses for Latin America; for example, Robles and Torero (2010) who estimated about a 2 percentage point rise in poverty for a 10% increase in food prices. Moreover, the observed increases in the GWP measure are about the same for Central America and the Caribbean as they are for South America. Among the countries witnessing the largest increases in self-reported food insecurity are El Salvador (40 to 48%), Honduras (42% to 48%), and the Dominican Republic (48% to 59%). In Haiti, where there were widely publicized food riots, which in turn caused a regime change, food insecurity actually fell over this period (from 63% to 60%), although the levels in both years were easily the highest in the region. In South America it appears that Ecuador was the worst affected country, since food insecurity rose from 36% before the crisis to 46% during the crisis period of 2007/2008.

We only have data for three Middle Eastern countries (including Turkey, plus Lebanon and Jordan), so the sharp increase in this region may be very

sensitive to the inclusion of more countries (see Section 6 below). Moreover, the result is heavily driven by Turkey, where self-reported food insecurity rose from 26% in 2005/06 to 47% in 2007/08, before falling again to 37% in 2008/2009. It is quite likely that food insecurity rose in other Middle Eastern and North African countries, as we discuss below.

Among the former communist «transition» countries there was very little change on average, but this masks considerable diversity across the countries. Some transition countries saw significant declines in food insecurity on the order of 6–15 percentage points (Romania, Kyrgyzstan, Armenia, Tajikistan), but Azerbaijan was a big exception with food insecurity rising from 37% to 60%.

Finally, self-reported food insecurity in Eastern and Southern Asia declined on average. Among East Asian countries food insecurity declined by 4 percentage points on average, but there is again a lot of diversity. China, Cambodia, and Vietnam saw large decreases, while Laos and Thailand saw increases of 8–12 percentage points, and as we discuss below, food insecurity probably increase somewhat in the Philippines. In South Asia food insecurity fell in India and Pakistan, as we noted above, but rose slightly in Bangladesh, and rose sharply in Sri Lanka where inflation was in double digits as a result of the large government deficits run during the civil war (Headey and Fan 2008)[5].

4. Sensitivity analysis

The results above suggest that self-reported food insecurity in around 70% of the developing world's population fell sharply from 2005/2006 to 2007/2008 by around 400 million people, before rising by around 100 million from 2007/2008 to 2008/2009. Since this is undoubtedly a controversial result, it behooves us to consider whether the result is sensitive to the exclusion of some important countries, or to alternative assumptions about events in China and India (the two countries which account for the largest country shares of this huge decline), or to more general measurement error.

Beginning with the China-India question, a first point of note is that excluding these two countries from our sample would suggest that self-reported food insecurity did indeed rise among the other 68-country sample, but only by 9 million people (and then by another 12 million people from 2007/08 to 2008/09).

[5] One final point of interest is the issue of tradability in Asian rice markets, with the data suggesting that both importers and exporters can be adversely affected by rising international prices. For example, the Philippines is regularly the world's largest importer of rice, so it is obvious that domestic food inflation would be directly related the higher cost of rice imports. But exporters can be affected too. Previous research has shown that Thailand's decision not to restrict its rice exports during the crisis did indeed lead to a sharp increase in domestic rice prices, in contrast to India where rice exports were heavily restricted (Headey 2010).

This result still conflicts with FAO/USDA and World Bank estimates of the change in poverty/hunger resulting from the crisis, which put the rise somewhere between 75 and 160 million people. Moreover, the fact the self-reported food insecurity did not rise by a larger number still largely seems to stem from the strong economic performance of other large developing countries (Figure 1 above).

More importantly, the exclusion of China and India is obviously not a valid one if one wants to assess global poverty trends. That said, we have noted some concerns over the self-reported food insecurity trends in China because in the 2005/2006 round the food affordability question followed more general questions about income, which may have primed respondents in that year to more likely answer yes to the question about food affordability. Certainly the 20 percentage point reduction in self-reported food insecurity from 2006 to 2008 is not very credible. Suppose, then, that we re-estimate global food insecurity trends after using an alternative series for China and India. Specifically, if we take the extreme position of keeping self-reported food insecurity constant in China (or equivalently, excluding China from the calculations), but keep the Indian series as is, then global self-reported food insecurity still falls by about 132 million people. Or suppose that we the margins of error reported by the GWP, which are around 3 percentage points at the 95% confidence interval, to re-estimate flatter trends for India and China by reducing their reported food insecurity rates by 3 points in 2005/06 and increasing the reported values by 3 points in 2007/08. If we carry out that exercise then global food insecurity still falls by 250 million people. If one adopts an even stricter but more arbitrary assumption regarding China, namely that self-reported food insecurity in China fell by just 10 percentage points rather than 20 points from 2005/06 to 2007/08, then global self-reported food insecurity fell by around 200 million people. Finally, suppose we discredit the GWP numbers for China and India entirely, and instead arbitrarily assume that self-reported food insecurity fell by just 3 percentage points in both countries (after all, their economic growth and food inflation were conducive to at least this much reduction). Under that assumption global food insecurity still fell by 63 million people. In short, various assumptions about the nature of any error in the 2005/2006 GWP surveys in China and India still suggest that global food insecurity fell by a large number.

What about some potentially important omissions from the 70 countries in which our «global» estimates in Tables 2 and 3 were based? As we noted above, most of the developing world's largest countries have complete data for the three periods considered, but there are some sizeable countries excluded. North Africa is excluded entirely, while three of Sub-Saharan Africa's largest countries are also excluded, as well as three medium size countries in that continent. In Latin America, Peru is a reasonably large country, while Paraguay is small. And in East Asia there is only one major exclusion, the Philippines, but that country has almost 85 million people, making it another sizeable omission.

These 16 excluded countries are listed in Table 5, where we note that their total population comprises nearly half a billion people. Table 5 therefore also reports what data are available for these countries, before estimating some

plausible trends in the self-reported food insecurity indicator based on trends in real domestic staple food prices from the FAO (2010), inflation data from the IMF (2011) when FAO data are unavailable, and post-2008 trends in the GWP self-reported food insecurity indicator (i. e. if this indicator fell after 2008, this would suggest that food insecurity in 2008 might have been unusually high).

We note that in all cases we have made very generous assumptions about the extent of change in the food insecurity indicator. Even so, there are also good grounds to think that many of these 16 countries were quite adversely affected by the global food crisis. North Africa, for example, is a huge wheat importer (Egypt is typically the largest wheat importer in the world) that has experienced significant inflation in recent years, and subsequent civil unrest in early 2011, including regime changes in Tunisia and Egypt. Ethiopia experienced very rapid food inflation from 2005 onwards. From 2005/06 to 2006/2007 self-reported food insecurity in Ethiopia rose by 14 percentage points. Since overall inflation peaked at around 60% in July 2008, it is highly likely that food insecurity kept rising in Ethiopia after the early GWP surveys terminated there. The Congo (DRC) and Sudan also saw sharp increases in staple food prices (Table 5). And finally, the Philippines is typically the largest rice importer in the world, and in the first quarter of 2008 it made what is widely regarded as a «panic purchase» that contributed to a further increase in international rice prices (specifically, the Philippines purchased more rice in the first quarter of 2008 that it did in all of 2007, mostly from Vietnam-see Headey (2011)).

These omissions are sizeable enough to suggest that the «global» trends reported in Tables 2 and 3 could be influenced by the exclusion of these 16 countries. Hence in the last column of Table 5 we report upper bound estimates of the possible rise in food insecurity among the 16. In the Middle East and North Africa we typically assume that food insecurity rose by around 10 percentage points, with a similar assumption for Sudan, the DRC and Sierra Leone. In Ethiopia we assume a 20 point increase because of the country's rapid food inflation and because its population is undoubtedly very vulnerable to food price increases. But in Malawi and Rwanda-where many poor people are smallholders-we make the more modest assumption of a 5 point increase (in any case these countries are much smaller than Ethiopia, Sudan or the DRC), an assumption which also pertains to Peru and Paraguay. Finally, we assume that food insecurity rose by 14 points in the Philippines. Based on these upper bound assumptions we find that these 16 countries could have added as much as 62 million to the ranks of the global numbers of self-reported food insecure. This is a big enough number to influence the global estimates discussed above, although even if subtracted from the China-India sensitivity tests above, we would still find that global food insecurity rose under every assumption.

Table 5

Countries excluded from the «global» estimates, and the likely impacts of the 2007/2008 food crisis on food insecurity

Country	Self-reported food insecurity data					Clues as to impact of global food crisis[a]	Assumed impact[b]
	2005/06	2006/07	2007/08	2008/09	2009/10		
Seven Middle Eastern and North African countries; total population = 230 million							
Afghanistan		49	38	38		All countries are dependent upon wheat imports, and GIEWS data often show rising domestic wheat prices, while overall inflation was often high (exceptionally high in Yemen). In many instances self-reported food insecurity fell from 2008 to 2009, suggesting 2008 might have been a year of unusually high food insecurity	11 points
Algeria			22	15	13		7 points
Iraq			25	12	18		13 points
Egypt			31	23	28		8 points
Morocco	36	29					5 points
Tunisia			22	11	9		11 points
Yemen			47	48			10 points
Three large African countries; total population = 190 million							
Ethiopia	24	38				In DRC and Sudan GIEWS data suggest that many food items increased by 50–100%. In Ethiopia overall inflation peaked at 60% in July 2008 but was already high before the global food crisis.	20 points
DRC			61				10 points
Sudan		27		38	50		10 points
Three medium-sized African countries;total population = 30 million							
Malawi	76	51		60		GIEWS data suggest rapid increases in maize, beans & rice prices in Rwanda & Malawi, although many poor people produce maize & beans. Sierra Leone is a large importer of rice; inflation rose to 17% by mid-2008	5 points
Rwanda	61			43			5 points
Sierra Leone	58	63					10 points
Two medium-sized Latin American countries; total population = 33 million							
Paraguay	40	36		31		In Paraguay there is no strong evidence on food inflation. In Peru maize, potato and wheat prices rose by 50%, but many poor people produce maize and potato.	5 points
Peru	50	45		46			5 points
One large East Asian country; total population = 86 million							
Philippines	56	64		68	62	Rice prices rose by 50%, and food insecurity trend is upwards	14 points
Total estimated change in self-reported food insecurity in all 16 countries							***62.4 million***

Notes: a. These clues include an assessment of FAO GIEWS data (2010), IMF inflation data (2011), and trends in the self reported food insecurity reported in columns 2 to 6. b. This is the assumed change in self reported food insecurity between 2005/06 and 2007/08.

Finally, we conduct a more systematic sensitivity test by disregarding the 2005/2006 GWP results – because of concerns that Gallup was still improving their survey design in this first round – and instead «predicting» the 2005/2006 food security levels based on trends in economic growth and food inflation from 2005/2006 to 2007/2008 and the coefficients estimated in Table 1. This back-casting approach is basically an instrumented variables (IV) approach, and like IV it may have the effect of reducing measurement error. Put another way, it will also «iron out» the influential outlying observations, such as China. A second advantage is that the country coverage becomes almost universal, including all the countries listed in Table 5, and other smaller omissions from the calculations of the previous section (the only sizeable omission is Morocco). A final advantage is that we can decompose the predicted change in self-reported food insecurity into an economic growth component and a food inflation component to how each of these factors appears to have been driving global food insecurity trends.

So what do we find? The basic result is that 87.3 million people are still thrown out of self-reported food insecurity from 2005/2006. Note that in these IV results self-reported food insecurity falls by just under 3 percentage points in China and just under 2 percentage points in India. By decomposing the results in growth and inflation effects one can conduct the kind of *ceteris paribus* experiments that simulation exercises pursue. For example, if food inflation changed as it did from 2005/06 to 2007/08 without any change in income-the experiment conducted in most LSMS-based simulations-then food insecurity is indeed predicted to have risen by 128.2 million people. This is somewhere in between the 80 or so million predicted by the FAO and USDA, and the 160 million person estimate derived by de Hoyos et al. (2009), who also used food inflation in their experiment.[6] However, the difference between our results and those other results is that we find that the benefits of rapid economic growth easily outweighed the costs of food price inflation. Had economic growth followed its historical path with no increase in food prices, then 215 million people would be predicted to leave the ranks of the food insecure.

Table 6 also finds an interesting result vis-à-vis the financial crisis. While economic growth slowed in 2009, the slowdown was very modest in many of the most populous countries so our results do not estimate a large negative impact via this channel. On the other hand food inflation slowed and in some cases was negative, thus mitigating the most severe impacts of the financial crisis on food insecurity.

[6] Without China, we find that food inflation would have raised self-reported food insecurity by 90 million people. Since de Hoyos et al. (2009) do not include China in their sample, this 90 million person estimate is actually the more relevant comparison. There are other differences too. We measure the food price increase from June 2006 to June 2008, but de Hoyos et al. measure it from January 2005 to December 2007 (although the magnitude of the change is very similar). More importantly de Hoyos et al. measure the impacts of food price changes relative to nonfood price changes, whereas our regressions only use nominal food price changes.

Table 6

Estimating changes in self-reported food insecurity by backcasting and forecasting

	2005/06 to 2007/08 (2006/06 backcasted)	2007/2008 to Dec-2009 (2009 forecasted)
Change in self-reported food insecurity	-87.3 million	+1.0 million
Change due to economic growth	-215.4 million	+17.2 million
Change due to food inflation	128.2 million	-16.2 million

Notes: In the second column changes in self-reported food insecurity are estimated by backcasting 2005/2006 food insecurity levels (June 2006) from 2007/2008 levels by using regression results in Table 1, which model food security changes as a function of economic growth and food inflation. For countries in which food inflation data were not available, overall inflation was used. For countries in which 2008 food insecurity data were not available, 2009 levels were used as the base. In the third column 2007/08 results were combined with economic growth and food inflation trends to forecast self-reported food insecurity in December 2009, in roughly the middle of the financial crisis.

Table 7

Alternative estimates of the global food insecurity trends

Estimation scenarios	Estimated change: 2005/06 to 2007/08
Raw results, 70 countries	-408 million
Raw results for 70 countries, plus upper bound assumptions for 16 omissions	-326 million
Raw results, 68 countries after excluding China + India	+9 million
Raw results, 69 countries after excluding China	-132 million
Raw results, China and India trends adjust by maximum margins of error	-250 million
Raw results, food insecurity in China and India falls by 3 percentage points	-63 million
As above plus upper bound assumptions for 16 omitted countries	-1 million
Predicted change after backcasting 2005/06 level, 88 countries	-87 million

Notes: See text in this section for more details regarding the assumptions and data.

Let us summarize the results of this section. First, many of the sensitivity analyses employed above were purposively designed to reduce the magnitude of the food insecurity reduction in China. While it is difficult to assess which of the assumptions regarding Chinese trends is most plausible, all of the assumed reductions in the Chinese trends show that global self-reported food insecurity still fell by a large number from 2005/06 to 2007/08. Making some generous assumptions about the adversity of food insecurity trends in some omitted countries would reduce the scale of the global reduction in food insecurity still further, but again, the magnitude of that reduction is still considerable. Finally, using the regression results from section 5 to backcast and forecast trends-in what is more or less an instrumental variables regress, still suggests that the numbers of self-reported food insecure in the developing world fell by around 87 million. So while various assumptions and techniques used in this section sizeable reduce the admittedly improbable raw trends calculated in the previous section, the qualitative result remains the same: self-reported food insecurity appears to have fallen from 2005/06 to 2007/08. Table 7 summarizes these results.

5. Caveats and conclusions

This paper has explored the usefulness of the Gallup World Poll indicators of self-reported food insecurity and hunger for assessing global food insecurity patterns and trends. In this concluding section we overview the strengths and weaknesses of these data, and summarize our main findings regarding trends in the two indicators of interest. To reiterate the main findings, our main results is that in 2007/2008 – the food crisis period-there were *fewer* people reporting trouble affording food than in 2005–06. We are hesitant to say exactly how many, though two of our most conservative estimates suggest that global food insecurity fell by 60–90 million people, although these would be lower bound estimates if the trends in China and India were somewhat stronger than a 2–3 percentage point reduction in food insecurity assumed or predicted in these scenarios. Certainly the fantastic growth rates and muted food inflation in these two countries could warrant a strong downward trend. Of course this conclusion does not mean that the global food crisis did not hurt. On the contrary, it hurt poor people in many countries, particularly in Africa. Yet our main finding is that the food crisis had a very limited impact in the most populous countries, thus casting into doubt existing estimates of global trends in food insecurity and hunger.

This last point is particularly important because all existing simulation-based estimates of the impacts of the food crisis omit China, and many omit other large countries. Yet our results suggest that strong economic growth prevented the surge in international food prices from resulting in a genuine global crisis. Moreover, the fact that populous countries tend to be wary of heavily relying on international cereal markets – and the fact that many large countries also imposed export restrictions to protect domestic prices (Headey 2011) – pre-

vented them from experiencing significant food inflation. However, on this last point we add a note of caution. The events of 2005–2008 are not necessarily a good predictor of food price impacts in 2010–2011. While countries like China and India are still growing rapidly, a notable difference in the current crisis (2010–11) is that some of these large countries are now experiencing quite rapid food inflation (although not yet rice price inflation). Hence the global impact of the current crisis could potentially be significantly worse than the 2007/08 crisis.

Our results also suggest that the Gallup World Poll indicator of food affordability may be a good metric for assessing the impacts of price shocks in the future, although much more work needs to be done to further assess the reliability of this indicator. Existing work on subjective indicators has often found them to have low test-retest reliability, or to be quite sensitive to the phrasing or placement of questions (Bertrand and Mullainathan 2001, Krueger and Schkade 2008). Further appraisal of the GWP indicators would certainly be useful. We know very little about how people define food security across countries or socio-economic groups, or how self-reported food insecurity varies within countries according to income or food consumption measures. Nevertheless, the fact that economic growth and food inflation explain trends in this indicator is encouraging, and it may be that further refinements to the survey question could be very useful. Moreover, a number of cross-country surveys ask self-reported food security questions, often with a more refined 5-point scale. These include Gallup (for Africa and Asia only), but also Afrobarometer, the World Bank's Core Welfare Indicator questionnaires (CWIQs) and the World Food Program's Rapid Comprehensive Food Security Surveys. At the moment, however, there is no coordination, comparison or systematic validation of these various surveys and indicators. Given the flaws of «objective» indicators of hunger and food insecurity, these institutions and others (such as the FAO) should seriously consider scaling up and improving these indicators as a basis for improved measurement of this critical dimension of human welfare.

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