Tools to Measure Impacts over Households of Changes in International Prices

Presented by:

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AGRODEP Workshop on Tools for Food Prices and Price Volatility Analysis

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Tools to Measure Impacts over Households of Changes In International Prices

AGRODEP MEMBERS' MEETING AND WORKSHOP
JUNE 6 -8, 2011
DAKAR, SENEGAL

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1. Overview

1. Welfare impact of changing food prices

    a) Analytical framework and methodology
    b) Empirical estimation: Bangladesh, Pakistan, Vietnam

2. Online welfare impact simulator
3. Other online tools

1. Overview: Welfare impact of changing food prices

- We answer the following question: What is the impact on households welfare of changing food prices?
- Microeconomic approach
- Data at the household level
- We go from household level to higher levels of aggregation (by region, by expenditure quintile, etc.)

1. Overview: Welfare impact of changing food prices

- Welfare impact estimates rely on the concept of **compensating variation**: amount of extra income required by a household in order to compensate this household for a change in prices.

- We take into account the fact that households might be consumers and producers of food (key in rural areas)

- Households' consumption and production decisions respond to price changes (substitution effects)

2. Welfare effects: Methodology

- We estimate “compensating variation” for all households
  - A formal representation of compensating variation is derived in Robles & Torero 2010

- We compare for every household:
  - Expenditure “without” price shock (directly estimated from household surveys)
  - Expenditure “with” shock = Expenditure “without” price shock – Compensating variation

2. Welfare effects: Methodology

- What do we need to estimate compensating variation?
  - Define commodities or group of commodities
  - Compute expenditure shares and production shares
  - Compensated demand elasticities (own and cross price elasticities)
    - We estimate econometrically a system of demand equations, the quadratic almost ideal demand system (QUAIDS):

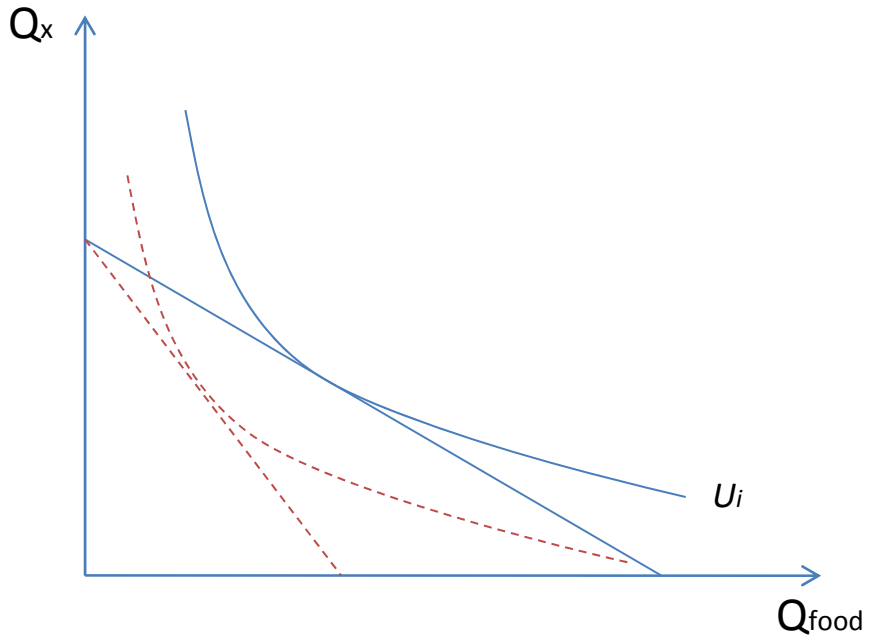
2. Welfare effects: Methodology

- What do we need to estimate compensating variation?
  - Define price changes (we simulate full and partial transmission for producers)
  - Estimate total household expenditure with and without price shock

3. Welfare effects: Methodology

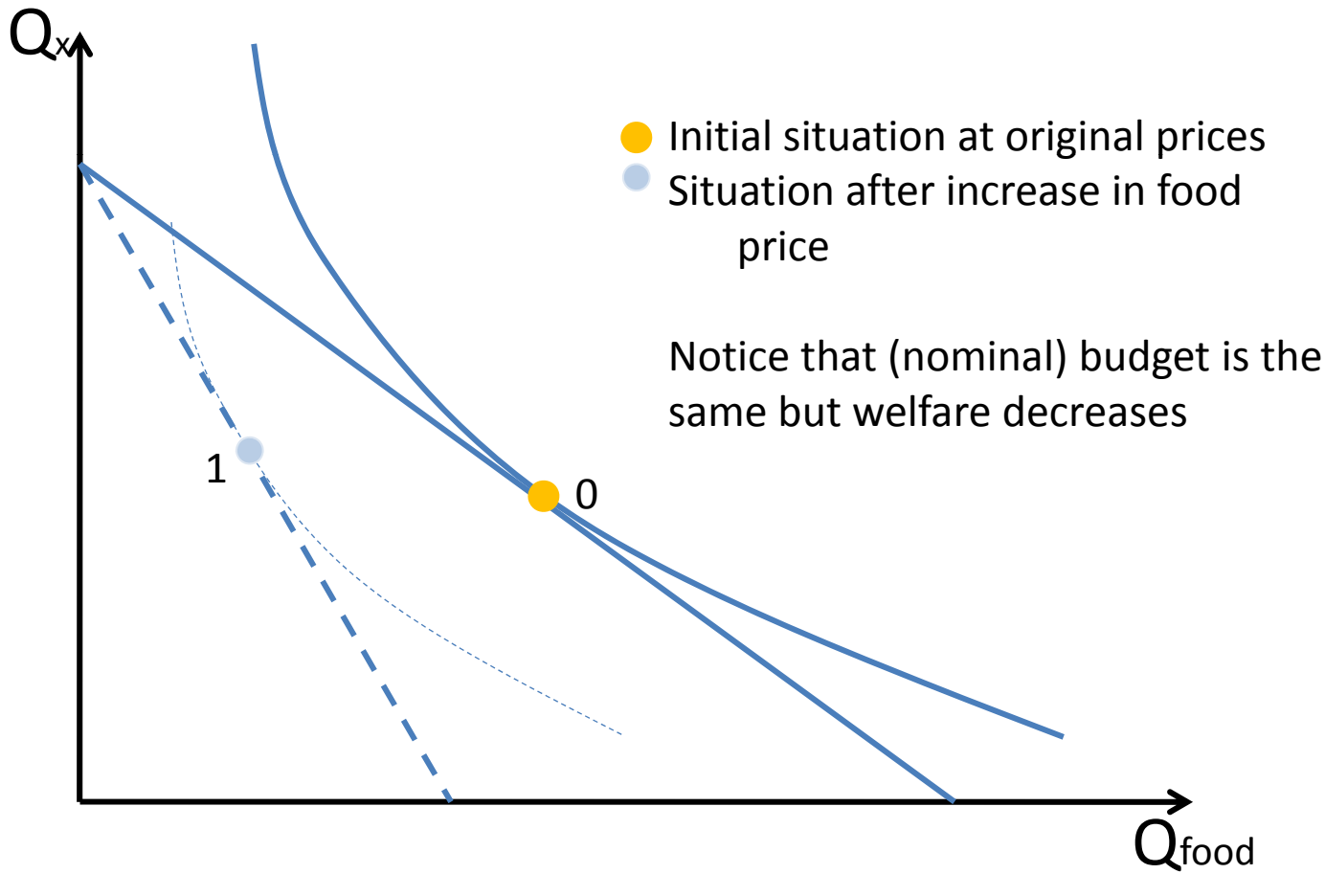
- We want to estimate by how much the welfare of household “i” is affected when faced with a change in the price of food.
- Idea is to estimate the change in welfare for any household “i”

$$\frac{dU_i(\,)}{dP_{food}} = ?$$

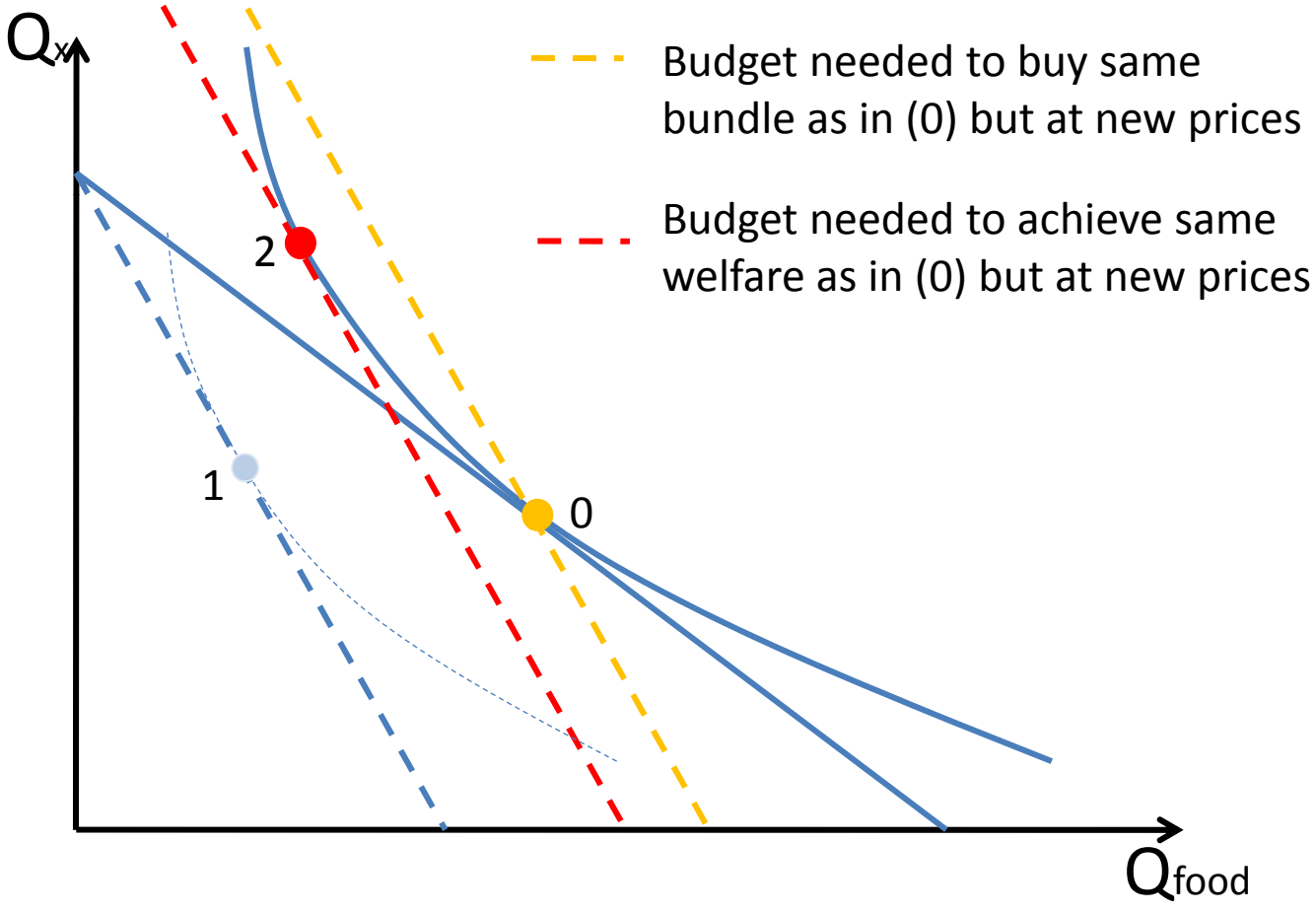


3. Welfare effects: Methodology

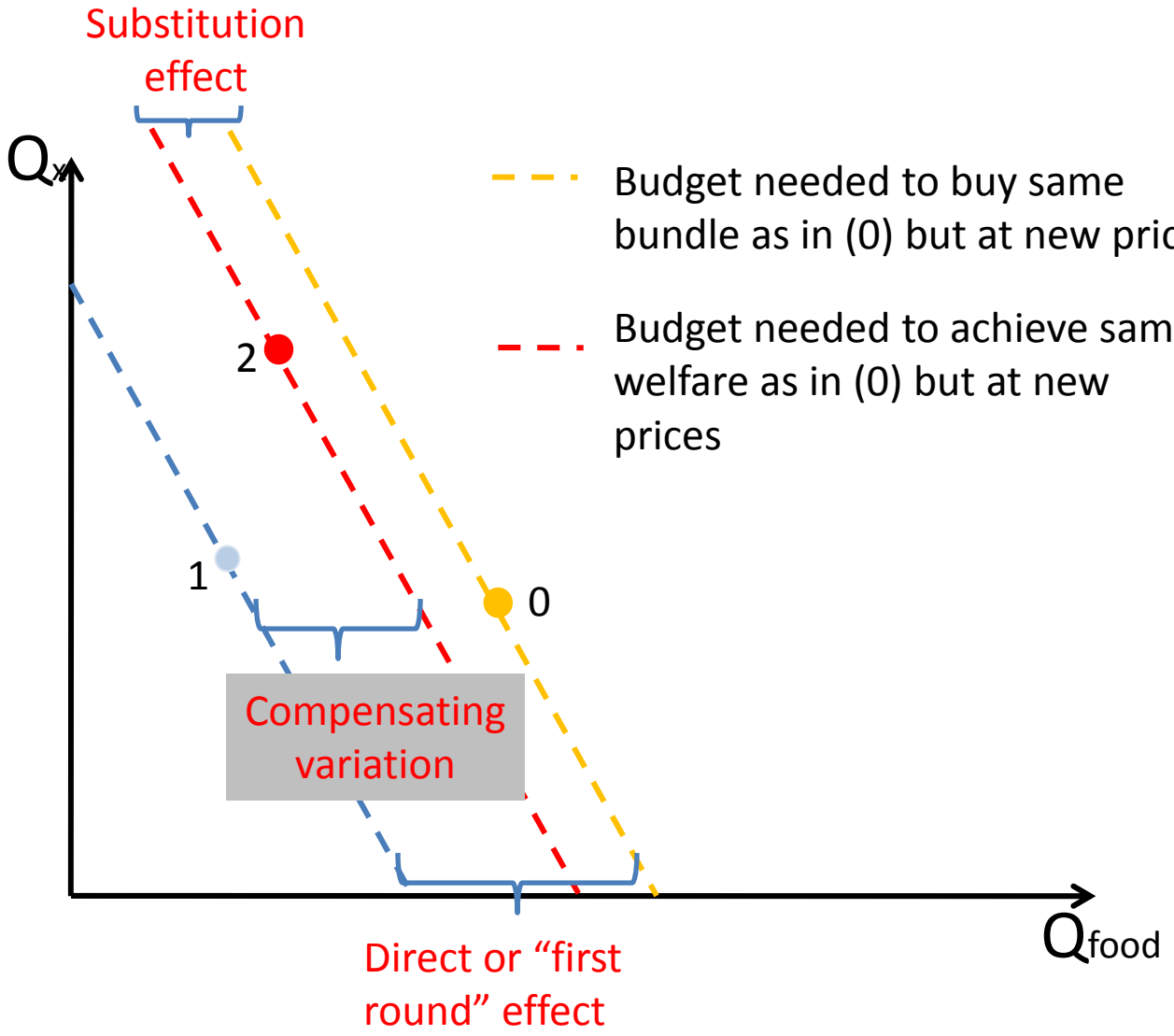
- Graphical representation of concept of compensating variation... It provides good intuition



3. Methodology: compensating variation



3. Methodology: compensating variation



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3. Methodology: compensating variation

- Graphical representation provides good intuition but it is an incomplete story !!!
  - We need to deal with several food and non-food commodities
  - We need to incorporate the possibility of food production

- A formal representation of the compensating variation is needed:

$$dB(p,w,U) = \left[\{s_h\} - \{s_y\}\right]' \left[\frac{dp}{p}\right] e + \frac{1}{2}\left[\frac{dp}{p}\right]' \{S_h\}\{E_{hp}\}\left[\frac{dp}{p}\right] e \qquad (1)$$

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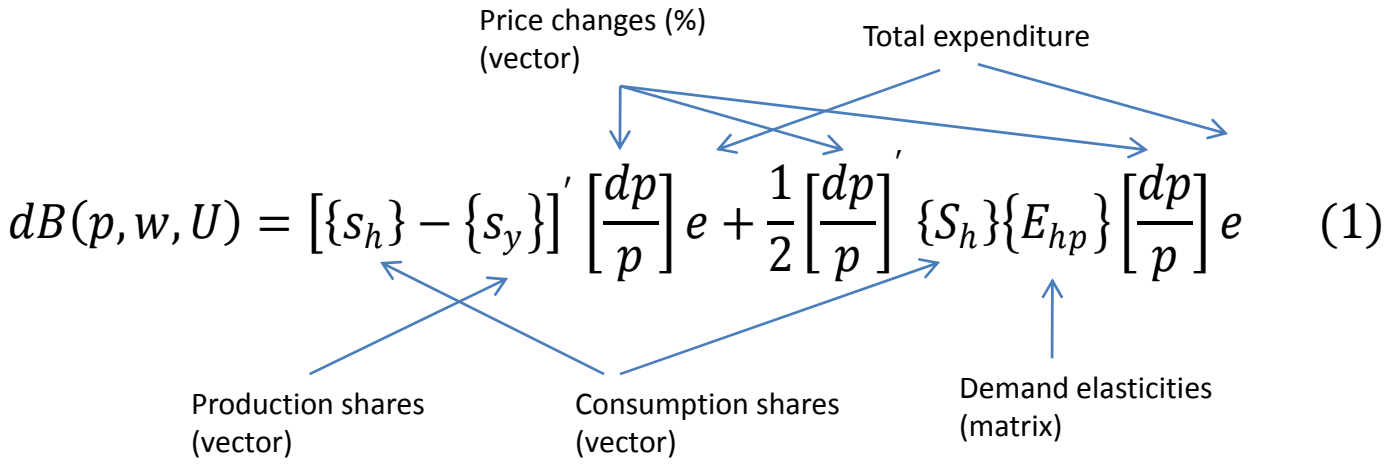
3. Methodology: compensating variation

- What do we need to estimate (1) ?
  - Define commodities or group of commodities
  - Compute expenditure shares and production shares
  - Compensated demand elasticities (own and cross price elasticities)
  - Price changes (full, partial transmission)
  - Total household expenditure



3. Methodology: compensating variation

- Direct effect and substitution effect
- Elasticities

Direct effect Substitution effect

$$dB(p,w,U) = \left[\{s_h\} - \{s_y\}\right]' \left[\frac{dp}{p}\right] e + \frac{1}{2}\left[\frac{dp}{p}\right]' \{S_h\}\{E_{hp}\}\left[\frac{dp}{p}\right] e \qquad (1)$$

Elasticities: We estimate econometrically a system of demand equations, the quadratic almost ideal demand system (QUAIDS):

$$\omega_i = \alpha_i + \sum_{j=1}^{m} \rho_{ij} x_j + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln\left[\frac{e}{a(p)}\right] + \frac{\lambda_i}{\mathrm{b}(p)}\left\{\ln\left[\frac{e}{a(p)}\right]\right\}^2 \qquad (2)$$

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3. Methodology: compensating variation

Elasticities: We estimate econometrically a system of demand equations, the quadratic almost ideal demand system (QUAIDS):

$$\omega_i = \alpha_i + \sum_{j=1}^{m} \rho_{ij} x_j + \sum_{j=1}^{n} \gamma_{ij} \ln p_j + \beta_i \ln \left[\frac{e}{a(p)}\right] + \frac{\lambda_i}{\mathrm{b}(p)} \left\{\ln \left[\frac{e}{a(p)}\right]\right\}^2 \qquad (2)$$

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3. Empirical strategy

- Definition of commodity groups

TABLE 1: Commodity groups

Bangladesh	Pakistan	Vietnam
1. Rice	1. Rice	1. Rice
2. Bread and Wheat	2. Bread and Wheat	2. Bread and Wheat
3. Legumes & Pulses	3. Legumes & Pulses	3. Legumes & Pulses
4. Roots & Tubes	4. Roots & Tubes	4. Roots & Tubes
5. Vitamin A-rich fruits & vegetables	5. Vitamin A-rich fruits & vegetables	5. Vitamin A-rich fruits & vegetables
6. Other fruits & vegetables	6. Other fruits & vegetables	6. Other fruits & vegetables
7. Meat, Fish & Dairy	7. Meat, Fish & Dairy	7. Meat, Fish & Dairy
8. Oils & Fats	8. Oils & Fats	8. Oils & Fats
9. Sugars	9. Sugars	9. Sugars
10. Others	10. Others	10. Alcohol
11. Non food	11. Non food	11. Others
		12. Non food

3. Empirical strategy

- Change in food prices: 3 simulations

TABLE 2: Change in food prices

Commodity group	dP1			dP2	dP3
	Ban	Pak	Vie	All	All
1. Rice	46.51%	49.75%	38.93%	10.00%	20.00%
2. Bread and Wheat	81.48%	32.01%	62.01%	10.00%	20.00%
3. Legumes & Pulses	3.00%	7.94%	4.72%	10.00%	20.00%
4. Roots & Tubes	3.00%	7.94%	4.72%	10.00%	20.00%
5. Vitamin A-rich fruits & vegetables	3.00%	7.94%	4.72%	10.00%	20.00%
6. Other fruits & vegetables	3.00%	7.94%	4.72%	10.00%	20.00%
7. Meat, Fish & Dairy	3.00%	7.94%	4.72%	10.00%	20.00%
8. Oils & Fats	3.00%	7.94%	4.72%	10.00%	20.00%
9. Sugars	3.00%	7.94%	4.72%	10.00%	20.00%
10. Alcohol	--	--	4.72%	10.00%	20.00%
10/11. Others	0.00%	0.00%	0.00%	0.00%	0.00%
11/12. Non food	0.00%	0.00%	0.00%	0.00%	0.00%

dP1: Real change in observed consumer prices between Q1 2006 and Q2 2008

dp2: flat 10% increase in all food groups other that other food

dp3: flat 20% increase in all food groups other that other food

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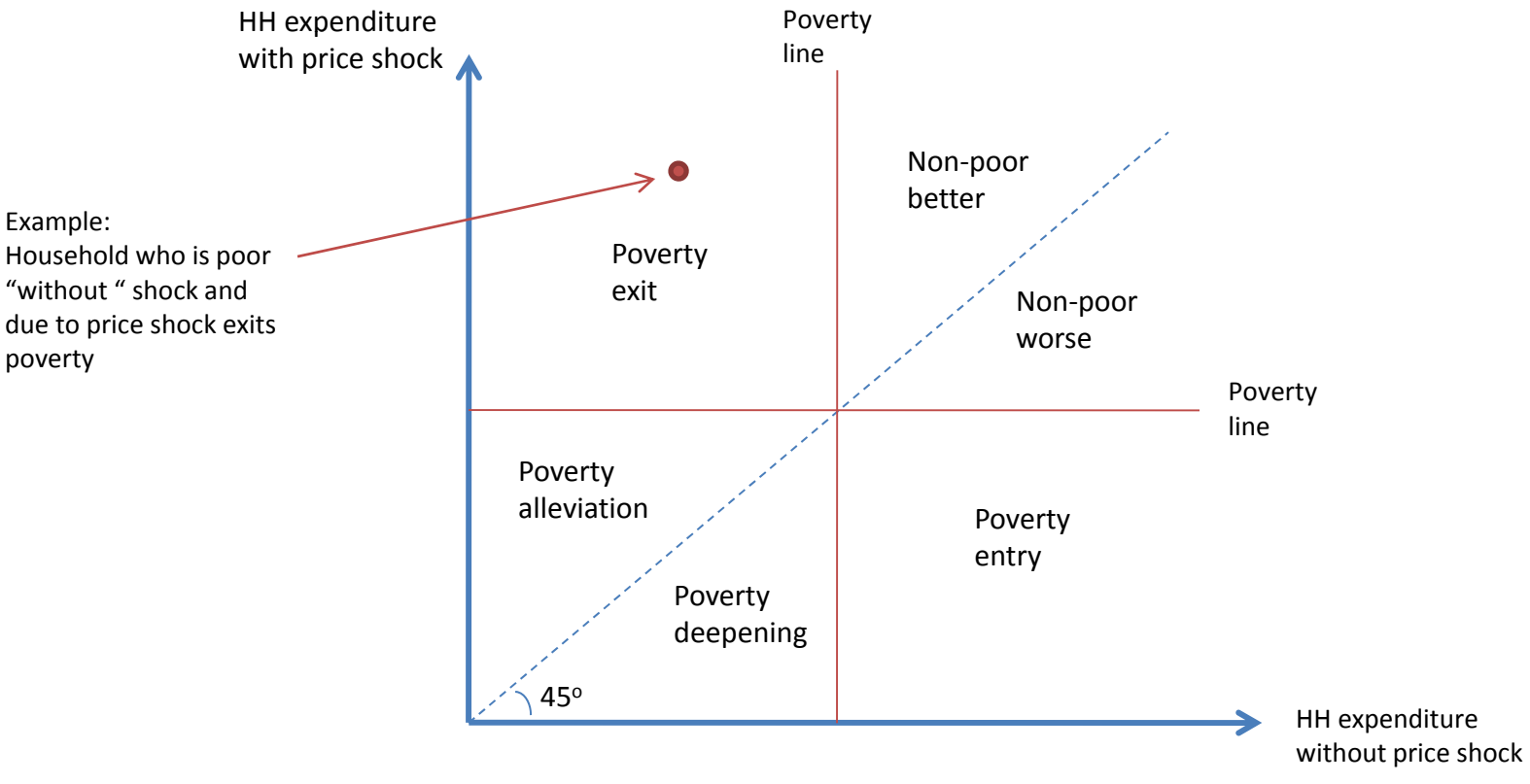
3. Empirical strategy

- Estimation of expenditure "without" and "with" food price shock (we subtract the compensating variation)…. Most people would call it "before" and "after" shock
- Analysis of "**poverty dynamics"**



3. Empirical strategy: scenarios

- Scenario A:
  - Observed change in food prices
  - Consumer prices and farm gate prices increase in the same proportion
  - Substitution effects

- Scenario 10%:
  - 10% change in food prices
  - Consumer prices and farm gate prices increase in the same proportion
  - Substitution effects

- Other scenarios considered in the study (not in this presentation)
  - No change in farm gate prices
  - Partial change in farm gate prices
  - No substitution effects
  - 20% change in food prices

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4. DATA

	Bangladesh	Pakistan	Vietnam
Survey	Household Income and Expenditure	Pakistan Social and Living Standards Measurement	Household Living Standards Survey
Year	2005	2005-06	2006
Sample size (HHs)	10,080	15,453	9,189
Rural (%)	63.5	59.6	74.9
Urban (%)	36.5	40.4	25.1

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5. Results

- Here we focus on
  - Scenario A: estimated real food price changes between Q1 2006 and Q1 2008
  - Scenario 10%: common 10% price shock to food prices in all three countries

- Analysis on:
  - Proportion of losers (and winners)
  - Size of losses
  - Aggregate loss
  - Poverty Dynamics

- Basic background information:
  - Bangladesh: 1,399 US$ GDP pc (PPP) Ranking = 154
  - Pakistan: 2,624 US$ GDP pc (PPP) Ranking = 133
  - Vietnam 2,794 US$ GDP pc (PPP) Ranking = 129

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5. Results: Scenario A

- Urban areas are the big losers
- But also more than 70% of rural households are worse off in Bangladesh and Pakistan
- Vietnam is different, 2/3 of rural households are better off and even more in the poorest quintile…

TABLE #: Proportion of losers by expenditure quintile
(Scenario A, %)

	Bangladesh			Pakistan			Vietnam		
Quintile	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
1	93.9	84.4	85.3	96.9	79.3	81.4	70.5	16.0	17.8
2	94.4	76.6	77.5	98.4	74.5	79.3	89.4	25.7	33.7
3	96.6	72.9	75.9	97.7	71.0	79.1	94.9	36.4	51.6
4	95.6	68.6	77.9	97.8	68.3	78.9	96.3	45.1	67.8
5	96.3	72.1	84.1	98.2	68.5	87.1	97.6	56.0	82.1
Total	95.4	74.9	80.1	97.8	72.3	81.1	89.7	35.8	50.6

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5. Results: Scenario A

- Regressive effect !!! When we look at loser households in all 3 countries the poor suffer more (relative to their expenditure level)…

TABLE XX: Mean compensating variation scenario A (% of household expenditure)

(Only losers included)

	Bangladesh			Pakistan			Vietnam		
Quintile	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
1	14.0	16.0	15.6	6.4	7.4	7.1	6.3	8.2	8.1
2	10.8	13.2	12.7	5.3	6.5	6.2	4.6	7.2	6.8
3	8.7	11.4	10.8	4.7	6.0	5.5	3.9	5.9	5.3
4	7.0	9.4	8.8	3.8	5.4	4.9	3.0	4.7	4.0
5	4.4	7.4	6.2	2.5	4.5	3.3	2.1	2.9	2.6
Total	8.9	11.7	10.8	4.5	6.0	5.4	3.8	5.1	4.5

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5. Results: Scenario A

- The aggregate losses are largest in Bangladesh, almost 7% of national consumption expenditure.
- In Bangladesh it would be expensive to fully compensate the bottom 40%: 2.54% of national consumption expenditure is required.
- In Vietnam only 0.31% is required.

TABLE #: Compensating variation (CV) as % of national consumption expenditure
(Scenario A, Only losses are included)

	Bangladesh			Pakistan			Vietnam		
Quintile	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
1	0.39	0.93	1.28	0.32	0.41	0.67	0.15	0.05	0.09
2	0.42	0.91	1.26	0.34	0.42	0.72	0.21	0.11	0.22
3	0.45	0.87	1.24	0.34	0.42	0.74	0.25	0.17	0.37
4	0.47	0.84	1.39	0.34	0.40	0.76	0.25	0.23	0.56
5	0.55	1.05	1.73	0.37	0.42	0.88	0.28	0.32	0.79
Total	2.29	4.61	6.90	1.70	2.07	3.77	1.14	0.89	2.03

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5. Results: Scenario A

- In Bangladesh and Pakistan poverty rates increase, especially in urban areas
- And in both countries around 80% of the rural poor are worse off
- In Vietnam there is an important positive effect on poverty (national poverty rate decreases 7.8% percent points)…

TABLE XX: Poverty dynamics scenario A (% of households)

	Bangladesh			Pakistan			Vietnam		
	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
Poverty Deepening	29.2%	36.5%	34.7%	13.1%	25.9%	21.5%	1.7%	4.9%	4.0%
Poverty Alleviation	1.3%	5.5%	4.4%	0.4%	4.4%	3.0%	1.0%	11.4%	8.6%
Poverty Exit	0.4%	3.3%	2.6%	0.2%	3.0%	2.0%	0.9%	12.0%	9.0%
Poverty Entry	7.6%	7.9%	7.8%	3.4%	4.3%	4.0%	0.7%	1.3%	1.1%
Non poor worse	58.5%	30.6%	37.7%	81.3%	42.1%	55.7%	87.3%	29.6%	45.5%
Non poor better	3.0%	16.3%	12.9%	1.7%	20.3%	13.8%	8.3%	40.8%	31.9%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Poverty change	7.2%	4.6%	5.3%	3.3%	1.3%	2.0%	-0.2%	-10.7%	-7.8%

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5. Results: Scenario C

- But the positive effect in Vietnam happens under the assumption of price transmission to producers
- If we eliminate price transmission to producers then poverty in Vietnam increases by 1.5 percent points
- Negative effects are magnified in all countries

TABLE XX: Poverty dynamics scenario C (% of households)

	Bangladesh			Pakistan			Vietnam		
	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
Poverty Deepening	30.1%	40.4%	37.8%	13.6%	33.3%	26.5%	3.6%	26.4%	20.1%
Poverty Alleviation	0.8%	4.8%	3.8%	0.0%	0.0%	0.0%	0.1%	1.9%	1.4%
Poverty Exit	0.0%	0.1%	0.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Poverty Entry	7.7%	8.1%	8.0%	3.5%	5.2%	4.6%	0.8%	1.8%	1.5%
Non poor worse	60.6%	41.3%	46.2%	82.9%	61.5%	68.9%	95.3%	67.6%	75.2%
Non poor better	0.9%	5.3%	4.2%	0.0%	0.0%	0.0%	0.3%	2.3%	1.8%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Poverty change	7.7%	8.0%	8.0%	3.5%	5.2%	4.6%	0.8%	1.8%	1.5%

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5. Results: Cross-country comparison (10% shock)

- In terms of proportion of winner and losers we get similar results:
  - Great majority if not all urban households are worse off in all 3 countries
  - Also true for rural Bangladesh and Pakistan (more than 80%) but different story in Vietnam
  - Vietnam: 60 % of rural households become winners

- We confirm regressive effect
- On average loser households suffer a reduction in real expenditure equal to:
  - Bangladesh = 4.8%
  - Pakistan = 3.8%
  - Vietnam = 3.1%

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5. Results: Cross-country comparison (10% shock)

- We also confirm that the size of aggregate losses are relatively large in Bangladesh (3.95%) and Pakistan (3.02%) and lower in Vietnam (1.69%)
- Vietnam is different because full compensation to the bottom 40% is much lower than in Bangladesh and Pakistan
  - Bangladesh = 1.09%, Pakistan = 1%, Vietnam = 0.18%

TABLE #: Compensating variation (CV) as % of national consumption expenditure

(Scenario 10%, Only losses are included)

	Bangladesh			Pakistan			Vietnam		
Quintile	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
1	0.17	0.36	0.50	0.22	0.28	0.46	0.10	0.02	0.05
2	0.22	0.42	0.59	0.25	0.31	0.54	0.16	0.07	0.13
3	0.27	0.46	0.68	0.27	0.33	0.59	0.22	0.11	0.27
4	0.32	0.52	0.86	0.28	0.35	0.64	0.24	0.18	0.46
5	0.45	0.77	1.31	0.34	0.39	0.80	0.31	0.28	0.78
Total	1.42	2.53	3.95	1.36	1.66	3.02	1.04	0.66	1.69

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5. Results: Cross-country comparison (10% shock)

- The largest increase in poverty rates takes place in Bangladesh (+3.8%). In Pakistan (+2.2%)
- In Vietnam poverty is reduced (-1.8%)
- In Vietnam only 20% of poor rural households are worse off (high poverty alleviation effect)

TABLE XX: Poverty dynamics scenario 10% (% of households)

	Bangladesh			Pakistan			Vietnam		
	Urban	Rural	National	Urban	Rural	National	Urban	Rural	National
Poverty Deepening	30.1%	41.2%	38.4%	13.4%	28.0%	22.9%	1.9%	5.8%	4.7%
Poverty Alleviation	0.7%	3.6%	2.9%	0.3%	4.3%	2.9%	1.3%	19.2%	14.3%
Poverty Exit	0.1%	0.5%	0.4%	0.0%	1.0%	0.7%	0.4%	3.3%	2.5%
Poverty Entry	3.8%	4.3%	4.2%	2.2%	3.2%	2.9%	0.4%	0.8%	0.7%
Non poor worse	64.4%	43.3%	48.7%	83.0%	50.8%	61.9%	88.1%	33.2%	48.3%
Non poor better	0.9%	7.2%	5.6%	1.2%	12.6%	8.7%	7.8%	37.8%	29.6%
	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%	100.0%
Poverty change	3.7%	3.8%	3.8%	2.2%	2.2%	2.2%	0.0%	-2.5%	-1.8%

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6. Final Comments

- Our findings show that the welfare impact of changing food prices is more or less similar in Bangladesh and Pakistan; however, in Vietnam impact effects are different. Using realized price (2006-2008) shocks we find:

- The fraction of households that are worse off due to increasing food prices is very similar in Bangladesh and Pakistan, around 80 percent. In Vietnam, this fraction is much smaller, 50.6 percent

- In urban areas the great majority of households suffer losses due to increasing food prices, as they do not engage in food production. Hence, most positively impacted households are located in rural areas. However, even in this region, in Bangladesh and Pakistan three-fourths of the rural households do not benefit from higher food prices. On the contrary, in Vietnam, 64.2 percent of rural households are better off.

- Among negatively impacted households there is a clear regressive effect pattern. This regressive pattern is more evident in urban areas

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6. Final Comments

- The largest average losses (again as fraction of household expenditure) are observed in Bangladesh (10.8 percent), followed by Pakistan (5.4 percent). In, Vietnam the average loss of negatively impacted households is 4.5 percent.

- The size of aggregate losses measured as a fraction of national aggregate consumption expenditure is also largest in Bangladesh (6.9 percent), followed by Pakistan (3.8 percent). In Vietnam, this number is smaller (2 percent).

- The total cost of fully compensating the losses of the poorest households (bottom quintile) is far from small in Bangladesh (1.3 percent of national aggregate expenditure) and about half in Pakistan (0.67 percent of national aggregate expenditure). In Vietnam, this cost is relatively low (0.31 percent of national aggregate expenditure).

- Poverty rates increase in Bangladesh and Pakistan (5.3 and 2 percent) but decrease in Vietnam (-7.8 percent). However, if we eliminate the price transmission channel to food producers, the poverty in Vietnam also increases (1.5 percent). This points to the importance of having reliable information at disaggregated levels on how food prices change and whether farmers really can benefit from higher food prices.

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6. Final Comments

When we use a common price shock across countries (10 and 20 percent increase in most food items), we observe the following results:

- Again we find similarities between Bangladesh and Pakistan but differences in Vietnam. Regardless of a 10 or 20 percent price shock, the proportion of negatively impacted households in Bangladesh is very close to 9 percent, while in Pakistan it is slightly more than 12 percent. In Vietnam, 46 percent of all households benefit from higher food prices. In rural areas, this proportion is as high as 60 percent.

- Total aggregate losses (measured as a fraction of total national aggregate consumption expenditure) are not that different in Bangladesh and Pakistan—3.95 percent in the former and 3.02 in the latter. In Vietnam, given the much larger proportion of positively impacted households, the total aggregate loss only reaches 1.7 of aggregate expenditure.

- While in Bangladesh and Vietnam a 10 percent price shock increases the national poverty rates, in Vietnam the poverty rate decreases. The largest effect on poverty rate happens in Bangladesh; here, poverty rate increases by 3.8 percent. In Pakistan, the increase is equal to 2.2 percent. In Vietnam, the effects on poverty are completely different. A 10 price shock reduces rural poverty by 2.5 percent, while urban poverty remains unchanged.

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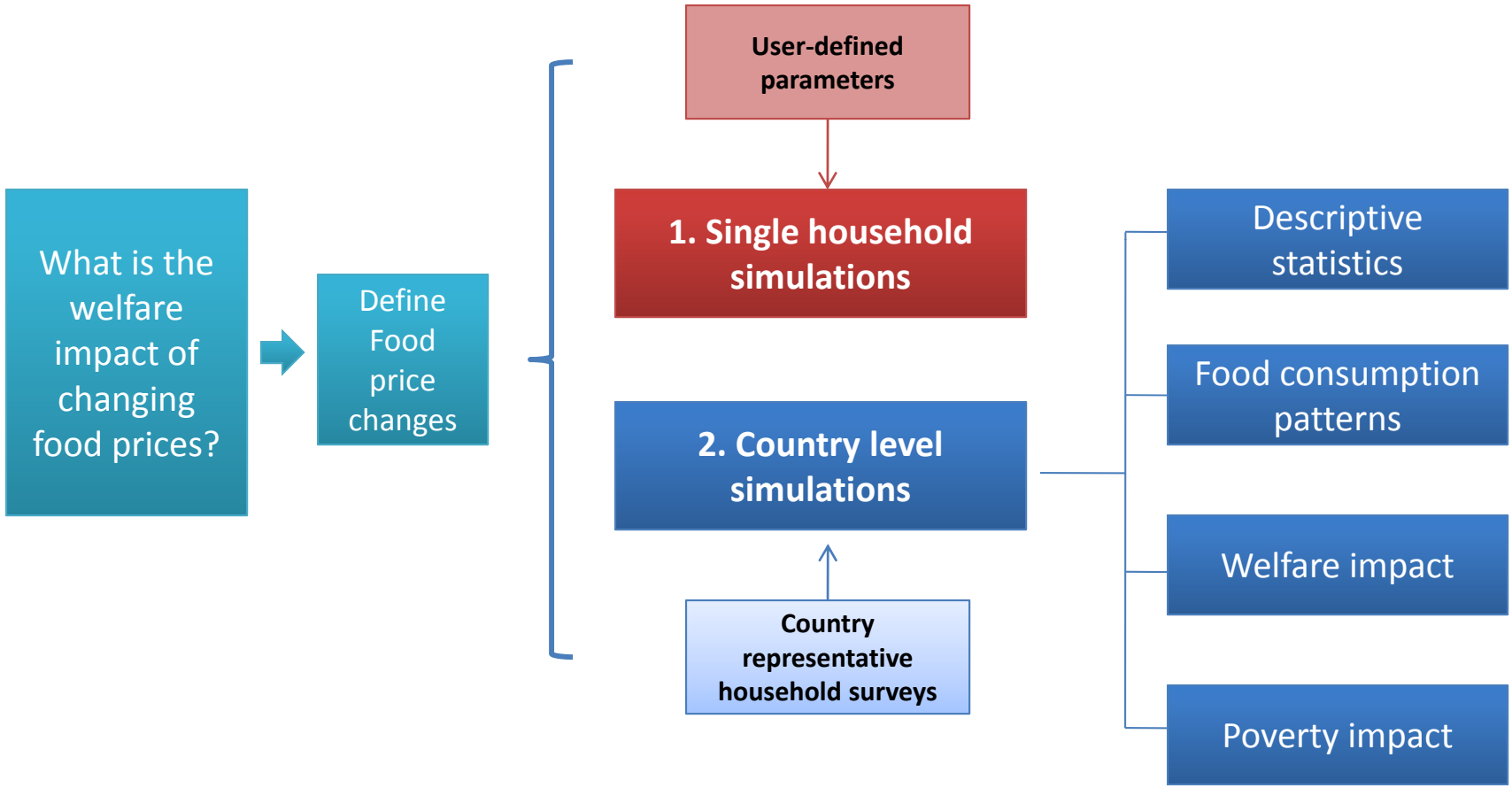
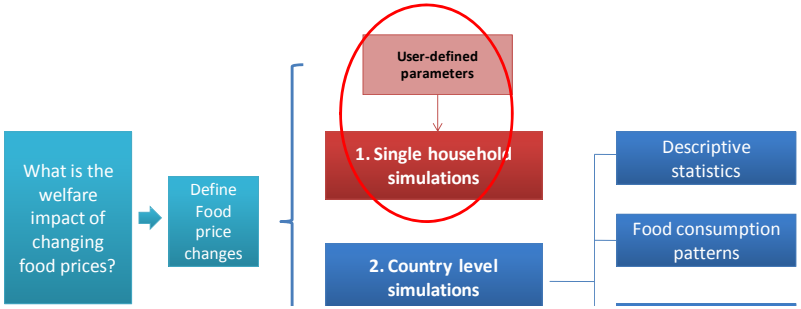
II. Online welfare impact simulator

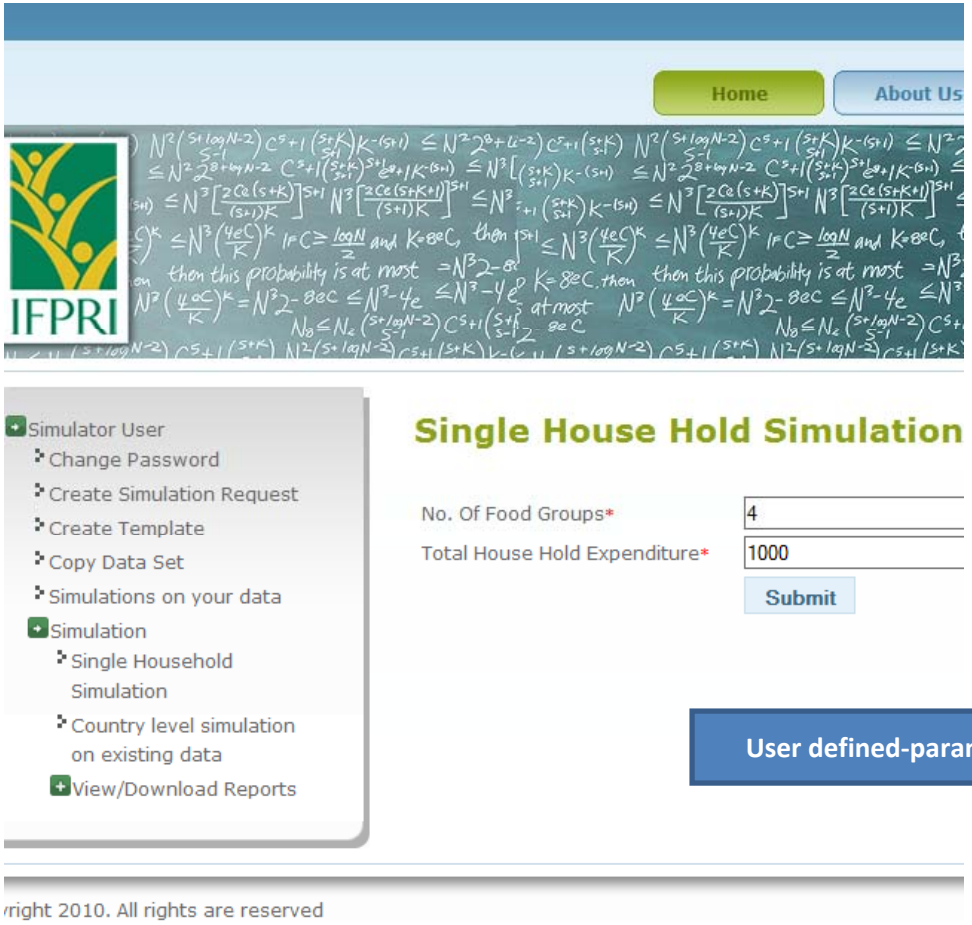
Welfare impact of changing food prices: online simulator

Welfare impact of changing food prices: online simulator

(developer testing site)







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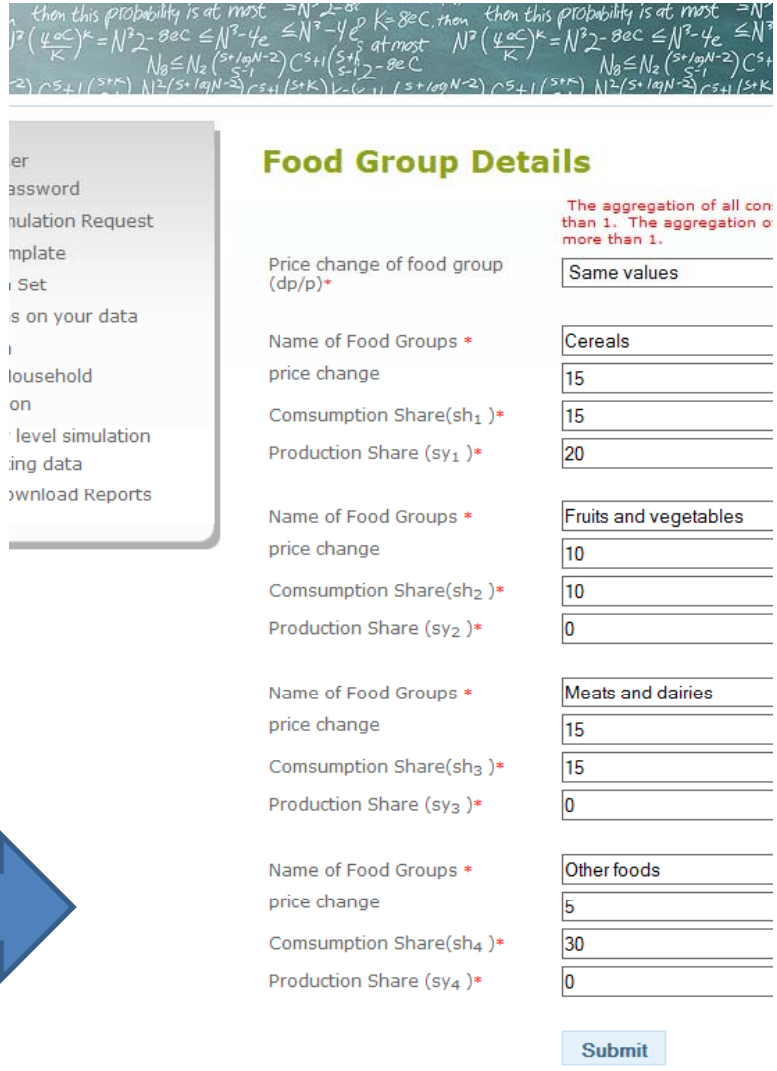
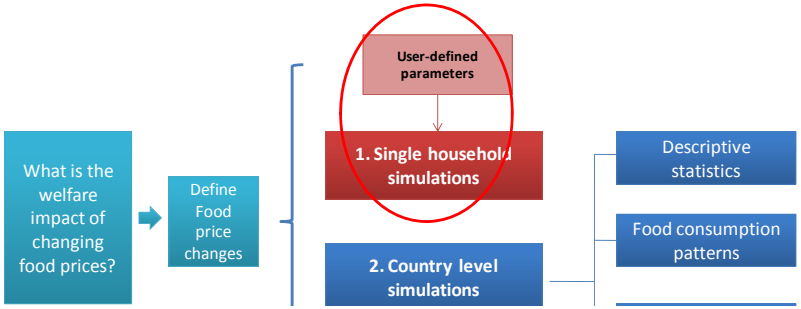
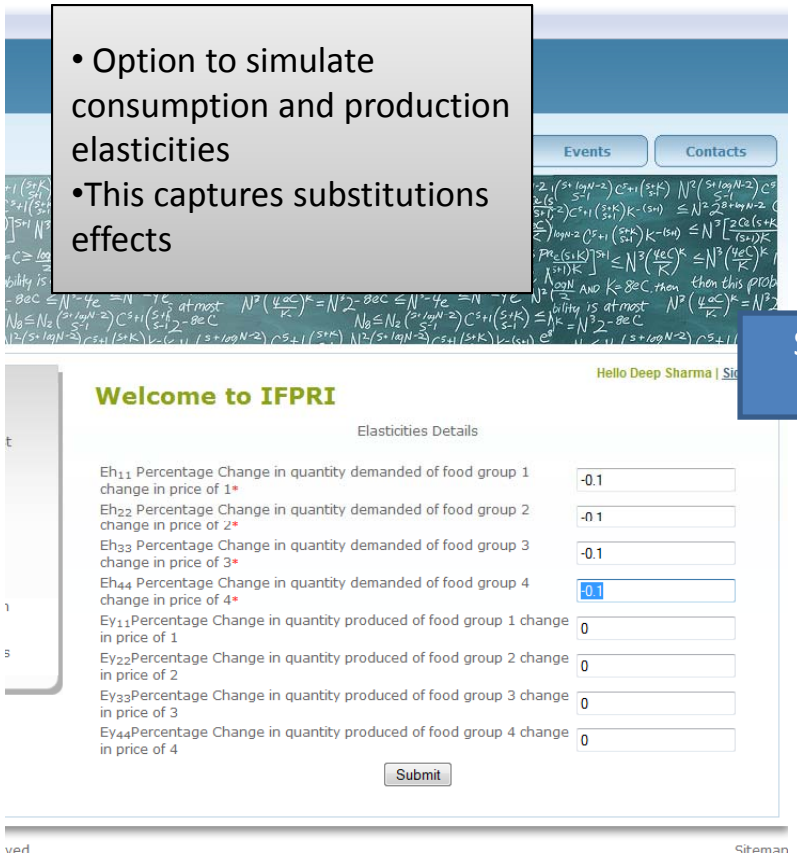
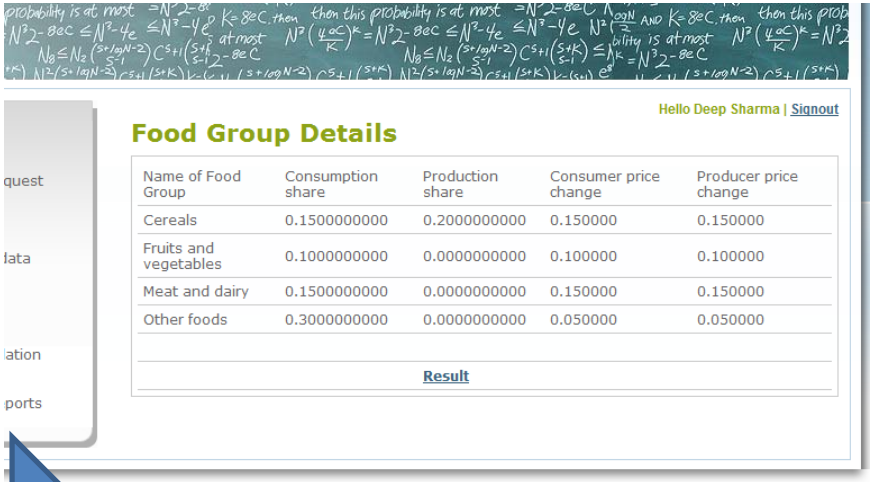


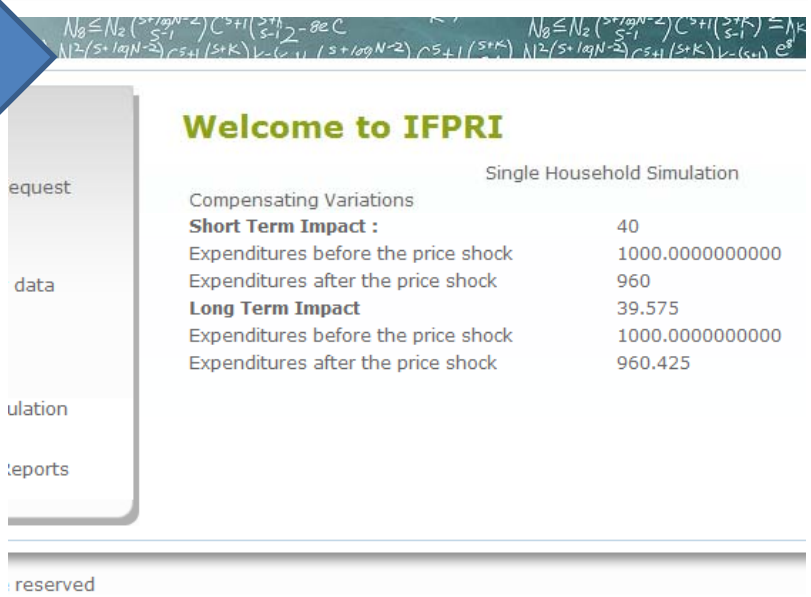


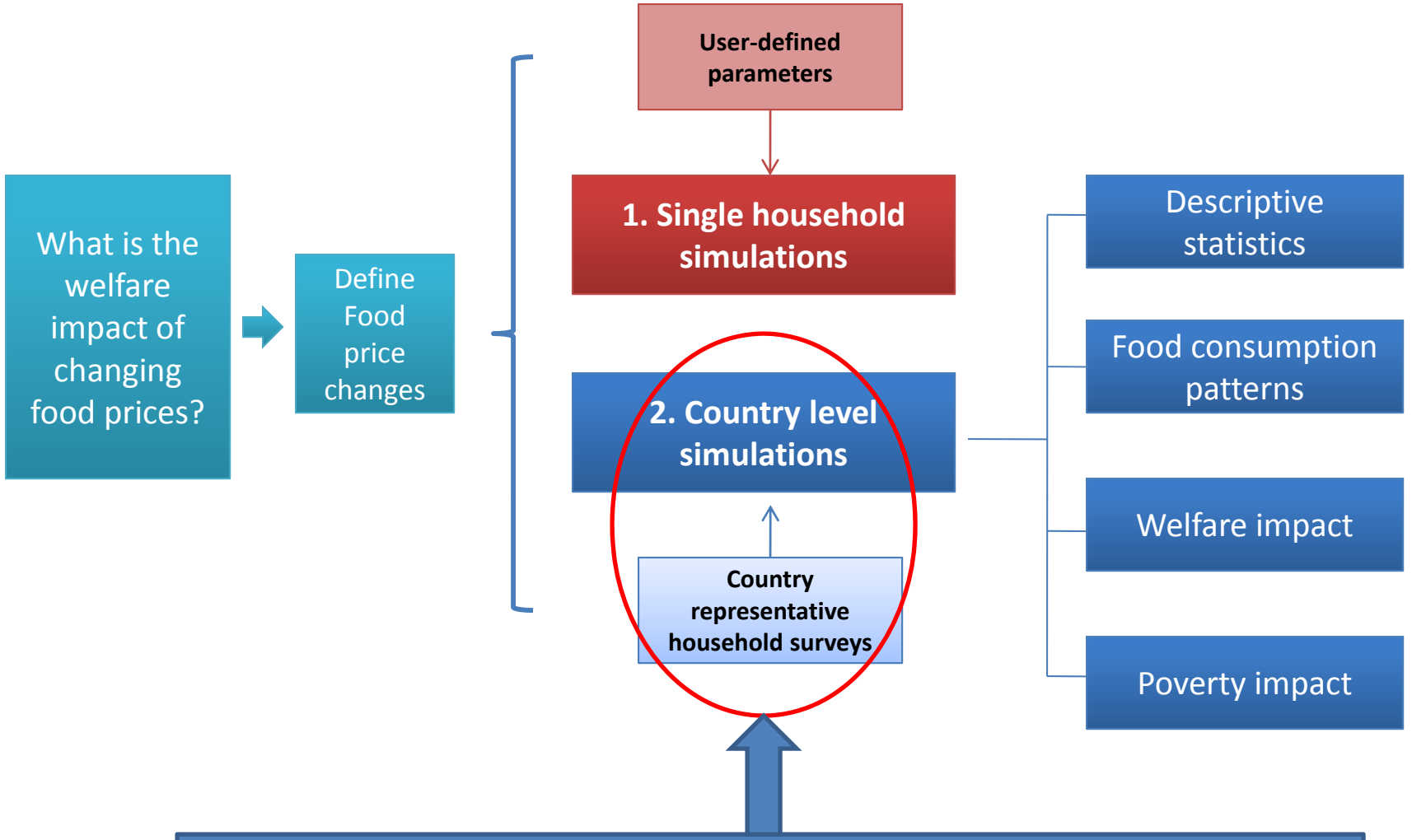
- Option to simulate consumption and production elasticities
- This captures substitutions effects



Simulation results





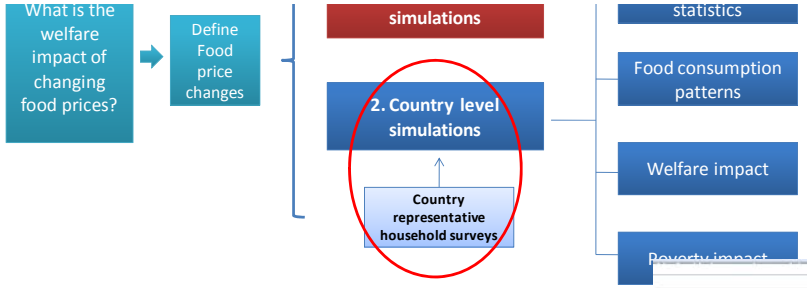


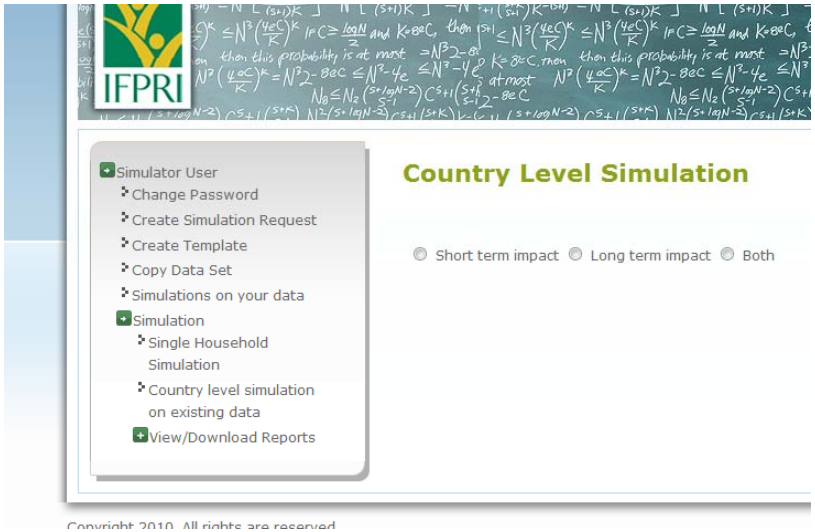
Current programming development stage: Guatemala
Initial set of countries for which data is available:

- Latin America: Mexico, Guatemala, Honduras, El Salvador, Nicaragua, Costa Rica, Panama, Dominican Republic, Jamaica, Ecuador, Peru
- Africa: Kenya, Ghana
- Asia: Bangladesh, Pakistan, Vietnam

Additional datasets can enter the system over time

IFPRI





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- Simulation
  - Single Household Simulation
  - Country level simulation on existing data
- View/Download Reports
  - Respective Price Change
  - Descriptive statistics of all the variables
  - Mean and median monthly expenditure before and after the shock
  - Proportion of losers and winners for each quintile
  - Mean compensating variation in local currency
  - Compensating variation as the percent of national consumption expenditure
  - Poverty dynamics after the shock

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the food groups considerate and the respective price changes for each group.

Group	Dph_1	Dpy_1
Rice	25 %	25 %
Corn	15 %	15 %
Bread and Wheat	12 %	12 %
Legumes & Pulses	18 %	18 %
Roots & Tubes	30 %	30 %
Fruits	20 %	20 %
Vegetables	10 %	10 %
Meat, Fish & Dairy	25 %	25 %
Oils & Fats	4 %	4 %
Sugars	1 %	1 %
Other Food	0 %	0 %
Non Food	0 %	0 %

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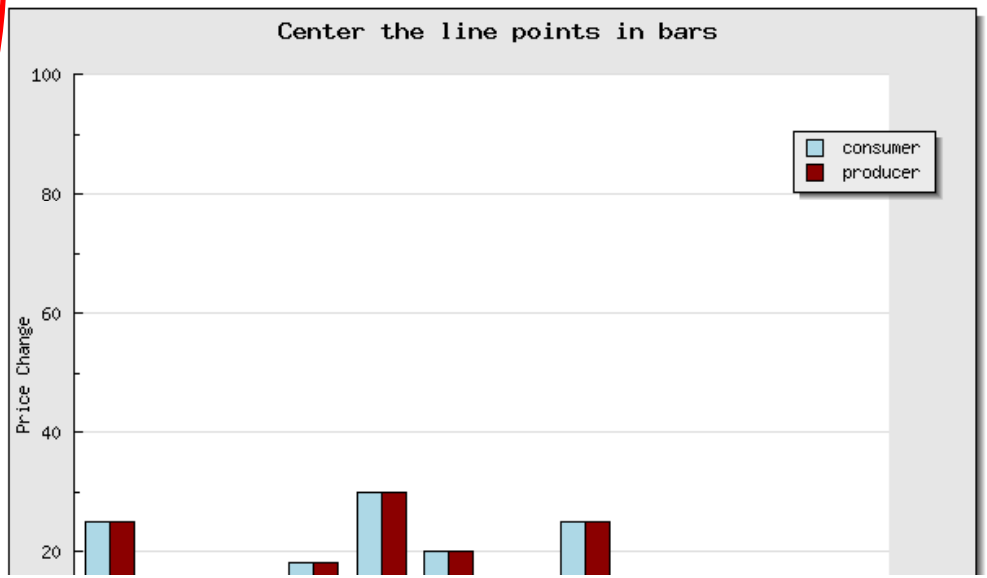

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The poverty dynamics after the shock.

	Urban	Rural	National
Poverty Deepening	33.68	68.12	49.8
Poverty Alleviation	0.43	3.36	1.8
Poverty Exit	0.02	0.11	0.06
Poverty Entry	3.49	2.99	3.25
Non poor worse	61.87	23.81	44.05
Non poor better	0.51	1.61	1.02
Poverty before (PB)	34.13	71.59	51.66
Poverty after (PA)	37.6	74.47	54.85
PA - PB	3.47	2.88	3.19

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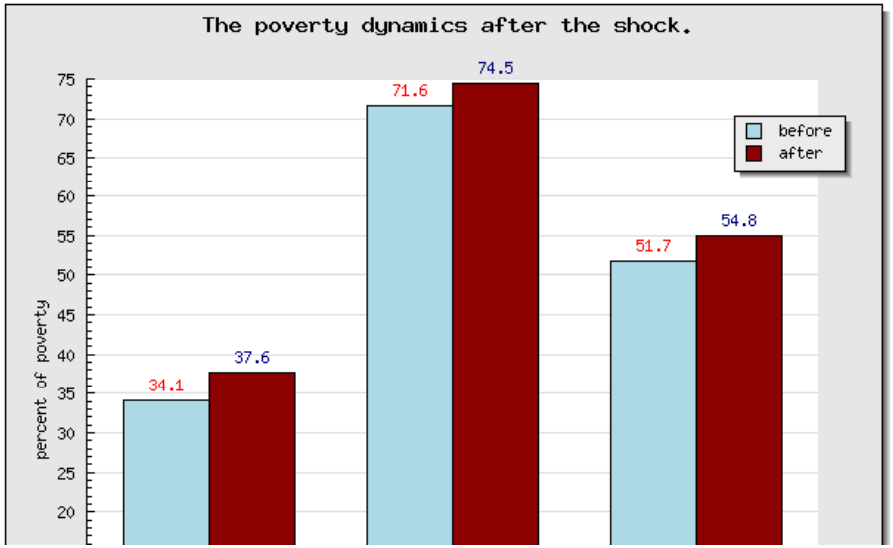

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THANK YOU !