The Australian Journal of
Agricultural and
Resource Economics

Journal of the Australian
Agricultural and Resource
Economics Society

Australian Journal of Agricultural and Resource Economics, 58, pp. 1–21

World food prices and poverty in Indonesia*

Peter Warr and Arief Anshory Yusuf†

Spikes in international food prices in 2007–2008 worsened poverty incidence in Indonesia, both rural and urban, but only by small amounts. The paper reaches this conclusion using a multisectoral and multihousehold general equilibrium model of the Indonesian economy. The negative effect on poor consumers, operating through their living costs, outweighed the positive effect on poor farmers, operating through their incomes. Indonesia's post-2004 rice import restrictions shielded its internal rice market from the temporary world price increases, muting the increase in poverty. But it did this only by imposing large and permanent increases in both domestic rice prices and poverty incidence. Poverty incidence increased more among rural than urban people, even though higher agricultural prices mean higher incomes for many of the rural poor. Gains to poor farmers were outweighed by the losses incurred by the large number of rural poor who are net buyers of food, and the fact that food represents a large share of their total budgets, even larger on average than for the urban poor. The main beneficiaries of higher food prices are not the rural poor, but the owners of agricultural land and capital, many of whom are urban based.

Key words: food prices, general equilibrium modelling, Indonesia, poverty incidence.

1. Introduction

Sharp increases in international food prices from 2007 to 2008 raised concerns of massive increases in global poverty, especially in the poorest countries. These concerns rested on two assumptions: higher food prices were permanent, or at least long lasting, and international food price increases worsen poverty. According to the evidence so far, the first assumption was premature, in that the massive price increases of 2008 subsequently receded, with some exceptions discussed below. The validity or otherwise of the second assumption is less clear-cut.

Increases in food prices affect poverty incidence in two opposing ways. First, poor consumers are harmed, in both urban and rural areas, particularly because of the high proportion of their budgets spent on food. Second, many poor farmers and some poor nonfarmers benefit, because higher agricultural prices raise the returns to the factors of production these households own; in developing countries, the majority of poor people reside in rural, not urban areas, and a high proportion of the rural poor are directly dependent on

* The helpful comments of two anonymous referees and an Associate Editor are gratefully acknowledged. The authors are responsible for all errors.

† Peter Warr (e-mail: Peter.Warr@anu.edu.au) is at Australian National University, Canberra, ACT, Australia. Arief Anshory Yusuf is at Universitas Padjadjaran, Bandung, Indonesia.

doi: 10.1111/1467-8489.12015

incomes derived in some way from agriculture. It is not obvious, *a priori*, which of these two conflicting effects dominates.

At the simplest level, higher food prices would seemingly increase poverty among households who are net purchasers of food but reduce it among net sellers. Ivanic and Martin (2008) study nine poor countries, not including Indonesia, arguing that net food purchasers outnumber net food sellers in most but not all cases. Warr (2008) argues that even in a major food exporting country (Thailand) higher food prices raise poverty incidence, on balance, because the negative effect on poor consumers outweighs the positive effect on poor producers. From this, it would seem likely that in net importing countries, higher international food prices would also worsen poverty. Other things being equal, in net food importing countries, the balance between net purchasers and net sellers favours the purchasers more heavily than in net food exporters.

Indonesia is a large net importer of food. Most of its major staples, including rice, maize, cassava, soybeans and sugar, are net imports, and Indonesia is now the world's largest importer of wheat. Its agricultural exports have tended to be nonstaples produced on estates, such as rubber, copra, coffee and tea, rather than staple foods produced by smallholders. But Indonesia's vulnerability to world food price increases is complicated by its policy on imports of its most important staple, rice. Until the early 2000s, Indonesia was the world's largest rice importer. With the country's transition to a more democratic form of government, the lobbying power of pro-farmer political groups led first to heavy tariffs on rice imports and then, in 2004, to a ban on rice imports. Despite the official prohibition, limited quantities of imports are occasionally permitted (Warr 2005, 2011). According to Fane and Warr (2008), by 2006, this policy had restricted imports to an average of about one-fourth of their previous volume and had increased domestic rice prices relative to world prices by about 37 per cent.

The import quota on rice meant that the 2007–2008 world price increase was not transmitted to the Indonesian rice market (Timmer 2008). Within Indonesia, this feature of the policy environment clearly affects the world price/poverty relationship. The central objective of this paper is to determine the effect that the world food price increases had on poverty in Indonesia. Section 2 reviews data on the world prices of six internationally traded agricultural commodities that are important for Indonesia. Section 3 argues the necessity of a general equilibrium treatment and summarizes the model of the Indonesian economy used for this purpose. Section 4 describes the simulations performed and presents their results. Section 5 concludes.

2. Recent increases in world food prices

Figure 1 and Table 1 summarize international prices for six commodities of significance for Indonesian food and agriculture: rice, maize, sugar, soybeans, cassava and wheat, showing their monthly prices, all measured in nominal US

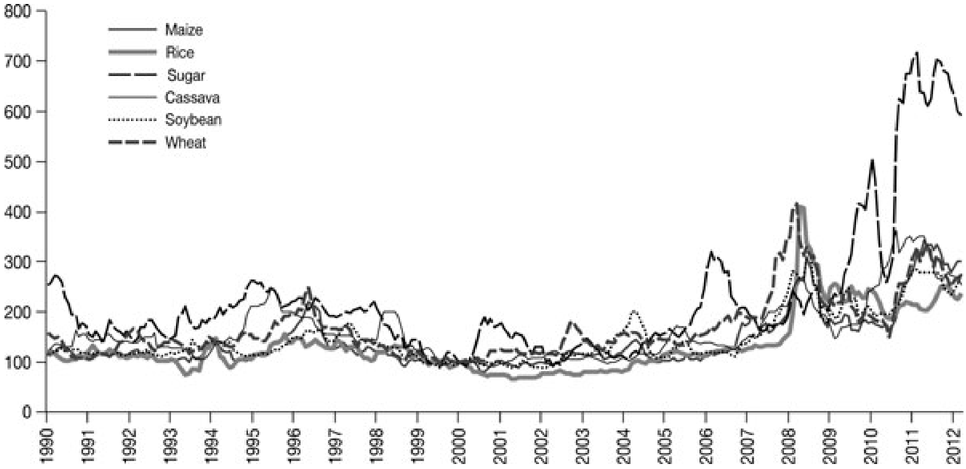

Figure 1 International prices of maize, rice, sugar, cassava, soybeans and wheat, monthly, January 1990 to March 2012. *Note:* All prices are in $US, indexed to Jan. 2000 = 100. *Data sources*: Cassava - Tapioca Starch Association (http://thaitapiocastarch.org/price.asp). All other commodities - International Financial Statistics (http://www.imfstatistics.org/imf/), except maize for May 2011 onwards, for which data are from http://ycharts.com/indicators/us_maize_price_gulf_ports.

Table 1 International price changes, Indonesia's agricultural imports and exports (January–June 2003 to January–June 2008 - per cent)

	Maize	Cassava	Soybeans	Rice	Sugar	Wheat
Nominal price	178	156	169	287	101	251
Real price, deflated using MUV Index	124	106	117	212	62	183

Source: Authors' calculations using data sources as follows:
Cassava - Tapioca Starch Association (http://thaitapiocastarch.org/price.asp).
All other commodities - International Financial Statistics (http://www.imfstatistics.org/imf/), except maize for May 2011 onwards, for which data are from http://ycharts.com/indicators/us_maize_price_gulf_ports.
Note: Because the price changes are large, the percentage change in the real price is not calculated as a linear approximation (the percentage change in the nominal price minus the percentage change in the deflator) but uses the more accurate formula $p^R = [(P_1^N/P_0^N)/(D_1^N/D_0^N) - 1] \times 100$, where p^R denotes the percentage change in the real price, P_1^N and P_0^N denote the nominal price of the commodity concerned at the final and initial dates, respectively, while D_1^N and D_0^N similarly denote the nominal value of the deflator (MUV index) at the final and initial dates, respectively.

dollars over the period 1990 to March 2012. In the figure, these nominal prices are all normalized to January 2000 = 100. The increase in these prices from mid-2007 to mid-2008 was dramatic, especially for rice and wheat, for which nominal prices more than tripled. Since 2008, for all commodities but sugar the price increases abated through 2009 and most of 2010. Except for rice, these prices surged again through 2011, though not matching their 2008 levels. Sugar is an exceptional case. In 2012, sugar prices remained at unprecedentedly high levels.

All six commodities are net imports for Indonesia. Rice is uniquely important. It is a central source of income for millions of Indonesian farmers

Table 2 Trade shares and elasticity assumptions, agricultural, processed food and resource-based industries, 2003

		Import Share (%)	Export share (%)	Armington elasticity of demand	Elasticity of substitution	Export demand elasticity
1	Paddy	0.00	0.00	5.05	0.24	10.10
2	Maize	4.85	0.02	1.30	0.24	2.60
3	Cassava	0.12	0.01	1.85	0.24	3.70
4	Beans	19.60	0.07	2.25	0.24	3.72
5	Other food crops	7.69	0.90	2.14	0.24	3.71
6	Estate crops	10.85	6.88	2.86	0.24	6.39
7	Livestock	5.56	1.65	1.65	0.24	3.81
8	Wood	2.14	1.17	2.50	0.20	5.00
9	Fishery	0.51	14.33	1.25	0.20	2.50
10	Coal mining	8.99	54.44	1.46	0.20	2.43
11	Oil and gas	26.12	67.99	10.50	0.20	12.33
12	Milled rice	1.14	0.00	12.00	1.12	24.00
13	Flour	2.01	0.25	2.00	1.12	4.00
14	Sugar	38.05	4.39	2.00	1.12	4.00
15	Other food	3.62	9.52	2.70	1.12	5.40
16	Fertilizer	1.44	6.45	2.25	1.12	5.74

Note: Import share means imports/domestic demand. Export share means exports/domestic production.
Source: Authors' calculations. Armington elasticities and export demand elasticities are derived from the GTAP database, as described in Hertel (1997).

and the staple food of most of the population. Maize and cassava are important staples in some regions, particularly Eastern Indonesia, where poverty is especially concentrated. Sugar is a net import but is an important cash crop in some regions. Wheat is an important input for many processed foods, but is not grown in significant quantities within Indonesia (Table 2).

We are especially interested in the price increases of 2007–2008. Table 1 summarizes, in the first row, nominal price changes for these six commodities, measured in US$, over the 5 years between the average of the first 6 months of 2003 and the corresponding average of the first 6 months of 2008. The second row shows the corresponding changes in these prices deflated by the Manufacturing Unit Value Index (MUV), an index of internationally traded manufactured goods prices, also measured in nominal US$. Based on these calculations, the real price of rice increased by 212 per cent, maize by 124 per cent, cassava by 106 per cent, wheat by 183 per cent, soybeans by 117 per cent and sugar by 62 per cent.

3. The INDONESIA-E3 Model of the Indonesian economy

3.1. The case for a general equilibrium treatment

The effects that international price shocks have on the welfare of individual households involves both impacts on household costs, operating through changes in consumer goods prices, and impacts on household incomes, operating through changes in factor returns. Higher international prices will be transmitted partially to domestic consumer and producer prices. When consumer prices of food rise, demand shifts to other commodities, potentially influencing their prices as well, depending on the detailed structure of commodity demands and supplies. The effect on the living costs of individual households then depends on these changes in consumer goods prices as well as the structure of household expenditures.

On the income side, factor returns will be affected.[1] Consider, for illustration, the consequences of an increase in rice prices. The rice industry can be expected to respond to a higher producer price with increased output, increasing demand for the factors of production that are important for the rice (paddy) industry. Returns to paddy land will increase. Moreover, since paddy is a large employer of unskilled labour and is labour-intensive, unskilled wages may rise, reducing returns to capital and fixed factors in all industries, and possibly affecting skilled wages. These changes in factor returns will then affect the structure of household incomes throughout the economy, depending on the pattern of factor ownership.

Clearly, analysis of the way large external price shocks affect the structure of household welfare, and thus poverty, is an inherently general equilibrium problem. In this study, we use a computable general equilibrium (CGE) model of the Indonesian economy, known as INDONESIA-E3 (Economy–Equity–Environment), designed with a strong emphasis on distributional analysis and capturing all of the economic relationships mentioned above.

The model belongs to the Johansen class of general equilibrium models, which are linear in percentage changes. Most structural features are as described in Warr and Yusuf (2011) – subsequently WY – to which the reader is referred. There are three exceptions. First, rather than the 43 industries described in WY, there are 41, listed in Table 2: agriculture 7 (rows 1–7), resources 4 (rows 8–11), agricultural processing 4 (rows 12–15), plus industry 13 and services 13. Second, the present model omits the regional disaggregation described in WY. Third, the present model contains a highly disaggregated household structure, designed to facilitate analysis of the way exogenous shocks affect poverty and inequality, but not included in WY.

3.2. Factor mobility

The labour force is segmented into 'skilled' and 'unskilled', based on workers' occupations. Skilled labour means clerical and managerial workers and unskilled means agricultural production workers and nonagricultural manual workers. Both categories of labour are assumed to be mobile across all sectors

[1] This effect is often ignored. For example, Friedman and Levinsohn (2002) use changes in consumer prices resulting from the 1997–1998 financial crisis to derive changes in Indonesian household welfare, measured as compensating variations. But the analysis ignores the income effects of these same price changes.

Table 3 Cost shares of major factors of production, 2003

	Unskilled labour	Skilled labour	Capital	Land	Total
Agriculture	62.2	2.0	17.6	18.2	100
Mining	10.5	4.5	85.0	0.0	100
Food Processing	35.1	9.7	55.2	0.0	100
Other manufacturing	24.0	9.1	66.8	0.0	100
Services	14.6	40.2	45.2	0.0	100
All industries	25.4	22.2	49.4	3.0	100

Source: Authors' calculations from Indonesia's official SAM and related data sources.

while capital and land are immobile across industries. These features imply an intermediate-run focus for the analysis, with an adjustment time of about 2 years. The focus is neither very short-run, or else labour would be less than fully mobile, nor long-run, or else capital and land would be more mobile. Table 3 summarizes the importance of the above factors of production within the cost structure of the major industry categories. Notably, 'skilled' labour represents a small share of total costs in agriculture.

3.3. Households and final demand

Two categories of households are identified, rural and urban, each divided into 100 subcategories of equal population size, with these subcategories arranged in order of expenditure per capita. Average sources of household incomes are summarized in Table 4. Urban and rural households differ considerably, particularly as regards skilled and unskilled labour. Ownership of rural land is surprisingly important among urban households. Net transfers are relatively minor. Within each of the urban and rural categories, there is considerable variation in factor ownership. Figures 2 and 3 summarize this information. The principal source of the factor ownership data is Indonesia's Social Accounting Matrix for 2003, supplemented by additional information outlined in Yusuf (2006).

Table 5 summarizes the characteristics of urban and rural households in relation to poverty incidence. Mean consumption expenditures per capita differ widely between urban and rural households. In the simulations

Table 4 Household income shares, 2003

	Factor income				Net transfers	Total income
	Unskilled labour	Skilled labour	Capital	Land		
Urban	25.45	37.34	29.89	3.70	3.63	100
Rural	44.24	15.11	32.74	4.05	3.85	100
Total	32.81	28.63	31.01	3.84	3.72	100

Source: Authors' calculations from Indonesia's official 203 Social Accounting Matrix and related data sources.

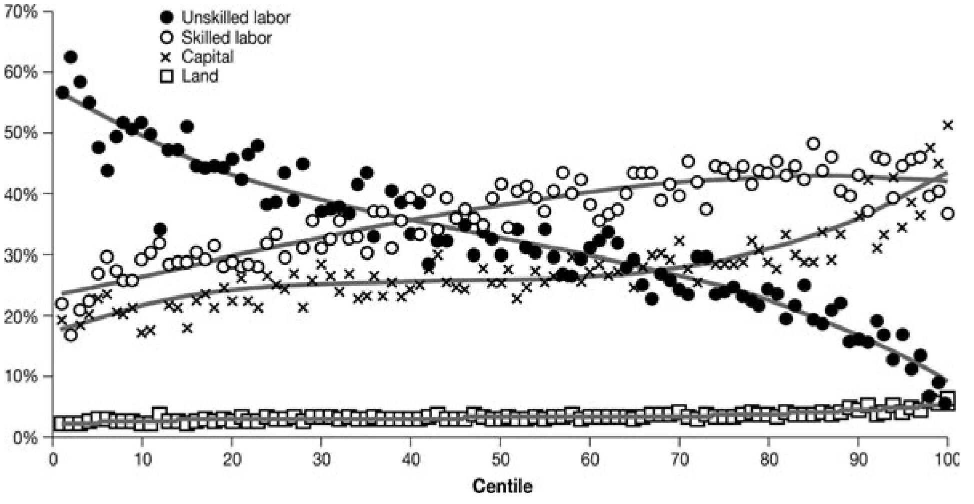

Figure 2 Factor shares in incomes of urban households. *Source*: Authors' calculations.

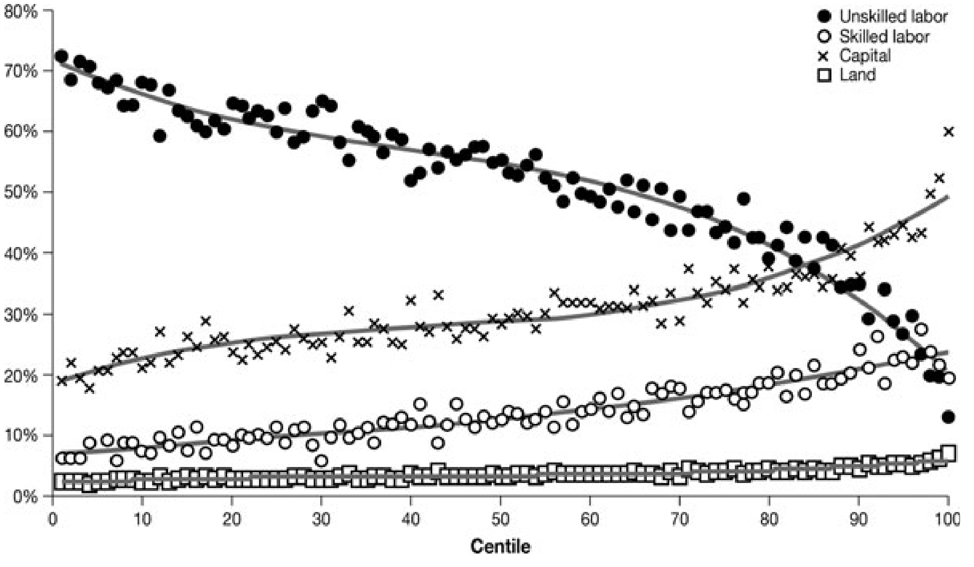

Figure 3 Factor shares in incomes of rural households. *Source*: Authors' calculations.

conducted below, poverty incidence is calculated for each of these two household categories, using poverty lines that replicate the official levels of poverty incidence reported from the Indonesian government's 2003 *Susenas* survey, as summarized in the final column of Table 5. Significant numbers of poor people are found in both categories: 13.6 per cent of the urban population and 20.2 per cent of the rural population. These numbers, together with the urban/rural population shares, imply that 64.2 per cent of all poor people within Indonesia reside in rural areas.

Table 5 Expenditure and poverty incidence by household group, 2003

	Per cent total population in this group	Per cent total households in this group	Mean per capita expenditure (Rp. /mo.)	Per cent population in this group in poverty
Urban	45.54	44.68	732,023	13.6
Rural	54.46	55.32	413,576	20.2
Total	100	100	558,597	17.19

Source: Authors' calculations from Indonesia's 2003 *Susenas* survey and related data sources.

International price changes produce both gainers and losers. We wish to discover the *net* effects on poverty incidence. Disaggregation of the total population into its rural and urban components suits this objective and is policy relevant. But the disaggregation might in principle have been done differently, such as division by socio-economic group or by occupational category – instead of, or in addition to, the rural/urban split employed here. A deeper disaggregation within each of the rural and urban household categories would be feasible, but a disaggregation not founded on the rural/urban distinction would face an empirical problem. The Indonesian statistical authorities have estimated group-specific poverty lines and base levels of poverty incidence for the rural and urban subpopulations, but not for any other population subcategories.

3.4. Analysing distributional impacts

Several different approaches have been adopted in analysing income distribution within a CGE context. The approach of this paper is the *integrated multihousehold method*, which disaggregates households into a discrete number of subcategories, arranged by expenditure or income per capita. These households are then fully integrated into the general equilibrium model. For example, Warr (2008) uses this approach in assessing the effects that the 2007–2008 food price crisis had on poverty incidence in Thailand. This approach has the strong methodological advantage of internal model consistency that is the essential feature of true general equilibrium analyses. It is possible to ensure that the microeconomic behaviour of individual household subcategories conforms to the properties required by economic theory and is fully integrated into the general equilibrium structure, an advantage not shared by more highly disaggregated 'tops-down' approaches. Distributional impacts of external shocks, including effects on poverty incidence or standard inequality indicators, can be estimated with any desired degree of accuracy by increasing the fineness of disaggregation of the household categories.

The calculation of poverty *ex ante* (before the shock) will now be described. We begin by dividing representative household survey data into rural and urban categories. Within each, households are then sorted according to expenditures per capita, arranged from poorest to richest, creating a smooth cumulative distribution of expenditures per capita. The rural and urban household data are then each divided into n^R rural subcategories, with equal population in each of the subcategories, and n^U urban subcategories, again with equal populations. For convenience, we will assume that $n^R = n^U = 100$, but the analytical method is flexible as to these numbers.

Now consider either the rural or urban set of 100 household subcategories. The following exercise is performed for each of them. Let y_c be expenditure per capita of a household of the c-th centile, where $c = 1, 2, \ldots, 100$. That is, y_1 is the poorest centile group, y_{100} the richest. By construction, $y_{i+1} \geq y_i$. The Foster–Greer–Thorbecke (FGT) class of poverty measures share the unique feature of additive separability. The FGT P_α measures of poverty are

$$P_\alpha(y_c, y_p) = \frac{1}{100}\left(\sum_c^I \left(\frac{y_p - y_c}{y_p}\right)^\alpha + \left(\frac{1}{2}\frac{\left(y_p - \max\{y_c \mid y_c \leq y_p\}\right)(P_0 - I)}{y_p}\right)^\alpha\right), \tag{1}$$

where y_P is the poverty line and $I = \max\{c \mid y_c \leq y_p\}$. As is well known, $\alpha = 0$, 1 and 2 correspond to the headcount measure of poverty incidence, the poverty gap and the poverty severity measures, respectively. In the important case of the headcount measure ($\alpha = 0$), this expression reduces to

$$P_0(y_c, y_p) = I + \frac{y_p - \max\{y_c \mid y_c \leq y_p\}}{\min\{y_c \mid y_c \geq y_p\} - \max\{y_c \mid y_c \geq y_p\}} \tag{2}$$

The first term of (2), I, is simply the highest centile for which expenditure per capita is less than or equal to the poverty line. The second term is a linear approximation to where poverty incidence lies between centiles I and $I + 1$.

The general equilibrium simulation of the impact of a particular shock generates estimated percentage changes in the distribution of real per capita expenditures. The meaning of 'real' is that the deflators used to obtain the distribution of real expenditures from the distribution of nominal expenditures are indices of consumer prices specific to the household centile categories concerned. They are calculated using the budget shares corresponding to each individual centile group. Let $\hat{y}_c$ denote the estimated percentage change in the real expenditure per capita of centile group c. The estimated *ex post* (after the shock) level of real expenditure per capita, as estimated by the general equilibrium model, is given by y_c^*, where

$$y_c^* = \left(1 + \frac{\hat{y}_c}{100}\right).y_c. \tag{3}$$

Different centile categories may be affected quite differently by the shock, as captured by the simulation results, and the ordering of centile groups according to their *ex post* real expenditures per capita may thereby have changed from their *ex ante* ordering. The distribution y_c^* is therefore not necessarily smooth; it may not be the case that $y_{i+1}^* \geq y_i^*$. If so, the method of equations (1) and (2) above could not be applied directly to the distribution y_c^*. The 100 household categories in the *ex post* distribution y_c^* are now *re-sorted* according to real expenditures per capita in the same way as described above, to obtain a new distribution y_c^{**} such that $y_{i+1}^{**} \geq y_i^{**}$. The distribution y_c^{**} differs from the distribution y_c^* only by this re-sorting. Because of the re-sorting, the particular households belonging to the *i*-th centile subcategory of the re-sorted *ex post* distribution y_c^{**} do not necessarily correspond to those contained in the *i*-th centile subcategory of the *ex ante* distribution y_c.

The re-sorted *ex post* distribution y_c^{**} is now used as the basis for recalculating poverty incidence in the same manner as in equations (1) and (2), substituting y_c^{**} for y_c to obtain $P_\alpha(y_c^{**}, y_P)$. That is, the same method is used to calculate the level of the poverty measure in the sorted *ex ante* and the re-sorted *ex post* distributions. The poverty line y_P is held constant in real terms and can be applied to both the *ex ante* and *ex post* distributions because both represent *real* household expenditures per capita. The estimated change in the poverty measure after a policy shock, as captured by a simulation of the model, is now

$$\Delta P_\alpha = P_\alpha(y_c^{**}, y_P) - P_\alpha(y_c, y_P). \tag{4}$$

4. Simulations and results

4.1. The shocks

Six initial sets of simulations were conducted, reflecting the real price changes depicted in the second row of Table 1. These are to be understood as simulations of the effects of changes in the international prices of these commodities facing Indonesia in the world market, relative to other six international prices. They are denoted Sim 1 to Sim 6 in the tables that follow. The other three sets of simulations shown in the tables (Sim 7 to Sim 9) are explained below.

4.2. Model closure

The macroeconomic features of the model closure and the reasons for them are as described in Warr and Yusuf (2011). Transfers received by households are exogenous, but all components of household factor incomes and all consumer prices are endogenous. An important feature of the model closure relates to the treatment of rice imports. As described in the Introduction, since 2004 Indonesia has officially banned rice imports above a minimal level.

The model closure reflects this fact by specifying the level of rice imports exogenously and allowing the domestic price of rice to be determined endogenously. The difference between the domestic wholesale price of rice and the *c.i.f.* import price thus constitutes a rent accruing to import licence holders, assumed to be the richest five per cent of urban households.

4.3 Results

Tables 6–10 summarize the results. The changes in the real prices of each of the six commodities are introduced as shocks to the model at the rates indicated in Table 1 and repeated at the top of each table of results. To illustrate the results and for brevity, it is convenient to discuss the maize price shock shown in the first column (Sim 1). The interpretation of the results of each of the other simulations follows a similar path. Table 6 summarizes the microeconomic (industry-level) effects of the shock. The increase in the international price of maize of 124 per cent raises its domestic producer price by only 9.2 per cent. The muted effect arises because the domestically produced and imported forms of maize are imperfect substitutes (Armington elasticity of substitution 1.3) and because the share of imported maize in total consumption is small (4.4 per cent). This small simulated price effect occurs in spite of the fixity of land used in maize, which limits domestic supply response.[2] The consumer price of maize increases by 15.4 per cent, reflecting its mixed composition of domestically produced and imported maize. Domestic production rises by 3.5 per cent, domestic consumption declines and imports of maize decline by 56 per cent.

Turning to macroeconomic results in Table 7, significant changes in GDP do not occur and should not be expected, because there is no technological progress occurring and factor supplies are fixed. ‘Real GDP’ means GDP calculated at base period prices. It takes no account of the deterioration of Indonesia’s terms of trade implied by an increase in import prices. The effect on real household consumption is a better indicator of the change in aggregate welfare. Real aggregate household consumption declines marginally, by 0.06 per cent. Real unskilled wages rise because as the maize industry increases its output the demand for unskilled labour rises, bidding up its wage. This increase in unskilled wages is transmitted through the entire economy, lowering the demand for skilled labour and capital, thus reducing their average real returns. But the fixity of land used in maize production means that its real return rises.

Table 8 now summarizes the effects on poverty and inequality. The three poverty measures (headcount, poverty gap and poverty gap squared) give

[2] Indonesian data for domestic maize prices, obtained from the Ministry of Agriculture, confirm that the increase during this period was moderate. Compared with the 124 per cent increase in the real international price of maize between early 2003 and early 2008 (Table 1), over the same period the domestic producer price of maize increased relative to the wholesale price index by only 8.1 per cent.

Table 6 Simulated microeconomic effects of commodity price shocks

Commodity Shock to world price (%)	Sim 1 Maize 124	Sim 2 Cassava 106	Sim 3 Soybeans 117	Sim 4 Rice 212	Sim 5 Sugar 62	Sim 6 Wheat 183	Sim 7 Sim 1–6 together	Sim 8 Rice tariff 212	Sim 9 Quota elimination
Outputs of agricultural industries									
Maize	3.475	−0.001	−0.210	−0.008	−0.115	−0.022	3.166	−0.071	0.326
Cassava	−0.058	0.101	−0.016	−0.010	−0.047	−0.006	−0.026	−0.039	0.169
Soybeans	−0.110	−0.001	11.319	0.001	−0.150	−0.022	11.094	−0.090	0.434
Rice	−0.043	0.000	−0.038	−0.005	−0.044	−0.004	−0.132	1.264	−6.848
Sugar	−0.078	−0.001	−0.009	0.031	26.960	−0.014	26.804	−0.128	0.650
Wheat	−0.195	−0.001	−0.306	−0.013	−0.070	2.182	1.591	0.043	−0.253
Producer price									
Maize	9.203	0.001	−0.357	−0.085	0.099	−0.016	8.798	0.169	−0.940
Cassava	−0.021	0.268	0.092	−0.091	0.243	0.022	0.530	0.245	−1.319
Soybeans	−0.137	0.001	43.567	−0.063	0.001	−0.017	42.897	0.126	−0.700
Rice	0.026	0.001	0.058	−0.081	0.320	0.023	0.348	2.838	−12.149
Sugar	0.023	0.001	−0.040	−0.066	4.848	0.135	3.350	0.143	−0.770
Wheat	−0.053	0.001	−0.136	−0.087	0.130	0.847	0.707	0.083	−0.504
Fertilizer	0.024	0.000	−0.046	−0.070	0.153	0.003	0.067	−0.504	0.0835
Consumer price									
Maize	15.403	0.001	−0.327	−0.078	0.091	−0.015	15.004	0.155	−0.861
Cassava	−0.021	0.331	0.091	−0.091	0.243	0.022	0.593	0.245	−1.317
Soybeans	−0.076	0.001	68.494	−0.035	0.001	−0.009	67.970	0.070	−0.389
Rice	0.026	0.001	0.058	−0.081	0.320	0.023	0.348	2.975	−12.790
Sugar	0.018	0.001	−0.032	−0.053	11.499	0.010	11.494	0.116	−0.625
Wheat	−0.050	0.001	−0.129	−0.082	0.123	4.560	4.418	0.073	−0.440
Fertilizer	0.021	0.000	−0.040	−0.061	0.134	0.003	0.297	−1.220	0.2133
Import Quantity									
Maize	−56.330	0.000	−0.545	−0.108	0.065	−0.033	−56.562	0.146	−0.871
Cassava	−0.091	−71.231	0.119	−0.173	0.392	0.034	−71.146	0.403	−2.193
Soybeans	−0.370	0.001	−49.918	−0.118	−0.150	−0.051	−50.464	0.143	−0.855
Rice	0.000	0.000	0.000	0.000	0.000	0.000	0.000	−97.888	743.749
Sugar	−0.057	0.001	−0.196	−0.122	−51.871	0.007	−52.032	0.193	−1.082
Wheat	−0.008	0.000	−0.151	−0.177	0.525	−85.069	−85.183	0.158	−1.003

Note: Underlining indicates own-commodity effects.
Source: Authors' calculations.

Table 7 Simulated macroeconomic effects of commodity price shocks

Commodity Shock to world price (%)	Sim 1 Maize 124	Sim 2 Cassava 106	Sim 3 Soybeans 117	Sim 4 Rice 212	Sim 5 Sugar 62	Sim 6 Wheat 183	Sim 7 Sim 1–6 together	Sim 8 Rice tariff 212	Sim 9 Quota elimination
Real GDP	−0.005	0.000	−0.008	−0.002	−0.011	−0.002	−0.028	−0.019	0.058
Real household consumption	−0.061	0.000	−0.084	−0.096	−0.086	−0.013	−0.339	−0.028	0.055
Export volume index	−0.021	0.000	−0.005	0.080	−0.085	−0.014	−0.048	−0.077	0.460
Import volume index	−0.187	−0.001	−0.224	−0.162	−0.330	−0.051	−0.954	−0.169	0.698
GDP price index	0.040	0.001	0.026	−0.159	0.109	0.010	0.022	0.146	−0.758
Consumer price index (CPI)	0.129	0.002	0.161	−0.114	0.238	0.023	0.431	0.202	−1.001
Change in real factor returns									
Wage: skilled	−0.326	−0.003	−0.551	−0.066	−0.423	−0.031	−1.385	−0.376	1.691
Wage: unskilled	0.017	0.001	−0.011	0.053	0.151	0.016	0.229	0.168	−0.875
Capital	−0.117	−0.001	−0.158	0.022	−0.193	−0.021	−0.463	−0.102	0.525
Land	1.009	0.011	1.872	0.021	0.344	−0.076	3.143	1.195	−4.540
Changes in components of nominal GDP (billions of Rupiah)									
Consumption	947.9	21.5	1,065.6	−2,928.3	2,122.3	142.6	1,271.8	2,425.7	−13,244.7
Investment	18.0	2.3	−106.9	−271.0	368.9	40.6	47.7	339.8	−1,918.6
Stock	−45.8	0.0	−229.4	34.3	−309.8	−12.3	−551.5	16.2	58.2
Government	−189.3	−0.8	−346.0	−247.4	−105.5	−1.4	−888.8	−111.6	313.6
Net export	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total GDP	730.8	23.0	383.3	−3,412.4	2,076.0	169.5	−120.7	2,671.9	−14,791.6

Source: Authors' calculations.

Table 8 Simulated effects on poverty and inequality

Commodity		Sim 1 Maize	Sim 2 Cassava	Sim 3 Soybeans	Sim 4 Rice	Sim 5 Sugar	Sim 6 Wheat	Sim 7 Sim 1–6 together	Sim 8 Rice tariff	Sim 9 Quota elimination
Shock to world price (%)		124	106	117	212	62	183		212	
	Ex ante level	Simulated Change (ex post level – ex ante level)								
Poverty incidence (headcount measure, %)										
Urban	13.600	0.016	0.000	0.044	0.008	0.049	0.005	0.118	0.032	−0.130
Rural	20.200	0.179	0.001	0.047	0.001	0.066	0.004	0.291	0.063	−0.249
Total	17.194	0.105	0.000	0.045	0.004	0.058	0.004	0.212	0.049	−0.195
Poverty gap index (%)										
Urban	2.445	0.007	0.000	0.014	0.002	0.013	0.001	0.037	0.013	−0.052
Rural	3.479	0.076	0.001	0.009	0.001	0.019	0.001	0.105	0.025	−0.092
Total	3.003	0.044	0.000	0.011	0.001	0.016	0.001	0.073	0.019	−0.074
Squared poverty gap index (%)										
Urban	0.685	0.003	0.000	0.005	0.001	0.004	0.000	0.012	0.005	−0.020
Rural	0.943	0.031	0.000	0.003	0.000	0.006	0.000	0.040	0.009	−0.034
Total	0.824	0.018	0.000	0.004	0.000	0.005	0.000	0.027	0.007	−0.028
Gini index of inequality (%)										
Urban	34.768	0.010	0.000	0.019	−0.079	0.013	0.000	−0.030	0.006	−0.091
Rural	27.762	0.082	0.001	0.006	−0.004	0.012	−0.002	0.112	0.040	−0.158
Total	35.047	−0.049	0.000	−0.007	0.052	−0.012	0.001	−0.030	−0.020	0.119

Source: Authors' calculations.

Note: The simulated change in the poverty measure or the Gini index means the *ex post* simulated level minus the *ex ante* level. A positive value therefore indicates an increase in the level and a negative value indicates a reduction.

qualitatively very similar results, and it is sufficient to focus on the headcount measure. The increase in the producer price of maize benefits maize producers and the increase in the consumer price harms maize consumers. But other people are affected as well, even those neither producing nor consuming maize, because real wages and returns to capital and land are affected throughout the economy. Urban and rural poverty incidence both increase. The negative effect on poor rural consumers of maize outweighs the positive effect of the increased returns to fixed factors owned by poor maize producers and the small increase in unskilled wages.

Rural inequality increases, but this is enough to reduce the economy-wide Gini coefficient of inequality by a small amount. This paradoxical outcome arises because the increase in rural inequality results mainly from an increase in the real incomes of households who are upper income within the rural population, but who, from a national perspective, are not upper income, but middle income. The increase in their incomes reduces total inequality.

Are these results highly sensitive to the particular parametric assumptions underlying the simulations? Table 9 analyses the degree to which the simulated changes in urban, rural and total poverty incidence are affected by varying systematically the underlying parametric assumptions about Armington elasticities, elasticities of substitution and export demand elasticities. For this purpose, we focus on Simulation 7 above (all six commodity prices increasing simultaneously). The results are displayed in Table 9 by varying the ratio of the parametric assumption used to the central parametric value. The central column headed *1.00* repeats the parametric assumptions used in Simulation 7 in Tables 6–8, and the results on poverty incidence are thus the same as those shown in Table 8. A ratio of *0.50* means that all values

Table 9 Sensitivity analysis: Effects on poverty incidence of the increased prices of maize, cassava, soybeans, rice, sugar and wheat combined

	Armington elasticity (ratio to central parametric value)						
	0.05	***0.25***	***0.50***	1.00	***1.50***	***1.75***	***2.00***
Urban	0.179	0.156	0.138	0.118	0.106	0.102	0.098
Rural	0.402	0.354	0.322	0.291	0.274	0.268	0.262
Total	0.300	0.264	0.238	0.212	0.198	0.192	0.187
	Elasticity of substitution in production (ratio to central parametric value)						
	0.05	***0.25***	***0.50***	1.00	***1.50***	***1.75***	***2.00***
Urban	0.225	0.191	0.153	0.118	0.102	0.098	0.094
Rural	1.035	0.654	0.456	0.291	0.221	0.199	0.183
Total	0.666	0.443	0.318	0.212	0.167	0.153	0.142
	Export demand elasticity (ratio to central parametric value)						
	0.05	***0.25***	***0.50***	1.00	***1.50***	***1.75***	***2.00***
Urban	0.096	0.117	0.118	0.118	0.118	0.118	0.118
Rural	0.251	0.283	0.288	0.291	0.291	0.291	0.291
Total	0.180	0.207	0.211	0.212	0.212	0.212	0.212

Note: The simulations above correspond to Simulation 7 in Tables 6–8, but where the parametric assumptions are varied as indicated.
Source: Authors' calculations.
Bold italics indicate the ratio of the assumed value of the parameter concerned to its value used in the simulations reported in Tables 6 to 8.

Table 10 Decomposition of simulated changes in expenditures of households on the poverty borderline

Commodity Shock to world price (%)	Sim 1 Maize 124	Sim 2 Cassava 106	Sim 3 Soybeans 117	Sim 4 Rice 212	Sim 5 Sugar 62	Sim 6 Wheat 183	Sim 7 Sim 1–6 together	Sim 8 Rice tariff 212	Sim 9 Quota elimination
Simulated effects (Rp billion)									
Urban poor (H14)									
Wage income: Unskilled	3.17	0.06	3.26	−1.32	8.47	0.86	14.37	8.06	−40.59
Wage income: Skilled	−2.60	−0.02	−5.14	−2.36	−2.45	−0.10	−12.62	−2.30	8.84
Capital	0.12	0.01	0.02	−0.93	0.45	0.02	−0.35	1.01	−4.87
Land	1.43	0.02	2.55	−0.12	0.73	−0.07	4.49	1.75	−6.88
Others (Transfers)	−0.04	0.00	−0.04	0.06	−0.10	−0.01	−0.13	−0.10	0.52
Total Income	2.07	0.06	0.65	−4.67	7.11	0.70	5.77	8.42	−42.97
Saving	−0.91	−0.01	−2.25	0.93	−0.93	0.04	−3.00	−0.71	3.16
Nominal consumption	2.98	0.07	2.90	−5.60	8.04	0.66	8.77	9.13	−46.13
Living cost	5.40	0.08	8.63	−4.85	12.68	1.19	22.71	12.70	−60.29
Real expenditure	−2.42	−0.01	−5.73	−0.75	−4.64	−0.53	−13.94	−3.57	14.16
Rural poor (H21)									
Wage income: Unskilled	3.80	0.07	3.91	−1.59	10.16	1.03	17.25	9.67	−48.71
Wage income: Skilled	−0.67	0.00	−1.33	−0.61	−0.63	−0.03	−3.27	−0.60	2.29
Capital	0.11	0.01	0.02	−0.88	0.43	0.02	−0.33	0.96	−4.60
Land	1.35	0.01	2.41	−0.11	0.69	−0.06	4.24	1.66	−6.50
Others (Transfers)	0.11	0.00	0.14	−0.10	0.18	0.02	0.34	0.14	−0.69
Total Income	4.69	0.09	5.14	−3.28	10.83	0.98	18.23	11.82	−58.21
Saving	−0.73	−0.01	−1.86	0.93	−0.73	0.05	−2.24	−0.55	2.45
Nominal consumption	5.42	0.09	7.00	−4.22	11.56	0.93	20.47	12.38	−60.67
Living cost	18.71	0.14	9.62	−4.14	15.99	1.18	41.21	16.44	−76.15
Real expenditure	−13.29	−0.05	−2.62	−0.07	−4.43	−0.25	−20.74	−4.06	15.48

Source: Authors' calculations.

of the parameter concerned are set at half of the values assumed in the previous simulations, and so forth. The qualitative pattern of the results is quite robust to plausible changes in the underlying parameters.

The poverty analysis described above rests on the Indonesian government's official poverty lines for rural and urban areas. Would the results have been qualitatively different with different poverty lines? This question can be addressed by constructing incidence curves for urban and rural households that show how the real expenditure of each household in the distribution is affected by the shock concerned. The effects on poverty can then be ascertained for *any* poverty line.

The results are summarized in Figures 4 (urban) and 5 (rural). In each panel, households are arranged horizontally by their *ex ante* centile subcategory. The poorest subcategory (centile 1) is on the far left, the richest (centile 100) on the far right. The vertical height of the bars shown is the percentage change in that centile group's real expenditure. The four panels refer to the effects of the international price increases of maize, soybeans, rice and sugar described above. The results for cassava and wheat are omitted because the effects are so small. In the case of rice (third subfigure), the reason that the richest urban households lose is the reduction of their rents derived from the ownership of rice import quotas. The only groups affected positively by any of the shocks are at centiles 96 and above. Poverty incidence could not decline under any of the four shocks, for any plausible poverty line.

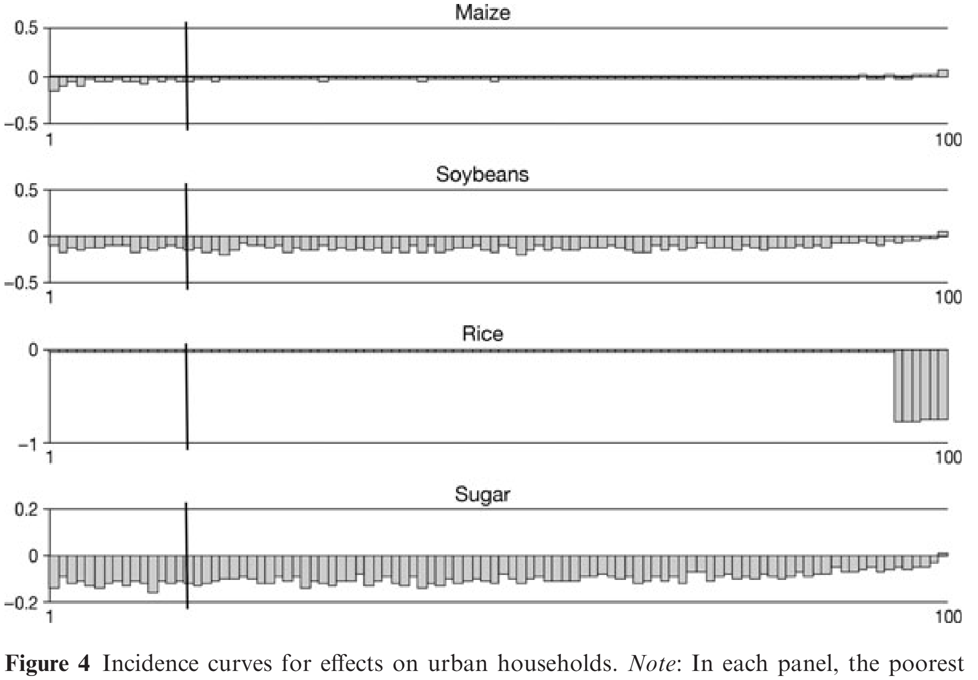

Figure 4 Incidence curves for effects on urban households. *Note*: In each panel, the poorest centile group (centile 1) is on the far left and the richest (centile 100) is on the far right. The vertical bar in each diagram indicates the centile group in which the official urban poverty line occurs (centile 14). *Source*: Authors' calculations.

Table 10 now makes it possible to analyse more deeply the reasons for the changes in poverty. Consider a rural household on the threshold of the poverty line (bottom half of the table). Because the base level of poverty incidence in rural areas is 20.2 per cent, the poverty line roughly coincides with the expenditure level of the rural household in the 21st centile. If this borderline household becomes better off, we would expect poverty incidence to decline, and vice versa, barring the existence of anomalous income or expenditure shares in the immediate neighbourhood of the poverty line. In the case of Simulation 1 (maize), the real expenditure of this household category declines by 13.29 billion rupiah (bottom row of the table) consistent with rural poverty incidence increasing. We can now examine in detail why its real expenditure declines.

It can be shown that the change in household-level real expenditure is equal to the change in nominal consumption minus the change in the cost of living (Warr 2008). The change in nominal consumption is itself equal to the change in total income minus the change in saving. By examining each of these components of the change in real expenditure, it is clear that the overwhelming source of the decline in real expenditures of this household is the increase in its cost of living, rather than any component of the change in its income. Poverty increases because the negative effect of the increase in the consumer price of maize exceeds the net beneficial effects on incomes.

This same sequence can be followed for the borderline-poor urban household (top half of the table) and for each of the other five commodities shown in the table. Now, comparing the results across commodities, the sizes of the changes in real expenditures shown at the bottom of Table 10 can be compared with one another. Simulation 7 is the result of applying all six of the commodity price shocks together. For the borderline-poor rural household, at least, the maize component is by far the largest. But this is strange. Rice is a far more important commodity for Indonesia than maize, and the increase in the international price of rice (212 per cent) is larger than the increase for maize (124 per cent). Why is the effect of the rice price increase so small?

Returning to Table 6, Simulation 4 shows that the increase in the rice price produces almost no increase in the producer price of rice, or the output of rice, or its consumer price, and no reduction at all in imports of rice. The reason is the quantitative restriction on rice imports. The increase in the international price merely reduces the rent associated with the limited amount of imports that are permitted. This may be a problem for the rich urban households who own the import licences, but it does almost nothing to the domestic market for rice, or to the poor.[3]

[3] The volume of imports did not change significantly during the period of the international price increases. From 1995 to 2003 (prior to the import ban), average annual rice imports were 2.11 million tonnes, 5.8 per cent of total supplies. From 2004 to 2009 (after the ban), average imports were 0.51 million tonnes, 1.4 per cent of total supplies. In 2007 and 2008, imports were 0.87 million metric tonnes, 2.3 per cent of total supplies.

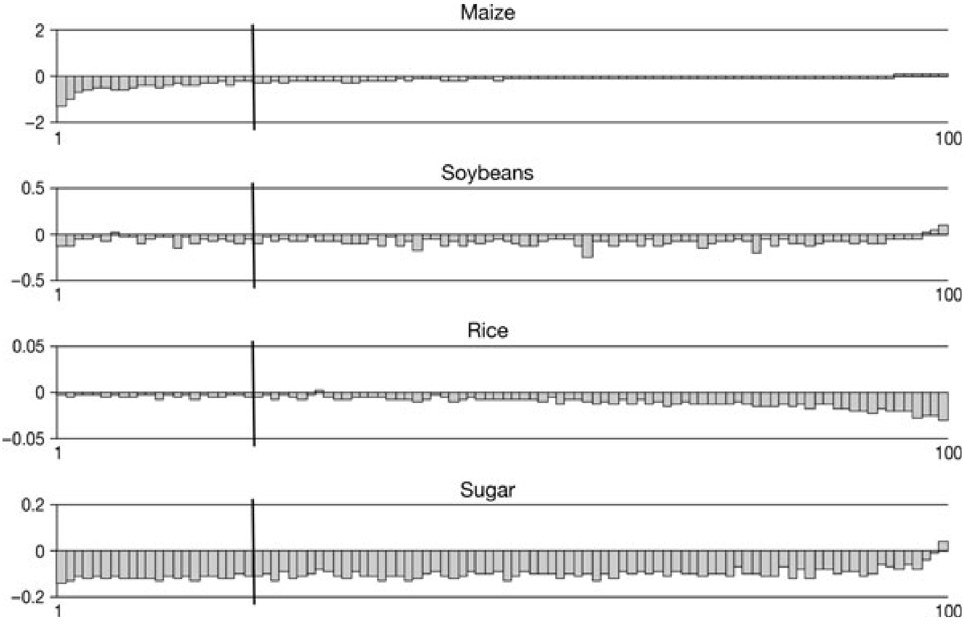

Figure 5 Incidence curves for effects on rural households. *Note*: In each panel, the poorest centile group (centile 1) is on the far left and the richest (centile 100) is on the far right. The vertical bar in each panel indicates the centile group in which the official rural poverty line occurs (centile 21). *Source*: Authors' calculations.

What if the instrument of rice industry protection had been a tariff instead of a quota? This possibility is analysed in Simulation 8, labelled 'Rice tariff'. The simulation is identical to Simulation 4, except that the instrument of protection is a fixed *ad valorem* tariff which initially restricts imports by the same amount as the quota. The same (212 per cent) international price increase is then imposed in this simulation. The huge price increase reduces rice imports by a further 98 per cent relative to the tariff-reduced level, significantly raising producer and consumer prices at the same time. Poverty incidence rises in both rural and urban areas (Table 8), overwhelmingly because of the increase in the cost of living of poor households (Table 10).

The fact that the actual instrument of protection was an import quota rather than a fixed *ad valorem* tariff shielded Indonesia's poor from transmission of the rise in the international price of rice. Does this mean that the quota benefited the poor? Consider the effect on poverty if it was eliminated, but international prices had not increased. This possibility is analysed in Simulation 9, labelled 'Quota elimination'. Poverty incidence declines in both rural and urban areas, again overwhelmingly because of the reduction in the living cost of the poor (Table 10). The reduction in poverty incidence (0.19 per cent of the total population, or roughly 450 thousand persons out of Indonesia's 2008 population of 228 million) is several times larger than the increase in poverty incidence resulting from the international

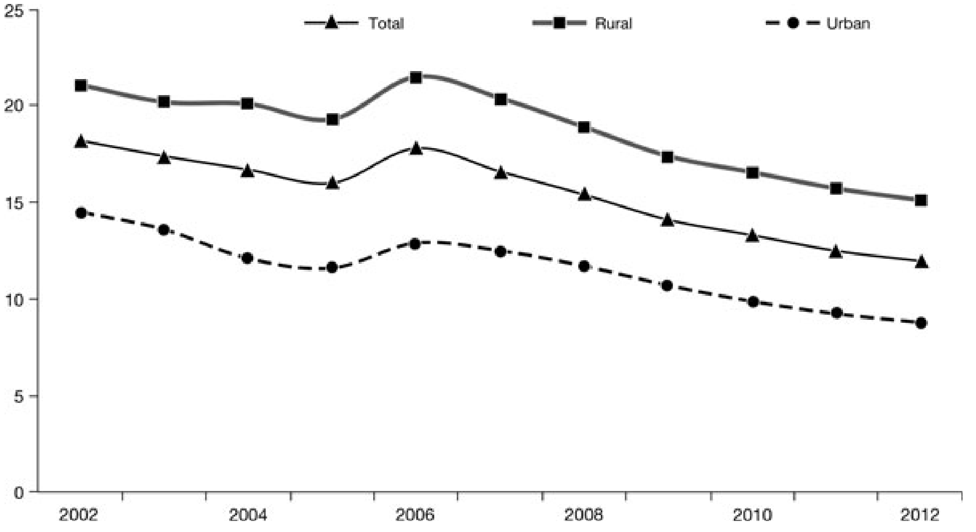

Figure 6 Poverty incidence in Indonesia, 2002–2012 (per cent). *Source*: Authors' calculations using data from Central Bureau of Statistics, Government of Indonesia, http://www.bps.go.id/eng/tab_sub/view.php?kat = 1&tabel = 1&daftar = 1&id_subyek = 23&notab = 1.

price increase in the presence of a tariff (0.05 per cent, or roughly 115 thousand persons).

Indonesian data on poverty incidence are consistent with the above account. Officially reported rural and urban poverty incidence increased noticeably between 2005 and 2006, but not noticeably during or shortly after the 2007–2008 food price shock (Figure 6). Observers of the Indonesian economy were surprised by the mid-decade increase in recorded poverty because real GDP growth was steady at the time, at between 6 and 7 per cent. Various possible explanations have been suggested, mainly related to the nature of Indonesia's growth at the time (Aswicahyono *et al.* 2011). This analysis suggests another explanation – protection of the rice industry. The rice import restrictions introduced from 2004 onwards permanently raised measured poverty incidence, both rural and urban, starting in 2005.

5. Conclusions

The increases in international food prices from 2007 to 2008 raised poverty incidence temporarily within Indonesia. The effect was significant but not large. For all commodities except rice, the international price increases harmed the poor, on balance – both rural and urban – primarily because of the increase in the consumer prices of staple foods.

The percentage increase in poverty incidence was even larger in rural areas than urban areas, despite the fact that, for many of the rural poor, higher agricultural prices mean higher incomes. Their gain was outweighed by the losses incurred by the large number of rural poor who are net buyers of food and the fact that, for these people, food represents a large share of their total budgets, even larger on average than for the urban poor. The main beneficiaries of higher food prices are not the rural poor, but the owners of agricultural land and capital, many of whom are urban based.

In the important case of rice, the poverty-increasing effect of the international price increase was muted by Indonesia's rice import restrictions. The increase in the international price reduced the value of the import quotas but was not transmitted to domestic rice prices. Nevertheless, the import quotas achieved this temporary benefit at the expense of large and permanent increases in both domestic rice prices and poverty incidence.

References

Aswicahyono, H., Hill, H. and Narjoko, D. (2011). Indonesian industrialization: jobless growth?, in: Manning, C. and Sumarto, S. (eds), Employment, Living Standards and Poverty in Contemporary Indonesia. Institute of Southeast Asian Studies, Singapore, pp. 113–133.

Fane, G. and Warr, P. (2008). Agricultural protection in Indonesia, *Bulletin of Indonesian Economic Studies*. 44, 133–150.

Friedman, J. and Levinsohn, J. (2002). The distributional impacts of Indonesia's financial crisis on household welfare: a 'Rapid Response' methodology, *World Bank Economic Review*. 16, 397–423.

Hertel, T.W. (ed.) (1997). *Global Trade Analysis: Modeling and Applications*. Cambridge University Press, Cambridge, UK.

Ivanic, M. and Martin, W. (2008). Implications of higher global food prices for poverty in low-income countries, *Agricultural Economics*. 39, 405–416.

Timmer, C.P. (2008) Causes of High Food Prices. ADB Economic Paper Series no. 128, Asian Development Bank, Manila.

Warr, P. (2005). Food policy and poverty in Indonesia: a general equilibrium analysis, *Australian Journal of Agricultural and Resource Economics*. 49, 429–451.

Warr, P. (2008). World food prices and poverty incidence in a food exporting country: a multihousehold general equilibrium analysis for Thailand, *Agricultural Economics*. 39, 525–537.

Warr, P. (2011). Food security vs. Food self-sufficiency: the Indonesian case, *The Indonesian Quarterly*. 39, 56–71.

Warr, P. and Yusuf, A.A. (2011). Reducing Indonesia's deforestation-based greenhouse gas emissions, *Australian Journal of Agricultural and Resource Economics*. 55, 297–321.

Yusuf, A.A. (2006) Constructing Indonesian Social Accounting Matrix for Distributional Analysis in the CGE Modelling Framework. Working Papers in Economics and Development Studies no. 200604, Department of Economics, Padjadjaran University, Bandung, Indonesia.