International food prices and poverty in Indonesia*

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Abstract

This paper argues that recent increases in international food prices worsened poverty incidence in Indonesia, even though many poor farmers benefited. This conclusion is based on the application of a multi-sectoral, multi-household general equilibrium model of the Indonesian economy. The positive effect on the welfare of poor farmers was exceeded by the negative effect on poor consumers. Indonesia's ban on rice imports since 2004 complicates this account. The import ban shielded Indonesia's internal rice market from the temporary world price increases from 2007 to 2008, but did so at the expense of permanently increasing both rice prices and poverty incidence.

Key words: Indonesia; food prices; poverty incidence; general equilibrium modeling.
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1. Introduction

Many Asia-Pacific countries have achieved substantial reductions of poverty incidence in recent decades, mainly due to the effects of economic growth. Indonesia is a good example (Fane and Warr 2002). More recently, sharp increases in international food prices since 2007 have raised concern that continued poverty reduction might not be feasible. These concerns were based on two kinds of assumptions: that higher food prices were permanent, or at least long-lasting; and that these international price increases actually worsen poverty.

According to the evidence so far, the first assumption appears to have been incorrect, in that the massive price increases of 2008 have subsequently abated significantly. The validity of the second assumption is less clear-cut. Increases in food prices affect poverty incidence in two quite different ways. On the one hand, they harm poor consumers, in both urban and rural areas, and poor consumers spend a high proportion of their budgets on food. But on the other hand, they may benefit poor farmers. 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 agriculture.

At the simplest level of analysis, higher food prices would seemingly increase poverty among households that are net consumers of food but reduce it among households that are net producers. An earlier paper (Warr 2008) argued that in a food exporting country, Thailand, higher food prices raise poverty incidence because, on balance, the negative effect on poor consumers outweighs the positive effect on poor producers. If this is correct, then in countries that are large net importers of food, it seem would probable that higher international food prices will also worsen poverty, perhaps even more strongly, because the balance between net consumers of food and net producers is more heavily weighted in favor of the former than is the case in a net food exporter.

Indonesia is a net importer of food. Several of its major staple food commodities, including rice, maize, cassava, soybeans and sugar, are net imports. Indonesia's agricultural

exports have tended to be estate crops other than staple foods, including rubber, copra, coffee and tea. But Indonesia's vulnerability to world food price increases is complicated by its policy on rice imports. 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. Then, from 2004 onwards, rice imports have officially been banned, although limited quantities of imports have occasionally been permitted. According to Fane and Warr (2008), by 2006 this policy had increased domestic rice prices relative to world prices by about 37 per cent. The leaky 'ban' on rice imports may more usefully be understood as a binding import quota, restricting imports to about one tenth of their previous volume, although the magnitude of the import restriction is regularly reviewed.

The import quota on rice meant that the world price increases were not transmitted to Indonesian markets, a point noted by several empirical studies (Timmer 2008; Dawes 2009). How does this feature of the Indonesian policy environment affect the relationship between world prices and poverty? The present paper analyzes this question using a general equilibrium framework. It is concluded that in the case of all major commodities except rice, higher world food prices raised poverty incidence in Indonesia. In the case of rice, the import quota shielded domestic rice markets from the effects of the temporary world price increases that occurred from 2007 to 2008 and thereby averted the temporary increases in poverty incidence that would otherwise have occurred if, for example, the instrument of protection had been a fixed *ad valorem* tariff. But the import ban achieved this outcome only at the expense of increasing domestic rice prices, and thereby increasing poverty incidence, on a permanent basis.

Section 2 of the paper briefly reviews data on the prices of five internationally traded agricultural commodities that are important for Indonesia, along with the price of urea fertilizer, an important net import used an input into agricultural production. This leads to a

summary of the changes in these prices, deflated by the Manufacturing Unit Value Index, that occurred over the five year period between the first half (January to June) of 2003 and the first half of 2008. Section 3 begins by arguing the necessity of a general equilibrium treatment of these issues. It then summarizes the general equilibrium model of the Indonesian economy, called INDONESIA E-3, that is used in the paper to simulate the effects of the recent increases in real commodity prices summarized in Section 2. Section 4 describes the simulations performed and presents their results. Section 5 concludes.

2. Recent increases in world food prices

Figure 1 shows international prices for six commodities of significance for Indonesian food and agriculture: rice, maize, sugar, soybeans, cassava and wheat. Figure 1 summarizes their monthly prices, all measured in nominal US dollars over the period 1990 to mid-2008. The sources of these data are summarized in Table 2. In the figure, these data are all normalized to January 2000 = 100. The increase in these prices since mid 2007 is obvious, especially for rice, for which the increase is especially dramatic. Rice is a uniquely important commodity for Indonesia. It is a central source of income for Indonesian farmers in most, though not all, regions of the country and the staple food of most of the Indonesian population. Maize and cassava are important staples in some regions of the country, particularly Eastern Indonesia, where poverty incidence is especially concentrated. Sugar is an important cash crop in some regions of the country. Wheat is an imported commodity, used as an input in many processed foods, but not grown in significant quantities within Indonesia.

[Figure 1 about here]

Table 1 summarizes nominal price changes for these six commodities, measured in US$, over the five years between the average of the first six months of 2003 and the

corresponding average of the first six months of 2008. These calculations are shown in the first row of the table. Our interest is not in changes in the *nominal* prices of these commodities, however, but changes in their prices relative to other international goods prices. Accordingly, these nominal prices were deflated by the Manufacturing Unit Value Index (MUV), an index of manufactured goods prices, also measured in nominal US$. The changes in these deflated prices are shown in the second row of Table 1.

Because the price changes are large, the percentage change in the real price is not calculated as a linear approximation - as 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. Based on these calculations, the real price of rice increased by 212 per cent, maize by 62 per cent, cassava by 106 per cent and soybeans 117 per cent.[1] The largest real price increase of all was urea, the price of which rose by 316 per cent.

[Table 1 about here]

[Table 2 about here]

What do changes in the international real prices of these commodities mean for poverty incidence in Indonesia? For staple food commodities like rice, maize, cassava and sugar, the effect is not obvious. There will be gainers and losers and detailed, quantitative economic

[1] The international prices of wheat and petroleum increased by 183 and 224 per cent, respectively.

analysis is needed to sort out the net effect. The next section describes a modeling approach to doing this.

3. The INDONESIA-E3 Model of the Indonesian Economy

3.1 Overview

The effect of the price changes described above on the welfare of individual households is not a simple matter and involves both changes in household expenditures, operating through consumer goods prices, and changes in household incomes, operating through changes in factor returns. When food prices rise, demand shifts to other commodities, influencing their prices as well. The final effect on the composition of consumer good prices depends on the detailed structure of commodity demands and supplies. The effect on the welfare of individual households then depends on these changes in consumer goods prices as well as the structure of expenditures of those households.

On the income side, factor returns will be affected by international commodity price changes. Consider, hypothetically, the effect of a large increase in rice prices. The rice industry can be expected to respond to higher prices with increased output, increasing demand for the factors of production that are important for the rice (paddy) industry. Returns to paddy land will increase. Since paddy is a large employer of unskilled labor, the equilibrium price of unskilled labor may rise throughout the economy, affecting other industries and thereby influencing returns to capital and fixed factors in these industries, as well as the return to skilled labor. These changes in factor returns will in turn affect the structure of household incomes, depending on the factor ownership characteristics of individual households.

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 section we describe a general equilibrium model of the Indonesian economy, known as the

INDONESIA-E3 (Economy-Equity-Environment) model, designed specifically for the analysis of these kinds of economic phenomena, with a strong emphasis on distributional analysis and capturing all of the relationships alluded to above. Most structural features of INDONESIA-E3 are standard. The distinctive feature of the model is its disaggregated household structure, designed to facilitate analysis of the way exogenous shocks to the model affect poverty and inequality.

The advantage of working with a general equilibrium model with a disaggregated household sector is that it becomes possible to conduct controlled experiments, which focus on the consequences for household incomes, expenditures, poverty and inequality that arise from different economic shocks, taken one at a time. The model identifies two categories of households, rural and urban, each of which is divided into 100 sub-categories of equal population size, with the sub-categories arranged by expenditures per capita.

As well as disaggregating households, INDONESIA-E3 also has a disaggregated industry and commodity structure, with 41 industries and 41 corresponding commodities. The microeconomic behavior assumed within it is competitive profit maximization on the part of all firms and competitive utility maximization on the part of consumers. In the simulations reported in this paper, the markets for final outputs, intermediate goods and factors of production are all assumed to clear at prices that are determined endogenously within the model.[2] The nominal exchange rate between the Indonesian currency (the rupiah) and the US dollar can be thought of as being fixed exogenously. The role within the model of the exogenous nominal exchange rate is to determine, along with international prices, the nominal domestic price level. Given that prices adjust flexibly to clear markets, a 1 percent increase in the rupiah/dollar exchange rate will result in a 1 percent increase in all nominal domestic prices, leaving all real variables unchanged.

[2] Variations to this assumption are possible. For example, the possibility of unemployment can be introduced by varying the closure to make either real or nominal wages exogenous, thereby allowing the level of employment to be endogenously determined by demand.

3.2 Model structure

The model contains 41 industries and 41 commodities. Of these, 10 are in agriculture (paddy, maize, cassava, beans, wheat, other food crops, estate crops, livestock, forestry, fishery). In addition 2 are in mining, 4 in food processing, 14 in other manufacturing and 9 in services. The structure of the model is based on the ORANI-G model (Horridge, 2000) with several modifications, of which the most important is multi-household feature mentioned above. This feature is fully integrated within the general equilibrium structure and enables the model to capture the way that changes in the economy affect households on the expenditure side, through changes in the prices of goods and services that they buy, and also on the income side, through changes in the returns to factors of production that they own.

The theoretical structure of INDONESIA-E3 is conventional for static general equilibrium models. It includes of the following major components:

- Household consumption demand systems for each of the 200 households, for each of the 41 categories of consumer goods. These demand functions are derived from the linear expenditure system.
- The household supplies of skilled and unskilled labor are assumed to be exogenous.
- A factor demand system, based on the assumption of CES production technology, that relates the demand for each primary factor to industry outputs and prices of each of the primary factors. This reflects the assumption that factors of production may be substituted for one another in ways that depend on factor prices and on the elasticities of substitution between the factors.
- A distinction between two kinds of labor: skilled and, which are ‘nested’ within the industry production functions. In each industry, both kinds of labor enter a CES production function to produce ‘labor’, which itself enters a further CES production function for industry output.

- Leontief assumptions for the demand for intermediate goods. Each intermediate good in each industry is assumed to be demanded in fixed proportion to the gross output of the industry.
- Demands for imported and domestically produced versions of each good, incorporating Armington elasticities of substitution between the two.
- A set of export demand functions, indicating the elasticities of foreign demand for Indonesia's exports.
- A set of equations determining the incomes of the 200 households from their (exogenous) ownership of factors of production, reflecting data derived from the 2003 *Social Accounting Matrix*, the (endogenous) rates of return to these factors, and any net transfers from elsewhere in the system.
- Rates of import tariffs and excise taxes across commodities, rates of business taxes, value added taxes and corporate income taxes across industries, and rates of personal income taxes across household types which reflect the structure of the Indonesian tax system, using data from the Indonesian Ministry of Finance.
- A set of macroeconomic identities which ensures that standard macroeconomic accounting conventions are observed.

The demand and supply equations for private-sector agents are derived from the solutions to these agents microeconomic optimization problems (cost minimization for firms and utility maximization for households). The agents are assumed to be price-takers, with producers operating in competitive markets with zero profit conditions, reflecting the assumption of constant returns to scale.

3.3 Social accounting matrix

The multi-household feature of the model required significant modifications to the data base used for constructing the CGE model. In contrast to other ORANI-G based CGE models,

which are based solely on an Input-Output table, this model requires many pieces of additional information which are available only from a Social Accounting Matrix. For example, in the Indonesian Social Accounting Matrix (SAM), constructed by the Government of Indonesia's Central Bureau of Statistics, the corporate or enterprise sector owns a great deal of undistributed earnings, and the values of transfers among institutions such as from government to households, are also recorded. These important features, essential for a multi-household model, cannot be captured from an I-O based model alone. Accordingly, INDONESIA-E3 incorporates inter-institution transfers, most importantly from the government to households.

The Indonesian Social Accounting Matrix 2003 serves as the core database for the INDONESIA-E3 model. Analyses of the distributional impact of policies have in the past been constrained by the absence of a Social Accounting Matrix (SAM) with disaggregated households. Since Indonesia's official SAM does not distinguish households by income or expenditure size, this fact has impeded accurate estimation of the distributional impact of exogenous shocks to the economy or policy changes, such as calculation of inequality or poverty incidence. The SAM used in this paper, is aggregated from a specially constructed SAM, representing the Indonesian economy for the year 2003, with 181 industries, 181 commodities, and 200 households (100 urban and 100 rural households sorted by expenditure per capita). This SAM (768×768 accounts) is the most disaggregated yet constructed for Indonesia at both the sectoral and household levels. Its structure is summarized in Table 3, but its detailed composition will not described fully in this paper. Interested readers may refer to Yusuf (2006).

[Table 3 about here]

3.4 Factors of production

The mobility of factors of production is a critical feature of any general equilibrium system. 'Mobility' refers here to mobility across economic activities (industries), rather than geographical mobility. The greater the factor mobility that is built into the model, the greater is the economy's simulated capacity to respond to changes in the economic environment. It is clearly essential that assumptions about the mobility of factors of production be consistent with the length of run that the model is intended to represent.

Two types of labor are identified, ‘unskilled labor’ and ‘skilled labor’, based on the educational characteristics of the workforce. Skilled labor is defined as those workers with lower secondary education or more. The way that these two kinds of labor are aggregated from the 16 categories of labor identified in the Indonesian SAM is summarized in Table 4. Table 5 summarizes the importance of the factors of production discussed above within the context of the cost structure of major industry categories. It notable that ‘skilled’ labor is unimportant in agriculture.

[Table 4 about here]

[Table 5 about here]

3.5 Households

The sources of income of the various households are of particular interest for this study because of their central importance for the distribution of income. These data are summarized in Table 6. Urban and rural households vary considerably in the composition of their factor incomes, particularly as regards skilled and unskilled labor. However, there is considerable variation within each of the urban and rural categories and Figures 2 and 3 summarize this information. This variation, between and within the rural and urban categories is fully captured by the database used for INDONESIA E-3. The principal source of the factor ownership matrix used in the model is Indonesia’s SAM for the year 2003, but this is supplemented by additional data as

described in Yusuf (2006).

[Table 6 about here]

[Figure 2 about here]

[Figure 3 about here]

Table 7 summarizes the characteristics of urban and rural households in so far as they relate to poverty incidence. Mean consumption expenditures per capita differ widely between urban and rural households. In the simulations conducted below, poverty incidence is calculated for each of these two household categories, using poverty lines for each category replicating the official levels of poverty incidence reported from the 2003 *Susenas* survey, using official poverty lines. These rates of poverty incidence are summarized in the final column of Table 7. 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 65 per cent of all poor people within Indonesia reside in rural areas.

[Table 7 about here]

3.6 Analyzing distributional impacts

Several approaches have been adopted in analyzing income distribution within a CGE context. The traditional one is the *representative household method*, where it is assumed that the incomes or expenditures of households follow a certain functional form of distribution, which is then assumed to remain constant before and after the shock. Obviously, when this assumption is untrue, it can significantly affect the results of the analysis (Decaluwé et al. 1999). For example, household-specific shocks, such as transfers to targeted household

groups, cannot be analyzed with the representative household approach. Studies on Indonesia by Sugema et al. (2005) and Oktaviani et al. (2005), among others, belong to this type of approach.

The second approach is the *socioeconomic class method*. Several CGE studies for Indonesia use this approach, based on the official household classification of the SAM, which divides the population into 10 socioeconomic classes. The distributional impact is analyzed by comparing the impact of policies among these socioeconomic classes. Studies by Resosudarmo (2003), Azis (2000), and Azis (2006), among others, follow this approach.

A third approach is the *top-down method*, in which price changes produced by the CGE model are transferred to a separate micro-simulation model, such as a demand system model or an income-generation model. Price changes are exogenous in this micro-model, and so the endogeneity of prices is ignored. Studies for Indonesia by Bourguignon et al. (2003) and Ikhsan et al. (2005) are among those adopting this approach. Some attempt has been made to improve this approach by providing feedback from the micro-model to the CGE model. Belonging to this category among others are studies by Filho and Horridge (2004) for Brazil, and Savard (2003) for the Philippines.

A fourth approach is the *microsimulation-CGE method*, which consists of multiplying the number of households into as many households as are available in the household level data. Increasing computation capacity allows a large number of households to be included in the model. It allows the model to take into account the full set of detailed information available from household-level data, and avoids pre-judgment about aggregating households into categories. All prices are endogenously determined by the model, and no prior assumption of parameter distribution is necessary. Data reconciliation is a difficult problem and the size of the model can become a constraint on the application of this approach. This microsimulation-CGE model has been implemented in various studies including Annabi et al.

(2005) for Senegal, Plumb (2001) for U.K., Cororaton and Cockburn (2005) and, Cororaton and Cockburn (2006) for the Philippines.

The fifth approach, to be used in this paper, is the *integrated multi-household method*, which consists of disaggregating households and arranging them by the size of expenditure or income per capita. If the categories are detailed enough, distributional impacts such as effects on poverty incidence or standard inequality indicators can be estimated with any desired level of accuracy. As the number of household categories is increased, greater accuracy can be achieved. For example, Warr (2008) used this approach in assessing the effects that the food price crisis had on poverty incidence in Thailand.

The ideal approach to distributional analysis would presumably be the use of disaggregated households, integrated into the CGE model when all observations in the household survey are represented. But this is costly and unnecessary. By using only a smaller number of representative households (say 100) classified by expenditure (or income) per capita, the calculation of poverty and inequality indicators can be quite accurate.

In this study, poverty incidence is calculated using the following formula. Let y_c be real expenditure per capita of a household of the c-th centile where c = 1,2, …, n, and n = 100. Poverty incidence is calculated using

$$P(y_c, y_P) = \max\left\{c \middle| y_c < y_P\right\} + \frac{y_P - \max\left\{y_c \middle| y_c < y_P\right\}}{\min\left\{y_c \middle| y_c > y_P\right\} - \max\left\{y_c \middle| y_c < y_P\right\}}$$

where y_P is the poverty line. The first term is simply the lowest centile of which expenditure per capita is closest to the poverty line. The second term is the linear approximation to where the poverty incidence lies between centiles c and c+1.

The change in poverty incidence after a policy shock (simulation) is calculated as

$$\Delta P = P(y_c', y_P) - P(y_c, y_P)$$

where

$$y'_c = \left(1 + \frac{\hat{y}_c}{100}\right) \cdot y_c ,$$

where $\hat{y}_c$ is the percentage change in real per capita expenditure of household of centile *c* produced from the simulation of the CGE model. The change in the real expenditure per capita across households is used to investigate both the *ex-ante* distribution (before the policy change) and *ex-post* distribution (after the policy change).

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, corresponding to the six commodities listed above. These are to be understood as simulations of the effects of changes in the international prices of these commodities, relative to other international prices, facing Indonesia in the world market. They are denoted Sim 1 to Sim 6 in the tables of results which follow. The other three sets of simulations shown in the tables (Sim 7 to Sim 9) will be explained below.

4.2 Model closure

Since the real expenditure of each household is used as the basis for the calculation of poverty incidence and inequality, the macroeconomic closure must be made compatible with both this measure and with the single-period horizon of the model. This is done by ensuring that the full economic effects of the shocks to be introduced are channeled into current-period household incomes and do not 'leak' in other directions, with real-world inter-temporal welfare implications not captured by the welfare measure. The choice of macroeconomic closure may thus be seen in part as a mechanism for minimizing inconsistencies between the

use of a single-period model to analyze welfare results and the multi-period reality that the model depicts.

To prevent these kinds of welfare leakages from occurring, the simulations are conducted with balanced trade (exogenous balance on current account). This ensures that the potential effects of the shock being studied do not flow to foreigners, through a current account surplus, or that increases in domestic consumption are not achieved at the expense of borrowing from abroad, in the case of a current account deficit. For the same reason, real government spending and real investment demand for each good are each fixed exogenously. The government budget deficit is held fixed in nominal terms. This is achieved by endogenous across-the-board adjustments to the *sales tax rate* so as to restore the base level of the budgetary deficit. The combined effect of these features of the closure is that the full effects of changes in policy are channeled into household consumption and not into effects that are not captured within the single period focus of the model.

4.3 Results

Tables 8 to 11 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, it is convenient to discuss first the case of the maize price shock shown in the first column (Sim 1). Table 8 summarizes the microeconomic (industry-level) effects of the shock. The increase in the international price of maize of 124 per cent raises the domestic producer price of maize by 9.2 per cent. This is considerably smaller than the international price increase because the domestically produced form and the imported forms of maize are imperfect substitutes and also because domestic marketing margins intervene between import prices and domestic wholesale prices. 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 and imports of maize decline by 56 per cent.[3]

[Table 8 about here]

Turning to macroeconomic results in Table 9, 'real GDP' in Indonesia declines by a very small amount. Real GDP means GDP calculated at base period prices. It takes no account of the deterioraton 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 welfare significance of a change in the terms of trade. Real aggregate household consumption declines marginally by 0.06 per cent. Real unskilled wages in Indonesia rise. The reason is that as the maize industry increases its output it raises the demand for unskilled labor, bidding up its wage. This increase in unskilled wages is transmitted through the entire economy, lowering the average real return to skilled labor and capital. But the return to land used in maize production rises. Higher domestic maize prices raise the Consumer Price Index and, to a lesser extent, the GDP price deflator.

[Table 9 about here]

Table 10 now summarizes the effects on poverty and inequality. 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 who neither produce nor consume maize, because real wages and returns to capital and land are affected throughout the economy. Urban poverty incidence increases marginally and rural poverty incidence increases from 20.20 per cent to 20.38 per cent. The negative effect on poor consumers of maize outweights 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 economy-wide inequality by a small amount.

[3] It is important that the simulated decline in imports of each of the six commodities is less than 100 per cent.

[Table 10 about here]

Table 11 makes it possible to understand more deeply the reason for the changes in urban and rural poverty. Consider a rural household on the threshhold 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 20th centile. The point of focusing on this particular household category is that if this borderline household becomes better off, we expect poverty incidence to decline, and vice versa. The real expenditure of this household category declines by 13.20 billion rupiah (bottom row of the table) consistent with rural poverty incidence increasing. We can now study in detail why its real expenditure declines.

[Table 11 about here]

It can be shown that the change in 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 increase in the consumer price of maize harms poor households.

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 11 can be compared with one another. Simulation 6 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 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). Indeed, the international rice price increase for rice (Sim 4) changes very little at all and the effect on poverty incidence is almost zero. The question is therefore: why is the effect of the rice price increase so small?

Returning to Table 8, Sim 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 (partially effective) ban 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 households who own the import licences, but it does almost nothing to the domestic market for rice, or to the poor. The quota prevents transmission of the price increase to the domestic market for rice.

Suppose the instrument of protection had been a tariff instead of a quota? This possiblility is analyzed in Sim 8, labelled 'Rice tariff'. The simulation is identical to Sim 4, except that the instrument of protection is a fixed *ad valorem* tariff instead of a fixed quota which initially restricts imports by the same amount (roughly 90 per cent). The same (212 per cent) international price increase is analyzed in this simulation. It reduces imports of rice 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 10), overwhelmingly because of the increase in the cost of living of poor households (Table 11).

Since the import quota protected Indonesia's poor from transimission of the rise in the international price of rice, does this mean it was a poverty-reducing policy? Suppose the quota was eliminated. What would be the effect on poverty? This question is analyzed in Sim 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 11). The reduction

in poverty incidence (0.19 per cent of the total population, or roughly 450 thousand persons)[4] is several times larger than the increase in poverty incidence resulting from the international price increase in the presence of a tariff (0.05 per cent, or roughly 115 thousand persons). The quota avoids the *temporary* increase that would have arisen under a tariff, but does so by imposing a *permanent* increase roughly four times as large. The welfare cost of the quota remains as long as the quota remains in place.

5. Conclusions

This paper argues that increases in international food prices from 2007 to 2008 raised poverty incidence in Indonesia. The increase in poverty incidence is significant but not dramatic. The poor lose primarily because of the increase in the consumer prices of staple foods. The main beneficiaries of the food price increases are not the poor, but the owners of agricultural land and capital. Unskilled wages rise in real terms, as agricultural production expands somewhat in response to the increase in farm level prices, but this effect is not strong enough to outweigh the negative effect on the poor of increased consumer prices of staple foods. The global community was right to emphasize the danger that international food price increases could threaten the sustainability of continued poverty reduction. Fortunately, the 2007-2008 international food price increases were temporary, based on the evidence to date. But this does not necessarily mean that similar episodes will not recur.

[4] Indonesia's population in 2008 was 228 million.

References

Annabi, N., F. Cissé, J. Cockburn, and B. Decaluwé (2005). Trade liberalisation, growth and poverty in Senegal: a dynamic microsimulation CGE model analysis. Cahiers de recherche 0512, CIRPEE. available at http://ideas.repec.org/p/lvl/lacicr/0512.html.

Azis, I. J. (2000). Simulating economy-wide models to capture the transition from financial crisis to social crisis. *Annals of Regional Science* 34(2), 251-278.

Azis, I. J. (2006). A drastic reduction of fuel subsidies confuses ends and means. *ASEAN Economic Bulletin* 23(1), 114-136.

Bourguignon, F., A.-S. Robilliard, and S. Robinson (2003). Representative versus real house-holds in the macro-economic modeling of inequality. Working paper DT 2003-10, DIAL.

Cororaton, C. B. (2003). Construction of Philippine SAM for the use of CGE-microsimulation analysis. mimeo, Philippine Institute for Development Studies, http://www.pep-net.org.

Cororaton, C. B. and J. Cockburn (2005). Trade reform and poverty in the Philippines: a com¬putable general equilibrium microsimulation analysis. Cahiers de recherche 0513, CIRPEE. available at http://ideas.repec.org/p/lvl/lacicr/0513.html.

Dawe, David (2009). 'Transmission of the world rice crisis to domestic economies', Agricultural Development Economics Division, Food and Agriculture Organization (FAO), Rome, June.

Decaluwé, B., J. C. Dumont, and L. Savard (1999). How to measure poverty and inequality in general equilibrium framework. CREFA Working Paper no. 9920. Laval University.

Dixon, P.B., B.R. Parmenter, J. Sutton and D.P. Vincent (1982). *ORANI: A Multisectoral Model of The Australian Economy*, Amsterdam: North-Holland.

Fane, George and Peter Warr (2002). 'How Economic Growth Reduces Poverty: A General Equilibrium Analysis for Indonesia', in A. Shorrocks and R. Van der Hoeven (eds.), *Perspectives on Growth and Poverty*, United Nations University Press, 217-34.

Fane, George and Peter Warr (2008). 'Agricultural Protection in Indonesia', *Bulletin of Indonesian Economic Studies*, vol 44. no 1, 133-50.

Filho, J. and M. Horridge (2004). Economic integration, poverty and regional in-equality in Brazil. Centre of Policy Studies/IMPACT Centre Working Papers g - 149, Monash University, Centre of Policy Studies/IMPACT Centre. available at http://ideas.repec.org/p/cop/wpaper/g-149.html.

Horridge, Mark. 2000. ORANI-G: A General Equilibrium Model of the Aus¬tralian Economy. Centre of Policy Studies/IMPACT Centre Working Papers op-93 Monash University, Centre of Policy Studies/IMPACT Centre. available at http://ideas.repec.org/p/cop/wpaper/op-93.html.

Ikhsan, M., T. Dartanto, Usman, and H. Sulistyo (2005, April). Kajian dampak kenaikan harga BBM 2005 terhadap kemiskinan. LPEM Working Paper http://www.lpem.org.

Oktaviani, R., D. Hakim, S. Sahara, and H. Siregar (2005, May). The impact of fiscal policy on Indonesian macroeconomic performance, agricultural sector and poverty incidences (a dynamic computable general equilibrium analysis). Report to the Poverty and Economic Policy (PEP) Network http: //www.pep-net.org/.

Plumb, M. (2001). An integrated microsimulation and applied general equilibrium approach to modelling fiscal reform. mimeo.

Savard, L. (2003). Poverty and income distribution in a CGE-household micro-simulation model: Top-down/bottom up approach. Cahiers de recherche 0343, CIRPEE. available at http://ideas.repec.org/p/lvl/lacicr/0343.html.

Sugema, I., M. Hasan, R. Oktaviani, Aviliani, and H. Ritonga (2005). Dampak ke¬naikan harga BBM dan efektivitas program kompensasi. INDEF Working Paper http://www.indef.or.id/download/pubs/BBM.PDF.

Timmer, C. Peter (2008). 'Causes of high food prices' ADB Economics Working Paper Series, no. 128, Manila, October.

Warr, Peter (2005). 'Food Policy and Poverty in Indonesia: A General Equilibrium Analysis', *Australian Journal of Agricultural and Resource Economics*, vol. 49, no. 4, December, 429-451.

Warr, Peter (2008). 'World food prices and poverty incidence in a food exporting country: A multihousehold general equilibrium analysis for Thailand", *Agricultural Economics*, vol. 39, no. 3 supplement (November), 525 537.

Yusuf, Arief Anshory (2006), Constructing an Indonesian social accounting matrix for distributional analysis in the CGE modelling framework. Working Papers in Economics and Development Studies 200604, Department of Economics, Padjadjaran University. available at http://ideas.repec.org/p/unp/wpaper/200604.html.

Table 1. International price changes, Indonesia's agricultural imports and exports,

(Jan-June 2003 to Jan.-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 sources in Table 2.

Table 2. Sources of International Price Data

Commodity	Definition	Primary source	Unit Value	Unit Measurement
Maize	US No.2, Yellow, U.S. Gulf (Friday)	USDA	US$	Ton
Cassava	Tapioca starch, FOB Bangkok (US Dollar per Metric tonne	USDA	US$	Metric Ton
Soybeans	US No.1, Yellow, U.S. Gulf (Friday)	USDA	US$	Ton
Rice	White Broken Rice, Thai A1 Super, f.o.b Bangkok (Friday closing price)	Jackson Son & Co. (London) Ltd.	US$	Ton
Sugar	I.S.A. daily price, Average of week	International Sugar Organization (ISO)	US cents	lb
Wheat	US No.2, Hard Red Winter ord. Prot, US Fob Gulf (Tuesday)	International Grain Council	US$	Ton

Table 3. Structure of 768 × 768 Indonesian SAM

		Activities 1…181	Commodity		Factor		Ind. Tax	S-I	Households 1…200	Transfers	Enterprises	Gov't	ROW	TOTAL
			Domestic 1…181	Imported 1…181	labour 1…16	Capital								
Activities	1 … 181		MAKE Matrix											Industry Sales
Domestic Commo-dities	1 … 181	_Domestic lntermedi-ate Input						Domestic Invest-ment	Domestic Hou. Con-sumption			_Domeatic Gov't Lon-sumption	Export	Total Dom. Demand
Imported Commo-dities	1 … 181	Imported Intermedi-ate Input						Imported Invest-ment	Imported Hou. Con-sumption			Imported Gov't Con-sumption		Total Import
labor	1 … 16	Salary and Wages											labour used abroad	Total labor Demand
Capital		Non-labor											Cap. used abroad	Capital Demand
Ind. Tax		Tax/ Subsidy		Tariff										Ind. Tax Reven.
Urban HH	1 … 100				Labor Income: Urban	Capital Income: Urban				Inter-Hous. Transfer			ROW transfer to HH	Total Hous. Income
Rural HH	1 … 100				labor Income: Rural	Capital Income: Rural				Inter-Hous.. Transfer			ROW transfer to HH	Total Hous. Income
Transfer									Transfer to HH					Int. Hous. Transter
S-I									Household Saving		Enterprise Saving	Gov't Saving		Total Saving
Govern-ment							Ind.Tax Revenue		Direct Tax		Ent. _Traps. to Gov t	Inter G Transfer	ROW Tans. to Gov t	Govt Revenue
Enter-prises						Enter-Enter-					Inter Ent. itans.		ROW Trans. to Enter.	Ente. Income
ROW				Import	Foreign labor	Foreign Capital			HH Transfer to abroad		Ent Trans. to abroad	G. Transfer to abroad		Forex Outflow
TOTAL		Industry Costs	Dom. Supply	Import Supply	Labor Supply	Capital Supply	Ind. Tax Revenue	Total Invest.	Household Spending	Int. Hou. Transfer	Enter. Spending	Govern. Spending	Forex Inflow	

Source: Yusuf (2006).

Table 4. Labor categories used in INDONESIA E-3 model

	16 SAM categories	2 skill categories
1	Urban, formal, agriculture	Unskilled
2	Rural, formal, agriculture	Unskilled
3	Urban, informal, agriculture	Unskilled
4	Rural, informal, agriculture	Unskilled
5	Urban, formal, production	Unskilled
6	Rural, formal, production	Unskilled
7	Urban, informal, production	Unskilled
8	Rural, informal, production	Unskilled
9	Rural, formal, clerical	Skilled
10	Rural, formal, clerical	Skilled
11	Urban, informal, clerical	Skilled
12	Rural, informal, clerical	Skilled
13	Urban, formal, professional	Skilled
14	Rural, formal, professional	Skilled
15	Urban, informal, professional	Skilled
16	Rural, informal, professional	Skilled

Source: 16 SAM categories from Central Bureau of Statistics, *Social Accounting Matrix, Indonesia, 2003*, Central Bureau of Statistics, Jakarta, 2003.

Table 5. Cost shares of major factors of production (2003)

	Unskilled labor	Skilled labor	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
Service	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.

Table 6. Household factor income shares

	Unskilled labor	Skilled labor	Capital	Land	Total
Urban	26.57	38.97	31.20	3.27	100
Rural	45.60	15.57	33.74	5.09	100
Total	34.08	29.74	32.20	3.99	100

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

Table 7. Expenditure and poverty incidence by household group, 2005

	% of total population in this group	% of total households in this group	Mean per capita expenditure (Rp. /mo.)	% of 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 *Susenas* survey and related data sources.

Table 8. Simulated microeconomic effects of commodity price shocks

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
ɔnsumer 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
ıport 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

Source: Authors' calculations.

Table 9. Simulated macroeconomic effects of commodity price shocks

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
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 10. Simulated effects on poverty and inequality

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
Effects on poverty Incidence (headcount measure, %)									
	Ex ante level	**Simulated Change in Poverty Incidence (head count %)**							
Urban	13.60	0.02	0.00	0.04	0.01	0.05	0.00	0.12	0.03	-0.13
Rural	20.20	0.18	0.00	0.05	0.00	0.07	0.00	0.29	0.06	-0.25
Total	17.19	0.10	0.00	0.05	0.00	0.06	0.00	0.21	0.05	-0.19
…									
Effects on inequality (Gini Index, %)									
	Ex ante level	**Simulated Change in Gini Index**							
Urban	34.77	0.01	0.00	0.02	-0.08	0.01	0.00	-0.04	0.01	-0.09
Rural	27.76	0.08	0.00	0.01	0.00	0.01	0.00	0.09	0.04	-0.16
Total	35.05	-0.05	0.00	-0.01	0.05	-0.01	0.00	-0.01	-0.02	-0.12

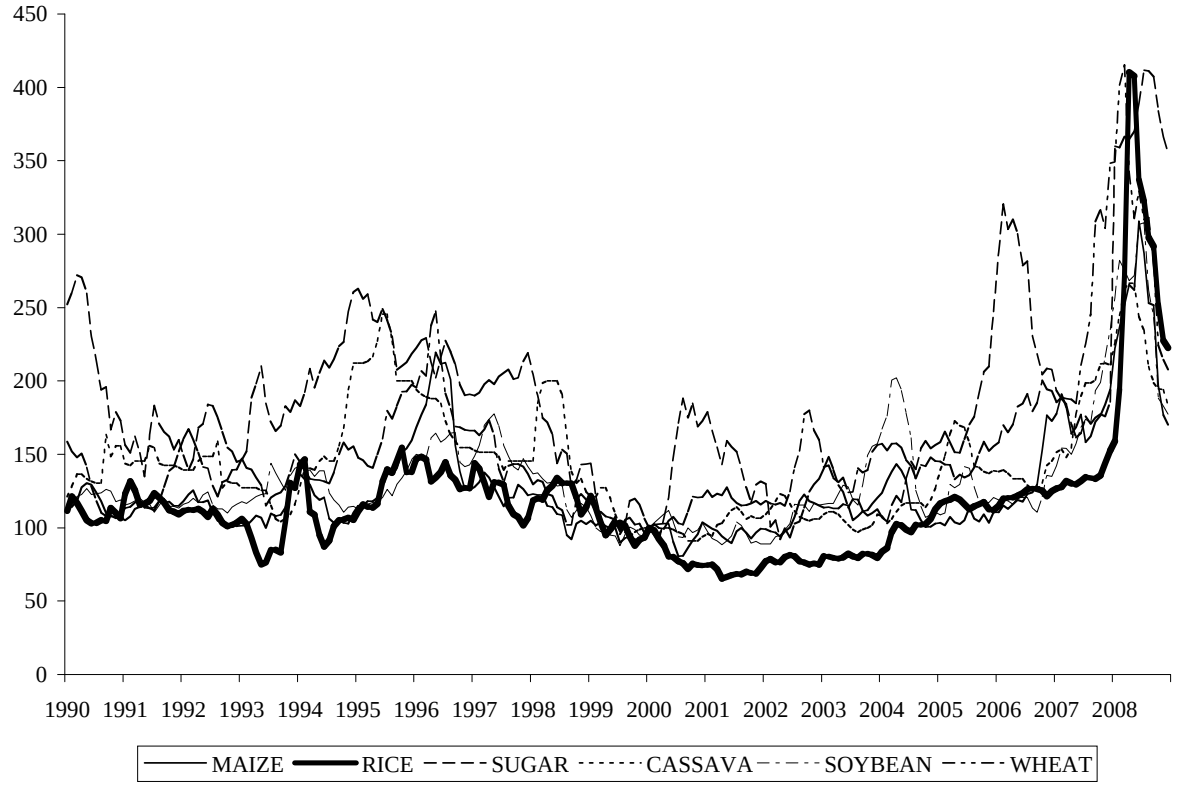
Source: Authors' calculations.
Note: The simulated change in poverty incidence or Gini Index means the *ex post* simulated level minus the *ex ante* level. A positive value therefore indicates an increase in the level and a negative value indicates a reduction.

Table 11. Decomposition of simulated changes in expenditures of households on the poverty borderline

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 (H13)									
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 (H20)									
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

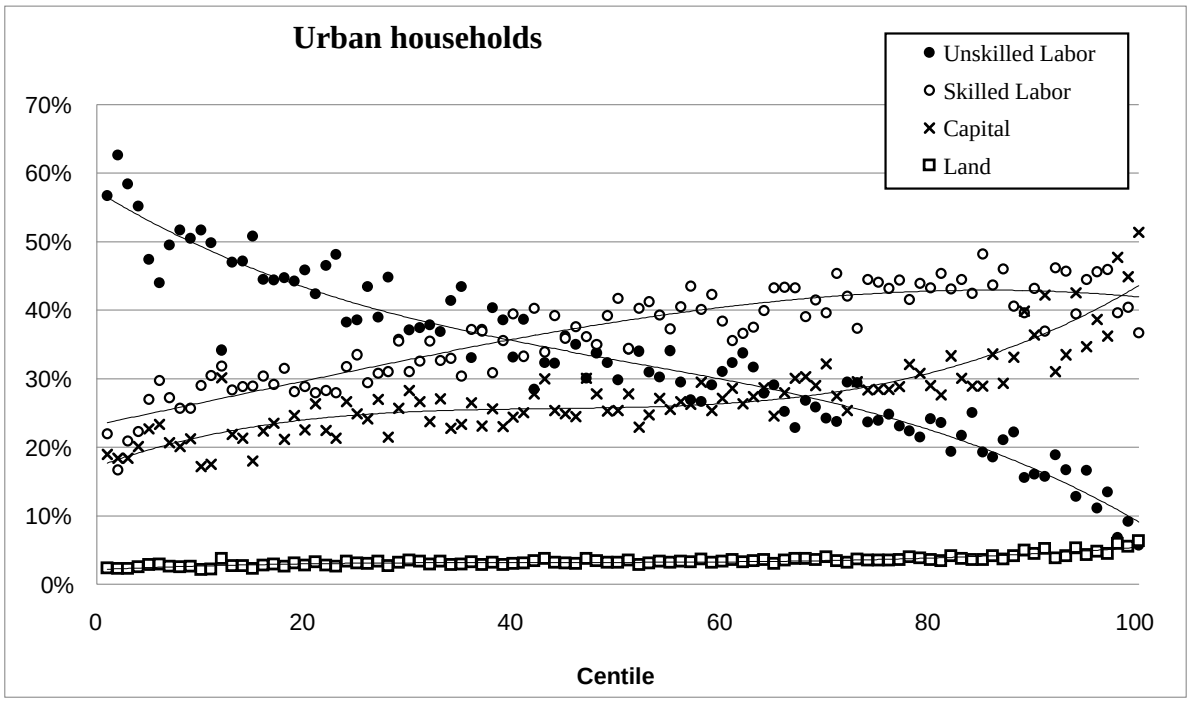
Source: Authors' calculations.

Figure 1 International prices of maize, rice, sugar, cassava, soybeans and wheat, 1990 to 2008 (all prices in $US, indexed to Jan. 2000 = 100).



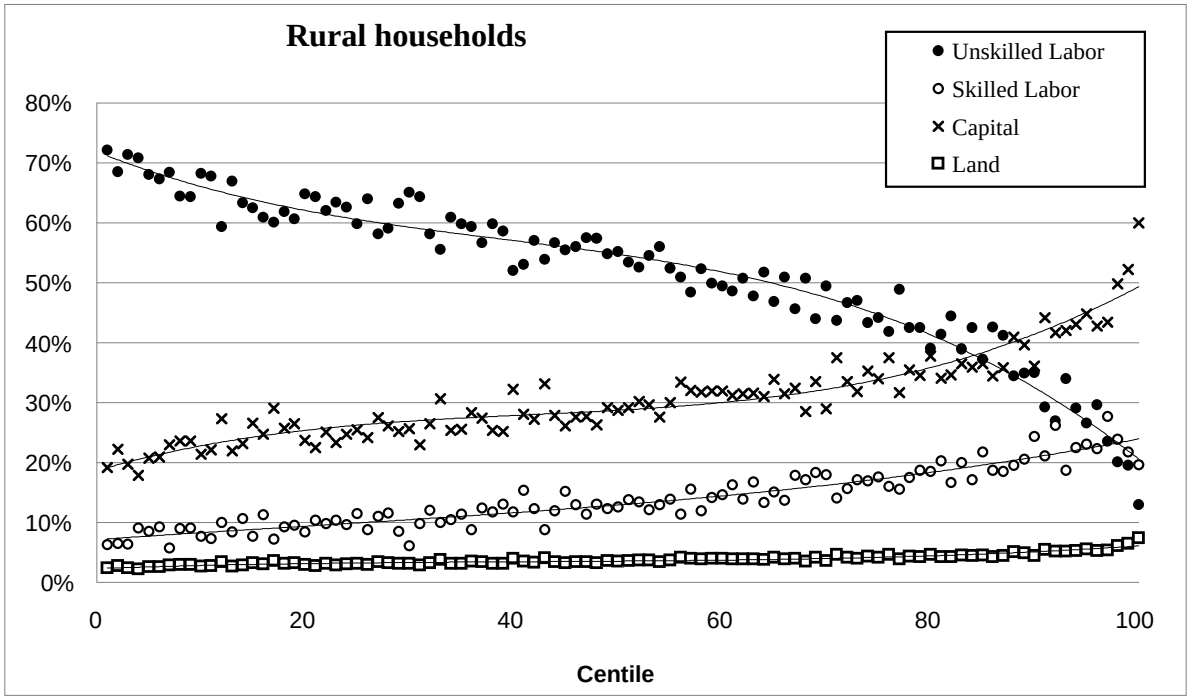
Sources: Authors' calculations using data summarized in Table 2.

Figure 2 Factor shares in incomes of urban households



Source: Authors' calculations.

Figure 3 Factor shares in incomes of rural households



Source: Authors' calculations.