The Australian Journal of Agricultural and Resource Economics, 49, 429–451

Food policy and poverty in Indonesia: a general equilibrium analysis*

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Rice is Indonesia's staple food and accounts for large shares of both consumers' budgets and total employment. Until recently, Indonesia was the world's largest importer, but rice import policy is now highly protectionist. Since early 2004, rice imports have been officially banned. Advocates of this policy say it reduces poverty by assisting poor farmers. Opponents say it increases poverty, stressing negative effects on poor consumers. This paper uses a general equilibrium model of the Indonesian economy to analyse the effects of a ban on rice imports. The analysis recognises 1000 individual households, including all major socioeconomic categories, disaggregated by expenditures per person. It takes account of effects on each household's real expenditure and its income, operating through wages and returns to land and capital. The results indicate that the rice import ban raises the domestic price of rice relative to the import price by an amount equivalent to a 125 per cent tariff, six times the pre-2004 tariff. Poverty incidence rises by a little under 1 per cent of the population and increases in both rural and urban areas. Among farmers, only the richest gain. These results are qualitatively robust to variations in key parametric assumptions.

Key words: general equilibrium, rice imports, trade policy, Indonesia.

1. Introduction: Indonesia's rice import policy

In staple food importing countries, policies affecting the quantities and prices of those imports are always politically sensitive. This is especially true of developing countries, where staple foods normally account for large shares of both consumers' budgets and total employment. In Indonesia the staple food, rice, represents 7.2 per cent of average consumer expenditure.[1] Its production employs 7.1 per cent of the total work

* In memory of Keith Oliver Campbell. The author gratefully acknowledges the assistance of Glyn Wittwer of Monash University, Damien Riwoe Tao Kong, Arriya Mungsunti, Arief Ramayandi and Arief Anshory Yusuf of the Australian National University, Andi Alfian and Hendro Hendratno of the University of Indonesia, Jakarta, Neil McCulloch of the World Bank office, Jakarta, and Sulton Mawardi, Agus Priyambada and Yusuf Suharso of SMERU Research Institute in Jakarta. Peter Rosner of Development Alternatives Inc. kindly provided the data used in Figures 1 and 2. The paper benefited from the comments of participants at the 2004 Australasian Meeting of the Econometric Society and seminars at SMERU Research Institute and the Australian National University.

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[1] This expenditure share is based on Indonesia's national accounts. The average expenditure share calculated from the national income and expenditure survey (*Susenas*) is considerably

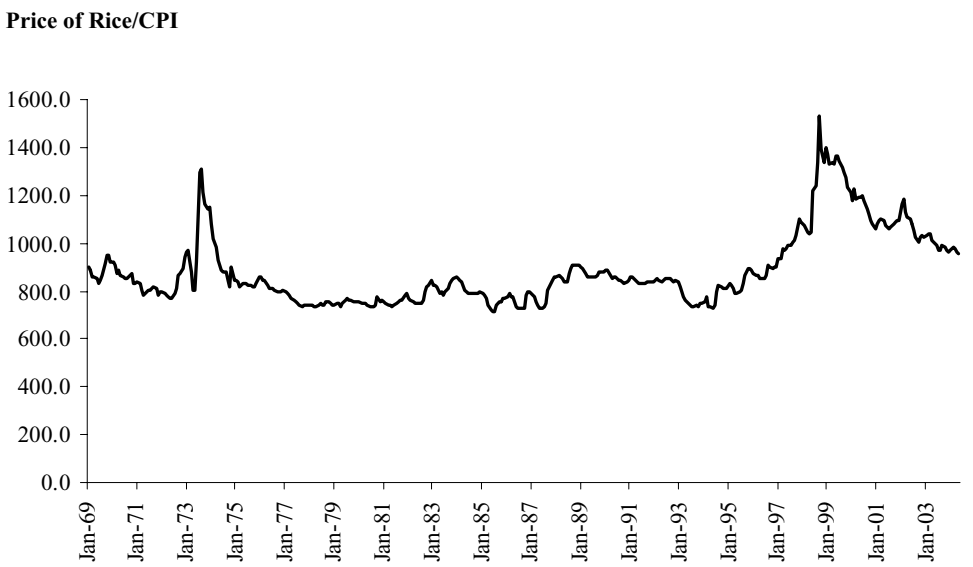

Figure 1 Real price of rice, Indonesia, 1969–2003.
Note: Units are Rp. per kg., 1996 prices. Source: Bulog (rice prices) and Central Bureau of Statistics, Jakarta (CPI).

force at the farm level alone. These points apply with particular force for the lowest income groups, for whom both the average share of rice in total consumption and the dependence on rice production as a source of employment far exceed the average for the whole population. For example, for that part of the workforce with only primary school education or less, the production of paddy (rice produced at the farm level) accounts for 18 per cent of total employment.

Indonesia is a net importer of rice, although the magnitude of its imports varies depending on domestic production, international prices, the size of Indonesia's stocks and the government's rice import policy. Over the 4 years following the Asian financial crisis of 1997–1998 (1998–2001, inclusive) Indonesia's rice imports were 9.1 per cent of its total consumption of rice and 18 per cent of the world's total imports, making Indonesia the world's largest importer. Thailand was the largest exporter, followed by Vietnam and the USA.

Before the financial crisis Indonesia's rice imports were monopolised by a public food marketing agency, *Bulog*. Figure 1 shows that the real price of rice in Indonesia was relatively stable from 1969 to 1996, except during the 1973 commodity price boom. The real price surged temporarily during the exchange rate volatility and inflation of 1997–1998, but its post-crisis level was above its level over the previous three decades, even though international rice prices have declined relative to other

higher than this, but the difference arises not from a difference in estimated expenditure on rice (the numerator), but a difference in *total* expenditures (the denominator). It appears that *Susenas* understates expenditures on non-food items, leading to the impression that rice expenditures are proportionately more important than they are.

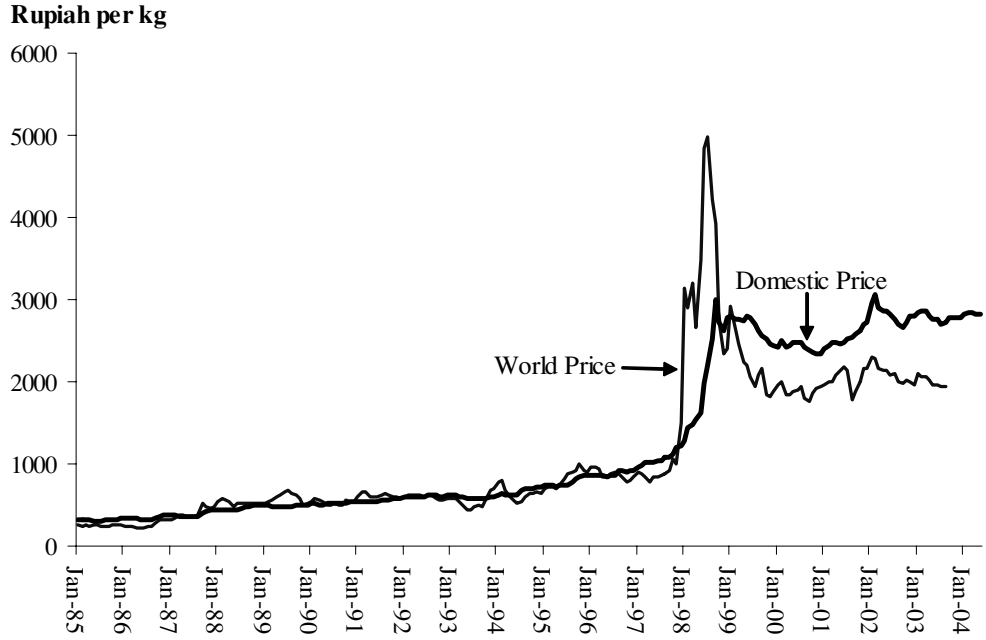

Figure 2 World price and domestic price of rice, Indonesia, 1985–2004.
Note: 'World price' means c.i.f. import price of milled rice in $US converted to Rupiah in current prices using market exchange rate. 'Domestic price' means market price in Jakarta of milled rice in Rupiah, current prices. Source: Bulog (rice prices) and Central Bureau of Statistics, Jakarta (exchange rates).

traded commodities. From this and from Figure 2, it is apparent that until the 1997–1998 crisis the effects of *Bulog*'s market interventions were to stabilise rice prices relative to international prices at a level not significantly different from the trend level of world prices (Timmer 1996, 2005). With the exchange rate volatility of the crisis period, local currency prices of imported rice surged. Despite this, Indonesian domestic prices remained below exchange rate adjusted world prices for a brief period, but from circa 2000 onwards they stabilised at levels 30–35 per cent *above* import prices.

The large difference between the domestic and import price arose from changes in rice import policy that followed the 1997–1998 crisis. *Bulog*'s monopoly on rice imports was abolished in 1998, but this agency still accounted for approximately 75 per cent of total imports. From 2000 onwards, private imports were subject to a specific tariff (rather than an *ad valorem* tariff) of Rp. 430 per kg. This was equivalent to 21.4 per cent of the average import price (c.i.f.) from January 2000 to December 2003 (Rp. 2007 per kg). The average domestic price over the same interval (Rp. 2643) exceeded the c.i.f. import price by 31.7 per cent. In addition, private sector rice imports were subject to 'red lane' customs treatment, meaning stricter standards of customs inspection than other food items, and were also subject to special import licensing requirements. The tariff plus these non-tariff barriers account for the increased difference between the domestic price and the landed price of imported rice.

In 2003, the Ministry of Agriculture proposed an increase in the tariff of 75 per cent – from Rp. 430 to 750 per kg – raising the *ad valorem* equivalent tariff from 21 per cent to approximately 37 per cent. The tariff increase was opposed by the Ministry of Finance, which has ultimate responsibility for all taxes, but not for non-tax instruments like an import ban, which in the case of rice is under the joint authority of the Ministry of Trade and the Ministry of Agriculture. In early 2004, a ban on rice imports was introduced. The ban was said to be 'seasonal', but more than a year later it remained in place and the word 'seasonal' had been dropped. Nevertheless, special exemptions and a certain amount of smuggling apparently still permitted some imports of rice to enter Indonesia.

A truly 'seasonal'; ban – one implemented only during specific, pre-announced times of the year – would have little effect. Anticipating the ban, importers would stockpile imports during periods when the ban was not in place, hoping to benefit from higher prices during the ban season. Holding the international price constant, the effect would merely be to force importers or others to incur more storage costs than would otherwise be optimal. Because of these costs, there would be a small price increase during the period of the ban, compared with the price that would otherwise obtain, but otherwise no effect. To be effective, a ban must be permanent, or at least unanticipated. However, a seasonal ban is capable of insulating the domestic price from temporary fluctuations in the international price which might occur during the period of the ban and which would otherwise be transmitted to the domestic price.

The following section summarises the debate over rice protection in Indonesia. The next section briefly describes the *Wayang* general equilibrium model of the Indonesian economy, which is then applied to the analysis of the distributional effects of a restriction of rice imports, focusing on its effects on poverty incidence. The analysis uses considerable sensitivity analysis around the assumed values of key parameters. The final section concludes.

2. The debate over rice protection

2.1 The argument for protection

Arguments supporting restrictions and/or tariffs on rice imports have come in part from *Bulog* and the Ministry of Agriculture. First, it has been said that without protection Indonesia's rice sector cannot achieve the goal of rice self-sufficiency – a strongly held objective of many of Indonesia's political leaders (World Trade Organization 2003) despite its lack of any sound economic foundation.

Second, protection has been said to be necessary because world rice prices are 'distorted' by export subsidies in major exporting countries. This argument is seemingly no stronger than the first (Erwidodo and Ratnawati 2004). If rice import prices were to be permanently depressed by exporter policies which amount to 'dumping', then no matter how 'distortionary' these policies may be from a global perspective, Indonesia's most rational policy would be to adjust to this feature of its international environment and reallocate resources accordingly, rather than to protect its domestic economy from the cheaper imports which the exporting countries now (so kindly) provide.

Third, protection has been said to be desirable because it has favourable income distributional effects. Compared with free trade, protection would supposedly reduce poverty because by raising the domestic price of rice it increases the incomes of poor farmers.

2.2 The argument against protection

Critics of protection for the rice industry have questioned the third of these arguments in particular. The distributional case for protection is at most a second-best argument. It assumes that first-best instruments like the social safety nets that were established in the aftermath of the Asian economic crisis are unavailable for redistributing incomes to poor farmers and/or other poor groups. However, the critics of protection have denied that protection of the rice industry really does benefit the poor, claiming that an increase in the domestic price will actually increase poverty incidence. The analysis advanced most frequently distinguishes net producers and net consumers of rice. It says that protection benefits the former at the expense of the latter.

The 'net producers' are sellers of rice, meaning farmers owning rice-producing land and renters of this land. The 'net consumers' are rural landless labourers, producers of agricultural commodities other than rice and virtually all urban residents, except for absentee owners of rice-producing land. This group also includes many farmers who produce some rice but who purchase additional rice with the proceeds from other sales. It is pointed out that there are more poor people among the net consumers than the net producers.

Based on these and similar arguments, several studies have claimed that by abandoning protection of the rice industry, Indonesia could achieve very large reductions in poverty. Examples include a quantitative study by Ikhsan (2002), which focuses on the way price increases affect consumers, and the various Working Papers and Policy Briefs produced by the Indonesian Food Policy Program sponsored by United States Agency for International Development (USAID).[2]

One difficulty with the argument that protection of the rice industry worsens income distribution is that most, but not all, of the analyses concerned focus on *counting* the numbers of poor people in each group. This approach disregards the potentially larger magnitude of the benefit received by each net producer from a price increase than the loss incurred by each net consumer. But this point is not necessarily decisive and there is a potentially more serious defect in the anti-protection argument.

The net producer/net consumer framework is partial equilibrium in character. The net producers are all supposed to gain from a price rise, while the net consumers all lose. The supposed beneficiaries – net producers – include only owners and renters of rice land. It is implicitly assumed that a price increase would affect net consumers of rice only through the consumer prices they face, and not through their incomes. For example, landless labourers employed in the rice sector, which includes vast numbers of poor people, are counted among the net consumers of rice – the supposed losers from protection – because they derive their incomes from the sale of their labour, rather than the sale of rice.

[2] These reports are available at www.macrofoodpolicy.com.

But suppose that rice producers respond to the increase in prices with an increase in rice output. Expansion of rice production would, in itself, increase the demand for unskilled labour. This would in turn be reflected in some combination of increased employment of otherwise unemployed unskilled workers and an increase in their real wages. Evidence in Manning (1998, pp. 114–133) and the earlier studies he cites confirms that the real wages of both skilled and unskilled workers are responsive to changes in the demand for labour. Because unskilled labour is the major asset of the poor, an increase in demand could affect the incomes of large numbers of net consumers. However, the argument that has been advanced against protection of Indonesia's rice industry ignores any such effects.

2.3 Supply response of domestic rice producers

It seems likely that long-run supply response in the Indonesian rice industry would be inelastic, but would it be zero? The nature of crop production is that supply response typically occurs only with some delay – say, 6 months to 2 years. So long as it remains in place, protection increases the domestic price *permanently*. The implicit assumption of zero supply response, implying zero income effect for 'net consumers', may be appropriate for the very short run – say, periods of less than 1 year – but possibly not for longer periods.

Several empirical studies have looked at the issue of supply response in the Indonesian context. A 1975 study by Mubyarto on the elasticity of rice planting area with respect to price, cited by Irawan (1997), estimated the long-run elasticity to be very low, at 0.03. Irawan (2002) cites two subsequent studies of the elasticity of planting area with respect to price. These were: a 1988 study by Tabor which estimated that in Java this elasticity was 0.22 in wet-land rice production and 0.45 in dry-land production; and a 1996 study by Hutauruk which estimated the same elasticity on Java to be 0.04 and off Java to be 0.78. Because the overall elasticity of supply includes the response of yield to price as well as the response of planted area, the implied output supply elasticities with respect to price will exceed these estimates.

Irawan (2002) estimates short- and long-term price elasticities of output supply for several regions and for both wet- and dry-land rice production. The short-term estimates for wet-land rice were: Java 0.11, Sumatra 0.12, Sulawesi 0.45 and Kalimantan 0.02. The long-run estimates were: Java 0.13, Sumatra 0.52, Sulawesi 1.25 and Kalimantan 0.21. His estimates for dry-land rice supply response are generally approximately 50 per cent larger than the above estimates. For example, the long-run estimate for dry-land rice supply response for Java is 0.21.

In summary, the available econometric evidence, while thin, supports the view that in Indonesia the overall elasticity of supply response of rice is low, but not zero. The estimates are higher in the long run than the short run, higher in dry-land conditions than wet-land conditions and generally higher off-Java than on-Java. The true value of the long-run elasticity of rice output with respect to price for Indonesia remains uncertain. Estimates in the range of 0.2–0.4, but *not* zero, would be consistent with the available evidence.

2.4 The optimal tariff argument

In the case of Indonesia's rice imports there is a possible further case for protection which rests on economic efficiency alone – the 'optimal tariff argument'. Strangely, the current debate on rice protection has ignored this argument, even though its potential implications are significant. Indonesia is a large importer of rice relative to the world market and seemingly possesses a degree of monopsony power. Higher imports from Indonesia will induce some increase in the world price. The marginal cost of Indonesia's imports therefore exceeds the world price. In these circumstances, starting from a position of zero protection, it is possible to raise national income by restricting imports. In a famous contribution, Harry Johnson demonstrated that if the elasticity of supply of imports to a country is ε, then the rate of tariff which maximises national income is $1/\varepsilon$ (Corden 1974). The lower the elasticity, the higher the optimal tariff. For example, if the elasticity of world supply was 5, the optimal tariff (or tariff-equivalent restriction of imports) would be 20 per cent.

How important could the optimal tariff argument be in the case of Indonesia's rice imports? Econometric estimates of the supply of imported rice to Indonesia have apparently not been undertaken, but a closely related question has been studied in depth. This is the elasticity of demand for rice on the world market for the world's largest exporter, Thailand. Indonesia's rice imports come primarily from Thailand, so the types of rice involved are identical. Suppose first that Thailand exported 1 million tons of *additional* rice onto the world market. The world price would fall, somewhat. Now suppose that Indonesia imported 1 million tons *less* rice from the world market. Again, the world price would fall, by the same amount.

Studies of the long-run elasticity of demand for Thailand's rice exports are reviewed in Warr (2001). They have produced estimates ranging from -2.5 to -5. If the volume of Indonesia's imports was the same as the volume of Thailand's exports, the elasticity of supply of rice imports to Indonesia would be the same as this but with the opposite sign. Over the 3 years (1998–2000), Indonesia's rice imports were approximately 70 per cent of the level of Thailand's rice exports, implying elasticities of supply of between 3.6 and 7.2. These elasticities imply optimal tariffs of 28 per cent and 14 per cent, respectively.

The central problem with this analysis, however, is that the econometrically based evidence almost certainly understates the true long-run elasticities of world supply. If the world price were to rise permanently, say because a major importer like Indonesia increased its imports relative to the level they would otherwise have taken, new suppliers would almost certainly enter the world market. But because these suppliers are not exporters at current world prices, their supply response behaviour is not reflected in available statistical data. This means the above estimates are almost certainly *upper bounds* on the values that an optimal tariff could reasonably take. The true value of the long-run elasticity of supply of rice imports to Indonesia would probably lie between 7 and 10. Tariffs in the neighbourhood of 10–14 per cent would therefore seem the largest that could be justified through the optimal tariff argument, based on maximisation of national income; but the optimum is presumably *not* zero.

The optimal tariff argument could never justify a complete ban on imports because a ban nullifies the terms of trade benefit that is central to the analysis. Furthermore,

even a partial ban (a binding but not prohibitive quantitative restriction) differs from a tariff in that it generates rents to the recipients of the import quotas rather than revenue for the government. In any case, the 'optimal' levels of protection discussed above relate to the maximisation of national income and ignore distributional effects. Protection also has distributional consequences. The analysis presented in this paper shows how these effects can be analysed.

3. The *Wayang* general equilibrium model

An adequate analysis of the distributional effects of a restriction on rice imports must take account of its effects on households' expenditures, disaggregated by household group, but also its effects on their incomes. This requires taking account of its effects on the labour market as well as on the returns to land. In doing this, the rice industry could not be considered in isolation. A change in unskilled wages would affect profitability in other industries, with effects on outputs, employment and prices in those industries. These effects would have repercussions on household incomes, which must then be balanced against the negative effects on consumers of an increase in the consumer price of rice. However, the consumption of rice could not be considered in isolation either. An increase in the price of rice would have implications for the demand for other staple foods, such as those based on corn and wheat flour, another significant import. Finally, import restrictions generate rents to quota holders and these also need to be considered.

For analysing the distributional effects of trade policy, a general equilibrium treatment is essential. The debate over Indonesia's rice protection illustrates this point. The economic issues involved are complex and interrelated. A framework is required which accounts for these interactions and which is internally consistent, meaning that it simultaneously satisfies all relevant market-clearing conditions and macroeconomic constraints. To address issues of poverty and inequality, such a framework must also include a disaggregated household sector. Moreover, as the above discussion has shown, the full effects of rice protection depend on the values of key economic parameters the true values of which are uncertain. A framework is therefore needed in which the values of key parameters can be varied to determine the sensitivity of the results to the assumed values of these parameters.

This study applies the *Wayang* general equilibrium model of the Indonesian economy (Warr *et al.* 1998; Wittwer 1999). Only its essential features are summarised here. A longer version of the present paper (Warr 2005) describes the model in greater detail and discusses the model closure and results more fully. Previous studies using the model include Warr and Thapa (2002) and Fane and Warr (2003). *Wayang* belongs to the class of general equilibrium models which are linear in proportional changes, which also includes the influential ORANI general equilibrium model of the Australian economy (Dixon *et al.* 1982), but the structure is adapted in light of Indonesian conditions. It is solved using the multi-step procedure described by Codsi *et al.* (1991). The principal structural features of the model are summarised in Table 1.

The model's database is derived from the Indonesian Input-Output Table for 2000, the Social Accounting Matrix (SAM) for 2000, and the 1999 *Susenas* household income and expenditure survey, all published by the Indonesian Central Bureau of Statistics.

Table 1 Structure of the *Wayang* general equilibrium model

Industries	Commodities	Factors	Households
Agricultural sectors: 18	Producer goods: 65	Skilled labour: 1	Rural households, in 7 socioeconomic categories: 700
Resource sectors: 5	Consumer goods: 20	Unskilled labour: 1	
Other sectors: 47		Capital mobile within agriculture: 1	Urban households, in 3 socioeconomic categories: 300
Total industries: 65		Sector-specific agricultural land: 18	
		Capital mobile within non-agriculture: 1	
		Sector-specific non-agricultural capital: 47	

Source: For further detail on *Wayang* model structure, see Warr (2005).

Table 2 compares the cost structure of the paddy industry (farm-level production of rice) with other agricultural industries and with the non-agricultural sectors. Contrary to what might be supposed, the paddy industry is not particularly intensive in its use of unskilled labour, which accounts for only 4.3 per cent of total costs and 5.25 per cent of total variable costs, both well below other agricultural industries and the rest of the economy, on average. This point will be important for later discussion.

The model contains 10 major household categories – seven rural and three urban – as identified in the Indonesian SAM. They are summarised in Table 3. The sources of income of each of these household types depend on their ownership of factors of production, as summarised in Table 4. The SAM is based primarily on the household income and expenditure survey called *Susenas*. Drawing on the 1999 *Susenas* data, each of the 10 household categories is subdivided into a further 100 subcategories each of the same population size, arranged by real consumption expenditures per capita, giving a total of 1000 subcategories. The consumer demand

Table 2 Cost shares of major factors of production: paddy and other industries (per cent of industry's total costs)

Cost components	Paddy	Other agriculture	Non-agriculture	All industries
Unskilled labour	4.3	9.0	8.7	8.5
Skilled labour	3.1	6.6	9.8	9.3
Mobile agricultural capital	20.6	21.3	–	2.3
Mobile non-agricultural capital	–	–	20.5	18.2
Land	18.1	20.2	–	2.1
Non-land fixed capital	–	–	11.7	10.5
Intermediate inputs	53.9	42.9	49.3	49.1
Total	100	100	100	100

Source: Database of *Wayang* model, based on Indonesian Input–Output Table, 2000, and Social Accounting Matrix, 2000, Central Bureau of Statistics, Jakarta.

Table 3 Household categories of *Wayang* model

Code	Name	Socioeconomic category	Characteristics
R1	Rural 1	Agricultural employees	Agricultural workers not owning land
R2	Rural 2	Small farmers	Agricultural workers owning land <0.5 ha
R3	Rural 3	Medium farmers	Agricultural workers owning land 0.5–1 ha
R4	Rural 4	Large farmers	Agricultural workers owning land >1 ha
R5	Rural 5	Rural low income	Non-agricultural households in rural areas
R6	Rural 6	Rural non-labour	Non-labour force and unclassified households, rural areas
R7	Rural 7	Rural high income	Non-agricultural rural managers, technicians, professionals, skilled workers
U1	Urban 1	Urban low income	Small urban store owners, entrepreneurs, personal service providers, clerical and manual workers
U2	Urban 2	Urban non-labour	Non-labour force and unclassified households, urban areas
U3	Urban 3	Urban high income	Urban managers, technicians, professionals, large entrepreneurs and skilled clerical workers

Source: Based on Central Bureau of Statistics, Social Accounting Matrix, 2000, Jakarta. Note: The *Wayang* model has 100 subcategories for each of the above 10 household categories, disaggregated according to real per capita expenditure, making a total of 1000 household subcategories.

equations for the various household types are based on the linear expenditure system. Within each of the 10 major categories, the 100 subcategories differ according to their budget shares in consumption.

Table 5 summarises the characteristics of the 10 major household categories in so far as they relate to poverty incidence. Poor people are found in all 10 household categories, in proportions varying from roughly 40 per cent (Rural 1) to 5 per cent (Urban 3). To illustrate, Figure 3 shows the cumulative distribution of real expenditures for the poorest of the 10 household categories, Rural 1. The officially calculated level of poverty incidence for this household is 39.8 per cent and the poverty line which

Table 4 Sources of factor incomes of the household categories (per cent of household income)

	Land	Skilled labour	Unskilled labour	Agricultural variable capital	Non-agricultural variable capital	Fixed capital	Total
Rural 1	4.06	1.37	53.62	2.12	9.33	29.50	100
Rural 2	1.58	6.13	26.74	1.38	16.31	47.87	100
Rural 3	9.77	2.71	14.06	4.83	16.05	52.58	100
Rural 4	9.71	3.96	7.76	4.86	17.37	56.33	100
Rural 5	7.55	6.99	43.27	3.57	8.68	29.95	100
Rural 6	2.77	29.18	15.19	1.73	12.74	38.40	100
Rural 7	12.58	20.69	4.47	5.86	12.41	44.00	100
Urban 1	4.13	12.82	24.39	2.35	13.84	42.47	100
Urban 2	3.22	21.97	42.28	1.69	7.42	23.43	100
Urban 3	4.09	23.78	1.33	2.47	16.95	51.38	100

Source: Database of *Wayang* model, based on Indonesian Social Accounting Matrix and *Susenas* survey, 1999, Central Bureau of Statistics, Jakarta.

Table 5 Expenditure and poverty incidence by household group

	% of total population in this group	Mean per capita expenditure (Rp./month)	% of this group in poverty	% of all poor people in this group
Household group				
Rural 1	8.0	3358	39.8	13.9
Rural 2	14.8	3608	34.9	22.4
Rural 3	7.1	7584	32.3	9.9
Rural 4	9.0	6618	27.8	10.9
Rural 5	16.0	3891	23.8	16.5
Rural 6	4.9	12 795	28.0	5.9
Rural 7	5.0	16 060	10.5	2.3
Urban 1	20.4	4210	15.2	13.4
Urban 2	6.1	17 813	11.2	2.9
Urban 3	8.7	14 353	5.0	1.9
Indonesia	100	12 084	23.1	100
Memo items				
Headcount poverty incidence national (%)				23.076
Headcount poverty incidence rural (%)				29.086
Headcount poverty incidence urban (%)				11.980
Gini coefficient national				0.26646
Gini coefficient rural				0.23676
Gini coefficient urban				0.30491

Source: Database of *Wayang* model, based on Indonesian Social Accounting Matrix and *Susenas* survey, 1999, Central Bureau of Statistics, Jakarta.

replicates this level of poverty incidence, using the *Susenas* data, is shown in the diagram. In the simulations, the real values of these poverty lines are held constant, using household-specific consumer price indices, based on household-specific budget shares.

Poverty incidence at the 'rural', 'urban' and 'total' levels is calculated by aggregating poverty incidence at these 10 household category levels, using their respective population shares as weights (Table 5). This produces an estimate of the base level of poverty incidence at the national level of 23.1 per cent. The incidence in rural areas (29.1%) is two and a half times that in urban areas (12%). Fully 81.8 per cent of all poor people reside in rural areas. Inequality is calculated for the rural, urban and total populations by constructing a Lorenz curve separately for each, as shown in Figure 4, and then using an Excel-based spreadsheet calculation to compute the Gini coefficient for each. Figure 4 confirms that inequality is higher in urban than rural areas.

The advantage of working with a general equilibrium model with a highly disaggregated household sector is that it becomes possible to conduct controlled experiments, imposing policy-relevant economic shocks one at a time, and then to focus on the consequences for household incomes, expenditures, poverty incidence and inequality that they imply.

4. The simulations

4.1 The shock

The database of the model was calibrated to reflect a 25 per cent tariff on rice imports. For analytical convenience it was assumed that there was a quantitative restriction in

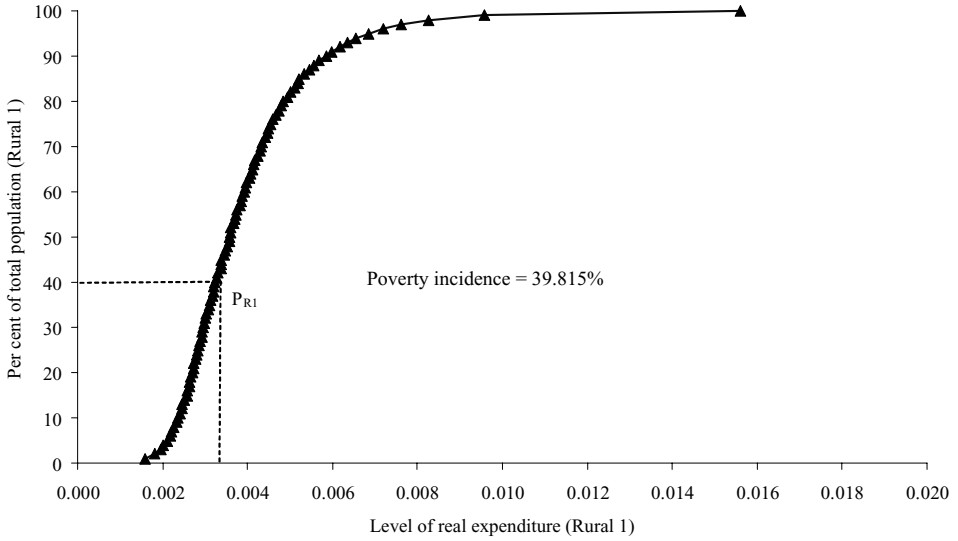

Figure 3 The cumulative distribution of real consumption expenditures per capita – Social Accounting Matrix (SAM) household category Rural 1, 1999.
Source: Author's calculations, based on *Susenas* 1999, Central Bureau of Statistics, Jakarta.

place in this base situation but that the restriction was initially non-binding. The shock then applied to this base solution was a tightening of the quantitative restriction sufficient to reduce the level of imports, relative to this base, by 90 per cent. The remaining imports continue to be subject to the 25 per cent tariff. Imports are not reduced to zero because, although the restriction is called a 'ban', some imports actually persist. The quota licenses are assumed to be owned by the household group Urban 3. The quota rent (revenue obtained from this implicit tax) is distributed in full to this household category, distributed among its 100 centile subcategories in proportion to their household expenditures per capita.

4.2 The closure

The simulations are conducted with balanced trade (exogenous balance on current account), fixed real government spending and fixed real investment demand for each good. The government budget deficit is held fixed in nominal terms. This is achieved by endogenous across-the-board adjustments to personal income tax rates so as to restore the base level of the budgetary deficit.

5. Results

The starting point for the results is Simulation A. In this core simulation:

- The assumed elasticity of supply of rice imports to Indonesia is 10.
- Constant elasticity of substitution (CES) technology is assumed in all industries and the assumed elasticities of substitution are 0.5 in all industries except paddy (rice production) where the value is 0.25, chosen to be consistent with the low values

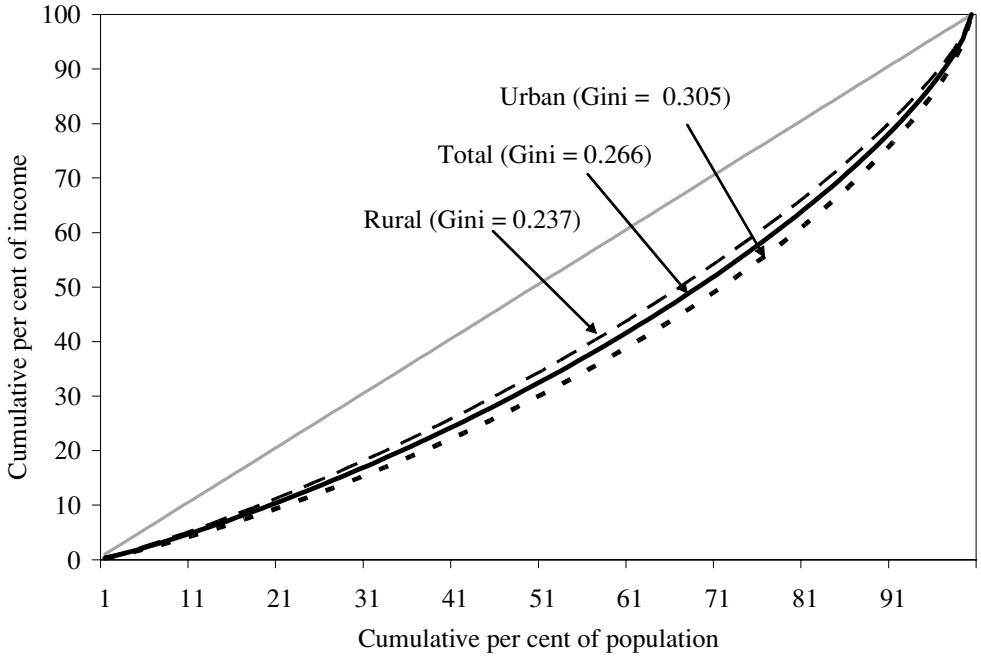

Figure 4 Lorenz curves of the *ex ante* distribution of real expenditures per capita, rural population, urban population and total population, 1999.
Source: Author's calculations, based on *Susenas* 1999, Central Bureau of Statistics, Jakarta.

of the elasticities of supply response which have been estimated empirically for the Indonesian rice sector.

- The Armington elasticity of substitution in rice demand (the elasticity of substitution in demand between imported and domestically produced rice) is 6, consistent with the statistical estimates reported in Warr (2006), implying that imported and domestically produced rice are close substitutes, but not identical.

Each of these parametric assumptions will subsequently be varied, as shown in Table 6. For the time being it is sufficient to focus on Simulation A.

5.1 Effects on the market for imported rice

The effects that the import restriction has on the market for imported rice are summarised in Table 6. As the volume of imports contracts, the import price of rice in foreign currency (c.i.f.) declines somewhat, but not enough to prevent the domestic price – both the producer price and the consumer price – from increasing. The increase in the domestic price stimulates rice production and reduces consumption. From Table 6, the import restriction raises the domestic (landed) price of imports massively, generating a large quota rent, equivalent to an *increase* in the initial tariff, in *ad valorem* terms, of 104 per cent. Clearly, the import ban is a highly protectionist measure.

The results for Simulation A may be understood as follows. Normalising initial prices at 1, the import restriction raises the domestic price from 1 to 1.6074 and lowers the

Table 6 Summary of parametric assumptions and simulated effects on the rice market of a 90 per cent effective rice import ban

Simulation	A	B	C	D	E	F	G	H	I	J	K	L	M	N
Parametric assumptions														
Elasticity of supply of imported rice to Indonesia	10	2.5	5	20	10	10	10	10	10	10	10	10	10	10
Elasticity of substitution in paddy production	0.25	0.25	0.25	0.25	0.15	0.20	0.30	0.35	0.25	0.25	0.25	0.25	0.25	0.25
Armington elasticity of substitution in rice demand	6	6	6	6	6	6	6	6	2	4	8	10	25	100
Effects on rice market – per cent change unless specified														
Quantity of imports	−90	−90	−90	−90	−90	−90	−90	−90	−90	−90	−90	−90	−90	−90
Import price of rice, c.i.f. ($US)	−20.41	−59.87	−36.65	−10.79	−20.41	−20.41	−20.41	−20.41	−20.41	−20.41	−20.41	−20.41	−20.41	−20.41
Domestic price of imports (Rp.)	62.51	62.54	62.52	62.50	65.06	63.56	61.73	61.13	268.36	98.46	47.26	38.81	19.86	10.15
Producer price of milled rice (Rp.)	7.82	7.84	7.83	7.82	9.86	8.66	7.20	6.72	9.30	8.15	7.67	7.58	7.36	7.24
Producer price of paddy (Rp.)	9.23	9.25	9.24	9.22	11.75	10.27	8.46	7.87	10.98	9.61	9.05	8.94	8.68	8.54
Production of milled rice	2.60	2.60	2.60	2.55	2.17	2.42	2.73	2.78	3.06	2.70	2.55	2.52	2.45	2.41
Production of paddy	2.55	2.56	2.55	2.55	2.14	2.38	2.68	2.83	3.01	2.65	2.50	2.48	2.41	2.37
Tariff equivalent of quota (%)	104	305	157	82	107	106	103	102	363	149	85	74	51	38

Source: Author's computations.

import price from 1 to 0.7959. Writing P_R for the domestic price of imported rice, the proportional tariff equivalent of the quota is then given by$t$, where $P_R = P_R^*(1 + t)$, and thus $t = (P_R/P_R^*) - 1$, giving $t = (1.6074/0.7959) - 1 = 1.0396$, or 104 per cent. This tariff equivalent of the quota is *additional* to the 21 per cent tariff in place before the quota, giving a tariff equivalent of the overall package of protection of 125 per cent.

5.2 Macroeconomic results

The macroeconomic results are summarised in Table 7. It is surprising that the increase in rice production does not induce an increase in real unskilled wages, but rather a *decline*. The reason is that while rice production uses large quantities of unskilled labour in total, according to our education-based definition of this category, the paddy industry is not intensive in its use of unskilled labour, as discussed above in relation to Table 2. The cost share of unskilled labour in the paddy industry is only 4.3 per cent, less than the average for all industries (8.5%) and less than the average for other agricultural industries (9%). Unskilled labour cost as a share of all variable factor costs (excluding land and fixed capital) is similarly below the economy wide average and below the average for agriculture.

Table 7 Simulated macroeconomic effects of a 90 per cent rice import ban: varying elasticity of supply of imported rice (per cent change)

Simulation		A	B	C	D
Parameter varied: import supply elasticity		10	2.5	5	20
Overall economy					
Gross domestic product	Nominal (local currency)	0.361	0.445	0.437	0.427
	Real	−0.076	−0.103	−0.084	−0.067
Consumer price index	0.651	0.657	0.654	0.649	
Gross domestic product deflator	0.510	0.548	0.521	0.495	
Wage (nominal)	Skilled	0.115	0.122	0.118	0.112
	Unskilled	0.192	0.200	0.195	0.189
Wage (real)	Skilled	−0.536	−0.535	−0.536	−0.537
	Unskilled	−0.459	−0.457	−0.458	−0.460
External sector (foreign currency)					
Export revenue		−0.212	−0.219	−0.214	−0.207
Import bill		−0.136	−0.126	−0.133	−0.142
Government budget (local currency)					
Revenue (local currency)	Total revenue	0.575	0.587	0.580	0.570
	Tariff revenue	0.220	0.230	0.224	0.216
Expenditure	Nominal (local currency)	0.485	0.494	0.488	0.480
	Real	−0.167	−0.164	−0.166	−0.169
Household sector					
Consumption	Nominal (local currency)	0.380	0.398	0.388	0.375
	Real	−0.267	−0.258	−0.264	−0.272

Source: Author's computations.

When the paddy industry expands, large quantities of intermediate goods are demanded, such as fertiliser, along with mobile agricultural capital, drawn from other agricultural industries, but small additional numbers of unskilled workers are hired directly in paddy production. These other agricultural industries are on average more labour-intensive than paddy. The mobile capital drawn from them lowers the productivity of unskilled labour in those industries, reducing their demand for unskilled labour by an amount which outweighs the increased demand in paddy production. Overall demand for unskilled labour *falls*, and unskilled wages decline, in real terms, rather than rise. This point is important for the simulated effects on poverty.

5.3 Effects on poverty and inequality

The simulated effects on poverty and inequality are summarised in Table 8. The results have the following important features:

1. *Overall poverty incidence rises*. The changes in real consumption expenditures are dominated by increased living costs, resulting in a reduction in the real expenditures of the poor and an increase in poverty incidence. Poverty incidence increases in all household categories, in both rural and urban areas, but the increase in urban areas (approximately 0.3%) is smaller than the rural increase (approximately 1%). The central reasons are: (i) urban budget shares for rice are in general well below rural budget shares; and (ii) the real return to unskilled labour declines and urban households receive, on average, a lower share of total income from this source.
2. *Overall inequality (measured by the Gini coefficient) increases very slightly*. Inequality increases in both rural and urban areas, but the magnitudes are trivial. The increase in rural inequality is a consequence of the increase in the return to land, which rises relative to the return to unskilled labour. The increase in urban inequality arises from the decline in real skilled and unskilled wages, which raises the return to capital.
3. *Within each of the10 household categories, households are not affected uniformly.* This is an interesting feature of the results and is illustrated in Figure 5, which is smoothed to reduce the 'noise' caused by fluctuations in the expenditure shares of rice as expenditures increase within each household category. Each of the 10 curves shows, for that socioeconomic group, the distribution across the 100 household centile subcategories (horizontal axis) of the proportional changes in real consumption expenditures (vertical axis). Points below the horizontal axis correspond to a decline in real expenditures (welfare loss) and points above it correspond to an increase (welfare gain). The figure thus summarises the distribution of gains and losses from the import ban, across the entire population.

A key point is that the curves slope up for each household; the proportional change in real consumption increases with the level of real expenditure. The principal reason is that the share of rice in total household expenditures declines as the level of total expenditures increases. Real consumption declines in all households with real expenditures in the neighbourhood of the poverty line, which is why poverty incidence rises

Table 8 Simulated distributional effects of a 90 per cent rice import ban: varying rice import supply elasticity (per cent change, except poverty incidence and Gini coefficient)

Simulation			A	B	C	D
Parameter varied: import supply elasticity			10	2.5	5	20
Real consumption expenditures, deflated by household-specific CPI (% change)						
Rural	Rural 1		−0.608	−0.652	−0.607	−0.609
	Rural 2		−0.539	−0.593	−0.538	−0.540
	Rural 3		−0.906	−0.944	−0.905	−0.907
	Rural 4		−0.910	−0.949	−0.909	−0.911
	Rural 5		−0.354	−0.418	−0.353	−0.355
	Rural 6		−0.666	−0.712	−0.665	−0.667
	Rural 7		−0.072	−0.014	0.075	0.071
Urban	Urban 1		−0.020	−0.099	−0.019	−0.022
	Urban 2		−0.319	−0.389	−0.318	−0.321
	Urban 3		0.190	−0.708	0.203	0.168
Poverty Incidence (% population concerned)		*Ex ante*	*Simulated outcomes*			
Rural households	Rural 1	39.815	40.475	40.518	40.475	40.477
	Rural 2	34.890	35.358	35.396	35.358	35.360
	Rural 3	32.294	32.994	33.232	32.994	32.995
	Rural 4	27.821	29.733	29.767	29.733	29.734
	Rural 5	23.779	25.244	25.306	25.243	25.246
	Rural 6	28.009	28.665	28.699	28.665	28.665
	Rural 7	10.501	10.573	10.655	10.572	10.575
Urban households	Urban 1	15.216	15.684	15.781	15.683	15.687
	Urban 2	11.162	11.325	11.342	11.325	11.326
	Urban 3	4.998	5.020	5.221	5.018	5.025
Rural population		29.086	30.032	30.103	30.033	30.035
Urban population		11.980	12.284	12.394	12.284	12.288
Total population		23.076	23.795	23.881	23.798	23.800
Gini coefficient of inequality (index)		*Ex ante*	*Simulated outcomes*			
Rural population		0.23676	0.23754	0.23752	0.23754	0.23754
Urban population		0.30491	0.30581	0.30572	0.30581	0.30580
Total population		0.26646	0.26737	0.26726	0.26737	0.26737

Source: Author's computations. CPI, consumer price index.

within each household category. However, households with high real expenditures in categories Rural 7 and Urban 1 gain from the import quota. The principle reasons for this result are that, compared with other households, these richer households: (i) have smaller shares of rice in their total expenditures; and (ii) are less reliant on wages as a source of income. They are thus less affected than others by the increase in the consumer price of rice and the decline in real wages.

To illustrate, consider the household category Rural 4. In Figure 5, the expenditure centile subcategory corresponding to the poverty line is indicated by the point marked P_{R4}. This point lies well below the horizontal axis, meaning that real expenditure for this subcategory falls. Real expenditure for all other poor households within the category Rural 4 (expenditure centiles below P_{R4}) also declines. *All* poor households in this socioeconomic category lose. Poverty incidence must be rising within the Rural

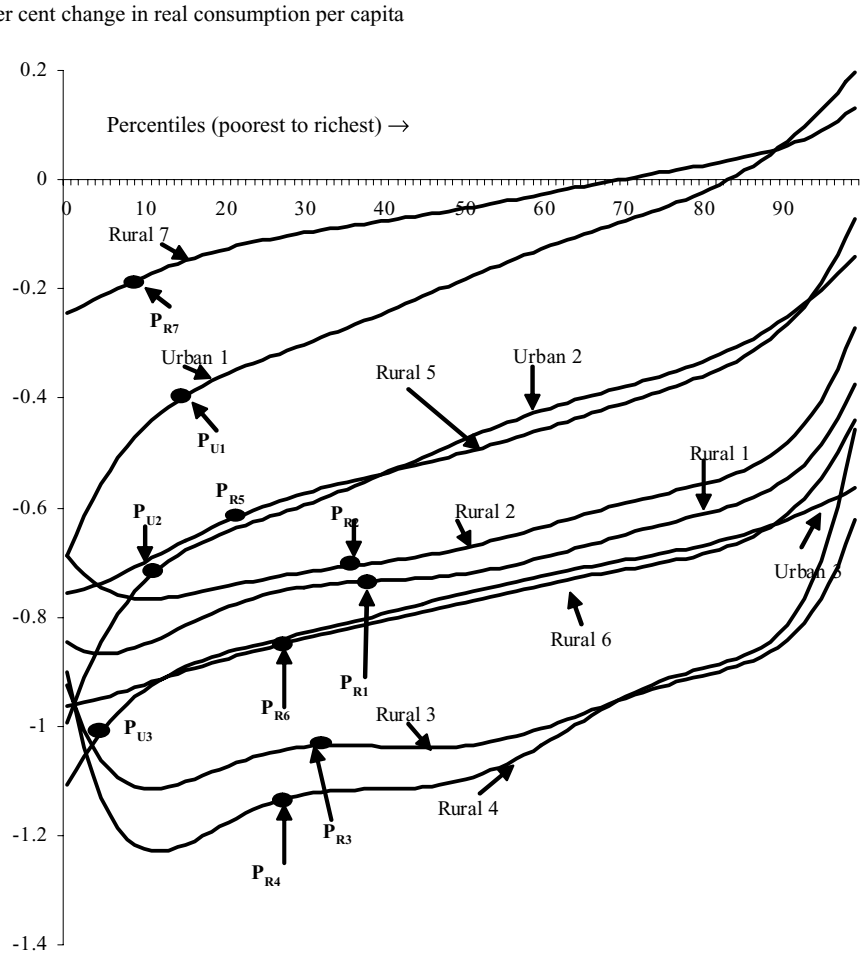

Figure 5 Simulation A: changes in real consumption by household category.
Source: Author's calculations.

4 category. But this statement applies to *every one* of the 10 household categories. Poverty incidence must be rising within each of them, as Table 8 confirms.

Figure 6 illustrates the way that the change in poverty incidence is calculated. The figure focuses on household Rural 4 and magnifies the section of the cumulative distribution of real expenditures for that household category that is close to the poverty line. The lower line (solid line) shows the *ex ante* distribution for household Rural 4 and the upper line (dashed line) shows the *ex post* distribution following Simulation A. Under the assumptions of Simulation A, as a result of the quota restriction, estimated poverty incidence within this household increases from 27.8 to 29.7 per cent.

6. Effects of varying key parameters

To what extent do the results summarised above depend on the values of key parameters assumed in Simulation A? This question arises because the above discussion

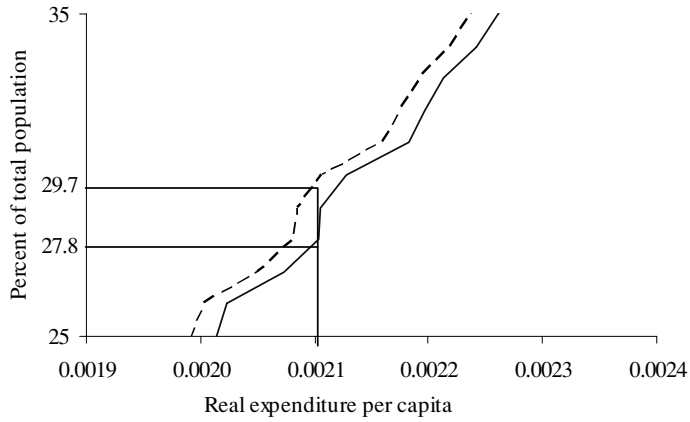

Figure 6 Estimated cumulative distribution of real consumption expenditures: household Rural 4, before and after Simulation A.
Note: The bottom line (solid) corresponds to the *ex ante* distribution (poverty incidence = 27.821) and the top line (dashed) corresponds to the *ex post* distribution resulting from Simulation A (poverty incidence = 29.733). Source: Author's calculations.

indicates that there is uncertainty about the true values of several parameters which seem particularly relevant. We shall vary, in turn, the elasticity of supply of rice imports to Indonesia, the elasticity of supply response of paddy with respect to its price, and the Armington elasticity of substitution in demand between domestically produced and imported rice.

6.1 The elasticity of supply of rice imports

Simulation A assumes that imports of rice are available to Indonesia with an elasticity of supply of 10. Values of 2.5, 5 and 20 are also considered, in Simulations B, C and D, respectively, and the simulated implications are summarised in detail in Tables 6–8. The implications for poverty incidence at the national, rural and urban levels are summarised graphically in Figure 7. Poverty increases in every case, including both rural and urban poverty incidence. It is argued above that values of this parameter below approximately 5 are implausible, but even in such cases poverty incidence increases.

Lower values of the supply elasticity of rice imports to Indonesia imply larger terms-of-trade benefits for a given level of import restriction, but these terms-of-trade effects are insufficient to prevent increased poverty incidence. The reason is that when the elasticity of world supply is low, very large increases in the domestic price of imported rice are required to achieve the 90 per cent reduction in the quantity of imports. Although the import price is forced down by the reduced quantity of imports, from the viewpoint of domestic consumers this price reduction is more than compensated by the implicit tax on rice imports. Improved terms of trade make possible increased imports of other goods, but this effect is dominated by the increased consumer price of rice.

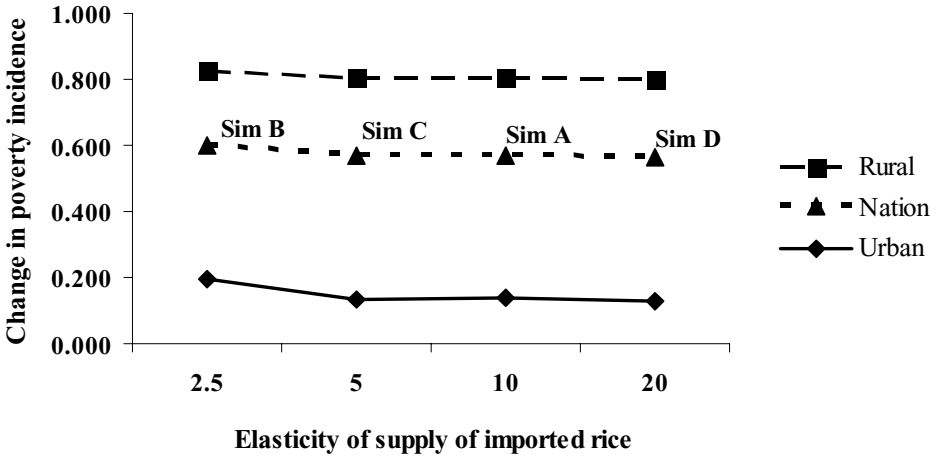

Figure 7 Simulated changes in poverty incidence: varying elasticity of world supply of imported rice.
Source: Author's calculations.

6.2 The price elasticity of supply response for paddy

It can be shown that the partial equilibrium elasticity of supply response with respect to the price of output is related to the parameters of the model by the equation $E_S = \sigma S_V/(S_F H_P)$, where E_S is the familiar partial equilibrium elasticity of supply response, σ is the elasticity of substitution between factors of production in the CES production function for paddy, S_V and S_F are the shares of variable and fixed factors, respectively in primary factor cost in paddy production (the variable factors are labour and mobile capital; the fixed factors are land and fixed capital), and H_P is the share of primary factors (labour, capital and land) in total costs in paddy production (the share of all inputs except intermediate, material inputs).

Higher values of σ imply greater supply response. The parametric assumptions underlying Simulation A imply an elasticity of supply response of 0.31, roughly consistent with the empirically estimated values of this response parameter, as reviewed above. It is possible to vary this implied elasticity by varying the assumed elasticity of substitution. Simulations E, F, G and H do this. The assumed elasticities of substitution of 0.15, 0.2, 0.3 and 0.35 imply elasticities of supply response of 0.186, 0.248, 0.372 and 0.434, respectively. This would seem to cover the full range of plausible values of this parameter, given the available empirical evidence. The results are summarised in Figure 8.

The elasticity of substitution in paddy production has no bearing on the expenditure-side effects that are the dominant source of the increased poverty, but it does affect changes in incomes. The larger this elasticity of substitution, the greater the supply response and the smaller is the reduction in the real wages of unskilled labour, and hence the smaller the increase in poverty incidence. Nevertheless, this effect is in every case too small to reverse the sign of the change in poverty incidence. Poverty incidence increases throughout the range.

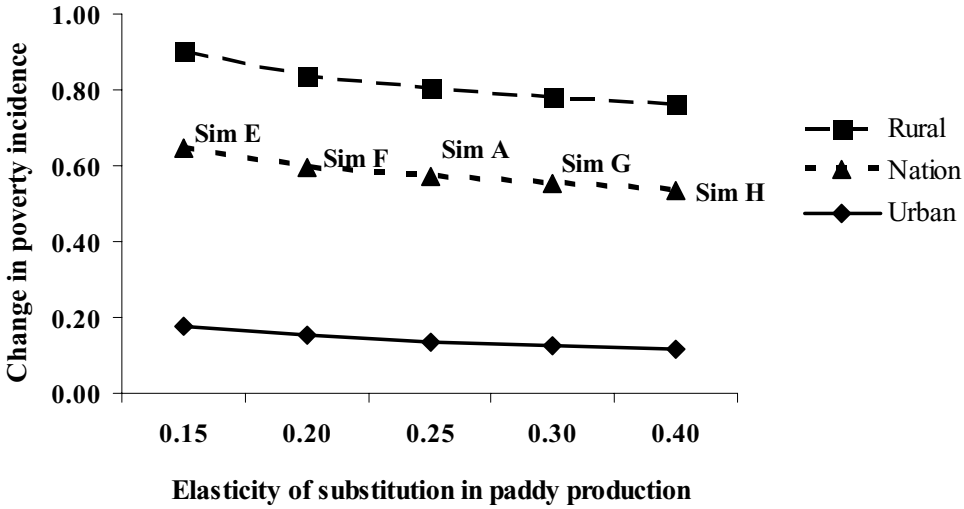

Figure 8 Simulated changes in poverty incidence: varying elasticity of substitution in rice production.
Source: Author's calculations.

6.3 The Armington elasticity of substitution in rice demand

Higher values of the Armington elasticity of substitution in demand between imported and domestically produced rice imply closer substitution between these two forms of rice. When this parameter is increased, the simulated increase in poverty incidence declines, but it does not change in sign. These results are summarised in Figure 9.

Increasing the Armington elasticity does *not* imply larger increases in the price of domestically produced rice, for a given level of quota restriction, as it would with a

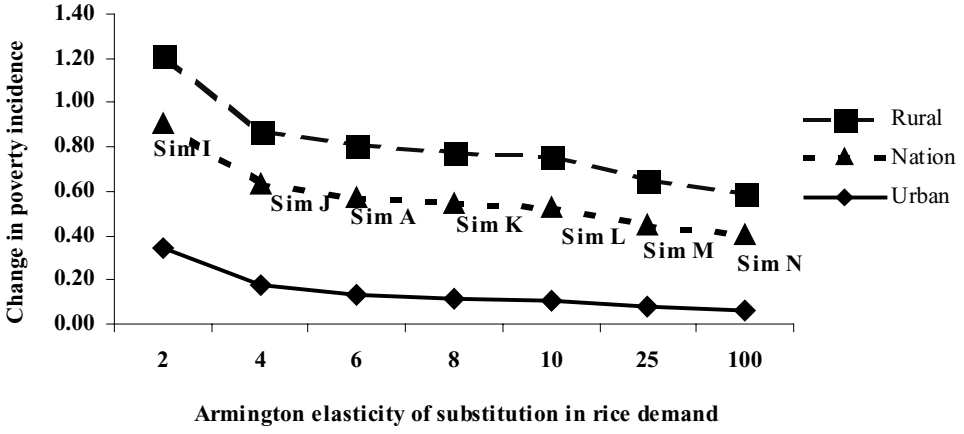

Figure 9 Simulated changes in poverty incidence: varying Armington elasticity of substitution in rice demand.
Source: Author's calculations.

fixed *ad valorem* tariff, but rather smaller increases in the landed price of imported rice. This feature of the results is shown clearly by Table 6 (see the columns for Simulations I–N). Imports are a small share of domestic consumption. Greater substitutability between imports and domestic rice reduces the rents obtainable from the quota on imported rice. The increase in the consumer price of rice, including both imported and domestically produced rice, actually declines as the Armington elasticity is increased and the estimated increase in poverty incidence is correspondingly smaller.

7. Conclusions

Before the 1997–1998 economic crisis, Indonesia was the world's largest importer of rice. Following the crisis, the movement towards a more democratic form of government in Indonesia has so far coincided with a more protectionist policy towards the rice industry. After a brief period of free imports there was first a tariff, at a rate equivalent to approximately 21 per cent of the import price. Then, from early 2004 onwards, rice imports have been officially banned, although some imports do continue to enter. It has been claimed, in support of the ban, that it reduces poverty by assisting poor farmers. This paper presents a full general-equilibrium analysis of these issues within a framework that includes all major socioeconomic groups within Indonesia. The analysis disaggregates households in considerable detail and also varies the assumed values of key parameters across the seemingly plausible range.

The results indicate that a 90 per cent effective ban on rice imports increases rice prices by 125 per cent, six times the amount of the pre-2004 tariff. Poverty incidence in Indonesia rises by a little under 1 per cent of the population – approximately 2 million people. Under all parametric variations considered, poverty incidence is increased by the ban. The increase in poverty occurs among all major socioeconomic groups, rural and urban – including poor farmers, the supposed beneficiaries. Only the non-poor benefit – the richest rural residents, who may be land owners but who tend not to be farmers, and some better-off urban consumers. These results are presumably relevant for the political economy underlying rice protection in Indonesia. The message of this paper is that it is not possible to justify the rice import ban by claiming that it reduces poverty.

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