FOOD POLICY AND POVERTY:
A GENERAL EQUILIBRIUM ANALYSIS FOR INDONESIA*

Peter Warr

Australian National University

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Executive Summary

The distributional effects of trade policies involving food are always controversial, particularly in countries for which staple foods are net imports. Indonesia is the world's largest importer of its staple food, rice, and this commodity simultaneously accounts, in its consumption, for a large share of consumers' budgets, and in its production, for a large share of total employment. These points apply with particular force for the poor. For them, both the share of rice in total consumption and the dependence on rice production as a source of employment are much greater than they are for the general population.

From the 1960s onwards Indonesia's imports of rice were subject to a government monopoly. This monopoly was ended in 1998, when private importation was permitted. There was a brief period of free trade, but from 2000 imports were subject to a specific tariff (levied per ton of imports rather than as a proportion of the landed value) equivalent to about 25 per cent of c.i.f. import values. Then, as of early 2004, and continuing to the present, imports were officially banned. Although the ban was said to be 'seasonal', at the end of 2004 it remained in place. The 'ban' is not fully effective, in that a small amount of rice imports still enter Indonesia, but much less than occurred before the ban was announced.

The intention of the post-1997 policies on rice imports has been to increase the domestic price of rice, but the way this outcome affects the poor has been hotly debated. Advocates of protection have claimed that it reduces poverty among those farmers who are net producers of rice, while opponents have stressed increases in poverty among net consumers. None of these analyses is fully satisfactory. An adequate analysis of the distributional effects of restrictions on rice imports needs to take account of its effects on different households' expenditures, disaggregated by

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household group, but also its effects on their incomes, operating through its effects on wages and on the returns to land. A general equilibrium framework is therefore essential and it must include a disaggregated household sector.

This paper applies the *Wayang* general equilibrium model of the Indonesian economy to analyze the effects of a 90 per cent effective import ban on rice, relative to its level in 2000. Extensive disaggregation of the household sector is a feature of the analysis. The model recognizes the 10 household categories defined in the official Indonesian Social Accounting Matrix (SAM) for 2000 and links them to the household income and expenditure survey for 1999 (*Susenas*) to divide each of the 10 SAM categories into 100 centile groups, arranged by real expenditures per household member. The analysis thus recognizes 1,000 individual households, fully incorporated into the general equilibrium framework.

The results indicate that a 90 per cent reduction rice imports has effects on the domestic price roughly corresponding to roughly a 125 per cent tariff, five times the pre-existing tariff. This policy intervention increases the headcount measure of poverty incidence by a little less than one per cent of the population. Poverty incidence rises in rural areas as well as urban areas and among all farming household categories. Among farmers, only the richest are net beneficiaries. These effects on poverty incidence are qualitatively robust to variations in the key parametric assumptions underlying the analysis; both rural and urban poverty incidence increase under all parametric combinations which were tried.

1. Introduction

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, on the consumption side, for a large share of consumers' budgets, and on the production side, for a large share of 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 force at the farm level alone. These points apply with particular force for the lowest income groups within Indonesia, where the average share of rice in total consumption and the dependence on rice production as a source of employment are both typically much greater than they are for the general 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, though the magnitude of its imports varies from year to year depending on domestic production, international prices and the size of Indonesia's stocks. Over the 4 years following the Asian financial crisis of 1997-98 (1998 to 2001, inclusive) Indonesia's rice imports were 9.1 per cent of its total consumption of rice (Table 1) and 18 per cent of the world's total imports (Table 2), making Indonesia the world's largest rice importer. Thailand was the largest exporter, followed by Vietnam and the US.

Prior to the 1997-98 crisis Indonesia's rice imports were monopolized by a public agency, *Bulog*. Figure 1 shows that except for the periods of the 1973 commodity price boom and the 1997-98 exchange rate crisis, the real price or rice in Indonesia has been relatively stable, but that its post-crisis level has been above its level over the previous three decades, even though international rice prices have declined relative to other traded commodities. From this and from Figure 2 it is apparent that the effects of *Bulog*'s market interventions were to stabilize rice prices

[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 higher than this, but the difference arises not from a difference in estimated expenditure on rice, but a difference in *total* expenditures. It appears that *Susenas* understates expenditures on goods and services other than rice, especially non-food, leading to the impression that rice expenditures are more important than they really are.

relative to international prices at a level not significantly different from the trend level of world prices (Timmer 1996). With the exchange rate volatility of the crisis period, local currency prices of imported rice surged. Despite this, Indonesian domestic prices remained well below exchange rate adjusted world prices, for a brief period, but from about 2000 until late 2004 they stabilized at levels 40 to 50 per cent *above* import prices.

The large difference between the domestic and import price arose from changes in rice import policy which followed the 1997-98 crisis. *Bulog*'s monopoly on rice imports was abolished in 1998, but this agency still accounted for around 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, which in mid 2002 was around 25 per cent of the import price (c.i.f.). 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 apparently account for the increased difference between the border price of imported rice and domestic prices.

In 2003 the Ministry of Agriculture proposed an increase in the tariff by 75 per cent – from Rp. 430 to 750 per kg. – raising the *ad valorem* equivalent tariff from 25 per cent to about 45 per cent. The tariff increase was reportedly opposed by the Ministry of Finance, which has ultimate responsibility for all taxes. In early 2004 a *ban* on rice imports was introduced.[2] The ban was said to be 'seasonal', but at the end of 2004 the ban remained in place. Nevertheless, special exemptions apparently still permitted some imports of rice to occur.

A truly 'seasonal' ban – one implemented only during specific, pre-announced times of the year – would have almost no 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. The effect would merely be to force importers or others to incur more storage costs than would otherwise be optimal. Due to 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.

[2] Since an import ban is not a tax, the Ministry of Finance does not have jurisdiction over it.

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 some of Indonesia's political leaders despite its lack of any sound economic foundation. In its preoccupation with food self-sufficiency, Indonesia is not different from many other staple food importing countries, at least those which are also significant producers of these commodities.

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. 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, 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.

Finally, and most controversially of all, protection has been said to be desirable because of its favorable income distributional effects. Compared with free trade, protection would supposedly reduce poverty by raising the incomes of poor farmers.[3]

The argument against protection

Critics of protection for the rice industry have focused in particular on its distributional effects, arguing 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 and 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 laborers, 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

[3] *Bulog* has also claimed that protecting the rice industry is good for the environment, because it would keep irrigated land in rice production that might otherwise become idle. Few observers have agreed that the increased pesticide and fertilizer use that would follow, not to mention increased demand for irrigation water, could have environmental benefits. In any case, there seems little possibility that

proceeds of the sale of other commodities. It is pointed out that there are more poor people among the net consumers than the net producers. Protection of the rice industry would therefore raise poverty incidence rather than lowering it. Seemingly strong claims have been made about the degree to which poverty would decline if protection was reduced and, conversely, the degree to which poverty incidence would worsen if it was increased, as proposed by the Ministry of Agriculture and *Bulog*.[4]

One difficulty with the argument that protection would worsen income distribution is that most, but not all, of those arguing this case have focused on *counting* the numbers of poor people in each group, disregarding 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 problem with the case that has been made against protection.

According to the anti-protection argument, the beneficiaries from a price increase – net producers – include only land holders. Landless laborers employed in the rice sector, which includes vast numbers of poor people, are counted among the net consumers of rice – the losers from protection. These people derive their incomes not from the sale of rice but from the sale of their labor. It is implicitly assumed in the net producer / net consumer framework that a price increase would affect the living costs of these people, through the consumer price which they face, but not their incomes. This in turn assumes that the price increase would not raise the aggregate demand for unskilled labor. If it did, the increase in labor demand would produce some combination of increased employment and increased real wages for landless laborers.

There is reason to think that these effects could be important. Suppose that rice producers respond to the increase in prices with an increase in output. The paddy (rice) industry is a large employer of unskilled labor. If it is also labor-intensive in its production technology, relative to the rest of the economy, in particular, intensive in its use of unskilled labor, then expansion of rice production would increase the

irrigated land not used for rice production would be left idle; it is too productive not to be used to produce other commodities.

[4] Examples include a quantitative study by Ikhsan (2002) and the various Working Papers and Policy Briefs produced by the Indonesian Food Policy Program sponsored by USAID. These reports are available at www.macrofoodpolicy.com.

demand for unskilled labor – the major asset of the poor – and presumably its price.[5] The argument that has been advanced against protection of the rice industry in Indonesia ignores any such effects.

The nature of crop production is that supply response generally occurs only with some delay – say, six months to two years. The assumption of zero supply response, implying zero income effect for 'net consumers', may be roughly correct for the very short run – say periods of less than one year – but beyond this length of time it is not at all clear that the argument is valid. So long as it remains in place, protection increases the domestic price *permanently*. How would Indonesian producers respond? It seems likely that the long run supply response in the Indonesian rice industry would be highly inelastic, but this does not mean that it would be zero. The notion that peasant farmers do not respond to price incentives, given sufficient time to adjust their production schedules, is one of the most thoroughly demolished myths in all of economics.

Supply response of domestic rice producers

Several empirical studies have looked at the issue of supply response in the Indonesian context, but their results vary. An early study by Mubyarto (1975) estimated the long run elasticity of planting area with respect to price on Java to be very low, at 0.03. Tabor (1988) estimated that in Java the elasticity of planting area with respect to price was 0.22 in wet land rice production and 0.45 in dry land production. A study by Hutauruk (1996) estimated the planting area response elasticity on Java to be 0.04 and off Java to be 0.78. Since 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 be larger than these estimates.[6]

Finally, a recent study by Irawan (2001) estimates short and long term elasticities of supply response for several regions and for both wet and dry land rice production. The short term estimates for wet land rice are: Java 0.11, Sumatra 0.12, Sulawesi 0.45 and Kalimantan 0.02. His long run estimates are: Java 0.13, Sumatra 0.52, Sulawesi 1.25 and Kalimantan 0.21. His estimates for dry land rice supply

[5] Conversely, if the rice industry proved not to be labor-intensive, then this argument could run in the opposite direction, potentially strengthening the case against protection.

response are generally about 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 and for Sulawesi it is above 2.

In summary, the available econometric evidence, while far from conclusive, 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. Estimates of the long run elasticity of output with respect to price in the range of 0.2 to 0.4 would be consistent with the available evidence. Nevertheless, it must be recognized that considerable uncertainty remains as to the true value of this key parameter.

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 – known as the 'optimal tariff argument'. Strangely, the current debate on rice protection has largely 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. Because the international price is affected by the volume of Indonesian imports, the marginal cost of Indonesia's imports exceeds the world price. In these circumstances, starting from a position of zero protection, it is possible to raise national income by restricting imports. The gains in national income are achieved through an improvement in the terms of trade – protection induces a reduction in the price of imports relative to exports by reducing the volume of imports. In a famous contribution, Harry Johnson demonstrated that if the elasticity of supply of imports to a country is ε, then the proportional rate of tariff which maximizes national income is $1/\varepsilon$ (Corden 1974). 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

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[6] The study by Mubyarto (1975) is cited in Irawan (1997) and the studies by Tabor (1998) and

depth. This is the elasticity of demand for rice on the world market for the world's largest exporter, Thailand. The direct connection between these two matters arises as follows. Suppose first that Thailand exported one million tons *additional* rice onto the world market. The world price would fall, somewhat. Now suppose that Indonesia imported one million tons *less* rice from the world market. Again, the world price would fall, by an amount virtually identical to that resulting from the increase in Thailand's exports. Indeed, because Indonesia's rice imports come primarily from Thailand, the types of rice involved are essentially the same.

Studies of the elasticity of demand for Thailand's rice exports have produced estimates ranging from -2.5 to -5.[7] 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 three years 1998 to 2000, Indonesia's rice imports were about 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, and with the econometric studies on which it are based, is that the estimated elasticities almost certainly understate the true long run elasticities of world supply. If the world price were to rise permanently, say because a major importer like Indonesia restricted 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 behavior is not reflected in available statistical data. This means that the optimal tariffs which can be estimated from arguments like those above are almost certainly *upper bounds* on the reasonable values that an optimal tariff could take.

It would seem likely that a reasonable estimate of the long run elasticity of supply of rice imports to Indonesia would be between 7 and 10 and therefore that tariffs in the neighborhood of 10 to 14 per cent would be the largest that could be justified through the optimal tariff argument. Nevertheless, the true value of the long run elasticity of supply of rice imports to Indonesia must be considered uncertain.

The 'optimal' levels of protection discussed above relate to the maximization of national income and ignore distributional effects. Of course, such protection would

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Hutauruk (1996) are cited in Irawan (2001).

also have distributional consequences, which would need to be considered in determining its appropriate level. The analysis presented in this paper shows how this can be done.

The case for a general equilibrium treatment

An adequate analysis of the distributional effects of rice import restrictions needs to 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 labor market as well as the returns to land. In doing this, the rice industry could not be considered in isolation. An increase in unskilled wages would affect profitability in other industries, with effects on outputs and prices in those industries as well. These effects would have repercussions on household incomes. These effects would then have to be balanced against the effects on consumers of an increase in the price of rice. But 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.

For analyzing 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 simultaneously satisfies all relevant market clearing conditions and macroeconomic constraints. To address issues of poverty and inequality, such a framework must 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, including supply response of domestic producers and the elasticity of supply of rice imports to Indonesia; but the true values of these parameters 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.

The following section describes the *Wayang* general equilibrium model of the Indonesian economy. The next section applies this model to the analysis of the distributional effects of a restriction of rice imports, in particular its effects on poverty

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[7] This literature is reviewed in detail in Warr (2001).

incidence. The analysis employs considerable sensitivity analysis around the assumed values of key parameters. The final section concludes.

2. The *Wayang* General Equilibrium Model

This study uses the *Wayang* general equilibrium model of the Indonesian economy (Warr *et al.* 1998; Wittwer 1999; Warr and Wittwer 2005), which identifies ten different types of households, representing ten socio-economic groups as defined in the Social Accounting Matrix (SAM) published by the Indonesian Central Bureau of Statistics. For the purposes of the present study each of these 10 SAM household categories is divided into 100 sub-categories of equal population size, with the sub-categories arranged by consumption expenditures per capita – that is, centile groups. The advantage of working with a general equilibrium model with a highly 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.

As well as disaggregating households, *Wayang* also has a disaggregated industry and commodity structure. The microeconomic behaviour assumed within it is competitive profit maximisation on the part of all firms and competitive utility maximisation 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.[8] The nominal exchange rate between 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.

This section briefly describes the major elements of the *Wayang* model (section 2.1). The household sector of the model is crucial for analysis of poverty incidence and its most important features are summarised in this overview. The theoretical structure of the model and its data base are described in sections 2.2 and 2.3.

Important features of the *Wayang* parameter estimates are described in Section 2.4.

2.1 Overview

The structure of the model itself is relatively conventional. *Wayang* belongs to the class of general equilibrium models which are linear in proportional changes, sometimes referred to as Johansen models, after the seminal work of Johansen (1964), which also used this approach. *Wayang* shares many structural features with the highly influential ORANI general equilibrium model of the Australian economy (Dixon, *et al.* 1982), which also belongs to this Johansen category, but these features have been adapted in light of the realities of the Indonesian economy. The principal features of the model are summarized below:

Industries

The national model contains 65 producer goods and services produced by 65 corresponding industries - 18 agricultural industries, 5 'resource industries' (forestry, fishing, mining and quarrying) and 47 other industries. Each industry produces a single output, so the set of commodities coincides with the set of industries. The various industries of the model are classified as either 'export-oriented' or 'import-competing'. The level of exports of an export-oriented industry is treated as being endogenous, while the exports of an import-competing industry are treated as being exogenous.[9] The criterion used to classify these industries is the ratio of an industry's imports to its exports. If this ratio exceeds 1.5, then the industry is regarded as producing an importable. If the import/export ratio is less than 0.5, then the industry is deemed to be export-oriented. For ratios between 0.5 and 1.5, additional relevant information is used in classifying the industry.

Commodities

Wayang contains two types of commodities - producer goods and consumer goods. Producer goods come from two sources: domestically-produced and imported. All 65 producer goods are in principle capable of being imported, although some have zero levels of imports in the database, services and utilities representing most of the

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[8] 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.

[9] Given that the exported and domestically sold good are treated as being identical, this assumption is necessary to make it possible to separate the domestic price of the import competing good from the price of the exported good. Otherwise, the Armington structure would be redundant.

examples. The 20 consumer goods identified in the model are each transformed from the producer goods, where the proportions of domestically produced and imported producer goods of each kind used in this transformation is sensitive to their (Armington) elasticities of substitution and to changes in their relative prices.

Factors of production

The mobility of factors of production is a critical feature of any general equilibrium system. 'Mobility' is used here to mean 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’. They are distinguished by the educational characteristics of the workforce: skilled labor is defined as those workers with lower secondary education or more. Both types of labor are assumed to be fully mobile across all sectors. These assumptions imply that skilled wages must be equal in all sectors. The same applies to unskilled wages, though skilled and unskilled wages can differ and need not move together.

There are two kinds of mobile capital - one that is mobile among agricultural sectors, and another that is mobile among non-agricultural industries. It is assumed that mobile agricultural capital cannot be used outside agriculture and mobile non-agricultural capital cannot be used in agriculture. In this treatment, agricultural capital is thought of as machinery such as tractors of various kinds, which can be used in a variety of agricultural activities. Non-agricultural mobile capital is thought of as industrial machinery and buildings.

In every sector, it is assumed that there is constant elasticity of substitution (CES) production technology with diminishing returns to scale to variable factors alone. However, we introduce a sector specific fixed factor in every sector to assure that there are constant returns to scale in production to all factors. We refer to the set of specific factors in the agricultural sectors as ‘land’, and to the set of those in the non-agricultural sectors as ‘fixed capital’. The assumption of constant returns means that all factor demand functions are homogeneous of degree one in output. In each sector, there is a zero profit condition, which equates the price of output to the minimum unit cost of production. This condition can be thought of determining the price of the fixed factor in that sector.

Households

The model contains ten major household categories - seven rural and three urban - differentiated by socio-economic group. The sources of income of each of these household types depend on their ownership of factors of production. These differ among the household categories and are estimated from the 2000 BPS *Social Accounting Matrix* (SAM). 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 sub-divided into a further 100 sub-categories each of the same population size, arranged by real consumption expenditures per capita, giving a total of 1,000 sub-categories.[10] The consumer demand equations for the various household types are based on the linear expenditure system. Within each of the 10 major categories, the 100 sub-categories differ according to their budget shares in consumption.

Since our focus is on income distribution, the sources of income of the various households are of particular interest. The source of the factor ownership matrix used in the model is Indonesia's SAM for the year 2000. The households are described as follows. The original Indonesian language descriptions are in square brackets:

1. Agricultural employees- Agricultural workers who do not own land
   [*Rumahtangga buruh tani*]

2. Small farmers - Agricultural workers with land < 0.5 ha
   [*Rumahtangga petani gurem (yang memiliki lahan pertanian < 0.5 ha*)]

3. Medium farmers - Agricultural workers with land 0.5 ~ 1 ha
   [*Rumahtangga pengusaha pertanian (yang memiliki lahan 0.5 ~ 1 ha)*]

4. Large farmers - Agricultural workers with land >1 ha
   [*Rumahtangga pengusaha pertanian (yang memiliki lahan >1 ha*)]

5. Rural low income - non-agricultural households, consisting of small retail store owners, small entrepreneurs, small personal service providers, and clerical and manual workers in rural areas
   [*Rumahtangga bukan pertanian golongan rendah di desa*]

[10] The population sizes of the 10 major categories are not the same, but *within* each of these 10 categories the population sizes of the 100 sub-categories are the same.

6. Rural non-labor households, consisting of non-labor force and unclassified households in rural areas
[*Rumahtangga bukanAngkatan kerja di desa*]

7. Rural high income - non-agricultural households consisting of managers technicians, professionals, military officers, teachers, large entrepreneurs, large retail store owners, large personal service providers, and skilled clerical workers in rural areas
[*Rumahtangga bukan pertanian gol. atas di desa*]

8. Urban low income households, consisting of small retail store owners, small entrepreneurs, small personal service providers, and clerical and manual workers in urban areas
[*Rumahtangga bukan pertanian golongan rendah di kot*a]

9. Urban non-labor households, consisting of non-labor force and unclassified households in urban areas
[*Rumahtangga bukan Angkatan kerga di kota*]

10. Urban high income households, consisting of managers, technicians, professionals, military officers, teachers, large entrepreneurs, large personal service providers, and skilled clerical workers in urban areas
[*Rumahtangga bukan pertanian gol. Atas di kota*].

In the social accounting matrix each household's sources of income are classified into several sources. A summary of the sources and disposal of income appearing in the social accounting matrix is:

1. Wages and salaries [*Upah dan gaji*]
2. Rent from capital [*Pendapatan kapital*]
3. Incoming transfer [*Penerimaan transfer*]
4. Total above [*Jumlah pendapatan*]
5. Income tax [*Pembayaran pajak langsung*]
6. Net income [*Pendapatan rumahtangga setelah pajak*]
7. Final consumption [*Pengeluaran konsumsi akhir rumahtangga*]
8. Outgoing transfer [*Pembayaran transfer*]
9. Saving [*Tabungan*]

The categories "wages and salaries" and "rent from capital" are each subdivided into various sub-categories. These categories did not corresponded exactly to those of the model. In agriculture, returns to land and capital were not separated in the SAM, but returns to owner-provided labor were separated. A previous study on the cost structure of paddy production was used to allocate returns among the land and capital categories and the various farming households received the same proportionate breakdown of this total. For agriculture the principle used was that machinery was considered "mobile" capital. Of course, mobile here means mobile across crops - tractors are the best example. This involves error in so far as some machinery is crop-specific. Land was considered immobile. It is best to think of what is called ‘land’ here as all immobile forms of agricultural capital, which includes much true land in the short run. In non-agriculture the principle used was that plant and buildings were classified as ‘mobile’. A factory building can be used for many purposes. Machinery was considered ‘immobile’, because most of it is more industry-specific than tractors are in agriculture.

Table 3 summarizes some features of the cost structure of the paddy industry (farm level production of rice) and compares it with the rest of the agricultural sector and the rest of the economy. Contrary to what might be supposed, the paddy industry is not intensive in its use of unskilled labor, 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 factor ownership characteristics of the 10 major household categories are summarized in Table 4. These household categories vary considerably in the composition of their factor incomes, but within the analysis of this paper, the composition of factor incomes is assumed to be uniform among the 100 sub-categories of each of these 10 major categories; these 100 sub-categories thus obtain their incomes from factors of production in the same proportions as one another. Of course, the incomes of these 100 sub-categories vary considerably, so they should be thought of as owning varying quantities of a uniform bundle of factors. The composition of the factor bundle varies across the 10 major household categories but is uniform within each.

Table 6 summarizes 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, at rates varying from roughly 40 percent (Rural 1) to 5 per cent (Urban 3). Within each of these household categories consumption expenditures per capita vary widely. In the simulations conducted below, poverty incidence is calculated for each of the 10 household categories, using poverty lines for each category which replicate the levels of poverty incidence calculated from the Susenas 1999 data set, using official poverty lines. These rates of poverty incidence are summarized in Table 6.

Figure 3 illustrates this procedure by showing the cumulative distribution of real expenditures for one of the ten household categories, Rural 1. The officially calculated level of poverty incidence for this household is 39.815 and the poverty line which 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 (see Table 6). 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%).

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 a spreadsheet calculation to estimate the Gini coefficient for each. Figure 4 reveals that inequality is higher in urban than rural areas and higher than for the general population.

2.2 Theoretical Structure

The analytical structure of the model includes the following major components:

- Household consumption demands, of each of the 10 broad household types, for 20 categories of consumer goods, one of which is rice. These are derived from the linear expenditure system.
- The household supplies of skilled and unskilled 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 skilled and unskilled labor, which are 'nested' within the sectoral production functions. In each non-agricultural sector, skilled and unskilled labor enter a CES production function to produce 'effective labor'. Effective labor,

variable capital and fixed capital then enter the production functions for domestic output.

- Leontief assumptions for the demand for intermediate goods. Each intermediate good in each sector is assumed to be demanded in fixed proportion to the gross output of the sector.
- Demands for imported and domestically produced versions of each good, incorporating Armington elasticities of substitution between the two.
- A set of equations determining the incomes of the 10 household types from their (exogenous) ownership of factors of production, reflecting data derived from the official 2000 *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.

2.3 Data Base

This section provides a description of INDOSAM 2000: a disaggregated social accounting matrix (SAM) for Indonesia, with a 2000 base. This SAM is intended to serve as the data base for *Wayang*, but it has other potential uses as well. The year 2000 is currently the latest for which it is possible to assemble the information required for construction of a social accounting matrix for Indonesia.

Two principle data sources compiled by the government's central statistical agency, BPS, were used to construct INDOSAM 2000: (i) the 2000 input-output tables (subsequently referred to as IO 2000); (ii) the 2000 social accounting matrix (subsequently SAM 2000). The table specifies 66 sectors. Other, supplementary, data sources were also used in the construction of specific tables, as described below. Abbreviations are used for these supplementary sources in the text and full references are provided at the end of the paper.

The principal data sources

The 2000 social accounting matrix produced by BPS contains 22 production sectors, which is insufficient for the purposes of this study. In addition, the SAM does not include the detail of tax payments and household sources of income that are required. The 2000 input output table specifies 66 production sectors. For the purposes of the present study, modifications to the data contained in IO 2000 were needed for the following reasons.

a) The table specifies only total intermediate goods and services transactions for each pair of producing and purchasing industries, at producer prices. Unlike the 1990 table, these transactions are not divided into goods and services from domestic and imported sources.
b) The table includes a sector (number 66, labelled "unspecified sector"), which is included as a balancing item. Sector 66 does not describe a true sector of the economy and in any case the data for this sector indicates negative final demand, an economic impossibility.
c) The table derived from BPS was not fully balanced. The major imbalances were that: (i) for most industries defined in the table, the industry-specific elements of row 210 (total input) were not equal to those of row 600 (total output) and (ii) the elements of row 200 (total imports) plus row 600 (total output) were not equal to those of row 700 (total supply).

These problems were overcome as follows:

a) The shares of imported intermediate goods and domestically produced intermediate goods for each cell of the table, as implied by the published 1990 IO table, were used to divide intermediate goods transactions into domestic and imported components.
b) Sector 66 was aggregated with the much larger sector 65 (labelled "other services"). This eliminated the problem of negative final demands. The resulting table thus has 65 sectors.
c) The revised table was balanced using the RAS adjustment method to ensure that all required accounting identities were observed.

2.4 Elasticity estimates

The elasticity estimates used in *Wayang* for the consumer and factor demand systems were taken from empirical estimates derived econometrically for a similar model of the Thai economy, known as PARA. These parameters were amended to match the differences between the data bases for *Wayang* and PARA so as to ensure the homogeneity properties required by economic theory. All export demand elasticities were set equal to 20. The elasticity of supply of imports to Indonesia were assumed to be infinite (import prices were set exogenously) except for rice, where the assumed elasticity was 10 (also varied in the discussion below). All production functions are assumed be CES in primary factors with elasticities of substitution of 0.5 except for the paddy production industry where this elasticity is set at 0.25, reflecting the empirical observation of low elasticities of supply response in this industry. The Armington elasticities of substitution in demand between imports and domestically produced goods were set equal to 2, except for rice, where the assumed value was 6 (varied in the results below). The higher value for rice reflects the assumption that imported and domestically produced rice are closer substitutes than is the case for most other commodities.

3. Simulations and Results

3.1 The shock

The data base of the model was calibrated to reflect a 25 per cent tariff on rice imports, as was the case from 2000 to 2003. For analytical convenience it was assumed that there was a quantitative restriction in place in this base situation but that the restriction was non-binding, with a magnitude of 102 per cent of the actual level of imports in this base situation (the year 2000). The shock then applied to this base solution was a 90 per cent reduction in the level of this quantitative restriction. This reduction makes the quot strongly binding and reduces the actual level of imports by 89.8 per cent. The reason that the restriction was not reduced to zero is that although the restriction is called a ‘ban’, some imports actually persist because of special exemptions. The quota licences 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 sub-categories in proportion to their household expenditures per capita.

3.2 The closure

Since the real consumption expenditure of each household is chosen as the basis for welfare measurement, and is the basis for the calculation of poverty incidence, 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 consumption and do not 'leak' into other directions, with real-world intertemporal 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 represents.

To prevent intertemporal and other welfare leakages from occurring, the simulations are conducted with balanced trade (exogenous balance on current account). This ensures that the potential benefits from, say, reduced imports of rice, do not flow to foreigners in the form of 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 held fixed exogenously. 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.

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 not captured within the single period focus of the model.

3.3 The results: Simulation A

The starting point for the results is Simulation A, the features of which are summarized in the first column of Tables 7, 8 and 9. For the purposes of the parametric variations performed below, it should be noted that in this core simulation:

- The assumed elasticity of supply of rice imports to Indonesia is 10.
- 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.[11]
- The Armington elasticity of substitution in rice demand (the elasticity of substitution in demand between imported and domestically produced rice) is 6, which implies that imported and domestically produced rice are relatively close substitutes.

Each of these parametric assumptions will subsequently be varied, as summarized in Table 7. For the time being it is sufficient to focus on the results of Simulation A.

Effects on the market for imported rice

We begin with the effects that the import restriction has on the market for imported rice, summarized in Table 7. The solutions can best be understood by performing a set of side calculations. The import price of rice in foreign currency (c.i.f.) declines as the volume of imports contracts, 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.

The magnitude of the reduction in the foreign currency import price can be understood as follows. The rest of the world supplies rice to Indonesia with a supply function given by

$$Q_R = a(P_R^*)^\beta, \qquad (1)$$

where Q_R is the quantity of Indonesia's rice imports, P_R^* is the foreign currency price of these imports, a is a constant reflecting the units of measurement of Q_R and P_R^* and β is the elasticity of supply to Indonesia, reflecting both the

[11] As will be explained below, this lower value of the elasticity of substitution for rice is chosen to be consistent with the low values of the elasticities of supply response which have been estimated empirically for the Indonesian rice sector.

elasticity of supply of exporters to the world market in general and Indonesia's imports as a share of this market. The proportional change approximation to this equation is

$$q_R = \beta p_R^* \quad , \tag{2}$$

where q_R and p_R^* denote the proportional changes in Q_R and P_R^*, respectively.

The solutions of interest are the solutions in levels, given by equation (1). The solutions to (2) are relevant only if they are good approximations to this, but this case is a good example of instances where proportional change approximations like (2) are highly inaccurate. The solution algorithm used in this paper uses a multi-step procedure to approximate the solutions to levels equations like (1).[12] The reduction in the c.i.f. import price given in Table 7 is 20.41 per cent. To understand this result, consider the inverse of equation (1)

$$P_R^* = b(Q_R)^\gamma, \tag{3}$$

where $b = 1/a$ and $\gamma = 1/\beta$, the inverse supply elasticity.

Suppose that initially $Q_R = P_R^* = a = 1$. As discussed above, when the import restriction is imposed the level of Q_R falls (by construction) by 90 per cent of its initial value, to 0.1. When $\beta = 10$ (top section of Table 7), $\gamma = 1/\beta = 0.1$. The *ex post* value of P_R^* can be checked by solving equation (1) using a hand calculator, giving $P_R^* = 0.7959$. That is, the reduction in P_R^* is 1 - 0.7959 = 0.2041. The c.i.f. import price falls by 20.41 per cent of its *ex ante* value, as indicated in Table 7.[13]

It is notable that if the proportional change approximation, equation (2), was used to estimate this price response, the result would be highly inaccurate. The calculation would be, inverting (2), $p_R^* = \gamma q_R = 0.1 \times 90 = 9$. That is, this approximation would give an estimate of the percentage change in the c.i.f. price of less than half the value obtained by solving the appropriate levels equation,

[12] For a technical description of this multi-step algorithm, see Codsi, Pearson and Wilcoxen (1991).

[13] The changes in P_R^* indicated in simulations B, C and D summarized in Table 6 can be confirmed in the same manner, noting that the values of γ in these three cases are 0.4, 0.2 and 0.05, respectively.

given by (1). Large errors of this kind can arise from using proportional change approximations when (i) the shocks are large, as in this case, and (ii) the underlying equation in levels is highly non-linear, as is the case with (1) and (3).

Table 7 indicates that the import restriction raises the domestic (landed) price of imports by a massive 62.51 per cent. This generates a large quota rent, which is equivalent to an *increase* in the initial tariff, in ad valorem terms, of 104 per cent. This result may be interpreted in the following way. The import restriction raises the domestic price from 1 to 1.6074 and lowers the import price price, as described above, 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

$$P_R = P_R^*(1+t), \tag{4}$$

and thus

$$t = (P_R / P_R^*) - 1$$

giving t = 1.6074 / 0.7959 – 1 = 1.0396, or 104 per cent. That is, as indicated in the final row of Table 7, a 90 per cent effective import quota raises the domestic price by an amount equivalent to a 104 per cent tariff, *in addition* to any tariff that was in place before the quota. The 'seasonal import ban' is an extremely protectionist measure. The solutions for simulations B to N summarized in Table 7 can be understood in a similar way.

Macroeconomic results

The macroeconomic results are summarised in Table 8. Perhaps surprisingly, the increase in rice production does not induce an increase in real unskilled wages. The reason for this result is that while rice production uses large quantities of unskilled labor, according to our education-based definition of this category, the paddy industry is not intensive in its use of unskilled labor. This point is summarized by the data shown in Table 3 and discussed above. The cost share of unskilled labor in the paddy industry is only 4.3%, less than the average for all industries (8.5%) and less than the average for other agricultural industries (9%). Unskilled labor cost as a share of all variable factor costs (excluding land and fixed capital) is far below the economy wide average. When the paddy industry expands, large quantities of intermediate goods are demanded, such as fertilizer, but small additional numbers of unskilled workers are hired; unskilled wages fall, in real terms, rather than rise. This point is particularly relevant for the simulated effects on poverty.

Effects on poverty and inequality

The simulated effects on poverty and inequality are summarised in Table 9. The results have the following important features.

(i) *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 areas and urban areas, but the increase in urban areas (around 0.3%) is smaller than the rural increase (around 1%). The central reasons are (i) urban budget shares for rice are in general well below rural budget shares (Table 5), and (ii) the real return to unskilled labor declines and urban households receive, on average, a lower share of total income from this source.

(ii) *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 labor. The increase in urban inequality arises from the decline in real skilled and unskilled wages, which raises the return to capital.

(iii) *Within each of the10 household categories, the sub-category households are not affected uniformly.* This is an interesting feature of the results and is illustrated in Figure 5. The curves slope up for each household; the proportional change in real consumption increases with the level of real expenditure. Real consumption declines in all households with real expenditures in the neighbourhood of the poverty line, which is why poverty incidence rises within each household category. However, households with high real expenditures in categories Rural 7 and Urban 1 actually gain from the import quota. The principle reason for this result is that these richer households have smaller shares of rice in total expenditures and are less affected by the increase in the consumer price of rice.

Figure 5 is somewhat noisy, due mainly to the non-smooth changes in the expenditure shares of rice as expenditures increase within each household category. Figure 6 presents a smoothed version of this figure, eliminating most of this noise.

Figure 7 illustrates the way that the change in poverty incidence is calculated for each of the 10 household categories. The figure focuses on household Rural 4 and magnifies the section of the cumulative distribution that is most relevant for poverty incidence. The lower line (horizontal dash legend) shows the *ex ante* distribution for household Rural 4 and the upper line (square legend) 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.

3.4 Effects of varying key parameters

To what extent do the results summarised above depend on the assumed values of key parameters assumed in Simulation A? This question is important, because the above discussion indicates that considerable uncertainty attaches to the true values of several parameters which seem particularly relevant. Variations in these parameters will now be discussed. 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.

(i) *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, and the simulated implications are summarised in detail in Tables 8 and 9. The implications for poverty incidence at the national, rural and urban levels are summarized graphically in Figure 8. Poverty increases in every case, including both rural and urban poverty incidence. It is argued above that values of this parameter below about 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 effects 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% 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 price of rice.

(ii) *The elasticity of supply response of paddy with respect to its price*

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 labor and mobile capital; the fixed factors are land and fixed capital), and H_P is the share of primary factors (labor, 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 and 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 summarized in Figure 9. Poverty incidence increases throughout the range.

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 labor, and hence the smaller the increase in poverty incidence. Nevertheless, this effect is too small to change the qualitative effect on poverty incidence.

(iii) *The Armington elasticity of substitution in rice demand*

When the Armington elasticity of substitution in demand between imported in domestically produced rice is varied, the estimated increases in poverty incidence are affected only trivially, as shown in Figure 10. Variations in the assumed Armington elasticity do not turn the simulated poverty increase into a reduction in poverty, nor do they turn a ‘moderate’ increase in poverty incidence into a ‘large’ one.

Higher values of this elasticity imply closer substitution between imported and domestically produced rice. However, this does *not* translate into larger increases in the price of domestically produced rice, for a given level of quota restriction, as it would with a 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 7 (see the columns for Simulations I to 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 slightly smaller.

4. Conclusions

The analysis presented in this paper indicates that a 90 per cent effective ban on rice imports increases poverty incidence by a little under 1 per cent. This result is based on a general equilibrium analysis which disaggregates households in considerable detail and which varies the values of key parametric assumptions across the seemingly plausible range. For all plausible parametric assumptions, poverty incidence increases as a result of the import restriction. The increase in poverty incidence is moderate but significant, and occurs in both rural and urban areas. It is not possible to justify the import ban by claiming that it reduces poverty.

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Table 1. Indonesia: Rice production, consumption and trade, 1990 to 2004

	Harvested area (Ha.)	Gabah production (GKG) - (Tons)	Rice production (Tons)	Rice consumption (Million Tons)	Import	
					Volume (Tons)	Value ('000 US$)
1990	10,502,357	45,178,751	28,552,971	24.41	6,378	2,907
1991	10,281,519	44,688,247	28,242,972	24.70	168,933	52,476
1992	11,103,317	48,240,009	30,487,686	24.99	566,441	159,049
1993	11,012,776	48,181,087	30,450,447	25.42	3,093	1,269
1994	10,733,830	46,641,524	29,477,443	25.85	268,802	68,736
1995	11,438,764	49,744,140	31,438,296	26.28	1,306,218	374,101
1996	11,569,729	51,101,506	32,296,152	26.16	1,231,745	731,055
1997	11,140,594	49,377,054	31,206,298	26.55	781,604	5,349
1998	11,716,499	49,199,844	31,094,301	26.86	6,076,542	831,763
1999	11,963,204	50,866,387	32,147,557	27.29	4,182,774	817,591
2000	11,793,475	51,898,852	32,800,074	27.72	1,511,611	925,562
2001	11,499,997	50,460,782	31,725,062	27.97	1,384,456	134,912
2002	11,521,166	51,489,694	32,541,487	n.a.	3,707,037	n.a.
2003	11,488,034	52,137,604	32,950,966	n.a.	2,606,285	n.a.
2004*	11,843,575	53,666,477	33,917,213	n.a.	n.a.	n.a.

Note: Assumed rate of gabah conversion to rice = 63.2%

Consumption is estimated based on the total population and estimates of per capita consumption.

n.a. means not available.

* 2004 data are estimates.

Data for 2001-2004 for column (2) and (3) is obtained from:
http://www.bps.go.id/sector/agri/pangan/table1.sthml

Source: Dept. of Agriculture, Jakarta.

Table 2. World Rice Trade by Country

Country	1998		1999		2000	
	000 ton	%	000 ton	%	000 ton	%
Export						
Taiwan	55	0.2	135	0.5	125	0.6
Myanmar	98	0.3	57	0.2	200	0.9
EU	346	1.2	300	1.2	300	1.3
Argentina	500	1.8	650	2.6	550	2.5
Uruguay	625	2.2	675	2.7	650	2.9
Australia	641	2.3	675	2.7	600	2.7
Japan	642	2.3	225	0.9	400	1.8
Pakistan	1,841	6.6	1,641	6.5	1,850	8.3
USA	3,211	11.5	2,665	10.6	2,500	11.2
Vietnam	3,774	13.5	4,537	18.0	4,200	18.8
China	3,965	14.1	2,920	11.6	2,400	10.7
India	5,305	18.9	2,855	11.4	1,500	6.7
Thailand	6,389	22.8	6,677	26.5	5,900	26.4
Others	633	2.3	1,138	4.5	1,175	5.3
Total export	28,025	100.0	25,150	100.0	22,350	100.0
Import						
Sri Lanka	168	0.6	160	0.6	150	0.7
Peru	220	0.8	150	0.6	150	0.7
China	244	0.9	175	0.7	200	0.9
Mexico	295	1.1	340	1.4	350	1.6
Japan	484	1.7	700	2.8	700	3.1
Iran	537	1.9	1,084	4.3	900	4.0
Senegal	559	2.0	871	3.5	600	2.7
Ivory Coast	641	2.3	465	1.8	500	2.2
EU 2)	787	2.8	750	3.0	750	3.4
Saudi Arabia	906	3.2	865	3.4	800	3.6
Brazil	1,438	5.1	925	3.7	1,000	4.5
Philippines	2,086	7.4	915	3.6	500	2.2
Bangladesh	2,545	9.1	1,475	5.9	500	2.2
Indonesia	6,080	21.7	4,144	16.5	3,500	15.7
Others	11,035	39.4	12,131	48.2	11,750	52.6
Total import	28,025	100.0	25,150	100.0	22,350	100.0

Note: EU data excludes trade among EU countries.
Source: *The Rice Trader,* 1998-2002.

Table 3 Cost shares of major factors of production: paddy and other industries

(per cent of total costs)

Cost components	Paddy	Other agriculture	Non agriculture	All Industries
Unskilled labor	4.3	9.0	8.7	8.5
Skilled labor	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: Data base of *Wayang* model.

Table 4 Sources of factor incomes of the broad household groups

	Land	Skilled Labour	Unskilled Labour	Agri var capital	Non-agri var capital	Fixed cap	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 *Susenas* 1999.

Table 5 Features of demand functions for rice by household category

	Expenditure elasticity - rice	Average budget share - rice	Marginal budget share - rice
Rural 1	0.772	0.081	0.063
Rural 2	0.766	0.102	0.078
Rural 3	0.713	0.099	0.071
Rural 4	0.705	0.121	0.085
Rural 5	0.726	0.093	0.068
Rural 6	0.684	0.065	0.044
Rural 7	0.687	0.035	0.024
Urban 1	0.726	0.071	0.052
Urban 2	0.684	0.054	0.037
Urban 3	0.570	0.032	0.018

Source: Author's calculations from data base of *Wayang* model.

Table 6 Expenditure and poverty incidence by household group

Household group:	% of total population in this group	Mean per capita expenditure (Rp. /mo.)	% of this group in poverty	% of all poor people in this group
Rural 1	8.0	6,358	39.8	13.9
Rural 2	14.8	3,608	34.9	22.4
Rural 3	7.1	7,584	32.3	9.9
Rural 4	9.0	6,618	27.8	10.9
Rural 5	16.0	3,891	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	4,210	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.

Table 7 Summary of parametric assumptions and simulated effects on the rice market of a 90% effective rice import ban

Simulation	A	B	C	D	E	F	G
Parametric assumptions							
Elasticity of supply of imported rice	10	2.5	5	20	10	10	10
Elasticity of substitution in paddy prod.	0.25	0.25	0.25	0.25	0.15	0.20	0.30
Armington elasticity in rice demand	6	6	6	6	6	6	6
Effects on rice market – per cent change unless specified							
Quantity of imports	-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
Domestic price of imports (Rp.)	62.51	62.54	62.52	62.50	65.06	63.56	61.73
Producer price of milled rice (Rp.)	7.82	7.84	7.83	7.82	9.86	8.66	7.20
Producer price of paddy (Rp.)	9.23	9.25	9.24	9.22	11.75	10.27	8.46
Production of milled rice	2.60	2.60	2.60	2.55	2.17	2.42	2.73
Production of paddy	2.55	2.56	2.55	2.55	2.14	2.38	2.68
Tariff equivalent of quota (%)	104	305	157	82	107	106	103

Source: Author's computations

Table 7 (Continued) Summary of parametric assumptions and simulated effects on the rice market of a 90% effective rice import ban

Simulation	**H**	**I**	**J**	**K**	**L**	**M**	**N**
Parametric assumptions							
Elasticity of supply of imported rice	10	10	10	10	10	10	10
Elasticity of substitution in paddy prod.	0.35	0.25	0.25	0.25	0.25	0.25	0.25
Armington elasticity in rice demand	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
Import price of rice, c.i..f., ($US)	-20.41	-20.41	-20.41	-20.41	-20.41	-20.41	-20.41
Domestic price of imports (Rp.)	61.13	268.36	98.46	47.26	38.81	19.86	10.15
Producer price of milled rice (Rp.)	6.72	9.30	8.15	7.67	7.58	7.36	7.24
Producer price of paddy (Rp.)	7.87	10.98	9.61	9.05	8.94	8.68	8.54
Production of milled rice	2.78	3.06	2.70	2.55	2.52	2.45	2.41
Production of paddy	2.83	3.01	2.65	2.50	2.48	2.41	2.37
Tariff equivalent of quota (%)	102	363	149	85	74	51	38

Source: Author's computations.

Table 8 Simulated Macroeconomic Effects of a 90% 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
GDP 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.

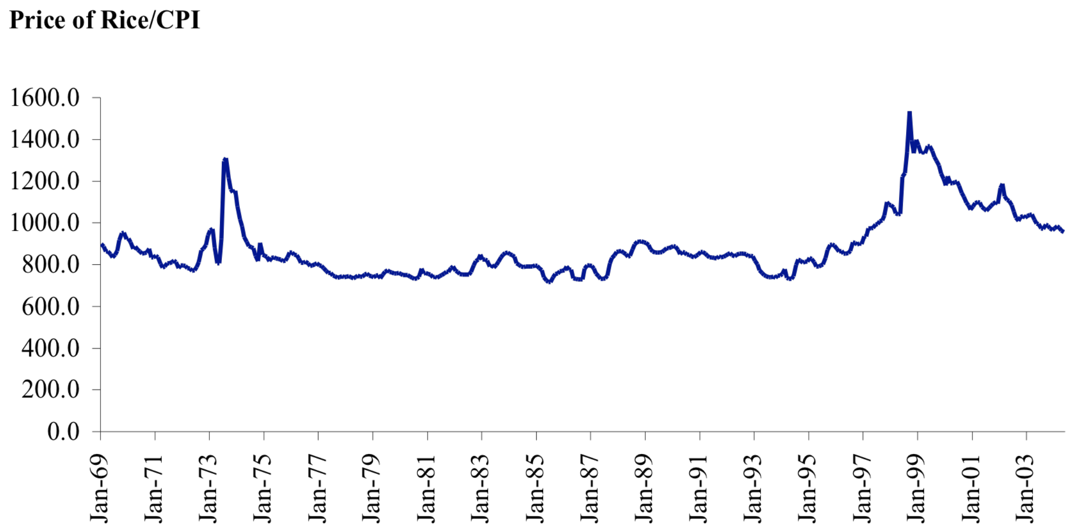
Table 9 Simulated Distributional Effects of a 90% Rice Import Ban: Varying rice import supply elasticity

(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	rural1		-0.608	-0.652	-0.607	-0.609
	rural2		-0.539	-0.593	-0.538	-0.540
	rural3		-0.906	-0.944	-0.905	-0.907
	rural4		-0.910	-0.949	-0.909	-0.911
	rural5		-0.354	-0.418	-0.353	-0.355
	rural6		-0.666	-0.712	-0.665	-0.667
	rural7		-0.072	-0.014	0.075	0.071
Urban	urban1		-0.020	-0.099	-0.019	-0.022
	urban2		-0.319	-0.389	-0.318	-0.321
	urban3		0.190	-0.708	0.203	0.168
Poverty Incidence (% population concerned)		*Ex-ante*		*Simulated outcomes*		
Rural households	rural1	39.815	40.475	40.518	40.475	40.477
	rural2	34.890	35.358	35.396	35.358	35.360
	rural3	32.294	32.994	33.232	32.994	32.995
	rural4	27.821	29.733	29.767	29.733	29.734
	rural5	23.779	25.244	25.306	25.243	25.246
	rural6	28.009	28.665	28.699	28.665	28.665
	rural7	10.501	10.573	10.655	10.572	10.575
Urban households	urban1	15.216	15.684	15.781	15.683	15.687
	urban2	11.162	11.325	11.342	11.325	11.326
	urban3	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

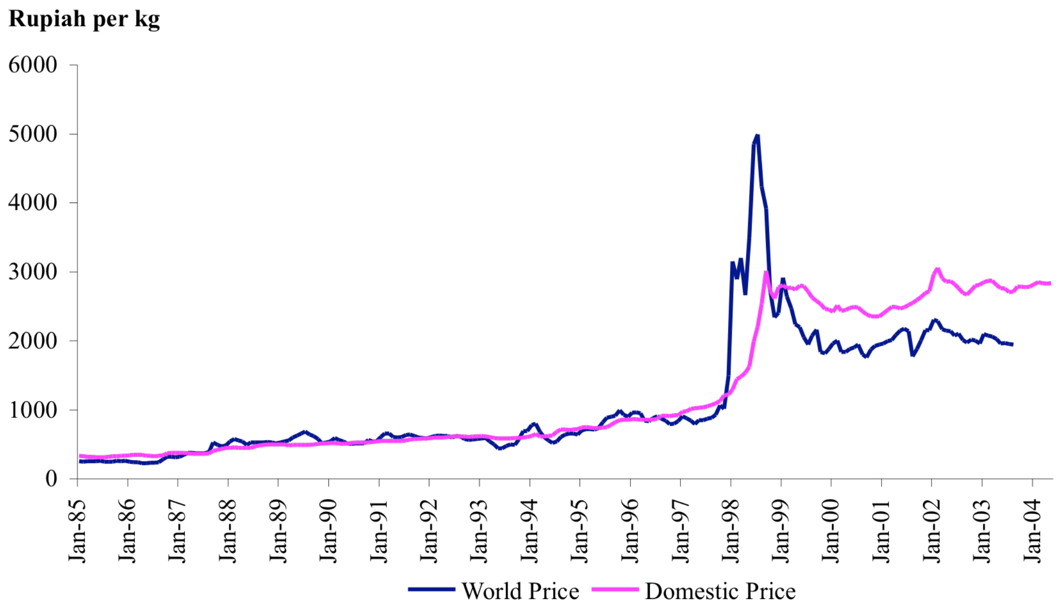
Source: Author's computations.

Figure 1 Real price of rice, Indonesia, 1969 to 2003



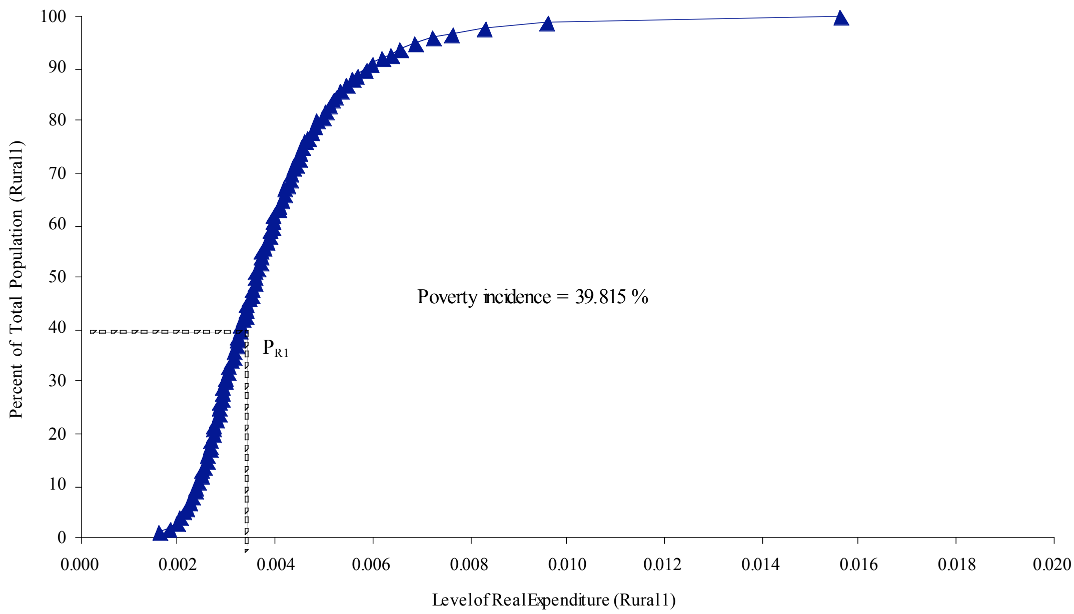
Note: Units are Rp. per kg., 1996 prices.
Source: *Bulog* (rice prices) and Central Bureau of Statistics, Jakarta (CPI).

Figure 2 World price and domestic price of rice, Indonesia, 1985 to 2004



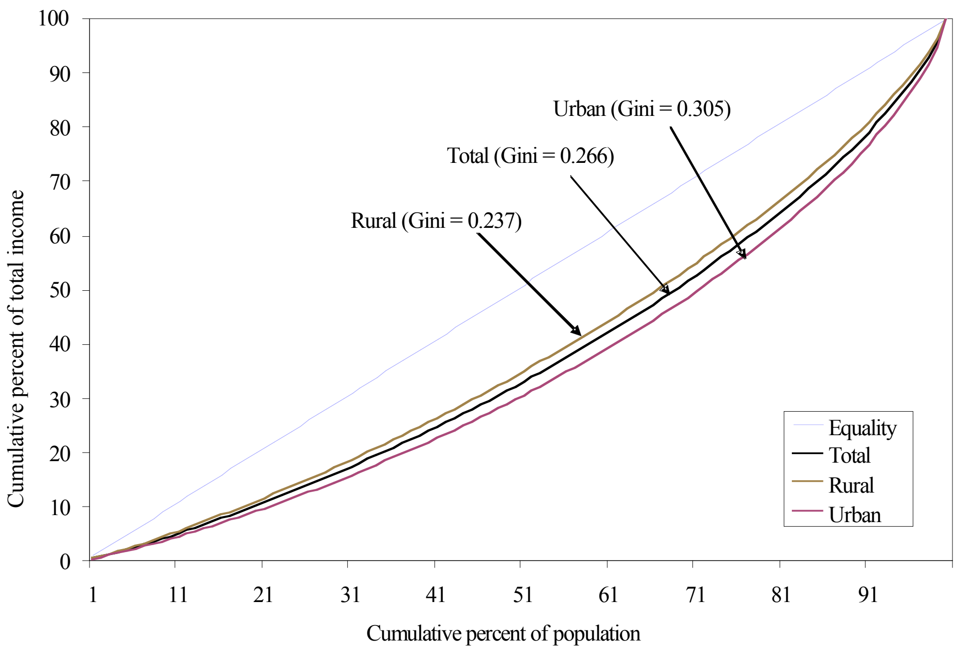
Note: "World price" means c.i.f. import price of milled rice in $US converted to Rupiah in current prices using market exchange rate. "Domestic price" means market price in Jakarta of milled rice in Rupiah, current prices.
Source: *Bulog* (rice prices) and Central Bureau of Statistics, Jakarta. (exchange rates).

Figure 3 The cumulative distribution of real consumption expenditures per capita - SAM household category Rural 1, 1999



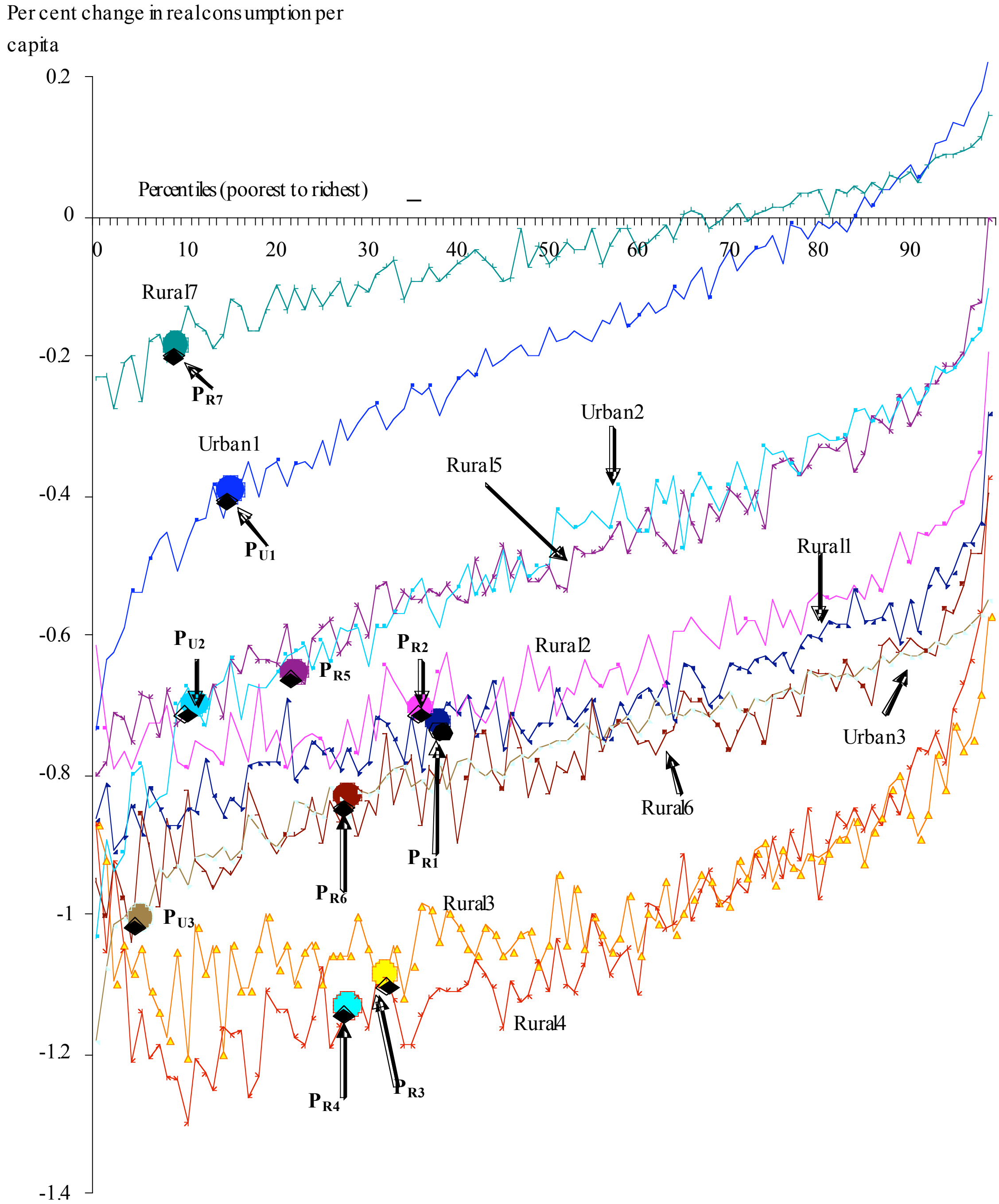
Source: Author's calculations, based on *Susenas* 1999, Central Bureau of Statistics, Jakarta.

Figure 4 Lorenz curves of the ex ante distribution of real expenditures per capita, rural population, urban population and total population, 1999



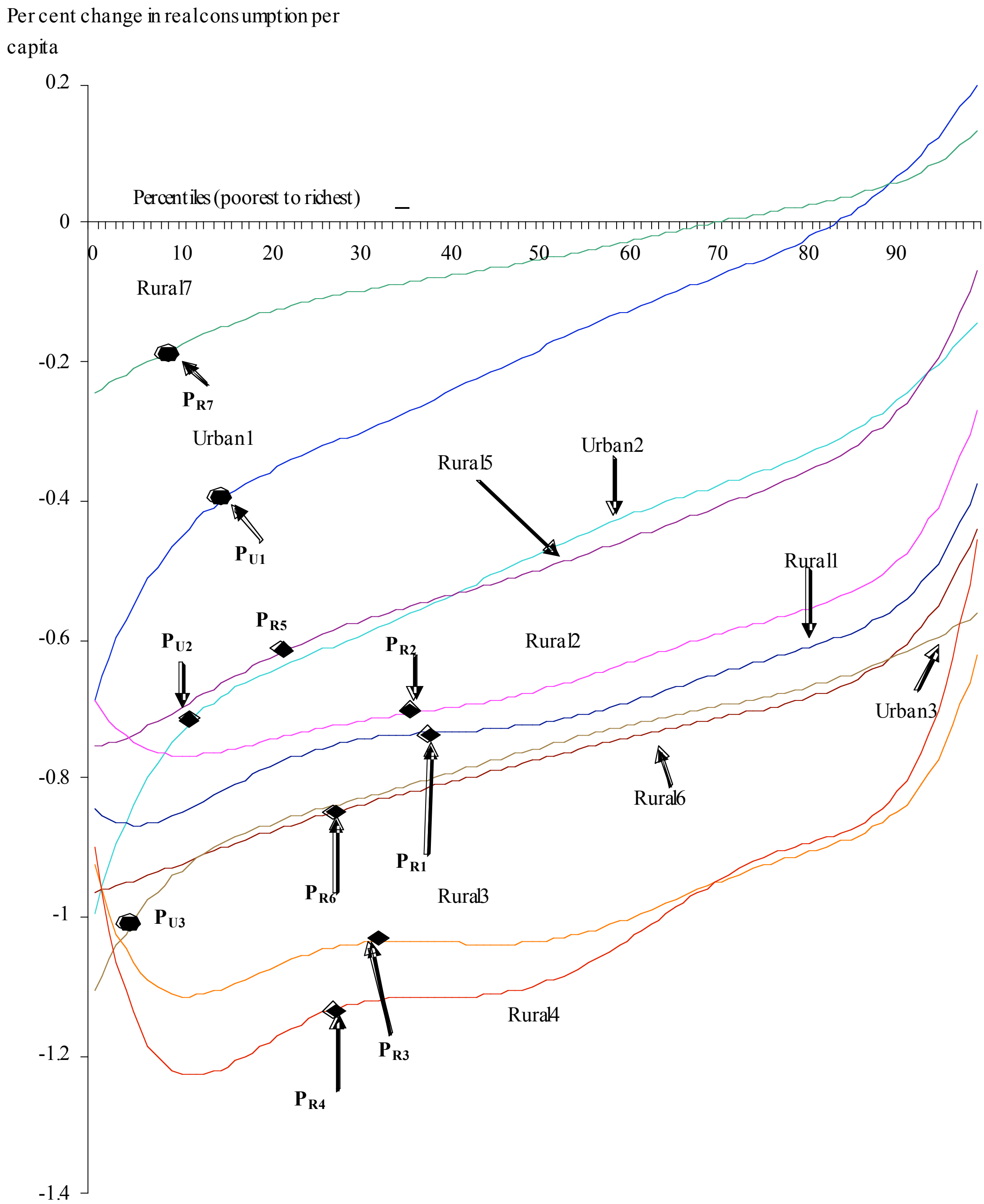
Source: Author's calculations, based on *Susenas* 1999, Central Bureau of Statistics, Jakarta.

Figure 5 Simulation A: Changes in real consumption by household category



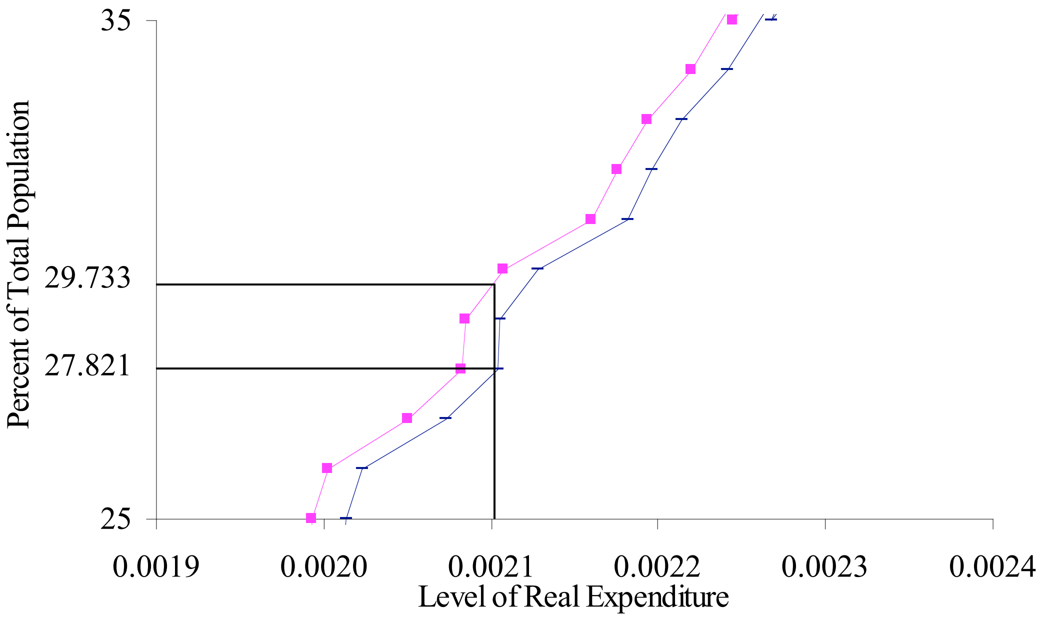
Source: Author's calculations.

Figure 6 Simulation A: Smoothed changes in real consumption by household category



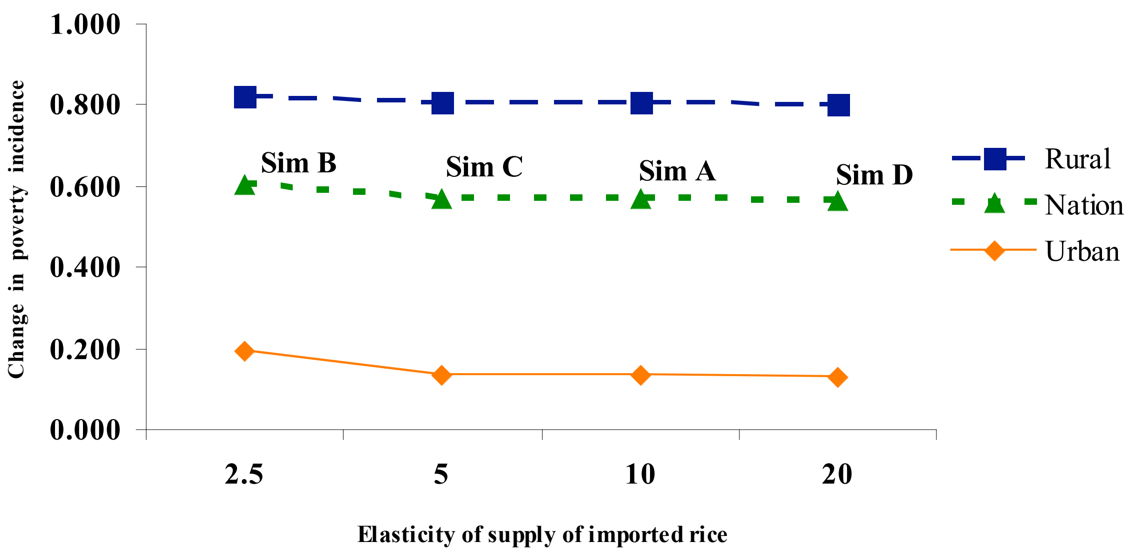
Source: Author's calculations.

Figure 7 Estimated cumulative distribution of real consumption expenditures: – Household Rural 4, before and after Simulation A



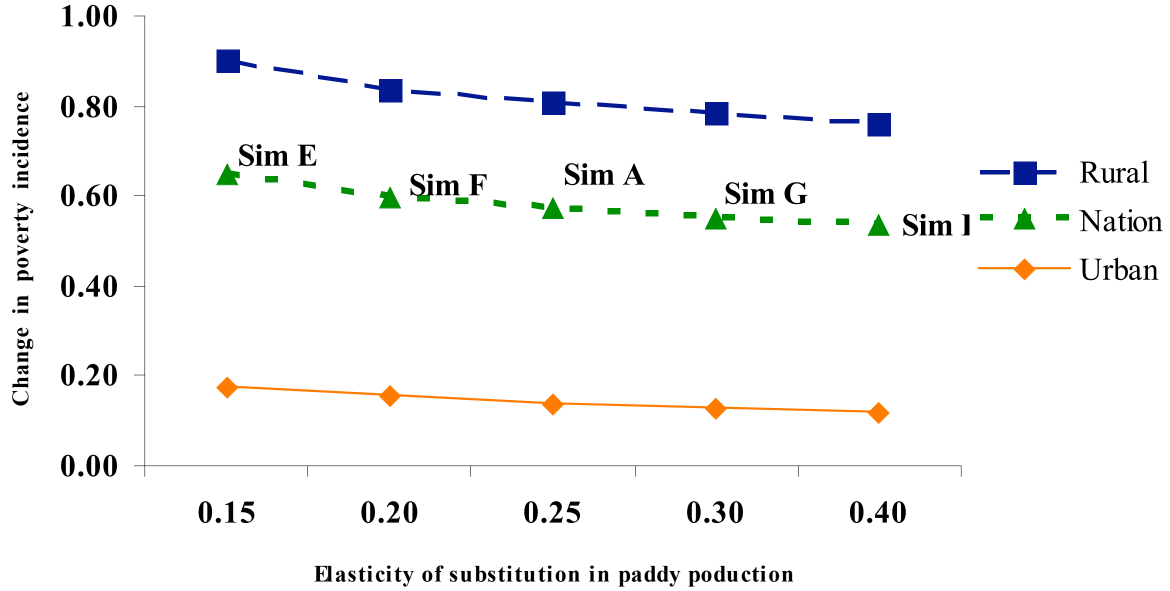
Note: The bottom line (horizontal dash legend) corresponds to the *ex-ante* distribution (poverty incidence = 27.821) and the top line (square legend) corresponds to the *ex-post* distribution resulting from Simulation A (poverty incidence = 27.821).
Source: Author's calculations.

Figure 8 Simulated changes in poverty incidence: Varying elasticity of world supply of imported rice



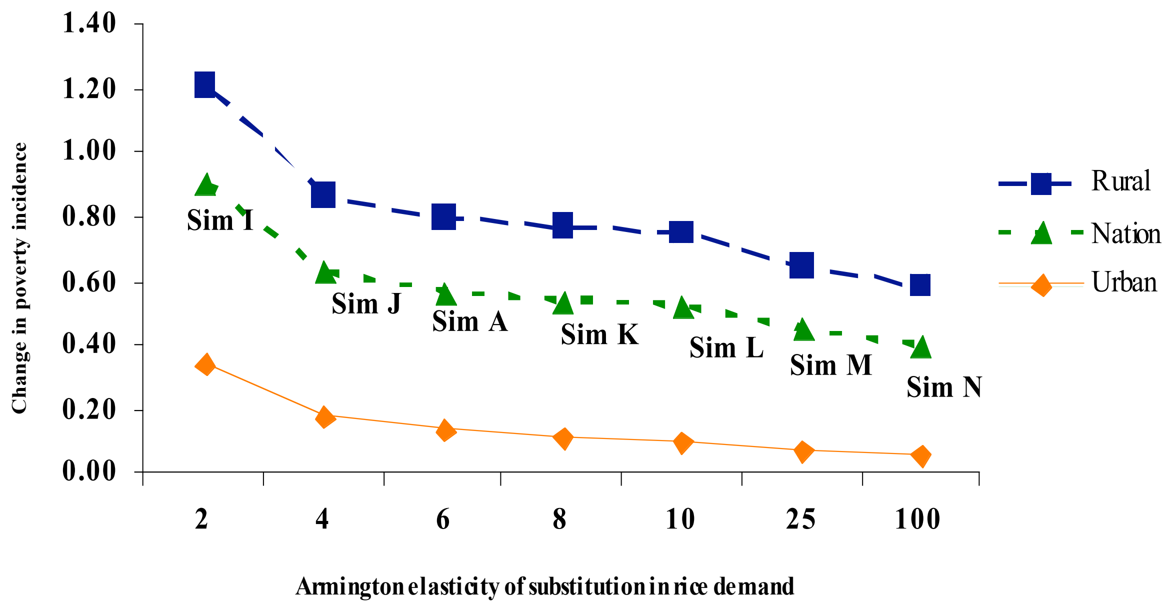
Source: Author's calculations.

Figure 9 Simulated changes in poverty incidence:
Varying elasticity of substitution in rice production



Source: Author's calculations.

Figure 10 Simulated changes in poverty incidence:
Varying Armington elasticity of substitution in rice demand



Source: Author's calculations.

APPENDIX: THE 'PASS-THROUGH' ELASTITY FOR RICE PRICES

In the course of the debate on Indonesia's rice policy it has been stated that the elasticity of the domestic price of rice with respect to the import price is close to 1 and that this finding implies that domestically produced and imported rice must be very close substitutes, corresponding to extremely high values of the Armington elasticity of substitution - perhaps 100 or even more. The time series econometric analyses on which the former statement has been based have not allowed for the fact that over time, the domestic price of rice and the landed price of imports have trended together in nominal terms. This is particularly important when the data series includes the period of the Asian Crisis of late 1997 thought 1998, during which Indonesia's exchange rate collapsed and nominal inflation was very rapid. We present below an econometric analysis which explores the 'pass-through' elasticity for rice and then relate these results analytically to the 'Armington' treatment of imports which is common within general equilibrium models, including *Wayang*.

A.1 The 'pass-through' elasticity

Data series were constructed for the following three price variables: $\ln P_d$, where P_d is the domestic price of milled rice in Rupiah; $\ln P_m = \ln P^* + \ln E$, where P_m is the landed cif price of imported rice in Rupiah, calculated as the international price of rice in \$US, P^*, adjusted by the Rupiah/\$US exchange rate, E; and an index of 'other' prices, $\ln P_o$, where P_o is the Indonesia-wide consumer price index. The data were monthly, covering the period January 1985 to August 2003. As is clear from Figure 2 above, the period of the Asian crisis was one of severe price instability. This period, from November 1997 to January 1999 was consequently omitted from the data set. There are therefore three periods covered by the data, the third of which is simply the pooling of the first two:

- Period I – *Pre crisis*: January 1985 to October 1997
- Period II: *Post crisis*: February 1999 to August 2003
- Period III: *Whole period*: January 1985 to August 2003, except for November 1997 to January 1999.

Dickey-Fuller tests were performed on each of the three price variables covering the periods concerned. The null hypothesis of a unit root failed to be rejected in any case. The variables concerned were each non-stationary, raising the possibility of spurious regression. Two types of regression analyses were performed. First, estimates of the likely long-term relationship were obtained from the regression

$$\ln P_d = a + b\ln P_m + c\ln P_o + \varepsilon,$$

where ε is a residual. The results are shown in Table A.1. The resulting estimates of the pass-through elasticity were 0.222 (pre-crisis), 0.445 (post-crisis) and 0.272 (whole non-crisis period).

The residuals were in each case found to be stationary and non—trending (the null hypothesis of a unit root was strongly rejected), suggesting that spurious regression is not an issue. However, this test is not conclusive and a better means of controlling for non-stationary series is to use an error correction model.

This was done by estimating the regression equation

$$\Delta\ln(P_d)_t = a\Delta\ln(P_m)_t + b\Delta\ln(P_d)_{t-1} + c\Delta\ln(P_o)_t$$
$$+e\{\ln(P_d)_{t-1} - f - g\ln(P_m)_{t-1} - h\ln(P_o)_{t-1}\} + \varepsilon.$$

The term in brackets $\{.\}$ is the assumed long term relationship. The estimates for the long term pass-through elasticity were 0.251 (pre-crisis), 0.701 (post-crisis) and 0.369 (whole non-crisis period). In short, these results suggest pass-through elasticities in the pre-crisis period of between 0.2 and 0.3 and in the post-crisis period of between 0.4 and 0.7. Over the entire period, the results suggest a pass-through elasticity of between 0.27 and 0.37.

Table A.1 Estimates of the likely long-term relationship

Period	Variable	Coefficient	t-stat	Prob.
Dependent variable $\ln P_d$				
	a (constant)	1.301	17.805	0.000
I:	$\ln P_m$ (log of international price)	0.222	9.298	0.000
	$\ln P_o$ (log of cpi)	0.861	26.359	0.000
	ADF Test for residuals	-0.074	-2.768	0.006
	a (constant)	2.765	4.771	0.000
II:	$\ln P_m$ (log of international price)	0.445	6.098	0.000
	$\ln P_o$ (log of cpi)	0.315	6.636	0.000
	ADF Test for residuals	-0.25	-3.009	0.003
	a (constant)	0.726	11.416	0.000
III:	$\ln P_m$ (log of international price)	0.272	9.616	0.000
	$\ln P_o$ (log of cpi)	0.926	29.419	0.000
	ADF Test for residuals	-0.061	-3.226	0.001

Note:
Period I: 1985:01 - 1997:10
Period II: 1999:02 - 2003:08
Period III: Whole period (except 1997:11 - 1999:01)

Table A.2 Estimates of error correction model

Period	Variable	Coefficient	t-stat	Prob.
Dependent variable $\ln P_d$				
	f (constant)	0.922	2.007	0.047
I:	$\ln P_m$ (log of international price)	0.253	1.847	0.067
	$\ln P_o$ (log of cpi)	0.912	4.940	0.000
	e (Error correction coeffieicnt)	-0.052	-2.153	0.033
	f (constant)	0.759	0.526	0.601
II:	$\ln P_m$ (log of international price)	0.701	3.718	0.000
	$\ln P_o$ (log of cpi)	0.326	3.228	0.002
	e (Error correction coeffieicnt)	-0.211	-3.533	0.001
	f (constant)	0.704	2.187	0.029
III:	$\ln P_m$ (log of international price)	0.369	2.521	0.012
	$\ln P_o$ (log of cpi)	0.789	4.773	0.000
	e (Error correction coeffieicnt)	-0.046	-2.868	0.005

Note:
Period I: 1985:01 - 1997:10
Period II: 1999:02 - 2003:08
Period III: Whole period (except 1997:11 - 1999:01)

A.2 Relationship to the 'Armington' elasticity[14]

The partial equilibrium relationship between the pass-through elasticity and the Armington elasticity can be derived as follows.[15] Drawing on the Armington treatment of the demand for imports *vis a vis* domestically produced goods, the proportional change in the demand for domestically produced rice is given by

$$q_d^D = q^D + \sigma S_m (p_m - p_d). \tag{1}$$

Lower case Roman letters are used to denote proportional changes of variables defined in levels. Thus q_d^D is the proportional change in the demand for domestically produced rice (superscript *D* denotes demand and subscript *d* denotes domestic production), q^D denotes the proportional change in demand for 'rice', a composite of domestically produced and imported rice, where the shares in expenditure are S_d and $S_m = 1 - S_d$, respectively, σ denotes the Armington elasticity of substitution between imported and domestically produced rice and p_m and p_d denote the proportional changes in the consumer prices of imported and domestically produced rice, respectively.

The proportional change in the demand for composite rice, q^D, depends on the prices of imported and domestically produced rice, each weighted by their shares in expenditure, 'other' consumer prices, and consumer income, which is held constant for this discussion. Thus

$$q^D = \eta^D (S_m p_m + S_d p_d) + \varphi^D p_o, \tag{2}$$

where $\eta^D \leq 0$ is the elasticity of demand for composite rice with respect to its own price, φ^D is the elasticity of demand for composite rice with respect to 'other' consumer prices, and p_o is the proportional change in an index of 'other' prices.

The supply of domestically produced rice depends on its own price, holding other producer prices constant, and is given by

$$q_d^S = \xi_d^S p_d, \tag{3}$$

where $\xi_d^S \geq 0$ is the elasticity of supply of domestically produced rice with respect to its own price. Substituting (2) into (1) and then equating (1) and (3), (that is, equating proportional changes in supply and demand for domestically produced rice), gives

$$\xi_d^S p_d = \eta^D (S_m p_m + S_d p_d) + \varphi^D p_o + \sigma S_m (p_m - p_d). \tag{4}$$

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[14] Helpful discussions with Peter Dixon are gratefully acknowledged.

[15] The analysis here is 'partial equilibrium' in the sense that it holds consumer incomes constant.

We can now rearrange this expression and rewrite it as

$$p_d = H_m p_m + H_o p_o, \quad (5)$$

where H_m and H_o are the elasticities of the domestic price of rice with respect to the import price and 'other' prices, respectively.

The former, the partial equilibrium form of the 'pass-through elasticity' of interest, is given by

$$H_m = S_m(\sigma + \eta^D)/(\xi_d^S + \sigma S_m - \eta^D S_d). \quad (6)$$

By inspection, we expect $H_m \le 1$ and for H_m to be and increasing function of the Armington elasticity, σ. The numerical relationship between the pass-through elasticity and the Armington elasticity can now be explored through a numerical example. Taking parameter values approximately relevant for the market for rice in Indonesia, we set ξ_d^S= 0.3, η^D= - 0.3, S_m= 0.1, and S_d= 0.9. The implied relationship between H_m and σ is shown in the diagram below.

These results confirm that Armington elasticity values of between 4 and 9 are consistent with 'pass-through' elasticities of between 0.3 and 0.7, depending on the own price elasticity of demand for rice - that is, within the range of the empirical estimates obtained above.

Figure A.1 Relationship between 'pass-through' elasticity and Armington elasticity