THE IMPLICATION OF POLICY REFORMS TO EAST JAVA AGRICULTURAL SECTOR: A PRICE ENDOGENOUS ANALYSIS

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Abstrak

Sektor pertanian memegang peranan yang penting di Jawa Timur, selama hampir 25 tahun ini. Untuk terus mempertahankan peranan tersebut, berbagai kebijaksanaan pertanian telah dilaksanakan di propinsi ini. Kajian ini bertujuan untuk mengevaluasi kebijaksanaan tersebut dan mempelajari perubahan-perubahan yang terjadi apabila terjadi reformasi dan kebijaksanaan tersebut. "Price endogenous mathematical programming sector model" digunakan dalam kajian ini dengan memperhatikan perbedaan skala usahatani, tipe lahan, dan alternatif pola tanam. Model ini selanjutnya digunakan untuk melihat efek dari perubahan kebijaksanaan yang berkaitan dengan situasi keuangan, harga dan kebijaksanaan subsidi. Selanjutnya, dibahas dampak perubahan-perubahan tersebut terhadap perekonomian di propinsi Jawa Timur. Hasil dari kajian ini, menunjukkan adanya perubahan yang cukup berarti dari reformasi kebijaksanaan di sektor pertanian terutama akan adanya distribusi yang berbeda terhadap pelaku-pelaku ekonomi di sektor pertanian. Hal yang terakhir, barangkali akan lebih menarik perhatian pengambil kebijaksanaan.

INTRODUCTION

The agricultural sector of East Java played a major role in the economic development of Indonesia in the past twenty five years (Altemeier, K. *et al.*, 1987). Several forms of agricultural policies have designed and implemented to continue this contributing role. This study aims to evaluate these policies and to assess the impacts of certain policies changes in a price endogenous modelling framework.

To achieve the above objectives, a price endogenous mathematical programming sector model is used as an analytical tool. Such a model is thought to be the most convenient analytical tool since it incorporates the simultaneity in production decisions and permits the researcher to analyze the effects of drastic changes in policy parameters which fall outside the historical experienced range of variation.

This approach is well known and has been extensively used in the literature. This study presents an original application to the agriculture of East Java where agricultural policy issues pertaining to Indonesia are investigated.

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METHOD OF ANALYSIS

A price endogenous mathematical programming sector model for East Java is used in this study. The price endogenous model was chosen for its flexibility in portraying all relevant aspects of the farm unit. Moreover, such a model is more suitable for the region, as East Java is a major food production center in Indonesia. The model is used to analyze the effects of various agricultural policies such as price policies and subsidies.

Let

X_{fk} = the level of the k^{th} cropping activity by f^{th} farm group,
q_{jf} = the amount of the j^{th} output supplied by farm f,
Q_j = the total amount of j^{th} output supplied by all farms
bif = the quantity of the i^{th} production factor available to the f^{th} producer,
cfk = the cost of purchased inputs per unit of the k^{th} production activity by farm f,
a_{ifk} = the quantity of the i^{th} production factor required by farm f for one unit the k^{th} cropping activity,
y_{jfk} = the quantity of the j^{th} output yielded by one unit of the k^{th} cropping activity by farm f.

Using these definitions, and assuming that the demand functions are independent of sector activity, the sector model formulation is as follows:

$$[SM] \quad \text{Max } Z = \sum_{j} Q_j (e_j - 0.5\, d_j\, Q_j) - \sum_{fk} C_{fk}\, X_k \quad \ldots\ldots (1)$$

subject to:

$$\sum_{k-i}^{p} a_{ifk}\, X_{fk} \leqslant b_{if} \text{ for all i, f} \quad \ldots\ldots (2)$$

$$q_{jf} - \sum_{k} y_{jfk}\, X_{fk} \leqslant 0 \text{ for all j, f} \quad \ldots\ldots (3)$$

$$Q_j - \sum_{f} q_{jf} \leqslant 0 \text{ for all j} \quad \ldots\ldots (4)$$

$$q_{jf},\ X_{fk},\ Q_j \geqslant 0 \text{ for all f, j, k}$$

The objective function no longer represents producer profits. The substitution of price-dependent, product demand, and factor supply schedules transforms the objective function into a measure of consumers' plus producers' surplus or net social

benefit, defined as the area between the demand and supply curves to the left of their intersection (Samuelson, 1952; Takayama and Judge, 1971).

The above model establishes the market equilibrium while maintaining the profit maximizing optimality conditions for individual firms under endogenous market prices (McCarl, B.A., and Spreen, T.H., 1980; Onal, H., 1985). To see this form, the Lagrangian of the sector model [SM]:

$$L = Z - \sum_{fk} \alpha_{if} (a_{ifk} X_{fk} - b_{if}) + \sum_{ifk} \beta_{jf} (q_{jf} - \sum_{k} y_{jfk} X_{fk})$$

$$- \sum_{jfk} \gamma_j (Q_j - \sum_{f} q_{jf}) \quad \text{..... (5)}$$

The corresponding Kuhn-Tucker conditions for the sector model [SM] are represented by the equations below:

$$\frac{\partial L}{\partial X_{fk}} = - C_{fk} - \sum_{i} a_{ifk} \alpha^{\circ}_{if} + \sum_{j} \beta^{\circ}_{jf} Y_{jfk} \leq 0 \text{ for all k, f} \quad \text{(6a)}$$

$$\frac{\partial L}{\partial X} X^{\circ}_{fk} = 0 \text{ for all k, f} \quad \text{..... (6b)}$$

$$X^{\circ}_{fk} \geq 0 \text{ for all k, f} \quad \text{..... (6c)}$$

$$\frac{\partial L}{\partial Q_j} = e_j - d_j Q^{\circ}_{j} - \gamma^{\circ}_{j} \leq 0 \text{ for all j} \quad \text{..... (7a)}$$

$$\frac{\partial L}{\partial Q_j} Q^{\circ}_{j} = 0 \text{ for all j} \quad \text{..... (7b)}$$

$$Q^{\circ}_{j} \geq 0 \text{ for all j} \quad \text{..... (7c)}$$

$$\frac{\partial L}{\partial q_{jf}} = \gamma_j - \beta^{\circ}_{jf} \leq 0 \text{ for all j, f} \quad \text{..... (8a)}$$

$$\frac{\partial L}{\partial q_{jf}} q^{\circ}_{jf} = 0 \text{ for all j, f} \quad \text{..... (8b)}$$

$$q^{\circ}_{jf} \geq 0 \text{ for j, f} \quad \text{..... (8c)}$$

$$\frac{\partial L}{\partial \alpha_{if}} = b_{if} - \sum_{k} a_{ifk} X^{\circ}_{fk} \geqslant 0 \text{ for all i, f} \quad \text{(9a)}$$

$$\frac{\partial L}{\partial \alpha_{if}} \alpha^{\circ}_{if} = 0 \text{ for all i, f} \quad \text{(9b)}$$

$$\alpha^{\circ}_{if} \geqslant 0 \text{ for all i, f} \quad \text{(9c)}$$

$$\frac{\partial L}{\partial \beta_{jf}} = -q_j + \sum_{k} Y_{jfk} X^{\circ}_{fk} \geqslant 0 \text{ for all j, f} \quad \text{(10a)}$$

$$\frac{\partial L}{\partial \beta_{jf}} \beta^{\circ}_{jf} = 0 \text{ for all j, f} \quad \text{(10b)}$$

$$\beta^{\circ}_{jf} \geqslant 0 \text{ for all j, f} \quad \text{(10c)}$$

$$\frac{\partial L}{\partial \gamma_j} = -Q^{\circ}_{j} + \sum_{f} q^{\circ}_{jf} \geqslant 0 \text{ for all j} \quad \text{(11a)}$$

$$\frac{\partial L}{\partial \gamma_j} \gamma^{\circ}_{j} = 0 \text{ for all j} \quad \text{(11b)}$$

$$\gamma^{\circ}_{j} \geqslant 0 \text{ for all j} \quad \text{(11c)}$$

If $Q_j > 0$, from Equations (7a) and (7b) the dual variable γ_j^{o} equals the market price corresponding to the amount Q_j. Furthermore, from Equation (11a), some micro units produce the j^{th} good (i.e.,$q_{jf} > 0$). For those micro units, Equation (8a) holds in strict equality form, which implies that the Kuhn-Tucker multiplier β_{jf}^{o} is also equal to the market price. Then, equation (7a) states the usual marginal condition, namely each farm uses the k^{th} production process until total revenue calculated at the market prices do not exceed the marginal cost of X_{fk}. Strict equality holds if $X_{fk}^{o} > 0$. This is consistent with the assumption of competitive firm behavior. Furthermore, if the market price γ_j^{o} is positive, the total demand equals the total supply of the j^{th} commodity, because strict equality holds in Equation (11a). This establishes the market equilibrium while satisfying individual firm behavior.

POLICY ANALYSIS WITH THE MODEL

The price endogenous sector model results presented above, and a comparison of the model results vis a vis the actual situation reported in the official statistics provide confidence about the model relations and the data base used. The model is then used to analyze the implications of some changes in agricultural policies in East Java including changes in: i) interest rate, ii) amount of loan, iii) reduce or phase out input subsidy, and iv) crop specific price policies. Impacts are measured with regard to the gross production value of crops, sectoral income by farm categories, and consumers' and producers' surplus (as a measure of welfare). The rationale of policy analysis are as follows:

i) Interest rate

As in many developing countries, credit rates for Government specific crop programs in East Java are often criticized for being much lower than a rational economic policy would dictate. On one hand, the lending (or administration cost) is high due to the high default rates, and on the other hand the government tried to maintain low interest rate in order to assist the agricultural sector (Bhargava, V.K., 1973; Donald, G., 1976; Dia, B., 1985). From the economic stand point, in order to maintain the viability of the credit system, either interest rate has to be raised and or the default rates have to be reduced. For example, given the 18 percent annual default rate in the BRI in 1982, The BRI would have to charge as high as 40 percent interest rate in order to attain at least break-even (CAER, 1987). Although this interest rates appears to be high for subsidized loans, one needs to consider it in order to prescribe an operating line for the bank and thus improve the outreach of the program. In this study the following rates are considered: 18 percent, 24 percent and 30 percent. Normally one would expect the farmer to borrow less when the interest rates are high.

ii) The loan amount

Most farmers have objected to the increasing interest rate but they are willing to pay higher interest rates if the amount of the loan and the interest rate simultaneously raised (Hadiwigeno, S., 1974; Dia, B., 1985). In this analysis, first the model considers 10 percent increase in institutional loans both to small and large farms. Later, 10 percent increase of the loan is considered only for small farms, and then for large farms in subsequent experiments. Finally, we analyzed the effect of increasing the interest rate to 30 percent, which is the market interest rate, combined with the alternative increases in the loan amounts to specified farm groups.

iii) Input subsidy

The government has employed fertilizer subsidy as a key instrument to stimulate crop production, particularly rice. The rapid growth in fertilizer use, induced in part by subsidy together with the adoption of modern varieties and massive investment in irrigation, has sharply increased the budgetary burden of subsidy. In 1986, the rates of subsidy on urea and TSP were at 35 and 55 percent, respectively, relative to border prices adjusted to the farm level (IFPRI and CAER report, 1987). In addition to setting farm level fertilizer prices, the government is heavily involved in the production, trade, and distribution of fertilizers. All domestic fertilizers are produced by government-owned plants, and imports and exports of fertilizer are controlled by the government. Domestic distribution is monopolized by the government to the wholesale level. Some Indonesian fertilizer plants are highly competitive internationally and export urea profitably. Others, however, are relatively high cost producers. The domestic fertilizer distribution is relatively inefficient, burdened by costly regulations and cumbersome distribution channels (Ministry of Agriculture of Indonesia, 1987). As a result, substantial subsidies are also paid for the production and distribution of fertilizers so that the farm price can be maintained.

Given the heavy burden of the fertilizer subsidies, and large cutbacks in the government budget, there is considerable discussion in government regarding possible reduction or complete elimination of the fertilizer subsidy. A phase out of the Indonesian fertilizer subsidy is simulated by an increase in the weighed price of urea and TSP from Rp 125 per Kg to Rp 210 per Kg or an increase by 60 percent of fertilizer cost (IFPRI report 1987, page 6.15).

Here the effect of this policy reform will be analyzed by increasing the input cost i) by about 40 percent if the fertilizer cost is 60 percent of input cost, ii) 30 percent if the fertilizer cost is 50 percent of input cost, and iii) 20 percent if fertilizer cost is 40 percent of input cost.

iv) Sugarcane price and trade policy

Since 1980 the government has controlled the domestic production and marketing of sugar and also controlled sugar imports to maintain sugar prices. The sugar industry has enjoyed protection as high as 200 percent in 1985, and in 1987, the nominal protection rate was still 75 percent after devaluation in 1983 (IFPRI report 1987, p. 7.14). The sugar production program on Java permits cane farmers, who were previously required to rent land to sugar mills, to farm their own land. The farmers, however, are in turn obligated to cultivate cane on this land and sell their entire crop to designated mills. As payment, farmers receive the proceeds of 60 – 65 percent of the total sugar produced from their cane, depending on the sugar

content. Although this new cultivation system has improved farmer control over management of their land, the system also retained area quotas to deliver targeted amount of cane production to the mills. In addition to this direct intervention in sugar production, the government has a monopoly on procurement, marketing, and distribution of sugar. BULOG (Badan Urusan Logistik: National Logistic Agency) purchases all sugar from the factories at a special quotation price determined by the government based on production costs, and "reasonable" consumer price levels. BULOG then distributes sugar to private wholesalers across the country. Retail prices are set to cover the ex-factory quotation price plus BULOG's, wholesalers' and retailers' transportation and storage costs, plus a "reasonable" profit margin for wholesalers and local retailers. The highly protected prices are maintained by government control over imports.

Within the policy analysis, three alternative policies are considered. First the share of sugarcane farmers in total sugar produced is increased from 60 percent to 70 percent. Then, the above policy is coupled with price adjustment, where the domestic sugar price is reduced to its world price equivalent. The third policy alternative is the same as the previous alternative but together with establishment of a 20 percent import tariff. Establishment of a moderate tariff represents a move toward full liberalization, and reduces the incentive-distorting effects of maintaining different and variable levels of protection. Such a tariff would be a relatively progressive tax, since consumption of sugar is much larger among high income groups (IFPRI report 1987, p. 7.15).

THE RESULTS

Effects of Varying Interest Rate

The results show that increasing the interest rate to market interest rate(30 percent per annum), does not affect rice production, while the production of all other crops decreases except sugarcane production increased by 1 percent. An increase in sugarcane can be explained by the changed relative profitability across crops and reduced operating capital to cover production expenses (this latter fact is because of paying the interest rate at the time credit placement). This makes profitable crop and large farms, being equipped with a better financial situation, continue to grow evenmore cane. As a consequence, production of other crops were slightly decreased causing an increase in food crop prices except rice price and sugarcane price (the latter was kept constant at the exogenous price).

The economic consequences of the above experiments are displayed in Table 1. The price endogenous sector model indicated that increasing the interest rate would significantly affect the crop production pattern, gross production value, sectoral

Table 1. Indexed economic consequences under varying interest rate.

	Base	P1	P2	P3
Gross production value:				
at endogenous prices	100	110.0	104.4	102.3
at constant prices	100	97.9	98.8	99.1
Income by farm*):				
Small Farms	100	115.1	106.8	103.4
Large Farms	100	121.9	109.9	105.5
Sectoral income:				
at endogenous prices	100	118.9	108.5	104.5
at constant prices	100	92.7	93.7	94.0
Consumer's surplus	100	95.0	97.7	98.7
Producer's surplus	100	130.6	114.0	107.7
Social surplus	100	100.1	99.9	99.7

Notes: P1 refers to increasing the interest rate to 30 percent a year;
P2 refers to increasing the interest rate to 21 percent a year;
P3 refers to increasing the interest rate to 18 percent a year.
*) calculated at endogenous prices.

income, and producers' and consumers' surplus. This policy reform not only improved the overall contribution of the sector, but also caused redistribution of welfare (Darmawan, D.H.A., 1991). The crop production pattern shifted from growing basic food crops toward commercial crops (mostly sugarcane). A higher interest rate caused reallocation of institutional credit between farm groups. Small farms obtained a larger share and produced more sugarcane, while large farms were discouraged to produce this cash intensive crop. Overall, this policy reform increased the sectoral income mainly due to increased sugarcane production.

Effects of Varying the Loan Size

Experiments with altered distribution of institutional credits revealed interesting outcomes. A 10 percent increase in the loan size to all farms slightly decreased the net income of large farms, while increasing the net income of small farms, and left the social surplus unchanged, unless this policy combined with the varying interest rate. Varying the loan size, combined with the increased interest rate, made consumers worse off while producers benefitted (see Table 2). This was mainly due to the altered crop pattern. A higher credit share made available to small farms motivated them to produce more sugarcane instead of renting more land from large

Table 2. Indexed economic consequences under varying the loan size.

	Base	P4	P5	P6	P7
Gross product value:					
at endogenous prices	100	99.5	99.8	99.5	105.9
at constant prices	100	100.0	100.0	100.0	98.6
Income by farm*):					
Small Farms	100	100.5	109.6	99.5	109.4
Large Farms	100	98.7	99.6	102.3	112.7
Sectoral income:					
at endogenous prices	100	99.5	100.1	99.2	111.2
at constant prices	100	100.1	100.0	100.1	98.5
Consumer's surplus	100	100.2	100.1	100.2	97.1
Producer's surplus	100	98.4	99.4	98.6	118.0
Social surplus	100	100.1	99.9	100.0	99.8

Notes: P4 refers to 10 percent increase of the amount of loan to all farm sizes with subsidized interest rate;
P5 refers to 10 percent increase of the amount of loan to small farm with subsidized interest rate;
P6 refers to 10 percent increase of the amount of loan to large farm with subsidized interest rate;
P7 refers to 10 percent increase of the amount of loan to all farm sizes with market interest rate.

farms. This concurrently increased the prices of other crops (the price of sugarcane remained constant). On the other hand, increasing the loan limit to small farms only increased their net income without seriously disturbing the large farms' net income, while the overall producers' and consumers' surplus remained almost unchanged (Darmawan, D.H.A., 1991).

Effect of Varying Input Cost

Another set of experiments changed the fertilizer subsidy which has been employed by the government as a key instrument to stimulate crop production, particularly rice. However, the rapid growth in fertilizer use, induced in part by subsidy, has sharply increased the budgetary burden of the subsidy. Empirical results obtained from the model by altering the subsidy rate demonstrated that reducing or removing the fertilizer subsidy which caused increases in input cost, slightly reduced rice production. Consequently, consumers suffered, because they had to pay higher prices (determined endogenously) while producers gained because they received higher prices for producing both rice and other crops.

The results, as presented in Table 3, shed some light on an important policy issue. It is often argued that agricultural subsidy is a bonus to large farms (Darmawan, D.H.A., 1991). The results obtained from the model indicated that

Table 3. Indexed economic consequences under varying fertilizer subsidy.

	Base	P8	P9	P10
Gross product value:				
at endogenous prices	100	101.5	104.9	97.8
at constant prices	100	97.5	98.7	95.9
Income by farm*):				
Small Farms	100	102.2	108.4	95.5
Large Farms	100	104.7	109.1	100.2
Sectoral income:				
at endogenous prices	100	103.6	108.8	98.1
at constant prices	100	96.6	98.1	94.8
Consumer's surplus	100	98.5	97.5	99.4
Producer's surplus	100	108.7	115.7	101.5
Social surplus	100	101.3	100.5	102.4

Notes: P8 refers to 20 percent fertilizer subsidy;
P9 refers to 30 percent fertilizer subsidy;
P10 refers to no subsidy alternative.
*) calculated at endogenous prices.

this is not totally true as both farm groups are affected at quite proportional rates (small farms even loose under P10 while large farms are not much affected). An equally important demonstration is that consumers are also beneficiaries of the input subsidy, because welfare losses occur when subsidy is reduced. Thus, all farm groups and consumers are target groups when subsidy is of concern.

Effects of Varying Sugar Policy

The last set of policy experiments involved changes in sugarcane policy. The effect of increasing the farmers' share in processed sugar revenue from 60 percent to 70 percent significantly increased sugarcane production, while production of other food crops was drastically decreased. This caused an increase in other food crop prices, as high as 20 percent. This policy significantly raised producers' surplus, because sugarcane farmers benefitted from higher cane price while other food crop producers benefitted from higher prices of other food crops.

This policy reform, however, significantly reduced consumers' surplus, because they had to pay higher prices for other food crops and pay the same for sugarcane. When this policy alternative was combined with a reduction of sugar price to the world market price, sugarcane production significantly decreased, while the production of other crops increased (except rice production, which remain unchanged).

These results (see Table 4) were expected, because decreasing sugarcane production allows sugarcane land be transferred to produce other food crops. The analysis under this policy reform showed that this policy alternative generated slight gains for consumers, because they could enjoy lower crop prices, while producers' welfare was not affected. Given the government's concern about farm income, and knowing that domestic sugarcane producers may not be ready to compete in the world market, a 20 percent import tariff on sugar import price was imposed in an experiment as a possible alternative to lessen the adverse effects of the reduced price policy. The analysis showed that consumers' gains from previous policy are reduced, but the negative effect of the previous policy on net farm revenues is also reduced.

Table 4. Indexed economic consequences under varying sugarcane policy.

	Base	P11	P12	P13
Gross product value:				
at endogenous prices	100	124.4	95.8	100.6
at contant prices	100	109.0	97.4	100.1
Income by farm*):				
Small Farms	100	137.2	95.5	102.9
Large Farms	100	145.5	93.9	100.7
Sectoral income:				
at endogenous prices	100	139.8	93.4	101.3
at constant prices	100	114.1	96.1	100.7
Consumer's surplus	100	93.1	100.1	99.8
Producer's surplus	100	154.5	91.5	99.5
Social's surplus	100	96.9	101.0	99.9

Notes: P11 refers to increase of cane farmer share to 70 percent;
P12 refers to increase of cane farmer share to 70 percent but world sugar prices are employed;
P13 refers to using world prices of sugar, but imposing a 20 percent of imports tariff.
*) calculated at endogenous prices.

CONCLUSIONS

In general, results of alternative policies suggest that the following policies may enhance the performance of both the food production sector and loan distribution in East Java:

(1) increase the interest rate for institutional loans;
(2) increase the loan limit to small farms;

(3) decrease input, especially fertilizer, subsidies; and
(4) reform the sugar policy by reducing the sugar price to a level between the world price and the current support price.

From a methodological point of view, the study leads to a decision making model for resource allocation problem for East Java agricultural sector. In substance, the study generates a set of policy decisions that could be implemented by the government to improve the sector's performance.

It was shown, using the price endogenous sector model, that significant changes in the structure of the East Java agricultural sector could occur as a result of various alternative policies. In particular, prices endogenously determined in the model lead to reallocation of resources used in the sector, on which basic crops and commercial crops compete. Prices not only allocate resources, but also generate income. Alternative policies significantly affect the distribution of income among farm groups. Because net incomes of farm groups are generally altered in different directions, direct or indirect income transfers to losing farm group(s) can occur with the policy change.

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