Myth of energy competitiveness in energy producing countries

Comparative analysis between Indonesia and Japan

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This paper examines the relative comparative advantage, focusing on energy prices, of an energy producing developing country (Indonesia) and a non-energy producing developed country (Japan). For energy producing developing countries, it is strategically important to increase the competitiveness of energy dependent industries, and encourage the development of value-added industries. Much work has been done on relative advantage analysis, but the effects of the energy price formation mechanisms on price competitiveness have not been analysed. In this paper a comprehensive approach, using production and cost functions and synchronized price formation by means of principal component analysis, is introduced.

Keywords: Energy competitiveness; Energy price formation

It is a high priority for developing countries to encourage industries which earn foreign currency in order to facilitate national development. For energy producing developing countries it is strategically important to increase the competitiveness of energy dependent industries, which have relative advantage compared to non-energy producing countries, and to encourage the development of value-added industries.

The policy problem for energy producing developing countries is how best to induce such changes, given the natural or social foundations. An empirical analysis aiming to identify how to induce such changes is essential.

Several authors have put forward such identification by analysing the total factor productivity (TFP). Terleckyj [5] compared the direct and indirect effects of technological progress on the competitiveness of industries: (i) direct effects by conducting technological improvement; and (ii) indirect effects through purchasing goods in which technological improvement is embodied. However, although TFP provides a practical analytical method for identifying the contribution of each factor to competitiveness, it has some fundamental limitations (Drysdale [2]).

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Englander [4] pointed out that while TFP growth can be taken as a measure of technological progress over the medium and longer term, it also reflects the effects of managerial efficiency, work habit and training over shorter periods. He also pointed out that changes in energy price could affect TFP growth. Therefore, in order to identify the effects of energy on competitiveness, it is essential to avoid this problem.

A production function using labour, capital, materials, energy and technological improvement as production factors could avoid, to some extent, such a duplication problem. This approach, together with a cost function taking into consideration the costs of respective factors, could provide an analytical method for identifying the price competitiveness of products [3]. Changes in energy prices influence not only the demand for energy, but also the rates of capital formation and labour utilization. These changes depend on the functional relationship between energy and the primary factor inputs. In particular, the relationship between energy and capital has been characterized by Apostolakis [1] that 'higher energy prices will stimulate the demand for investment'. Therefore, in order to identify price competitiveness focusing on energy prices, it is necessary to incorporate an analysis of the mechanism regulating an energy price formation. However, none have challenged this integrated and consistent approach.

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This paper challenges this integrated and consistent approach by using (i) production and cost function analyses to estimate relative price changes; and (ii) principal component analysis to estimate the contribution of variables to energy price changes and price formation.

The prime objective is to analyse (i) the pattern of change; and (ii) the reasons for change in the relative comparative advantage of Japan (a typical non-energy producing developed country) and Indonesia (a typical energy producing developing country) over the last 20 years, focusing on energy prices.

Effects of energy on price competitiveness

Methodology

By developing a production function and a cost function which takes into account labour, capital, materials (intermediate inputs other than energy), energy and technological improvement (total factor productivity: TFP), a comparative analysis of the price changes of manufacturing industries in Japan and Indonesia over the period of 1970–87 has been made.

We assume that there exists in manufacturing industries, in both Indonesia and Japan, a differentiable aggregate production function and cost function which relates the flow of gross output (Y) to five inputs: labour (L), capital (K), materials (M), energy (E) and technological improvement (T).

Production function: $Y = F(L, K, M, E, T)$ (1)

Cost function: $C = C((Y, Pl, Pk, Pm, Pe)$ (2)

C = gross cost, Pl, Pk, Pm and Pe = price of labour, capital, materials and energy.

Production change. Differentiating Equation (1) with respect to time

$$\frac{dY}{dt} = \frac{\delta Y}{\delta L}\cdot\frac{dL}{dt} + \frac{\delta Y}{\delta K}\cdot\frac{dK}{dt} + \frac{\delta Y}{\delta M}\cdot\frac{dM}{dt} + \frac{\delta Y}{\delta E}\cdot\frac{dE}{dt} + \frac{\delta Y}{\delta T}\cdot\frac{dT}{dt}$$
$$= \alpha\frac{Y}{L}\cdot\frac{dL}{dt} + \beta\frac{Y}{K}\cdot\frac{dK}{dt} + \gamma\frac{Y}{M}\cdot\frac{dM}{dt} + \delta\frac{Y}{E}\cdot\frac{dE}{dt} + \Theta\frac{Y}{T}\cdot\frac{dT}{dt} \quad (3)$$

where α, β, γ, δ, and Θ are elasticities related to L, K, M, E, and T

$$\alpha = \frac{\delta Y}{\delta L}\bigg/\frac{Y}{L}, \quad \beta = \frac{\delta Y}{\delta K}\bigg/\frac{Y}{K}, \quad \gamma = \frac{\delta Y}{\delta M}\bigg/\frac{Y}{M}$$
$$\delta = \frac{\delta Y}{\delta E}\bigg/\frac{Y}{E}, \quad \Theta = \frac{\delta Y}{\delta T}\bigg/\frac{Y}{T} = 1 \quad (4)$$

Equation (3) could be changed to

$$\frac{\blacktriangle Y}{Y} = \alpha\frac{\blacktriangle L}{L} + \beta\frac{\blacktriangle K}{K} + \gamma\frac{\blacktriangle M}{M} + \delta\frac{\blacktriangle E}{E} + \frac{\blacktriangle T}{T} \quad (5)$$

where

$$\blacktriangle Y = \frac{dY}{dt}, \quad \blacktriangle L = \frac{dL}{dt}, \quad \blacktriangle K = \frac{dK}{dt},$$
$$\blacktriangle M = \frac{dM}{dt}, \quad \blacktriangle E = \frac{dE}{dt}, \quad \blacktriangle T = \frac{dT}{dt}$$

Cost change. (i) Identification of elasticities: provided that production factor prices are decided competitively

$$V = Y + \Gamma[\bar{C} - C(Y, Pl, Pk, Pm, Pe)] \quad (6)$$

where Γ is Lagrange Multiplier which maximizes Equation (1) subject to Equation (2), that is the same as finding maximum solution on Equation (6) ($V = Y$ under the condition (2)). Therefore,

$$\frac{\delta V}{\delta Y} = \frac{\delta V}{\delta L} = \frac{\delta V}{\delta K} = \frac{\delta V}{\delta M} = \frac{\delta V}{\delta E} = \frac{\delta V}{\delta \Gamma} = 0$$

The cost function could be defined as follows as long as the production function is linear and homogeneous

$$C = PyY = PlL + PkK + PmM + PeE \quad (7)$$

where, Py = unit production cost.

$$\frac{\delta V}{\delta Y} = 1 - \Gamma\frac{\delta C}{\delta Y} = 1 - \Gamma Py = 0 \qquad \therefore \Gamma = \frac{1}{Py}$$
$$\frac{\delta V}{\delta L} = \frac{\delta Y}{\delta L} - \Gamma Pl = 0$$
$$\frac{\delta Y}{\delta L} = \alpha\frac{Y}{L} = \Gamma Pl \qquad \therefore \alpha = \Gamma\frac{PlL}{Y} = \frac{PlL}{PyY} = \frac{GLC}{C}$$
$$\frac{\delta V}{\delta K} = \frac{\delta Y}{\delta K} - \Gamma Pk = 0 \qquad \beta = \Gamma\frac{PkK}{Y} = \frac{PkK}{PyY} = \frac{GCC}{C}$$
$$\frac{\delta V}{\delta M} = \frac{\delta Y}{\delta M} - \Gamma Pm = 0 \qquad \gamma = \Gamma\frac{PmM}{Y} = \frac{PmM}{PyY} = \frac{GMC}{C}$$
$$\frac{\delta V}{\delta E} = \frac{\delta Y}{\delta E} - \Gamma Pe = 0 \qquad \delta = \Gamma\frac{PeE}{Y} = \frac{PeE}{PyY} = \frac{GEC}{C} \quad (8)$$

where

GLC = gross labour cost
GCC = gross capital cost
GMC = gross materials cost
GEC = gross energy cost

$$C = GLC + GCC + GMC + GEC \quad (9)$$

$$\alpha + \beta + \gamma + \delta = 1 \quad (10)$$

(ii) Cost change: differentiating Equation (9) with respect to time

$$\frac{\delta C}{\delta t}=\frac{\delta GLC}{\delta t}+\frac{\delta GCC}{\delta t}+\frac{\delta GMC}{\delta t}+\frac{\delta GEC}{\delta t}$$

$$\blacktriangle C=\blacktriangle GLC+\blacktriangle GCC+\blacktriangle GMC+\blacktriangle GEC$$

$$\frac{\blacktriangle C}{C}=\frac{\blacktriangle GLC}{C}+\frac{\blacktriangle GCC}{C}+\frac{\blacktriangle GMC}{C}+\frac{\blacktriangle GEC}{C}$$

$$=\alpha\frac{\blacktriangle GLC}{GLC}+\beta\frac{\blacktriangle GCC}{GCC}+\gamma\frac{\blacktriangle GMC}{GMC}+\delta\frac{\blacktriangle GEC}{GEC} \quad (11)$$

Price change.

$$\blacktriangle C=\blacktriangle PyY+\blacktriangle YPy$$

$$\frac{\blacktriangle C}{C}=\frac{\blacktriangle PyY+\blacktriangle YPy}{PyY}=\frac{\blacktriangle Py}{Py}+\frac{\blacktriangle Y}{Y}$$

Therefore, price changes can be obtained as a balance between cost and production changes as follows:

$$\frac{\blacktriangle Py}{Py}=\frac{\blacktriangle C}{C}-\frac{\blacktriangle Y}{Y}$$

(11)−(5)

$$=\alpha\left(\frac{\blacktriangle GLC}{GLC}-\frac{\blacktriangle L}{L}\right)+\beta\left(\frac{\blacktriangle GCC}{GCC}-\frac{\blacktriangle K}{K}\right)+\gamma\left(\frac{\blacktriangle GMC}{GMC}-\frac{\blacktriangle M}{M}\right)+\delta\left(\frac{\blacktriangle GEC}{GEC}-\frac{\blacktriangle E}{E}\right)-\frac{\blacktriangle T}{T} \quad (12)$$

since $GLC=PlL$,

$$\blacktriangle GLC=\blacktriangle PlL+\blacktriangle LPl,$$

$$\frac{\blacktriangle GLC}{GLC}=\frac{\blacktriangle PlL+\blacktriangle LPl}{PlL}=\frac{\blacktriangle L}{L}+\frac{\blacktriangle Pl}{Pl},$$

$$\frac{\blacktriangle GLC}{GLC}-\frac{\blacktriangle L}{L}=\frac{\blacktriangle Pl}{Pl}$$

Data construction and sources

The data used for the above analysis were constructed as follows (all manufacturing industries (Manufacturing Industry Total, Chemicals, and Iron and steel) for both Japan and Indonesia over the period of 1970–87):

(i) Production: value of output
(ii) Labour: number of workers × working hours[1]
(iii) Capital: capital stock × operation rate[2]
(iv) Materials: intermediate input except energy
(v) Energy: energy consumption
(vi) Technological improvement: balance between (i) and (ii) and (v)
(vii) Cost: gross cost
(viii) Labour cost: wages and salaries
(ix) Capital cost: gross capital cost
(x) Materials cost: gross materials cost
(xi) Energy cost: gross energy cost

[1]Number of workers in Indonesia.
[2]Capital stock for Indonesia.

All the basic data for Japan were obtained from *Industrial Statistics* (MITI); *Labour Force Survey* (Management and Coordination Agency of Japan: MCA); *Statistics of Enterprises' Capital Stock* (Economic Planning Agency of Japan: EPA); *Energy Balances in Japan* (Institute of Energy Economics of Japan: IEE); and *Input Output Table* (MCA). All the basis data for Indonesia were obtained from *Industrial Statistics* (Central Bureau of Statistics: CBS); *Statistics Yearbook* (United Nations: UN); *Survey Report on Indonesian Economic Development* (JICA); and *Input Output Table* (CBS).

Empirical results

Three sectors were analysed: Manufacturing industry total, Chemicals, and Iron and steel. Points of the outcomes of differences in the price change between Indonesia and Japan are illustrated in Figures 1 and 2. Reliability of the analysis was checked by inspecting the correlation between the estimated value and WPI, which showed significance (see Figure 3). Typical trends in price change, focusing on labour, energy, and technology in both countries, are summarized in Table 1 (figures indicate average of annual change: %).

Manufacturing industry total. As a Manufacturing industry total (see Figure 1), we obtained the following:

(i) Indonesia could enjoy a labour advantage owing to relatively stable wage hikes.
(ii) Contrary to expectations, Indonesia enjoyed an energy advantage, only in the period 1979–82 (between the second oil crises and the fall of the international oil prices).
(iii) Although improving steadily, the contribution of technological progress in Indonesia was far behind the progress in Japan.

Chemicals. The trends in price competitiveness in Chemicals were nearly the same as the trends for Manufacturing industry total (Figure 2). However, in this industry, Indonesia also enjoyed energy advantages in the period 1973–79 (between the first and second oil crises period).

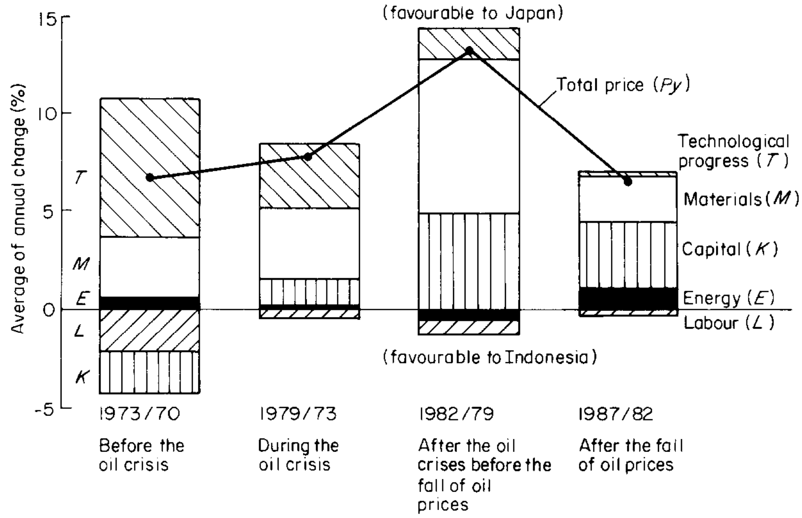


Figure 1. Differences in price changes between Japan and Indonesia (manufacturing industry, 1970–87).

Iron and steel. In Iron and steel, Indonesia did not enjoy energy advantages in any period (Figure 2). Furthermore, Indonesia lost its labour advantage between 1982 and 1987 (after the fall in international oil prices).

The above analyses indicate that Indonesia has not been gaining its competitiveness by means of energy prices. This is contrary to our expectations. Indonesia should enjoy advantages in energy price competitiveness as an energy producing country, and such advantages should contribute to the price competitiveness of Indonesian products. This is considered to be due to the problems in the energy price formation mechanism and also to poor energy saving efforts.

Table 1. Typical trends in price change (average of annual change, %).

	Japan				Indonesia			
Manufacturing industry total	Y	(L	E	T)	Y	(L	E	T)
1973/70	7.2	(2.4	0.2	−1.9)	13.9	(0.3*	0.9	5.4)
1979/73	8.7	(1.5	1.4	−0.8)	16.6	(1.1*	1.6	2.3)
1982/79	−0.8	(1.9	1.7	−2.2)	12.5	(1.2*	1.2*	−0.6)
1987/82	−1.2	(0.1	−0.4	−0.9)	5.5	(−0.1*	0.7	−0.9)
Chemicals	Y	(L	E	T)	Y	(L	E	T)
1973/70	10.5	(1.9	0.4	−1.5)	13.5	(−1.2*	0.5	1.4)
1979/73	5.2	(1.6	1.7	−0.5)	18.2	(0.4*	0.4*	2.1)
1982/79	−0.8	(1.1	3.1	−2.5)	15.8	(0.1*	0.2*	4.9)
1987/82	−2.5	(0.3	−0.4	−1.6)	6.2	(0.1*	0.1	1.5)
Iron and steel	Y	(L	E	T)	Y	(L	E	T)
1979/74	2.7	(0.8	1.4	−3.4)	21.1	(−1.0*	7.2	−2.5)
1982/79	3.1	(0.6	0.9	2.6)	17.9	(0.1*	9.6	3.4)
1987/82	−0.6	(0.1	−0.8	−2.2)	6.9	(0.7	1.1	−0.5)

* Indicates Indonesia's advantages.

Energy price formation

Methodology

On the basis of the suggestions obtained from previous analysis, we have attempted to identify the problems considered to be embodied in the energy price formation mechanism and also in energy saving efforts in Indonesia, through a comparative analysis with Japan. In order to achieve this objective, we have analysed the following aspects in both countries by using Principal Component Analysis (PCA);[3]

- (i) synchronization of factors influencing energy price formation;
- (ii) correlations analysis between synchronized index (SEPF:[4] Synchronized Energy Price Formation) and energy prices; and
- (iii) identification of the factors governing energy price formation.

In our analysis, we have assumed that an energy price (Pe) can be defined by the following linear form: $Pe = a + b * SEPF$.

[3]The reasons why we have used PCA are as follows. PCA is stable to irregular fluctuation rather than regression analysis. Therefore, it fits analysis of trends in structural change rather than normal trends. PCA is also suitable in synchronizing factors with different dimensions.

[4]Index which synchronized the factors influencing energy price formation.

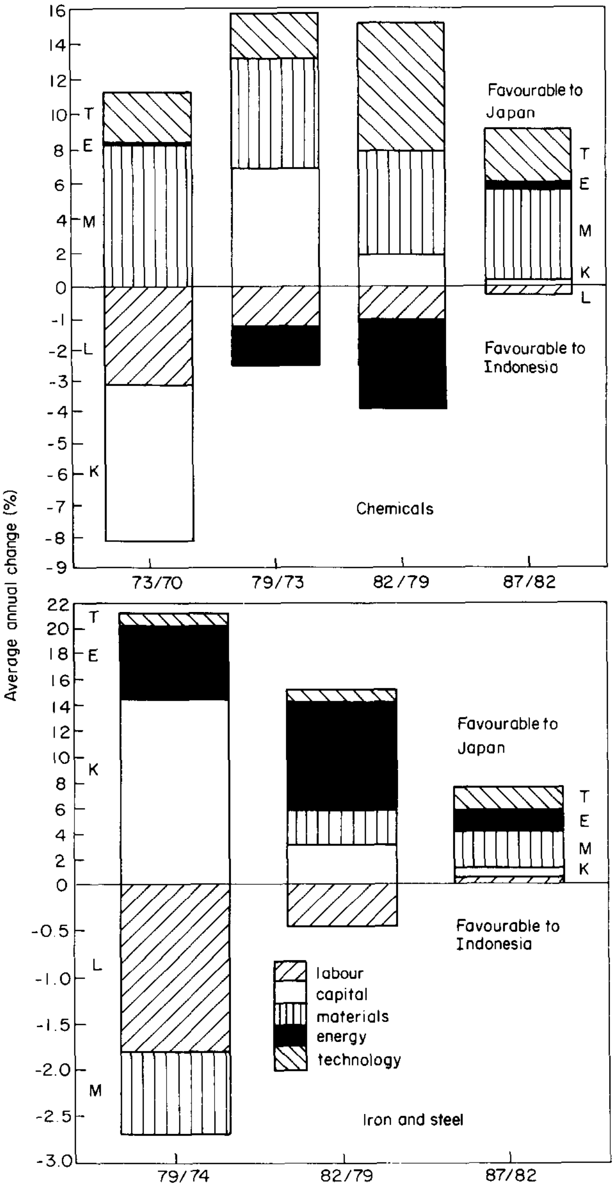


Figure 2. Differences in price changes between Japan and Indonesia (chemicals and iron and steel, 1970–87).

Data construction and sources

The data used for the above analysis were constructed as follows for both Japan and Indonesia over the period 1970–86.

(i) GNP
(ii) IIP: index of industrial production
(iii) ECN: energy consumption
(iv) EI: energy imports
(v) OI: oil imports
(vi) IOP: international oil prices
(vii) RDSTK: R&D stock general
(viii) ERDSTK: energy R&D stock
(ix) ER: exchange rate
(x) EPR: energy production
(xi) Oexp: oil export

All the basic data for Japan were obtained from *Annual Report on National Accounts* (EPA); *Energy Balances in Japan* (IEE); *Report on Survey of Research and Development* (MCA); and *International Financial Statistics* (IMF). All the basic data for Indonesia were obtained from *Statistical Yearbook* (CBS); *Annual Statistical Bulletin* (referred by IEE), and *Statistic Yearbook* (UN).

Empirical results

Synchronization of factors influencing energy price formation. A comparison of factors influencing energy price formation between Japan and Indonesia over the period 1970–86 is illustrated in Tables 2 and 3 which suggests the following implications:

Japan

- The energy price formation in Japan over the period could be explained by the following six factors at the rate of 81.3% (proportion 81.3%): GNP, IIP (Index of Industrial Production), ECN (energy

Table 2. Comparison of the factors defining energy prices (Japan).

	A	B	C	D	E	F	G	H	I	J
GNP	×	×	×	×	×			×	×	×
IIP						×	×	×		
ECN	×	×	×	×	×	×	×	×	×	×
EI			×	×	×	×	×	×	×	×
OI		×								
IOP	×	×	×	×	×	×	×	×	×	×
RDSTK				×		×		×		×
ERDSTK					×		×			
ER									×	×
Proportion (%)	72.0	67.8	78.5	80.4	78.1	79.0	77.4	81.3*	77.0	78.6

Note: GNP = gross national product; IIP = index of industrial products; ECN = energy consumption; OI = oil imports; EI = energy imports; IOP = international oil prices; RDSTK = R&D stock; ERDSTK = energy R&D; ER = exchange rate.

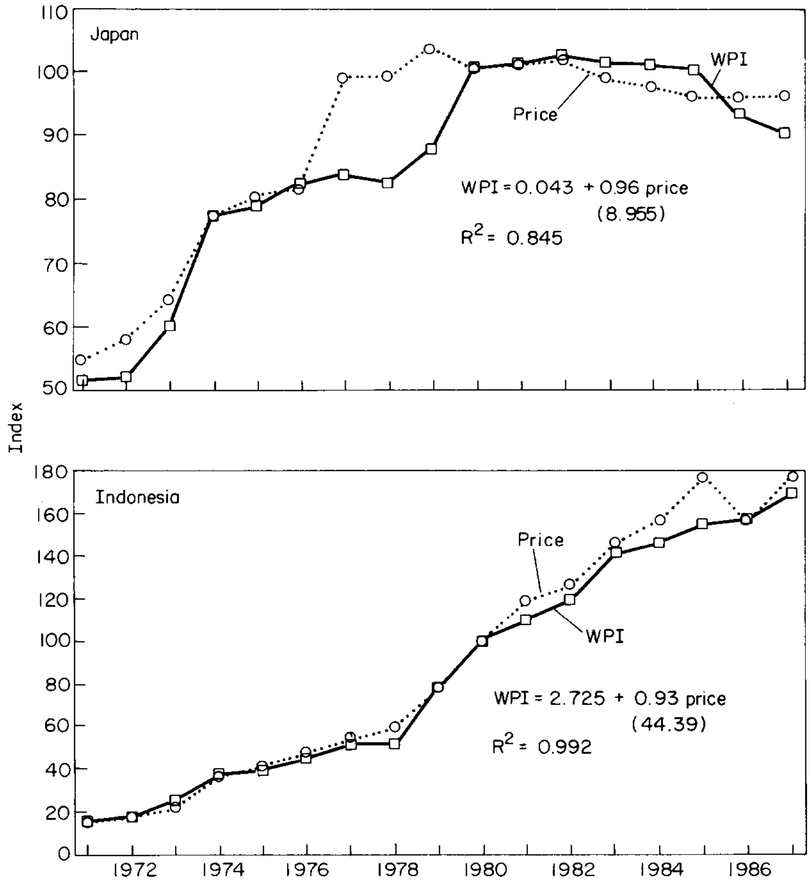


Figure 3. Reliability of the analysis (manufacturing industry).

Table 3. Comparison of the factors defining energy prices (Indonesia).

	A	A′	B	C	C′	D
GNP	×	×	×	×	×	×
ECN	×	×	×			×
EPR	×			×		×
Oexp		×			×	
IOP	×	×	×	×	×	×
Proportion (%)	90.9	70.6	94.2*	89.3	62.3	73.1

Note: GNP = gross national products; ECN = energy consumption; EPR = energy production; IOP = international oil prices; Oexp = oil exports.

consumption), EI (energy imports), IOP (international oil prices) and RDSTK (technological knowledge stock).

- Among the six factors, there were no significant differences in the influence on energy price formation except for ECN (energy consumption), which had relatively little influence.
- Technological knowledge stock by R&D general (RDSTK) explained better than the stock only by energy R&D.
- Exchange rates acted to decrease the proportion. This is considered due to auto-correlation with other factors.[5]

Indonesia

- The energy price formation in Indonesia over the period 1970–86 could be explained by the following three factors at the rate of 94.2%: GNP, ECN (energy consumption) and IOP (international oil prices).
- There were no significant differences in the influence among these three factors (see Table 3).

[5]GNP and EPR in Indonesia, for example, have an auto-correlation as indicated in DW in the following analysis:

$$GNP = 41.37 + 0.59\,EPR, \quad R^2 = 0.8914, \quad DW = 0.789$$
$$(6.37) \quad (9.06)$$

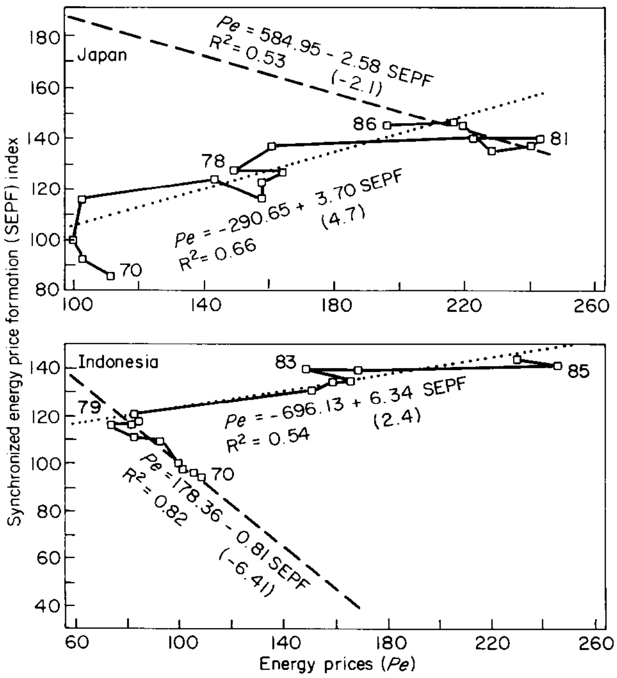


Figure 4. Trends in correlation.

- Oexp (oil export) and EPR (energy production) acted to decrease the proportion (94.2% → 70.6% and 90.9% respectively).

These are also considered due to auto-correlation with other factors.

Correlation between synchronized energy price formation (SEPF) and energy prices. By using the synchronized energy price formation (SEPF), we have made correlation analyses between the trends in SEPF and energy prices (real base). Outcomes are summarized in Figure 4. Looking at Figure 4, we note that the correlations between two indices both in Japan and Indonesia are significant, which proves that our postulated function ($Pe = a + b * SEPF$) provides a reasonably good indicator of energy price formation for both countries.

On the basis of the above analysis, we could identify several structural changes inherent to both countries. They are outlined in Table 4 (figures in parentheses indicate slope).[6]

The analysis in Table 4 suggests that the major structural changes in energy price formation occurred in 1982 (the year when international oil prices changed to falling trends) in Japan and 1979 (the year of the second oil crisis) in Indonesia.

In order to identify the locomotive power which induced the structural changes in both countries, we have made a comparative correlation analysis between respective factors composing SEPF and the energy prices. Outcomes of the analysis are summarized in Table 5, which suggests the following important implications:

(i) Energy prices in Japan have been consistently influenced most greatly by IOP (international oil prices) followed by GNP and RDSTK (technological knowledge stock) before the structural changes, and also by IIP after the structural changes.

(ii) Japan has been greatly influenced by IOP, which led to the sharp rise and fall in Japan's energy prices.

(iii) On the other hand, in the case of Indonesian energy prices, there has been no significant correlation between factors, including IOP. Indonesian energy prices have been influenced by all three factors together in a composite and synchronized way.

(iv) Indonesia has been less influenced by IOP and continued to decrease its energy prices even after the first oil crisis. Change into an upward trend was after the second oil crisis and since then, with the exception of the fall in 1982, oil prices have continued to increase.

(v) These facts suggest that Indonesian energy prices have been greatly influenced by two synchronized factors (GNP and energy consumption) rather than IOP and that in order to elucidate the problem inherent to the energy price formation mechanism, in-depth analysis of the synchronized aspects related to these two factors seems essential.

Identification of factors governing energy price formation in Indonesia. On the basis of the above findings, the relationship among factors related to energy price formation in Indonesia is shown in Figure 5. Trends for each factor are shown in Figure 6, where we note that the Indonesian economy, which enjoyed rapid growth in the 1970s, has been, to a great extent, dependent on the production, export and tax revenue of energy, chiefly of oil. Therefore, the mechanism of energy price formation which aimed at the expansion and sustenance of export and tax revenues from energy has been criticized as discouraging the development of domestic industries, especially manufacturing industries.[7] In order to overcome the stagnation of

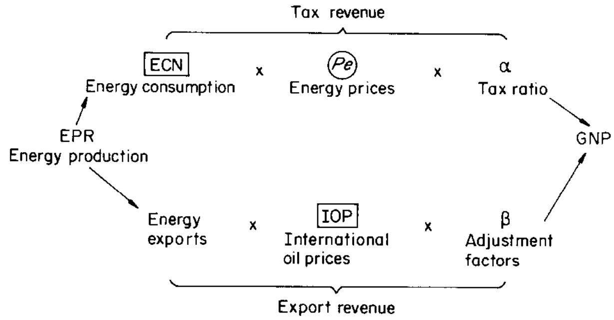
[6] The phase indicates: 1973, the first oil crisis; 1979, the second oil crisis; and 1981 start of the fall in the oil prices.

[7] (i) During the period of strong economic growth, the government introduced regulations which subsidized domestic oil prices via a tax on exported oil. (ii) A package of ten policies aimed at tax reform and relaxation of regulations was introduced in April 1985. This also acted negatively on reasonable energy price formation, because it resulted in increased tax rates on oil exports and higher public utility charges. (iii) In April 1989, electricity charges increased 24%, and resulted in an average cost of Rp 116/kWh, almost the same level as other ASEAN countries, including non-energy producing countries.

Table 5. Correlation between related factors and energy prices.

Regression	$Pe=a+bX$ (1970~1986) 1986/70 t	R^2	DW	b	Before structural changes	t	R^2	DW	b	After structural changes	t	R^2	DW	b
1 Japan														
A X=GNP	2.30***	0.20	0.54	36.7	83/70	8.06*	0.83	1.32	135.1	86/84	1.44	0.26	1.82	8.0
B X=IIP	5.35*	0.62	0.59	85.1	80/70	3.63*	0.55	1.41	124.0	86/81	−5.46*	0.83	1.76	−99.7
C X=ECN	0.70	−0.03	0.21	6.8	79/70	2.86***	0.44	1.10	43.5	86/80	1.85	0.26	1.07	6.3
D X=EI	0.19	−0.06	0.18	2.7	79/70	2.56***	0.38	0.95	47.7	86/80	1.98	0.29	1.17	9.8
E X=IOP	6.27*	0.69	0.88	90.9	81/70	15.6*	0.96	1.78	117.1	86/82	2.60	0.54	1.35	29.5
F X=RDSTK	3.36*	0.38	0.82	62.0	79/70	7.51*	0.86	1.30	79.9	86/80	0.83	−0.05	0.56	10.4
2 Indonesia	**1986/70** t	R^2	DW	b	**Before structural changes**	t	R^2	DW	b	**After structural changes**	t	R^2	DW	b
A X=GNP	5.31*	0.63	0.86	7.3	76/70	−8.11*	0.93	1.11	−6.33	86/77	5.42*	0.74	2.24	12.41
B X=ECN	4.02*	0.49	0.63	6.4	79/70	−7.70*	0.87	0.73	−2.88	86/80	1.95	0.32	1.88	10.67
C X=IOP	3.30*	0.38	0.42	6.03	79/70	−5.68*	0.77	2.08	−3.0	86/80	−0.99	0.00	1.46	−10.49

Note: *Statistically significant at 1% *level*. *** Statistically significant at 5% level.



$Pe = a + b$ SEPF

SEPF = F (GNP, ECN, IOP)

Figure 5. Energy price formation in Indonesia.

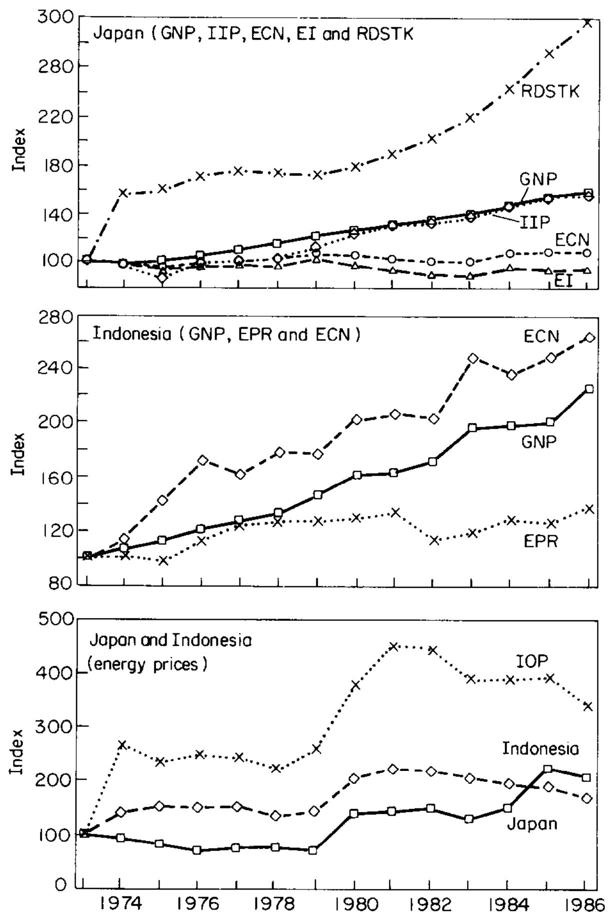


Figure 6. Trends in factors defining energy prices (Japan and Indonesia, 1973 = 100, at constant price).

exports due to the fall of international oil prices, the Indonesian government introduced a package of policies in March 1983 directed toward tax reform and the relaxation of regulations. These policies have been contributing to the increase in exports on one hand, while, on the other hand functioned negative to reasonable energy price formation in such a way as

Table 4.

	Japan	Indonesia	
Phase I	73/70	79/70 (−1.1)	SEPF up → Pe down
Phase II	82/73 (3.4)	84/79 (4.01)	SEPF up → Pe up
Phase III	86/82 (−1.8)	86/85	SEPF up → Pe down

to increase the tax rate of energy consumption in industries and public utility charges such as electricity charges. This explains, to a great extent, the reason why, Indonesia, despite being an energy-producing country, has not gained price competitiveness in energy prices.

The fall in international oil prices since 1982 has accelerated the various problems which result from domestic industries not being able to enjoy the benefit of lower oil prices.

Figure 6 indicates increasing expectations regarding the promotion of energy savings during periods of high energy export in order to allocate as much energy as possible for export.

However, energy saving efforts were in reality generally poor (see Figure 7) for the following

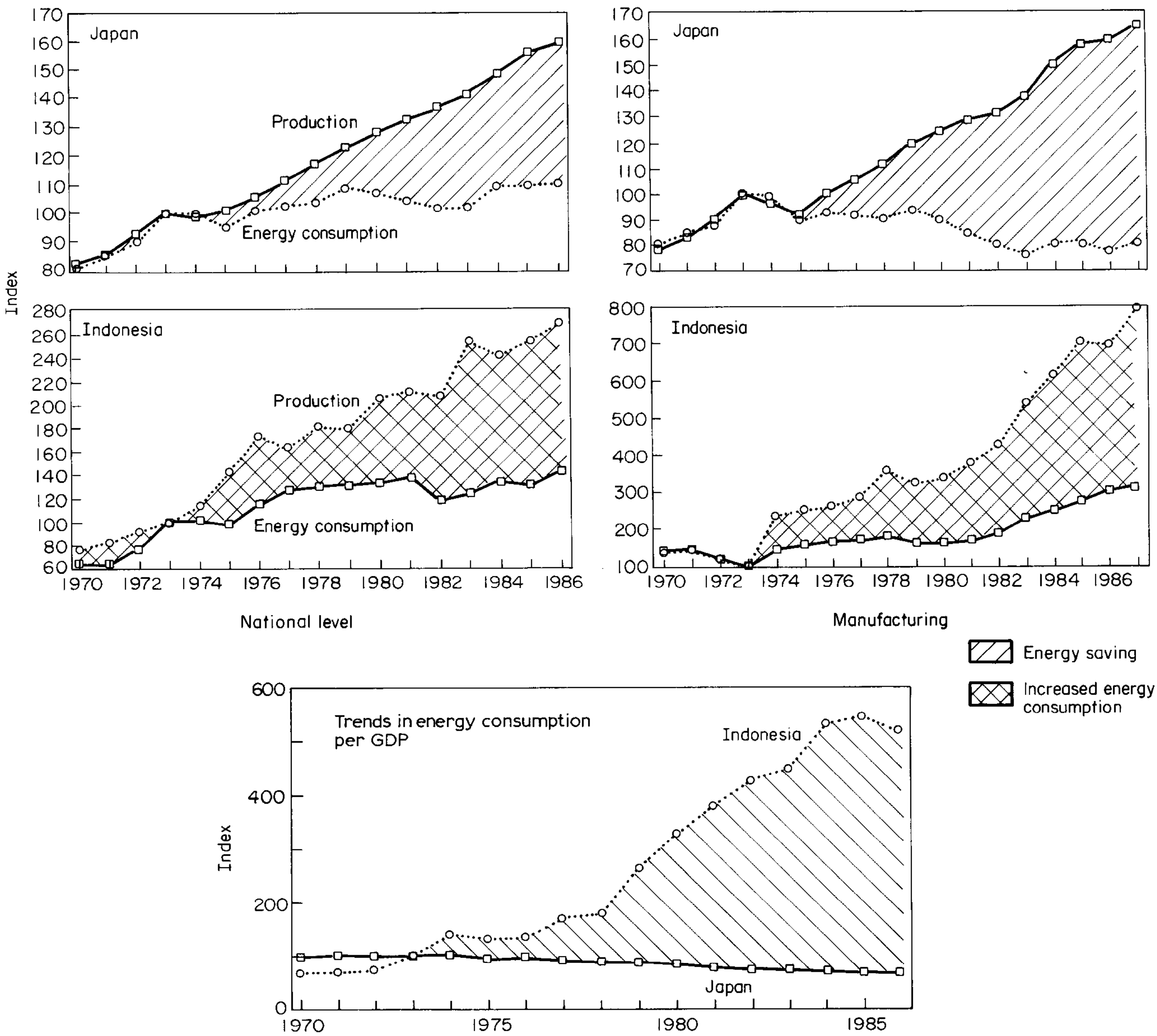


Figure 7. Trends in energy saving efforts (Japan and Indonesia).

reasons:

(i) The increase in energy exports was due to an increase in energy production, rather than by energy saving.
(ii) There was a reluctance in government efforts regarding energy saving policies due to a technically and administratively underdeveloped energy saving promotion system, and also to a lack of a political will not to reduce tax revenue from energy consumption.

Policy effect analysis

As mentioned above, despite being an oil-producing country, Indonesia has not enjoyed its potential advantage in energy prices, and this has accelerated the poor price competitiveness in manufacturing industries. Government dependence on tax revenue from oil exports, and the resulting distortions to the market mechanism have acted as fetters to competitiveness.

On the basis of the analyses and policy review, we obtained a definite understanding that, in order to improve Indonesia's competitiveness, it is imperative to improve the country's energy price formation mechanism and energy-saving policies. The effects of this improvement could be assessed by means of a simulation analysis using the production and cost functions explained earlier.

A simple analysis suggests that such package policies aiming at 20% energy savings together with a 30% decrease in energy prices (by improvement of energy price formation) could contribute to a 30% decrease in product prices.

Conclusion and policy implications

On the basis of the empirical results of the price competitiveness analysis, we have identified that Indonesia, contrary to expectations, did not enjoy its energy advantage. We have also pointed out that this is due to the country's energy price formation mechanism and also poor energy-saving efforts.

Following these findings, we have made a comparative analysis of the energy price formation mechanism both in Japan and Indonesia using principal component analysis. We have identified that the factors influencing energy price formation in Japan were GNP, IIP, energy consumption, energy imports, R&D stock and international oil prices. On the other hand, Indonesia was affected by a combination of GNP, energy consumption and international oil prices.

In the case of Japan, energy prices were greatly influenced by international oil prices before structural changes in 1982, although that influence weakened after the structural changes. On the other hand, the influence of international oil prices on Indonesia's energy prices has been relatively little and this has resulted in Indonesia not being able to enjoy the benefits of the fall in international oil prices. Package policies aimed at exports promotion have accelerated this mechanism.

On the basis of the numerical analysis of the policy effect, we have confirmed the significant contribution of the improvement of energy price formation and of energy-saving efforts to the increase in price competitiveness. All findings suggest the importance of these policies for the development of the Indonesian economy through the improvement of her competitiveness.

These findings lead to the following policy implications which, we are confident, contribute to policy-making in oil-producing developing countries, especially Indonesia.

First, in order to identify ways to increase the competitiveness of strategic industries (eg non-oil industries for Indonesia), it is essential to identify the competitiveness and factors influencing it through comprehensive and consistent analysis.

Second, we would like to emphasize the importance of the development of analytical methods which are practically applicable to broad policy-making fields. The efforts in developing and applying price function and principal component analysis to identify price competitiveness demonstrated the effectiveness and applicability of these analytical methods in policy-making fields, especially for developing countries.

On this basis, we have noted that the package policies aiming at export promotion contributed to improving Indonesia's export competitiveness; however on the other hand, they provided a negative impact on energy price formation (eg higher tax rates for the energy industry and also higher electricity charges), which resulted in a weakening of Indonesia's competitiveness in general.

Therefore, we would like to propose a careful and comprehensive assessment of the impact of package policies. In this context, our first and second recommendations are important.

As we mentioned previously, energy policy is a dilemma for Indonesia. However, our analysis showed a need for an improvement in the energy price formation system. Although, this improvement will result in a decrease of government revenue in the short run, our analysis indicated that over the long run, this improvement was expected to contribute to an increase in the price competitiveness of Indonesian industries, thereby resulting in an increase in government revenue.

It is strategically important to emphasize that an improvement in the energy price formation system should be based upon long-term views.

Finally, we would like to emphasize the significance of policy direction toward a shift from an oil dependent industrial structure to a non-oil dependent industrial structure. Although, we could not provide a complete analysis of the effects of such a shift due to the limitations and constraints of available data, we have a general indication that such a structural shift would contribute to an improvement in the energy price formation system and price competitiveness.

References

1 Bobby E. Apostolakis, 'Substitutability/complementarity: the dichotomy', *Energy Economics*, Vol 12, No 1, January 1990, pp 48–57.

2 Peter Drysdale, *International Economic Pluralism: Economic Policy in East Asia and the Pacific*, Allen & Unwin, Sydney, Wellington, London, Boston, in association with The Australian-Japan Research Center, Australian National University, 1988.

3 *Economy Survey of Japan 1984–1985*, Economic Planning Agency, Japanese government, Tokyo, 1985.

4 A. Steven Englander and Mittelstadt Axel, *Total Factor Productivity: Macroeconomic and Structural Aspect of the Slowdown*, OECD Economic Studies, 1988.

5 Nestor E. Terleckyj, 'Direct and indirect effects of industrial research and development on the productivity growth of industries', John W. Kendrick and Beatrice N. Vaccara, eds, *Developments in Productivity Measurement and Analysis*, The University of Chicago Press, Chicago and London, 1984, pp 359–377