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№ 7

Relative Price Changes
and
Biases of Technical Change in Japan

by

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Abstract

We experienced a remarkable change of the relative price system in Japan by the impact of the oil crisis. In our paper we aim to search quantitatively the possibility of the substitution among various inputs corresponding to the changes of the relative price systems and measure the bias of technical change with respect to each input. Here we classified the Japanese economy into thirty industrial sectors and observed during the period 1960-1977. We tried to describe the producer behavior by a trans-log price frontier function. We can draw on the work of Jorgenson and Fraumeni(1981) as a related research. As in the Japanese economy the oil crisis in 1973-1974 had an enomous impact on the economic structure, we can expect that there exists some structural changes on the parameters of the price frontier function. Therefore we tried to estimate the parameters of price frontier function firstly in the samples during the period 1960-1972 and secondly in the samples during the period 1960-1977, which include the samples after the oil crisis. If the impacts of the oil crisis were dominant in the samples after 1973, estimated parameters in the latter samples might have statistically significant differences from the previously estimated parameters.

According to the results we find that properties in terms of the elasticities of substitution do not change drastically at the oil crisis except the relation between capital and energy, which revealed a remarkable change from the independent relationship to the complimentary relationship in the several industries. Results are summarized in [Table 5].

On the other hand the bias of technical changes with respect to time had experienced a remarkable change in some industries. Before the oil crisis in Japan "capital using - labor saving - energy and material neutral" bias of technical changes are dominant in many industries. After the oil crisis, the results suggest that the bias of technical change moved significantly corresponding to the changes of the relative prices as shown in [Table 6].

The bias of technical change with respect to capital input moves to the input saving way for eleven industries. On the contrary in sixteen industries the bias of technical change with respect to labor input moves to the input using way. Also the bias of technical change with respect to energy and materials moves into the input saving way in almost one-third of the thrity industries.

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1. Theoretical Framework

Our production model aims to explain the producer behavior in each industrial sector of Japan. We assume that there exist a twice differentiable production function, by which the gross flow of output , X_i in i-th sector is related to the service flows of four inputs : labor(L_i), capital(K_i), energy(E_i) and other intermediate materials(M_i).

We assume further that the production function is characterized by constant returns to scale and Hicks - neutral technical changes.

(1.1) $$X_i = f_i(L_i, K_i, E_i, M_i, t),$$

where t denotes time trend.

Under the competitive market conditions, producer behavior can be described equivalently in terms of production functions or price possibility frontiers. We can deduce the price possibility frontier as a dual framework of the production function (1.1).

(1.2) $$q_i = g_i(P_{Li}, P_{Ki}, P_{Ei}, P_{Mi}, t)$$

where q_i is the price of output of industry i and P_{ji}(j=K,L,E,M) represent the price of labor service, capital service, energy input and other intermediate material input in industry i respectively.(1

Further we assume that the price possibility frontier (1.2) can be specified by the following trans-log price function.(2

(1.3) $$\ln q_i = \alpha o^i + \sum_j \alpha_j^i \ln P_{ji} + \frac{1}{2} \sum_k \sum_j \beta_{kj}^i \ln P_{ki} \ln P_{ji} + \alpha_t \cdot t + \sum \beta_{jt}^i \ln P_{ji}^i t + \frac{1}{2} \beta_{tt} t^2$$

where αo^i, α_j^i (j=K,L,E,M), β_{kj}^i (k,j=K,L,E,M), α_t^i, β_{jt}^i (j=K,L,E,M) and β_{tt}^i denote the parameters of the price function of i-th sector.(3

As well known, trans-log price function is one of sufficiently flexible functional forms, which give a second order approximation to an arbitrary twice-differentiable function.

According to well known Shapard Lemma under the condition of the perfect competitive market, we can obtain the share function assuming the profit maximization behavior of producer.(4

$$(1.4) \quad \frac{\partial \ln q^i}{\partial \ln P_j^i} = \frac{P_{ji}}{q_i} \cdot \frac{Y_{ji}}{X_i} = W_{ji}, \quad (j=K,L,E,M)$$

where Y_{ji} corresponds to each input, K_i, L_i, E_i and M_i for j=K,L,E and M and W_{ji} represents income share of j-th input in the i-th industrial sector.

Similarly we can define the rate of technical change as the negative of the shift of the function in terms of the price possibility frontier.

$$(1.5) \quad - \frac{\partial \ln q^i}{\partial t} = W_{ti}$$

where W_{ti} denotes the rate of technical change.

From the trans-log specification of the price possibility frontier, we can deduce the following system of the share functions and the negative of the rate of technical change.

(1.6)

$$W_{Ki} = \frac{P_{Ki}K_i}{P_iX_i} = \alpha_K^{i} + \beta^{i}_{KK}\ln P_{Ki} + \beta^{i}_{KL}\ln P_{Li} + \beta^{i}_{KE}\ln P_{Ei} + \beta^{i}_{KM}\ln P_{Mi} + \beta^{i}_{Kt}t$$

$$W_{Li} = \frac{P_{Li}L_i}{P_iX_i} = \alpha_L^{i} + \beta^{i}_{LK}\ln P_{Ki} + \beta^{i}_{LL}\ln P_{Li} + \beta^{i}_{LE}\ln P_{Ei} + \beta^{i}_{LM}\ln P_{Mi} + \beta^{i}_{Lt}t$$

$$W_{Ei} = \frac{P_{Ei}E_i}{P_iX_i} = \alpha_E^{i} + \beta^{i}_{EK}\ln P_{Ki} + \beta^{i}_{EL}\ln P_{Li} + \beta^{i}_{EE}\ln P_{Ei} + \beta^{i}_{EM}\ln P_{Mi} + \beta^{i}_{Et}t$$

$$W_{Mi} = \frac{P_{Mi}M_i}{P_iX_i} = \alpha_M^{i} + \beta^{i}_{MK}\ln P_{Ki} + \beta^{i}_{ML}\ln P_{Li} + \beta^{i}_{ME}\ln P_{Ei} + \beta^{i}_{MM}\ln P_{Mi} + \beta^{i}_{Mt}t$$

$$-W_{ti} = \frac{\partial \ln q_i}{\partial t} = \alpha_t^{i} + \beta^{i}_{tK}\ln P_{Ki} + \beta^{i}_{tL}\ln P_{Li} + \beta^{i}_{tE}\ln P_{Ei} + \beta^{i}_{tM}\ln P_{Mi} + \beta^{i}_{tt}t$$

$$(\, i = 1 \cdots\cdots\cdots 31 \,)$$

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(1) For further discussion, see Samuelson(1953) and Fuss-Mcfadden (1978).

(2) For trans-log specification, see Christensen, Jorgenson and Lau(1973).

(3) The trans-log KLEM price frontier function is estimated by Berndt and Wood (1975) in the U.S. manufacturing during the period 1947-1971. Fraumeni-Jorgenson (1981) tried to estimate the trans-log model by the 36 industrial sectoral data in U.S. Wills (1979) analyzed the properties of the technical change in the U.S. primary metal industry by a trans-log price frontier. In the articles of the productivity analysis, we can find several articles in which fluctuations of the productivities are related to the specification of the trans-log production or price frontier functions ; Gollop and Jorgenson (1980), Mohr (1980) and Madoo and Hansen (1980).

Deductions of the trans-log price function give the economic interplitation of parameters as the share elasticity with respect to input price, biases of technical change and the rate of change of the negative of the rate of technical change.

Share Elasticity

$$(1.7) \qquad U^i_{jk} = \frac{\partial W_{ji}}{\partial \ln P_{ki}} = \beta^i_{jk} \qquad (j.k = K.L.E.M).$$

Biases of technical change

$$(1.8) \qquad U^i_{jt} = \frac{\partial(-W_{ti})}{\partial \ln P_{ji}} = \beta^i_{jt} \qquad (j= K.L.E.M).$$

The rate of change of the negative of the rate of technical changes

$$(1.9) \qquad U^i_{tt} = \frac{\partial(-W_{ti})}{\partial_t} = \beta^i_{tt} .$$

We have to introduce some theoretical constraints in the formulation of trans-log price frontier function, so that the trans-log price function becomes consistent with the theory of producer's equilibrium.(5

Firstly adding-up condition of accounting identity imposes the following restrictions on (1.3). Under these restrictions the relative share must sum to unity and only three of the first four equations in (1.6) is independent.

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(4) See Shephard (1970).
(5) Fraumeni-Jorgenson (1981).

$$\alpha_K^{i} + \alpha_L^{i} + \alpha_E^{i} + \alpha_M^{i} = 1$$

(1.10)
$$\beta^i_{KK} + \beta^i_{LK} + \beta^i_{EK} + \beta^i_{MK} = 0$$

$$\beta^i_{KL} + \beta^i_{LL} + \beta^i_{EL} + \beta^i_{ML} = 0$$

$$\beta^i_{KE} + \beta^i_{LE} + \beta^i_{EE} + \beta^i_{ME} = 0$$

$$\beta^i_{KM} + \beta^i_{LM} + \beta^i_{EM} + \beta^i_{MM} = 0$$

$$\beta^i_{Kt} + \beta^i_{Lt} + \beta^i_{Et} + \beta^i_{Mt} = 0$$

In our four inputs model, which we will call KLEM model below, it involves estimating explicitly thirty parameters for each industry. If the material share equation is delated, the six additional parameters are calculated from independently estimated twenty-four parameters.

Secondly the ten symmetry restrictions of the KLEM model with the material share equation delated are as follows.

(1.11)

$$\beta^i_{KL} = \beta^i_{LK}$$

$$\beta^i_{KE} = \beta^i_{EK}$$

$$\beta^i_{KM} = \beta^i_{MK} = -\beta^i_{KK} - \beta^i_{LK} - \beta^i_{EK}$$

$$\beta^i_{LE} = \beta^i_{EL}$$

$$\beta^i_{LM} = \beta^i_{ML} = -\beta^i_{KL} - \beta^i_{LL} - \beta^i_{EL}$$

$$\beta^i_{EM} = \beta^i_{ME} = -\beta^i_{KE} - \beta^i_{LE} - \beta^i_{EE}$$

$$\beta^{i}_{Kt} = \beta^{i}_{tK}$$

$$\beta^{i}_{Lt} = \beta^{i}_{tL}$$

$$\beta^{i}_{Et} = \beta^{i}_{tE}$$

$$\beta^{i}_{Mt} = \beta^{i}_{tM} = - \beta^{i}_{Kt} - \beta^{i}_{Lt} - \beta^{i}_{Et}$$

Given these restrictions, there are fourteen unknown KLEM model parameters to be estimated for each industry. The accounting identity and symmetry restrictions taken together imply that the price possibility frontiers are homogeneous of degree one.

Finally monotonicity and concavity are desiable price possibility frontier curvature properties according to economic theory. The conditions for monotonicity and concavity can be obtained by differentiating the price possibility frontier with respect to prices. With respect to the KLEM model, the first order partial derivatives are

(1.12) $$\frac{\partial q_i}{\partial P_K{}^i} = \frac{q_i}{P_K{}^i} \cdot \frac{\partial \ln q_i}{\partial \ln P_K{}^i} = \frac{q_i}{P_K{}^i} W_K{}^i ,$$

$$\frac{\partial q_i}{\partial P_L{}^i} = \frac{q_i}{P_L{}^i} \cdot \frac{\partial \ln q_i}{\partial \ln P_L{}^i} = \frac{q_i}{P_L{}^i} W_L{}^i ,$$

$$\frac{\partial q_i}{\partial P_E{}^i} = \frac{q_i}{P_E{}^i} \cdot \frac{\partial \ln q_i}{\partial \ln P_E{}^i} = \frac{q_i}{P_E{}^i} W_E{}^i ,$$

$$\frac{\partial q_i}{\partial P_M{}^i} = \frac{q_i}{P_M{}^i} \cdot \frac{\partial \ln q_i}{\partial \ln P_M{}^i} = \frac{q_i}{P_M{}^i} W_M{}^i$$

The second order partial and cross-partial derivatives of the price possibility frontier can be written by

(1.13)
$$\frac{\partial^2 q_i}{\partial P_j^{i\,2}} = \frac{q_i}{P_j^{i\,2}} (\beta_{jj}^i + W_j^{i\,2} - W_j^i)$$
$$(j = K.L.E.M) \,.,$$

and

$$\frac{\partial^2 q_i}{\partial P_j^i \partial P_K{}^i} = \frac{q_i}{P_j^i P_K{}^i} (\beta_{jK}^i + W_j^i W_K^i)$$
$$(j, K = K, L, E, M) \,.$$

These second order partial derivatives determine the Hessian of the price possibility frontier, H^{*i} at the point of base year (q_i, $P_{ji} = 1.0$, j=K.L.E.M).

(1.14)

$$H^{*i} = \begin{bmatrix} \beta_{KK} + W_K^i(W_K^i - 1) & \beta_{KL} + W_K^i W_L^i & \beta_{KE} + W_K^i W_E^i & \beta_{KM} + W_K^i W_M^i \\ & \beta_{LL} + W_L^i(W_L^i - 1) & \beta_{LE} + W_L^i W_E^i & \beta_{LM} + W_L^i W_M^i \\ & & \beta_{EE} + W_E^i(W_E^i - 1) & \beta_{EM} + W_E^i W_M^i \\ & & & \beta_{MM} + W_M^i(W_M^i - 1) \end{bmatrix}$$

H^{*i} can be expressed by an alternative way of expressing H^i as follows.

(1.15)

$$H^i = (\beta_{jK}^i) + W^i W^{i'} - \hat{W}^i$$

$$(\beta_{jK}^i) = \begin{bmatrix} \beta_{KK}^i & \beta_{KL}^i & \beta_{KE}^i & \beta_{KM}^i \\ \beta_{KL}^i & \beta_{LL}^i & \beta_{LE}^i & \beta_{LM}^i \\ \beta_{KE}^i & \beta_{LE}^i & \beta_{EE}^i & \beta_{EM}^i \\ \beta_{KM}^i & \beta_{LM}^i & \beta_{EM}^i & \beta_{MM}^i \end{bmatrix}$$

$$W_i = \begin{bmatrix} W_K^i \\ W_L^i \\ W_E^i \\ W_M^i \end{bmatrix} \quad \text{and} \quad \hat{W}^i = \begin{bmatrix} W_K^i & & & 0 \\ & W_L^i & & \\ & & W_E^i & \\ 0 & & & W_M^i \end{bmatrix}$$

Monotonicity requires that each element of W^i has to be non-negative. If each element of W^i were non-negative, matrix, $\bar{W}^i\bar{W}^i - \hat{W}^i$ might be a negative semi-definite matrix, so that the sufficient condition of concavity of H^{*i} is consistent with the negative semi-definiteness of $[\beta_{jk}^i]$. In this case the negative semi-definiteness of $[\beta_{jk}^i]$ guarantees the monotonicity

and concavity of the price frontier function regardless of the level of W_j^1. We call it conditions of "global concavity". The negative semi-difiniteness of $[\beta_{jk}^1]$ for the global concavity might be tested by searching the negativity of diagonal factors in the Cholesky Factorization of $[\beta_{jk}^1]$.
Instead of the global concavity, we can impose the weaker condition of concavity on the price possibility frontier, which means that the concavity of the function might be satisfied within the observed fluctuation of the income share, W_j^1 (j= K,L,E,M). We call it the condition of "local concavity".

Our KLEM production model describing the producer behavior in terms of the trans-log price possibility frontier has to be imposed the above theoretical restrictions: homogeniety, symmetry, monotonicity and concavity.

2. Stochastic Specification and Estimation

Stochastic specification of KLEM model can be drawn on the U.S. model estimated by Jorgenson-Fraumeni [1981]. They assumed the additive disturbances ε_j^* in each of the equations (1.6), reflecting errors in cost minimization. Under the adding-up condition one of the equations in (1.6) is not independent. This implies that the sum of the additive disturbance terms in the first four equations equals zero in every time period. Therefore they assumed that the truncated covariance matrix corresponding to one equation being deleted might be nonsingular and the truncated vector of disturbances is independently and identically normally distributed with a zero mean vector and covariance matrix Ω.
We will use the same assumption in our KLEM model.

The rate of technical change for the production possibility frontier, W_t in (1.6) is unobservable directly. Following descrete divisia index of technical change is exact with the trans-log price frontier function. (Diewert (1976))

$$
\begin{aligned}
(2.1) \quad -W_{ti} = {} & \ln q_i(t) - \ln q_t(t-1) \\
& - \bar{W}_{ki}(\ln P_{ki}(t) - \ln P_{ki}(t-1)) \\
& - \bar{W}_{Li}(\ln P_{Li}(t) - \ln P_{Li}(t-1)) \\
& - \bar{W}_{Ei}(\ln P_{Ei}(t) - \ln P_{Ei}(t-1)) \\
& - \bar{W}_{Mi}(\ln P_{Mi}(t) - \ln P_{Mi}(t-1)) \; ,
\end{aligned}
$$

where

$$
\begin{aligned}
\bar{W}_{Ki} &= \frac{1}{2}\,[W_{Ki}(t) + W_{Ki}(t-1)], \\
\bar{W}_{Li} &= \frac{1}{2}\,[W_{Li}(t) + W_{Li}(t-1)], \\
\bar{W}_{Ei} &= \frac{1}{2}\,[W_{Ei}(t) + W_{Ei}(t-1)], \\
\bar{W}_{Mi} &= \frac{1}{2}\,[W_{Mi}(t) + W_{Mi}(t-1)], \\
\bar{W}_{ti} &= \frac{1}{2}\,[W_{ti}(t) + W_{ti}(t-1)] \; .
\end{aligned}
$$

Using this index number - W_t, the final behavioral equation, (1.6) becomes

$$
\begin{aligned}
(2.2) \qquad - \bar{W}_t = {} & \alpha_t + \beta_{Kt}\overline{\ln P_{Ki}} + \beta_{Lt}\overline{\ln P_{Li}} \\
& + \beta_{Et}\overline{\ln P_{Ei}} + \beta_{Mt}\overline{\ln P_{Mi}} + \beta_{tt}\cdot\bar{t} \; ,
\end{aligned}
$$

where

$$\overline{\ln P_{Ki}} = \frac{1}{2}[\ln P_{Ki}(t) + \ln P_{Ki}(t-1)],$$

$$\overline{\ln P_{Li}} = \frac{1}{2}[\ln P_{Li}(t) + \ln P_{Li}(t-1)],$$

$$\overline{\ln P_{Ei}} = \frac{1}{2}[\ln P_{Ei}(t) + \ln P_{Ei}(t-1)],$$

$$\overline{\ln P_{Mi}} = \frac{1}{2}[\ln P_{Mi}(t) + \ln P_{Mi}(t-1)],$$

$$\bar{t} = \frac{1}{2}[t + (t-1)].$$

We then transform the set of behavioral equation (1.6) into the following set of equations that can be estimated:

(2.3)

$$\overline{W_{Ki}} = \alpha_K^i + \beta_{KK}^i \overline{\ln PKi} + \beta_{KL}^i \overline{\ln PLi} + \beta_{KE}^i \overline{\ln PEi} + \beta_{KM}^i \overline{\ln PMi} + \beta_{Kt} \cdot \bar{t} + \overline{\varepsilon_K}$$

$$\overline{W_{Li}} = \alpha_L^i + \beta_{KL}^i \overline{\ln PKi} + \beta_{LL}^i \overline{\ln PLi} + \beta_{LE}^i \overline{\ln PEi} + \beta_{LM}^i \overline{\ln PMi} + \beta_{LT} \cdot \bar{t} + \overline{\varepsilon_L}$$

$$\overline{W_{Ei}} = \alpha_E^i + \beta_{KE}^i \overline{\ln PKi} + \beta_{LE}^i \overline{\ln PLi} + \beta_{EE}^i \overline{\ln PEi} + \beta_{EM}^i \overline{\ln pMi} + \beta_{Et}^i \cdot \bar{t} + \overline{\varepsilon_E}$$

$$\overline{W_{Mi}} = \alpha_M^i + \beta_{KM}^i \overline{\ln PKi} + \beta_{LM}^i \overline{\ln PLi} + \beta_{EM}^i \overline{\ln PEi} + \beta_{MM}^i \overline{\ln PMi} + \beta_{Mt}^i \cdot \bar{t} + \overline{\varepsilon_M}$$

$$-\overline{W_t} = \alpha_t^i + \beta_{Kt}^i \overline{\ln PKi} + \beta_{Lt}^i \overline{\ln PLi} + \beta_{Et}^i \overline{\ln PEi} + \beta_{Mt}^i \overline{\ln PMi} + \beta_{tt}^i \cdot \bar{t} + \overline{\varepsilon_t}$$

where

$$\overline{\varepsilon_K} = \frac{1}{2} [\varepsilon_K(t) + \varepsilon_K(t-1)]$$

$$\overline{\varepsilon_L} = \frac{1}{2} [\varepsilon_L(t) + \varepsilon_L(t-1)]$$

$$\overline{\varepsilon_E} = \frac{1}{2} [\varepsilon_E(t) + \varepsilon_E(t-1)]$$

$$\overline{\varepsilon_M} = \frac{1}{2} [\varepsilon_M(t) + \varepsilon_M(t-1)]$$

$$\overline{\varepsilon_t} = \frac{1}{2} [\varepsilon_t(t) + \varepsilon_t(t-1)]$$

The error terms { $\overline{\varepsilon_K}$, $\overline{\varepsilon_L}$, $\overline{\varepsilon_E}$, $\overline{\varepsilon_M}$, $\overline{\varepsilon_t}$ } are now serially correlated. Applying NL3SLS in TSP system, we tried to estimate parameters in the simultaneous equation (2.3) after deleting the serial correlation in the errors. (Jorgenson-Fraumeni (1981))
Here we will list the instrumental variables in our estimation. Gallant [1974] has shown that NL3SLS estimation is strongly consistent, asymptotically normally distributed.

List of Instrumental Variables

Z1 : Constant
Z2 : Time trend
Z3 : Nominal government current expenditure
Z4 : Nominal government fixed capital formation
Z5 : Total time endowment
Z6 : Average effective rate of indirect tax
Z7 : Average effective rate of income tax
Z8 : Effective rate of corporate income tax
Z9 : Effective rate of corporate enterPrise tax
Z10: Effective rate of non-corporate inocme tax
Z11: Effective rate of non-corporate enterprise tax

Z12: Aquisition tax rate for real estate
Z13: Property tax rate for buildings and other structure
Z14: Property tax rate for automobile
Z15: Property tax rate for depreciable goods except automobil and building
Z16: Property tax rate for land
Z17: Over-all price of labor service

We can obtain some measurement of technological properties in each industry from the estimated parameters.
Allen partial elasticity of substitution is defined in terms of trans-log price possibility frontier as follows: (6

$$(2.4)\qquad \sigma^i_{kj} = \beta^i_{kj}/W^i_k W^i_j + 1 \qquad (k \neq j,\ k,j = K.L.E.M)$$

$$\sigma^i_{jj} = \beta^i_{jj}/{W^i_j}^2 - 1/W^i_j + 1 \qquad (j = K.L.E.M).$$

Also we can define the price elasticity of demand under the perfect competitiveness of the market as follows:

$$(2.5)\qquad \frac{\partial \ln x_{ji}}{\partial \ln P_{ki}} = \frac{P_{ki}}{x_{ji}} \cdot \frac{\partial x_{ji}}{\partial P_{ki}} = W^i_k \sigma^i_{jk} \qquad (k,j = K.L.E.M.).$$

Concavity restriction in the price possibility frontier requires the following conditions.

$$(2.6)\qquad \sigma^i_{jj} = \beta^i_{jj}/{W^i_j}^2 - 1/W_j + 1 < 0$$

or

$$\beta^i_{jj} < W^i_j\,(1-W^i_j) \qquad (j = K.L.E.M.)$$

$$(2.7)\quad W^i_L\sigma^i_{KL} + W^i_E\sigma^i_{KE} + W^i_M\sigma_{KM} < 0 ,$$

$$W^i_K\sigma^i_{LK} + W^i_E\sigma^i_{LE} + W^i_M\sigma_{LM} < 0 ,$$

$$W^i_K\sigma^i_{EK} + W^i_L\sigma^i_{EL} + W^i_M\sigma_{EM} < 0 ,$$

$$W^i_K\sigma^i_{MK} + W^i_L\sigma^i_{ML} + W^i_E\sigma_{ME} < 0 .$$

Substituting (2.4) into each equation of (2.7) and imposing the restriction of homogeniety of degree one, we can deduce (2.6) again. This implies that if condition (2.6) is imposed on the trans-log price possibility frontier local concavity condition is satisfied during the sampling period. In our estimating procedures we try to estimate trans-log price function with restriction, (2.6), when unconstrained parameters did not accomplish to concavity condition.

3. Design of Experiment and Data Sources

Annual observations during the period, 1960-1977 were prepared for estimating the trans-log price possibility frontier in 30 industrial sectors shown in [Table 1]. As well-known, discrete divisia index are consistent with a trans-log aggregator functional form. Here we will summerize briefly compiling procedures for price index of output and inputs in each industrial sector.(7

<u>Output, Energy and Intermediate Material Input</u>:

Divisia price index of output, energy and intermediate material input were constructed from the estimated time-series input-output tables. In Japan input-output tables classified

[Table 1] List of Industrial Sectors

		Industry Name: 31 industrial orders	Gollop-Jorgensn (1980): 51 industrial orders
[A]	1.	Agriculture, Forestry and Fisheries	Agricultural Production
			Agricultural Service
[M]	2.	Mining	Metal mining
			Coal mining
			Crude Petroleum & N.Gas
			Nonmetallic mining
[C]	3.	Construction	Contract Construction
[Fo]	4.	Food and Kindred Products	Food & kindred Products
[Tx]	5.	Textile Mill Products	Textile Mill Products
[Ap]	6.	Apparel and other Fabricated Textile Products	Apparel & Other Fabr. Tex.
[Lm]	7.	Lumber and Wood Products, except Furniture	Lumber and Wood Prod.
[F]	8.	Furniture and Fixture	Furniture & Fixture
[P]	9.	Paper and Allied Products	Paper & Allied Products
[Pr]	10.	Printing, Publishing and Allied Products	Printing & Publishing
[Ch]	11.	Chemical and Allied Products	Chemical & Allied Products
[R]	12.	Petroleum Refinery and Related Industries	Petroleum & Coal Products
[Ru]	13.	Rubber and Miscellaneous Plastic Products	Rubber & Misc. Plastic Prod.
[Le]	14.	Leather and Leather Products	Leather & Leather Products

Continued

[S]	15.	Stone, Clay and Glass Products	Stone, Clay & Glass Prod.
[I]	16.	Iron and Steel	Primary Metal Products
[N]	17.	Non-ferrous Metal	
[Fa]	18.	Fabricated Metal Products	Fabricated Metal Products
[MH]	19.	Machinery	Machinery Ex. Electrical
[EM]	20.	Electric Machinery	Elec. Machinery Eqpt. & Supplies
[Mv]	21.	Motor Vehicles and Equipment	Motor Vehicles & Eqpt.
[Te]	22.	Transportation Equipment except Motor	Trans. Eqpt. Ex. Motor
[PM]	23.	Precision Instruments	Prof. Photo Eqpt. & Watches
[OM]	24.	Miscellaneous Manufacturing	Misc. Manufacturing Industry
			Tabacco Manufacturing
[Tr]	25.	Transportation and Communication	Railroad & Rail Express Service
			Street Rail, Bus Lines & Taxi
			Trucking Services & Warehousing
			Water Transportation
			Air Transportation
			Transportation Service
			Telephone, Telegraph Mics.
			Radio Broadcasting & TV.
[El]	26.	Electric Utility, Gas Supply and Water Supply	Electric Utility
			Gas Utility
			Water Supply & Sanitary Service
[W]	27.	Wholesale and Retail Trade	Wholesale Trade
			Retail Trade
[Fi]	28.	Finance and Insurance	Finance, Insurance & Real Est.
[RE]	29.	Real Estate	
[Sv]	30.	Service	Service Ex. Priv Households

on commodity basis have been compiled every five years since 1955. At first we tried to estimate the time-series input-output tables compiled with concistent concepts and definitions over the period 1960-1977, by using published tables as bench marks. We applied here Lagrangian method instead of well-known RAS method. Secondly we tried to convert estimated tables classified by commodity basis into transaction tables based upon industry by using information of product mix in each industrial sector. Column vector in estimated transaction table represents the intermediate input structure classified by commodity and the primary input structure in each industrial sector. Commodity transaction in each cell includes both domestic and imported goods. We tried to sum up non-competitive imports like crude oil in each sector and reclassify them as a directly allocated import. In Japan almost all of crude oil products are imported. Then imported crude oil are allocated directly to mining, petroleum refinery industry and electric utility sector. Finally secondary energy products fabricated in the petroleum refinery industry or electric utility sector are provided to other industrial sectors. In such dependency of intermediate input transaction we can simply understand that energy inputs in each industry except mining, petroleum refinery and electric utility are secondary energy produced in the latter three industries and directly allocated energy import is one of intermediate inputs in mining, petroluem refinery industry and electric utility sector. Energy input price index in i-th industry is defined by the aggregated price of both petroleum refinery and electric utility products as follows.

(3.1)

$$P_{Ei}(t) = P_{Ei}(t-1) \prod_{12.26}^{j} \left(\frac{P_{oj}(t)}{P_{oj}(t-1)} \right)^{\frac{1}{2}(S_j(t) + S_j(t-1))}$$

where $P_{oj}(t)$ represents the over-all price of j-th commodity and $S_j(t)$ denotes input share of j-th energy input to total energy input in i-th sector.

$P_{oj}(t)$ is defined by the similar divisia aggregation of both j-th domestic and imported commodity prices.

(3.2)
$$P_{oj}(t) = P_{oj}(t-1) \prod_{k=1}^{2} \left(\frac{P_{cjk}(t)}{P_{cjk}(t-1)} \right)^{\frac{1}{2}(u_{jk}(t) + u_{jk}(t-1))}$$

where $P_{cj1}(t)$ denotes price of domestically produced j-th commodity and $P_{cj2}(t)$ denotes price of imported j-th commodity.

$u_{j1}(t)$ represents share of j-th domestically produced commodity and $u_{j2}(t)$ is share of j-th imported commodity.

Price index of other intermediate material inputs is defined by similar divisia aggregation.

(3.3)
$$P_{Mi}(t) = P_{Mi}(t-1) \prod_{\substack{j=1 \\ (j \neq 12, 26)}}^{n} \left(\frac{P_{oj}(t)}{P_{oj}(t-1)} \right)^{\frac{1}{2}(S_i(t) + S_i(t-1))}$$

where $P_{oj}(t)$ is a over-all price of j-th commodity.

Price index of j-th industrial output is also defined by the divisia aggregation of domestically produced commodity price.

(3.4)
$$q_j(t) = q_j(t-1) \prod_{i=1}^{n} \left(\frac{P_{ci1}(t)}{P_{ci1}(t-1)} \right)^{\frac{1}{2}(v_{i1}(t) + v_{i1}(t-1))}$$

where $v_{i1}(t)$ represent the nominal share of i-th commodity product to total product in j-th industry.

Labor Input

Similarly we can formulate discrete divisia price index of labor service as follows:

(3.5)

$$P_{Li}(t) = P_{Li}(t-1) \prod_{klmn} \left(\frac{w_{klmn,i}(t)}{w_{klmn,i}(t-1)} \right)^{\frac{1}{2}[u_{klmn,i}(t)+u_{klmn,i}(t-1)]}.$$

where $w_{klmn,i}(t)$ denotes price of klmn-th labor service type in i-th sector and $u_{klmn,i}$ stands for the income share of klmn-th labor type in total labor compensation of i-th sector.

Labor type is classified as follows:
(1) Employment status (1. ordinary employee, 2. temporary worker, 3. dayly worker, 4. self-employed, 5. Un-paid family worker), (2) Sex (1.Male, 2. Female), (3) Occupation (1. Blue-collar worker, 2. White-collar worker), (4) Education (1. Elementary and Junior high school, 2. High school, 3. Junior college and Technical school, 4. College and University), (5) Age (1. less 17 years old, 2. 18-19 years old, 3. 20-24 years old, 4. 25-29 years old, 5.30-34 years old, 6. 35-39 years old, 7. 40-44 years old, 8. 45-49 years old, 9. 50-54 years old, 10. 55-59 years old, 11. 60-64 years old, 12. more than 65 years old), (6) Industry shown in Table [1-1]. Data for the ordinary workers in the non-agricultural sectors are principally available on the source of Basic Wage Structure Survey (BWSS). Estimates for the ordinary workers in agricultural and government service sectors are deduced from Labor Force Survey (LFS). Data for temporary worker, dayly worker, self-employed and un-paid family worker were estimated from LFS, Manufacturing Census, Establishment Census and Employment Status Survey.

Capital Input

We can define divisia price index of capital service input as follows:

(3.6)

$$P_{Ki}(t) = P_{Ki}(t-1) \prod_{klmn} \left(\frac{C_{klmn.i}(t)}{C_{klmn.i}(t-1)} \right)^{\frac{1}{2}(\omega_{klmn.i}(t)+\omega_{klmn.i}(t-1))}$$

where Cklmn.it represents capital service price of klmn-th type capital service input and ωklmn.i(t) stands for the income share of klmn-th capital service type in total capital compensation of i-th sector.

Unlike the prices of labor service, we can not directly observe the price of capital service, Cklmn.it. According to well-known procedures of imputative calculation, we can deduce a relationship in which the capital service price is regarded as a function of price of klmn-th investment goods, qklmn,it, rate of return on capital γ_{it}, economic rate of replacement, μ_{it} and certain tax variables.

Ignoring tax variables for the simplicity, we can derive the next well-known relationship,

(3.7)

$$C_{klmn.it} = q_{klmn.it}(\gamma_{it} + \mu_{klmn.it} - \frac{\dot{q}_{klmn.it}}{q_{klmn.it}}) .$$

On the other hand the data of business surplus adjusted for compensation of capital in i-th sector, B_{it} are available through the estimation of time-series input-output tables. Under the assumptions of the competitive market and of the linear homogeniety of price possibility frontier function, B_{it} must be equalized to the total capital service cost of i-th industry.

(3.8)

$$B_{it} = \sum_{klmn}\sum\sum\sum C_{klmn.it} \cdot K_{klmn.it}$$

$$= \sum_{klmn}\sum\sum\sum q_{klmn.it}(\gamma_{it} + \mu_{klmn.i} - \frac{\dot{q}_{klmn.it}}{q_{klmn.it}}) K_{klmn.it} .$$

where $K_{klmn.it}$ denotes klmn-th type capital asset in constant price. Regarding this relation as the equation of unknown variable, γ_{it} and putting the observed data of B_{it}, $q_{klmn.it}$, $\mu_{klmn.i}$ and $K_{klmn.it}$ to this equation, we can solve the rate of return, γ_{it} in i-th sector and hence impute the capital service price, $C_{klmn.it}$ in (3.7).
Substituting estimated time-series of $C_{klmn.it}$ into (3.6), we can estimate divisia price index of capital service.

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(6) Allen partial elasticity of substitution is defined as follows:

$$(1) \quad \sigma_{ij} = \frac{\Sigma fiai}{aiaj} \cdot \frac{Fij}{F}$$

where a_i denotes quantities of i-th input, f_i represents the first derivatives with respect to i-th input and F and F_{ij} stand for the matrix of the second order derivatives with respect to inputs and its co-factor of f_{ij} in F. Under the assumption of competitive equilibrium, definition (1) can be rewritten as follows:

$$(2) \quad \sigma_{ij} = \frac{\Sigma \frac{P_i}{P} a_i}{a_i a_j} \cdot q \cdot \frac{\partial a_i}{\partial P_j} = \frac{\Sigma P_i a_i}{a_i a_j} \cdot \frac{\partial a_i}{\partial P_j} ,$$

where P_i denotes prices of i-th input and q denotes prices of output.
According to the Shephard'Lemma,

$$(3) \quad \frac{\partial q}{\partial P_i} = g_i = a_i ,$$

$$(4) \quad \frac{\partial^2 q}{\partial P_i \partial P_j} = g_{ij} = \frac{\partial a_i}{\partial P_j}$$

Substituting (3) and (4) into (2), we obtain

$$(5) \quad \sigma_{ij} = \frac{q}{g_i g_j} g_{ij} = q\left(\frac{\partial^2 q}{\partial P_i \partial P_j}\right) \Big/ \left(\frac{\partial q}{\partial P_i}\right)\left(\frac{\partial q}{\partial P_j}\right)$$

Assumming the trans-log specification of price frontier function and substituting partial derivatives of the first two orders, we can obtain the equations,(2.4).

(7) For further discussion, see Jorgenson and Kuroda(1981) and Kuroda and Imamura(1981).

4. Estimated Results

We estimated trans-log price frontier function in the 30 industrial sector level. In the Japanese economy the oil crisis in 1973-74 had an enomous impact on the economic structure through the rapid changes of the relative price system. We can expect that the parameters of price frontier function might have been changed adjusting with the dramatic fluctuation of economy.

Therefore we tried to estimate the parameters of price frontier function firstly in the samples during the period 1960-1972, which do not include the impacts of oil crisis, and secondly in the samples during the period 1960-1977, which reflect the fluctuations after the oil crisis. If the impacts of the oil crisis were dominant in samples including after 1973, parameters estimated in the latter samples might have statistically significant differences from those in the former samples. We call below the former samples and the latter samples case [A] and case [B] respectively.

First of all we estimated parameters only on the restrictions of homogeniety and symmetricity both during the period 1960-1972 and 1960-1977. Results satisfied with monotonicity and concavity globally are obtained in only one industry; transportation equipment in case [A] and four industries; mining, machinery, whole-sale and real estate in case [B]. With respect to industries which did not satisfy with monotonicity and concavity conditions we tried to estimate paremeters with restrictions of (2.6) in order to accomplish to the local concavity. To test the validity of the local concavity restrictions we can obtain test statistics. From the results of unrestricted and restricted estimations we calculate the change in the weighed sum of squared residuals resulting from restrictions imposed. We divide this change by the sum

[Table 2] F-Ratios for Test of Concavity Restriction on the Form of Price Possibility Frontiers

		Sample 1960-1972		Sample 1960-1977	
		d.f.(ν_1/ν_2)	F-value	d.f.(ν_1/ν_2)	F-value
1.	Agriculture	(4 / 38)	1.0357	(1 / 54)	0.4940
2.	Mining	(1 / 38)	0.5618		——**
3.	Construction	(3 / 38)	0.2406	(2 / 54)	0.0 *
4.	Food & Kindred	(2 / 38)	2.2980	(1 / 54)	0.0 *
5.	Textile	(2 / 38)	0.4721	(1 / 54)	0.0 *
6.	Apparel	(3 / 38)	0.0 *	(2 / 54)	3.2676
7.	Lumber	(4 / 38)	0.9266	(2 / 54)	4.1660
8.	Furniture	(2 / 38)	0.0 *	(2 / 54)	0.0 *
9.	Paper	(1 / 38)	0.3384	(1 / 54)	1.1133
10.	Printing	(4 / 38)	3.4987	(1 / 54)	0.0 *
11.	Chemical	(1 / 38)	0.6398	(2 / 54)	3.5734
12.	Petroleum	(1 / 38)	0.0 *	(2 / 54)	1.2638
13.	Rubber	(2 / 38)	0.4805	(2 / 54)	1.6727
14.	Leather	(3 / 38)	1.1368	(2 / 54)	2.0012
15.	Stone	(1 / 38)	1.5765	(2 / 54)	1.4509
16.	Iron	(1 / 38)	0.0 *	(2 / 54)	0.0 *
17.	Non-ferrous	(2 / 38)	0.0 *	(2 / 54)	2.8761
18.	Fab.Metal	(2 / 38)	0.1742	(2 / 54)	1.5956
19.	Machinery	(1 / 38)	0.4398		——**
20.	Elec. M.	(1 / 38)	0.2114	(1 / 54)	3.7352
21.	Motor	(2 / 38)	0.0 *	(2 / 54)	0.0 *
22.	Trans. Eq.		——**	(2 / 54)	0.0 *
23.	Precision	(1 / 38)	3.5867	(1 / 54)	0.9935
24.	Mis. Mng.	(3 / 38)	1.9053	(2 / 54)	4.6226
25.	Trans.	(1 / 38)	5.5098	(1 / 54)	0.7245
26.	Elec. U.	(1 / 38)	2.9600	(1 / 54)	5.8452
27.	Whole-sale	(2 / 38)	1.0302		——**
28.	Finance	(2 / 38)	0.0 *	(1 / 54)	0.1936
29.	Real Estate	(3 / 38)	0.0 *		——**
30.	Service	(3 / 38)		(2 / 54)	0.7925

* The estimated change in the sum of squared residuals is negative.

** Parameters are satisfied with concavity condition in the non-restricted estimation.

of squared residuals at unrestricted estimation. Finally, we divide both numerator and dominator of this ratio by the appropriate number of degree of freedom. The resulting test statistics is distributed, asymptotically, as $F(\nu_1, \nu_2)$, where ν_1 is numerator degrees of freedom and ν_2 is the dominator degrees of freedom. F statistics by industries are summarized in [Table 2]. At a level of significance of 0.01 we accept the hypothesis that restrictions implied by (2.6) are valid for the price frontier function in all industries.

Lists of estimated parameters are reported in Appendix. Values in parenthesis denote t-value of each parameter, which is strongly consistent, asymptotically normally distributed.

Let us summarize our results.

The estimated share elasticities with respect to price : β_{KK}, β_{LL}, β_{EE} and β_{MM} describe the implications of patterns of substitution for the distribution of the value of output among capital, labor, energy and materials inputs. Positive share elasticities imply that the corresponding value shares increase with an increae in prices ; negative share elasticities imply that the value share decrease with price ; zero share elsticities correspond to value share that are independent of price. Some parameters of share elasticities are apri-o-ri given for the concavity conditions of (2.6). Since other unrestricted parameters are normally distributed, we can test the statistical validity of null-hypothesis (β_{ii}=0) in each industry. Results are summarized in [Table 3].

According to the results β_{KK} is positive for nineteen (restricted (8) + unrestricted(11)) of thrity and approximately zero for eleven of thirty industries in case[A], so that the value share of capital input increases with an increase of price in the two-third of thirty industries while the value share is independent of price in other one-third of thirty industries.On the other hand this property of

[Table 3] Summary of Share Elasticity

	[Case A]					[Case B]				
	Restricted		Non-restricted			Restricted		Non-restricted		
	β>0	β<0	β>0	β=0	β<0	β>0	β<0	β>0	β=0	β<0
β_{KK}	8	0	11	11	0	15	0	9	6	0
β_{LL}	14	0	3	13	0	2	0	4	23	1
β_{EE}	18	0	0	10	2	21	0	0	7	2
β_{MM}	0	0	10	19	1	0	0	4	24	2

Notes: (1) column 'Restricted' represents the numbers of industries in which parameters are restricted by constraints (2.6).
(2) At a level of significant of 0.01 we test the null-hypothesis (β_{ii}=0) in each parameter. columns 'Non-restricted' denote the numbers of industries.

β_{KK} does not change remarkably in case [B]. β_{LL} is positive for seventeen (restricted(14) + unrestricted(3)) of thirty and zero for thirteen of thirty industries in case [A], so that the number of industries in which its value share of labor input increases with an increase of price is more than the number of industries in which its change is independent of price. On the other hand in case [B] the number of industries with positive share elasticity is less than the number of industries with zero share elasticity, so that after the oil crisis the changes of value share of labor input trend to be independent of its price. β_{EE} is positive for eighteen, zero for ten and negative for two of thirty industries in case [A], so that the value share of energy input increases with an increase of price in the two-third of thirty industries. This properties of energy share elasticity are maintained after the oil crisis.

[Table 4] Estimates of Own Price Elasticity

	E K K		E L L		E E E		E M M	
	Sam.13	Sam.18	Sam.13	Sam.18	Sam.13	Sam.18	Sam.13	Sam.18
(1) Agriculture	-0.184[a]	-0.184[a]	-0.0511[a]	-0.264	-0.261[a]	-0.696	-0.249*	-0.546*
(2) Mining	-0.319	-0.215	-0.0541[a]	-0.732	-2.377*	-2.161*	-1.426*	-2.327*
(3) Construction	-0.465[a]	-0.518[a]	-0.0344[a]	-0.879*	-0.242[a]	-0.341[a]	-0.112	-0.175
(4) Food & Kindred	-0.616*	-0.780*	-0.721*	-0.697*	-0.136[a]	-0.213[a]	-0.378*	-0.369*
(5) Textile	-0.529*	-0.573*	-0.437	-0.610*	-0.0965[a]	-0.322[a]	-0.236*	-0.254*
(6) Apparel	-0.833[a]	-0.833[a]	-0.676*	-1.05*	-5.746	-0.357[a]	-0.400*	-0.600*
(7) Lumber	-0.204[a]	-0.722[a]	-0.183[a]	-0.691*	-0.146[a]	-0.426[a]	-0.089*	-0.266*
(8) Furniture	-0.760[a]	-0.760[a]	-0.289	-0.796	-0.275[a]	-0.306[a]	-0.193	-0.307*
(9) Paper	-0.668*	-0.476*	-0.146[a]	-0.653*	-2.491	-0.130[a]	-0.362	-0.252*
(10)Printing	-0.191[a]	-0.860[a]	-0.122[a]	-0.792*	-0.183[a]	-0.263	-0.123*	-0.517*
(11)Chemical	-0.394*	-0.358[a]	-0.130[a]	-0.463*	-0.263	-0.0530[a]	-0.169	-0.229*
(12)Petroleum	-0.372*	-0.505[a]	-0.0311[a]	-0.314[a]	-1.918*	-1.54*	-0.236	-0.297*
(13)Rubber	-0.316*	-0.500[a]	-0.184[a]	-1.048*	-0.356	-0.181[a]	-0.138*	-0.396*
(14)Leather	-0.545	-0.512[a]	-0.255[a]	-0.906*	-0.438[a]	-0.507[a]	-0.142*	-0.195*
(15)Stone	-0.566*	-0.359[a]	-0.936*	-1.074*	-0.0117[a]	-0.0117[a]	-0.771*	-0.427*
(16)Iron	-0.589*	-0.500*	-0.0909[a]	-0.521*	-0.526	-0.211[a]	-0.180	-0.152*
(17)Non-ferrous	-0.747*	-0.637*	-0.265[a]	-0.265[a]	-0.0787[a]	-0.0787[a]	-0.141	-0.270*
(18)Fab. Metal	-0.510[a]	-0.510[a]	-0.570	-0.893*	-0.394[a]	-0.394[a]	-0.380*	-0.362*
(19)Machinery	-0.644*	-0.518*	-0.792*	-1.256*	-3.112*	-0.565	-0.543*	-0.487*
(20)Elec. M.	-0.780*	-0.682*	-0.680	-1.139*	-0.0727[a]	-0.239[a]	-0.376*	-0.375*
(21)Motor	-0.567*	-0.605*	-0.859*	-0.701*	-1.819	-0.965	-0.362*	-0.293*
(22)Trans. Eq.	-0.529*	-0.539[a]	-0.392*	-0.650*	-1.290	-0.259[a]	-0.314*	-0.467*

[Table 4] Continued

(23)Precision	-0.456*	-0.467*	-0.608*	-0.568	-1.583*	-0.272a	-0.432*	-0.316*
(24)Mis. Mng.	-0.358*	-0.509a	-0.197a	-0.726*	-0.174a	-0.174a	-0.118*	-0.295*
(25)Trans.	-0.567	-0.532*	-0.865*	-0.613*	-0.0415a	-0.0415a	-1.017	-0.823
(26)Elec. U.	-0.355*	-0.321*	-0.450*	-0.536*	-1.451*	-2.10*	-0.220	-1.29*
(27)Whole-sale	-0.438*	-0.403*	-0.344	-0.627*	-0.897a	-1.60*	-0.127	-0.610*
(28)Finance	-0.492*	-0.449*	-0.892*	-0.975*	-0.111a	-0.293a	-0.743*	-0.632
(29)Real Estate	-0.142*	-0.144*	-0.0399a	-1.69*	-0.251a	-0.483	-0.559*	-0.900*
(30)Service	-0.573a	-0.159a	-0.622*	-0.371*	-0.0285a	-0.0285a	-0.0577	-0.0082

Notes:
(1) All values of own price elasticity are evaluated at the base period, 1970.
(2) Values attached mark "a" are calculated from constrained parameter, β_{ij} for the local concavity restriction.
(3) Values attached mark "*" are statistically significant on the level of significance of .01.
(4) Columns 'Sam. 13' and 'Sam. 18' denote estimates in case [A] and case [B] respectively.

Finally β_{MM} shows to be approximately zero in the two-third of thirty industries in both case [A] and case [B]. In six industries the positive value share elasticity changed into approximately zero after the oil crisis.

[Table 4] represents the estimated own price elasticity in each industry. Own price elasticity of capital service is less than unity absolutely in all industries of case [A] and case [B]. On the other hand own price elasticity of labor input is significantly more than unity in some industries of case [B]; apparel, rubber products, stone and clay, electric machinery and real eatate. Own price elasticity of energy input is estimated higher than that we expected. Especially in mining, petroleum and electricity and gas utility the price elasticities are more than unity. As I mentioned in the design of experiments of our work, directly imported energy resource is allocated into above three sectors and products of these three sectors are distributed into other industries as secondary energy products. Therefore in the above three sectors the price elasticity of energy input might be reflected on the price elasticity of materials inputs. We have to notice that the price elasticity of materials input in petroleum refinary industry is less than unity; -0.236 in case [A] and -0.297 in case [B]. On the other hand the price elasticity of materials input in mining and electric utility are also more than unity, so that these facts might reflect substitution between alternative energy resources historically. Own price elasticities of energy input in other sectors are less than unity. Especially industries like stone and clay, iron and steel and chemical which are designated as energy intensive industries have smaller price elasticity than the average. Finally own price elasticities of materials input are less than unity in all industries except mining and transportation in case [A] and mining and electric utility in case [B].

Parameters $\beta_{ij}(i \neq j)$ of the cross products in the price frontier function are related to the elasticity of substitutions among inputs. Allen partial elasticity of substitution is defined as (2.4), which is shown in [Table 5]. Values of elasticities in [Table 5] are evaluated at the base period, 1970, by using observed value shares in 1970. At the given level of each value share in 1970 we can test the statistical validity of the null hypothesis, $\sigma^{i}_{kj} = 0$. Positive Allen partial elasticity, $\sigma^{i}_{kj} > 0$ imply that the k-th input is substitutable to the j-th input; negative Allen partial elasticity, $\sigma^{i}_{kj} < 0$ imply that the k-th input is complementary to the j-th input; zero Allen partial elasticity, $\sigma^{i}_{kj}=0$ imply that the k-th input is independent to the j-th input.(8 We find that the Allen partial elasticity of substitutions between capital and labor are significantly positive, that is substitutable, only for seven industries in case [A] and in nine industries in case [B]; negative, that is complementary, only for five industries in case [A] and five industries in case [B]; zero, that is independent, for eighteen industries in case [A] and sixteen industries in case [B].

Secondly the Allen partial elasticity of substitutions between capital and energy are significantly positive for nine industries in case [A] and three in case [B]; negative for two in case [A] and ten in case [B]; zero for nineteen in case [A] and seventeen in case [B]. After the oil crisis the relations between capital and energy trend to be complimentary for several industries such as mining, chemical, nonferrous metal, fabricated metal, finance and services.

Thirdly elasticities of substitution between capital and materials are significantly positive for all industries both in case [A] and case [B], so that relations between capital and materials are substitutable with fairly large elasticities of substitution.

[Table 5] Estimates of Allen Partial Elasticity of Substitution

A K L (Sample-13)						A K L (Sample-18)					
Substitutable			Complementary			Substitutable			Complementary		
2	Mining	0.690**	1	Agriculture	-0.390*	2	Mining	0.344	1	Agriculture	-0.462 *
3	Construction	0.377	4	Food & Kindred	-0.028	3	Construction	0.242	5	Textile	-0.0823
6	Apparel	1.393*	5	Textile	-0.461	4	Food & Kindred	0.937*	6	Apparel	-0.889 *
9	Paper	0.479	7	Lumber	-1.014**	8	Furniture	0.124	7	Lumber	-0.00286
11	Chemical	0.782	8	Furniture	-0.481	10	Printing	0.691*	9	Paper	-0.177
16	Iron	0.735	10	Printing	-0.292	11	Chemical	0.878	17	Non-ferrous	-0.171
17	Non-ferrous	1.08	12	Petroleum	-1.603	12	Petroleum	1.71 *	18	Fab. Metal	-0.653**
20	Ecle. M.	0.0149	13	Rubber	-0.0638	13	Rubber	1.198*	19	Machinery	-0.505
25	Trans.	0.270	14	Leather	-0.616	14	Leather	1.131	20	Elec. U.	-0.090
26	Elec. U.	1.534*	15	Stone	-0.123	15	Stone	1.095*	22	Trans. Eq.	-1.085 *
27	Whole-sale	0.819*	18	Fab. Metal	-1.36 *	16	Iron	1.097**	23	Precision	-0.491 *
28	Finance	1.027*	19	Machinery	-0.82 *	21	Motor	0.235			
29	Real Estate	0.873*	21	Motor	-0.251	24	Mis. Mng.	0.191			
30	Service	1.47 *	22	Trans. Eq.	-0.174	25	Trans.	0.630			
			23	Precision	-0.761*	26	Elec. U.	0.864			
			24	Mis. Mng.	-0.317	27	Whole-sale	0.539*			
						28	Finance	1.057*			
						29	Real Estate	0.803*			
						30	Service	0.217			

Notes:
(1) AKL, AKE, AKM, ALE, ALM and AEM denote Allen Partial Elasticity of Substitution among four inputs-capital, labor, energy and intermediate material respectively.
(2) Values attached marks "*" and "**" are statistically significant on the level of significance of .0.1 and .0.5.
(3) Results in Sample-13 and Sample-18 are corresponding to results in case [A] and case [B].

[Table 5] Continued

A K E (Sample-13)

Substitutable			Complementary		
1	Agriculture	1.910*	6	Apparel	-7.279
2	Mining	0.385	9	Paper	-0.372
3	Construction	0.214	15	Stone	-2.813*
4	Food & Kindred	0.320	16	Iron	-1.202
5	Textile	1.286*	19	Machinery	-1.434**
7	Lumber	2.31	24	Mis. Mng.	-1.295
8	Furniture	9.03**			
10	Printing	0.940			
11	Chemical	0.711			
12	Petroleum	0.251			
13	Rubber	1.107*			
14	Leather	4.08			
17	Non-ferrous	0.144*			
18	Fab. Metal	0.312			
20	Elec. M.	2.081			
21	Motor	1.464*			
22	Trans. Eq.	0.903			
23	Precision	1.631*			
25	Trans.	1.318			
26	Elect. U.	0.143*			
27	Whole-sale	2.854			
28	Finance	1.126**			
29	Real Estate	1.600			
30	Service	0.615			

A K E (Sample-18)

Substitutable			Complementary		
1	Agriculture	1.128	2	Mining	-1.558**
3	Construction	0.808	4	Food & Kindred	-0.113
5	Textile	0.464	6	Apparel	-6.64*
7	Lumber	5.488	9	Paper	-1.19
8	Furniture	1.781	11	Chemical	-0.966**
10	Printing	1.324	13	Rubber	-0.124
12	Petroleum	2.42*	14	Leather	-2.403
21	Motor	1.277	15	Stone	-2.367*
23	Precision	1.618	16	Iron	-6.286*
25	Trans.	0.691	17	Non-ferrous	-0.411*
27	Whole-sale	2.71*	18	Fab. Metal	-3.889**
29	Real Estate	1.11*	19	Machinery	-1.362
			20	Elec. M.	-0.405
			22	Trans. Eq.	-2.192
			24	Mis. Mng.	-3.240*
			26	Elec. U.	-0.160
			28	Finance	-16.207**
			30	Service	-1.854**

[Table 5] Continued

	A K M (Sample113)		
	Substitutable		Complementary
1	Agriculture	0.643*	
2	Mining	0.387	
3	Construction	0.610*	
4	Food & Kindred	1.006*	
5	Textile	0.813*	
6	Apparel	0.969*	
7	Lumber	0.507*	
8	Furniture	1.21 *	
9	Paper	0.922*	
10	Printing	0.493*	
11	Chemical	0.433**	
12	Petroleum	0.648*	
13	Rubber	0.493*	
14	Leather	0.836**	
15	Stone	1.364*	
16	Iron	0.863*	
17	Non-ferrous	1.01 *	
18	Fab. Metal	1.28 *	
19	Machinery	1.25 *	
20	Elec. M.	1.149*	
21	Motor	0.869*	
22	Trans. Eq.	0.903*	
23	Precision	1.001*	
24	Mis. Mng.	0.642*	

	A K M (Sample-18)		
	Substitutable		Complementary
1	Agriculture	0.760*	
2	Mining	1.194*	
3	Construction	0.716*	
4	Food & Kindred	1.11 *	
5	Textile	0.843*	
6	Apparel	1.65 *	
7	Lumber	0.894*	
8	Furniture	1.097*	
9	Paper	0.792*	
10	Printing	1.103*	
11	Chemical	0.558*	
12	Petroleum	0.447*	
13	Rubber	0.394*	
14	Leather	0.492*	
15	Stone	0.560*	
16	Iron	1.167*	
17	Non-ferrous	1.02 *	
18	Fab. Metal	1.195*	
19	Machinery	0.971*	
20	Elec. M.	1.068*	
21	Motor	0.833*	
22	Trans. Eq.	1.256*	
23	Precision	0.915*	
24	Mis. Mng.	0.766*	

[Table 5] Continued

25 Trans.	1.362**	25 Trans.	0.797**
26 Elec. U.	0.195	26 Elec. U.	0.731*
27 Whole-sale	0.265	27 Whole-sale	0.422**
28 Finance	0.615*	28 Finance	0.874*
29 Real Estate	0.906*	29 Real Estate	0.929*
30 Service	0.642*	30 Service	0.343**

A L E (Sample-13)

Substitutable		Complementary	
1 Agriculture	2.897*	2 Mining	-2.231*
4 Food & Kindred	4.56*	3 Construction	-1.607
5 Textile	1.02*	6 Apparel	-0.453
7 Lumber	2.03*	9 Paper	-3.85
8 Furniture	2.23	11 Chemical	-2.49
10 Printing	1.73*	15 Stone	-3.48
12 Petroleum	20.78**	19 Machinery	-0.553
13 Rubber	0.486	20 Elec. M.	-3.12
14 Leather	2.90*	22 Trans. Eq.	-0.476
16 Iron	1.35		
17 Non-ferrous	9.06**		
18 Fab. Metal	3.48		
21 Motor	0.941		
23 Precision	0.395		
24 Mis. Mng.	1.023**		
25 Trans.	2.97**		
26 Elec. U.	2.59		

A L E (Sample-18)

Substitutable		Complementary	
1 Agriculture	0.177	2 Mining	-0.0487
3 Construction	15.90*	6 Apparel	-3.76
4 Food & Kindred	2.81	7 Lumber	-2.08
5 Textile	3.54	11 Chemical	-0.76
8 Furniture	10.24*	12 Petroleum	-12.64*
9 Paper	0.627	13 Rubber	-1.52
10 Printing	1.25	24 Mis. Mng	-1.09
14 Leather	9.10**	27 Whole-sale	-13.14*
15 Stone	0.178		
16 Iron	14.963*		
17 Non-ferrous	0.578		
18 Fab. Metal	9.91*		
19 Machinery	9.04		
20 Elec. M.	16.30**		
21 Motor	0.905		
22 Trans. Eq.	4.30		
23 Precision	5.50**		

[Table 5] Continued

27	Whole-sale	0.831*
28	Finance	1.54*
29	Real Estate	27.33
30	Service	12.28*

25	Trans.	0.105
26	Elec. U.	2.04**
28	Finance	32.09**
29	Real Estate	57.51
30	Service	16.50*

A L M (Sample-13)

Substitutable			Complementary		
1	Agriculture	0.331*	12	Petroleum	-1.45
2	Mining	0.132	16	Iron	-0.151
3	Construction	0.016	17	Non-ferrous	-0.567
4	Food & Kindred	1.09*	26	Elec. U.	-2.245
5	Textile	0.761	29	Real Estate	-5.868*
6	Apparel	0.770*	30	Service	-0.285
7	Lumber	0.316*			
8	Furniture	0.460			
9	Paper	0.318			
10	Printing	0.244*			
11	Chemical	0.225			
13	Rubber	0.295**			
14	Leather	0.380*			
15	Stone	2.10*			
18	Fab. Metal	1.05**			
19	Machinery	1.47*			
20	Elec. M.	1.09			
21	Motor	1.332*			
22	Trans. Eq.	0.691*			

A L M (Sample-18)

Substitutable			Complementary		
1	Agriculture	1.05*	16	Iron	-0.856*
2	Mining	2.46**	26	Elec. U.	-0.516
3	Construction	0.819**	30	Service	-0.168
4	Food & Kindred	0.669*			
5	Textile	0.845*			
6	Apparel	1.81*			
7	Lumber	1.00*			
8	Furniture	1.02*			
9	Paper	0.960*			
10	Printing	1.26*			
11	Chemical	0.539			
12	Petroleum	1.10*			
13	Rubber	1.48*			
14	Leather	0.930*			
15	Stone	1.51*			
17	Non-ferrous	0.425			
18	Fab. Metal	1.18*			
19	Machinery	1.93*			
20	Elec. M.	1.47*			

[Table 5] Continued

23	Precision	1.15*	
24	Mis. Mng.	0.297*	
25	Trans.	2.31*	
27	Whole-sale	0.211	
28	Finance	1.67**	

21	Motor	0.964*
22	Trans. Eq.	1.28*
23	Precision	0.918*
24	Mis. Mng.	1.05*
25	Trans.	1.66*
27	Whole-sale	1.32*
28	Finance	1.13
29	Real Estate	6.56

A E M (Sample-13)

Substitutable			Complementary		
2	Mining	11.46*	1	Agriculture	-2.844*
3	Construction	0.824	4	Food & Kindred	-0.719
6	Apparel	10.090**	5	Textile	-0.396*
9	Paper	4.33	7	Lumber	-0.577*
11	Chemical	0.639	8	Furniture	-1.53
12	Petroleum	1.76**	10	Printing	-0.838
13	Rubber	0.149	14	Leather	-0.68
15	Stone	2.07**	17	Non-ferrous	-0.979
16	Iron	0.872	18	Fab. Metal	-0.669
19	Machinery	5.416*	25	Trans.	-5.60*
20	Elec. M.	0.214	27	Whole-sale	-0.588
21	Motor	2.165	28	Finance	-3.00*
22	Trans. Eq.	1.98	29	Real Estate	-9.86
23	Precision	2.06**	30	Service	-5.14*
24	Mis. Mng.	0.125			
26	Elec. U.	3.579*			

A E M (Sample-18)

Substitutable			Complementary		
1	Agriculture	1.42	3	Construction	-4.53*
2	Mining	11.26*	4	Food & Kindred	-0.0957
6	Apparel	2.88*	5	Textile	-0.163
7	Lumber	0.587	8	Furniture	-4.10*
9	Paper	0.384	10	Printing	-0.487
11	Chemical	0.601**	14	Leather	-1.20
12	Petroleum	2.12*	18	Fab. Metal	-2.10
13	Rubber	0.857**	19	Machinery	-1.142
15	Stone	0.764*	20	Elec. M.	-3.15**
16	Iron	0.381	22	Trans. Eq.	-0.331
17	Non-ferrous	0.195	23	Precision	-2.03
21	Motor	0.907	25	Trans.	-0.596
24	Mis. Mng.	0.981*	28	Finance	-10.51
26	Elec. U.	7.03*	29	Real Estate	-13.75**
27	Whole-sale	2.36	30	Service	-4.20

Forthly elasticities of substitution between labor and energy are significantly positive for fourteen in case [A] and ten in case [B]; negative for one in case [A] and two in case [B]; zero for fifteen in case [A] and eighteen in case [B].

Fifthly elasticities of substitution between labor and materials are significantly positive for sixteen in case [A] and twenty-three in case [B]; negative for one in case [A] and one in case [B]; zero for thirteen in case [A] and six in case [B].

Finally elasticities of substitution between energy and materials are positive for seven industries in case [A] and eight in case [B]; negative for six in case [A] and four in case [B]; zero for seventeen in case [A] and eighteen in case [B].

We continue the interpretation of the parameters estimates given in Appendix with estimated biases of technical change with respect to price. These parameters can be interpreted as the change in the share of each input with respect to time, holding prices constant. If the bias of technical change with respect to the price of the j-th input is positive, we call that technical change is j-th input using; if the bias is negative, we say that technical change is j-th input saving; if the bias is approximately zero, we say that technical change is neutral. Since the estimated parameters, β^{i}_{jt} are asymptotically normally distributed, we can test the statistical validity of the null-hypothesis, $\beta^{i}_{jt}=0.0$

A classification of industries by patterns of the biases of technical change is given in [Table 6]. In the table, U.N and S denote that the bias of technical change is using,neutral and saving in each input respectively.

According to the results in case [A] the bias of technical changes with respect to capital input is positive for nineteen of thirty industries and zero for eleven, so that the bias is capital using for two third of thirty industries. On the other hand the bias with respect to labor input is negative for fourteen

[Table 6] Changes of Bias of Technical progress

		Case [A] Sample 1960-1972				Case [B] Sample 1960-1977							
		K	L	E	M	K	L	E	M	K	L	E	M
1.	Agriculture	U	S	N	U	U	S	N	N				o
2.	Mining	U	S	U	N	U	N	U	N		×		
3.	Construction	U	S	N	U	U	N	S	N		×	o	o
4.	Food & Kindred	U	N	S	N	N	N	N	N	o		×	
5.	Textile	U	N	S	N	U	N	N	S			×	o
6.	Apparel	N	N	N	N	U	N	N	S	×			o
7.	Lumber	U	S	N	U	N	N	N	N	o	×		o
8.	Furniture	N	N	N	N	S	U	S	N	o	×	o	
9.	Paper	N	S	N	N	U	N	N	N	×	×		
10.	Printing	U	S	N	U	S	U	N	S	o	×		o
11.	Chemical	U	S	U	N	N	N	U	N	o	×		
12.	Petroleum	U	S	S	N	S	S	U	U	o		×	
13.	Rubber	U	S	S	N	N	U	N	S	o	×	×	o
14.	Leather	U	S	N	N	N	U	S	S	o	×	o	o
15.	Stone	U	N	N	S	U	N	N	S				
16.	Iron	U	S	N	N	U	S	N	N				
17.	Non-ferrous	N	N	N	N	U	S	N	N	×	o		
18.	Fab.Metal	U	N	N	N	U	N	S	N			o	
19.	Machinery	U	N	N	N	U	U	N	N		×		
20.	Elec.M.	N	N	N	N	N	U	S	N		×	o	
21.	Motor	N	U	N	N	S	U	N	U	o			×
22.	Trans. Eq.	U	S	N	N	U	N	N	S		×		o
23.	Precision	U	N	N	N	U	N	S	N			o	
24.	Mis. Mng.	U	S	U	N	U	N	N	S		×	o	o
25.	Trans.	N	U	N	U	S	U	U	N	o		×	o
26.	Elec. U.	N	N	N	N	N	N	N	N				
27.	Whole-sale	N	N	N	N	U	U	N	S	×	×		o
28.	Finance	N	N	N	N	S	U	S	N	o	×	o	
29.	Real Estate	N	S	N	U	S	U	N	N	o	×		o
30.	Service	U	U	S	S	U	N	S	S		o		

Note:

(1) U, N and S denote that the bias of technical changes is using, neutral and saving in each input respectively. U means that parameter βjt (j=K.L.E.M) is significantly positive. S means that parameter βjt is significantly negative. In the case that null hypothesis $\beta jt=0$ is not rejected, bias of technical progress is regarded as neutral.

(2) First four columns are results estimated from the sample period 1960-1972 and fifth through eighth columns represent results estimated from the sample period 1960-1977.

(3) Marks o and × represent the evaluation of changes in bias of technical changes, o implies the bias of technical progress changes to the input saving way. × implies it changes to the input using way.

and zero for fifteen of thirty industries; so that we can not find labor using technology bias before the oil crisis. Thirdly the bias of technical changes with respect to energy input is energy using for two industries, energy saving for five and energy neutral for twenty-three of thirty industries. Finally the bias of technological changes with respect to materials input is material using for six, saving for two and neutral for twenty-two of thirty industries.

We can say roughly the properties of the bias of technical change as capital using - labor saving - energy and material neutral technical bias over the period before the oil crisis. This fact with respect to the technical bias is consistent with the changes of the relative prices among four inputs, so that it might suggest the explanation of the technical bias by the induced technology theory. After the oil crisis, the results suggest that the bias of technical change moved relevantly. In [Table 6], mark o and × represent the evaluation of changes in bias of technical changes. o implies that the bias changes to the input saving way ; × implies that it changes to the input using way.

As for the bias of capital input, the bias changes to the input saving way for twelve of sixteen industries, in which the change of the bias is statistically significant. On the contrary, the bias of technical changes with respect to labor input move to the input using way for sixteen of eighteen industries, in which the change of the bias is statistically significant. As for the bias of technical changes with respect to energy and materials, results suggests that the biases with respect to those inputs move to the saving way for eight industries of thirteen industries and thirteen industries of fourteen industries respectively, in which the changes of the bias are statistically significant.

The final parameter in our models is the rate of change of the negative of the rate of technical change, β^{i}_{tt}. We find that the null-hypothesis, $\beta^{i}_{tt}=0$ in each industry does not reject in all industries, so that the rate of change of the negative of the rate of technical change is approximately zero.

5. Concluding Remarks

Description of the producers behavior in the 30 industrial sectors by measuring the trans-log price frontier function reveals some properties in terms of the price elasticity, the elasticity of substitutions and the bias of technical changes as given in the previous section.

Our research suggested some possibility and the necessity of the further research.

1. The estimation of the trans-log price frontier function —— even if the inputs are only four inputs – K.L.E and M.– is fairly unstable. Especially the fittness of the negative of the rate of technical change, $-W_t$ has some possibility of the improvement. Specification of the factor argumenting technical progress instead of the Hick neutrality might be one of possibility to be tested.(9

2. It might be an interesting subject to describe the bias of the technical change in terms of the induced inovation theory. Especially the movement of the bias of technical change after the oil crisis in Japan has to be explained consistently with the fluctuation of the relative prices.

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(8) We can refer other measurement of the partial elasticities of substitution with respect to capital, labor and energy input in the macro production analysis. Berndt – Wood(1975) and Hudson – Jorgenson(1974) reported that energy is complement to capital, substitutable to labor and materials in the analysis of the U.S. manufacturing data. Griffin – Gregory(1976) and Pindyck(1977) reported that energy is substitutable to capital and labor in the analysis of OECD data.

(9) Wills(1979) reported the some specification in terms of the factor argumenting technical progress.

[Appendix] Estimated Parameter of Trans-log Price Frontier Function

	1. Agriculture				2. Mining			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.167	(14.30)	0.164	(13.934)	0.270	(11.409)	0.290	(7.335)
BKK	0.16		0.16		0.114	(2.982)	0.154	(3.153)
BKL	-0.119	(9.55)	-0.125	(9.243)	-0.0312	(1.036)	-0.0661	(1.238)
BKE	0.00493	(1.69)	-0.00392	(0.776)	-0.0255	(2.540)	-0.106	(3.674)
BKT	0.0148	(13.14)	0.0156	(15.038)	0.00995	(4.381)	0.00688	(2.061)
AL	0.486	(91.99)	0.443	(20.917)	0.489	(39.838)	0.296	(4.509)
BLL	0.18		0.124	(4.167)	0.18		0.00119	(0.0140)
BLE	0.00825	(5.58)	-0.00358	(0.279)	-0.0925	(4.564)	-0.0300	(0.730)
BLT	-0.0201	(30.61)	-0.0162	(8.799)	-0.0204	(14.029)	-0.00215	(0.377)
AE	0.0154		0.00838	(1.148)	0.0268	(1.323)	0.0513	(1.540)
BEE	0.012		0.00477	(0.517)	-0.161	(3.728)	-0.138	(3.887)
BET	0.0000115	(0.152)	0.000741	(1.038)	0.00706	(3.970)	0.00544	(1.904)
AT	-0.0101	(0.158)	-0.0129	(0.268)	0.0713	(0.879)	0.0619	(0.985)
BTT	0.000995	(0.126)	0.00215	(0.483)	-0.0103	(1.029)	-0.00663	(1.141)
AM	0.332	(29.188)	0.385	(14.250)	0.215	(5.964)	0.363	(5.090)
BKM	-0.0459	(4.02)	-0.0309	(1.834)	-0.0576	(1.587)	0.0182	(0.439)
BLM	-0.0692	(5.55)	0.00464	(0.107)	-0.0563	(1.415)	0.0949	(1.100)
BEM	-0.0251	(7.20)	0.00273	(0.106)	0.279	(5.492)	0.274	(5.312)
BMM	0.1403	(6.10)	0.0235	(0.302)	-0.165	(1.868)	-0.387	(2.693)
BMT	0.00523	(4.603)	-0.000136	(0.0547)	0.00342	(0.994)	-0.0102	(1.498)

	3. Construction				4. Food & Kindred			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.0665	(5.375)	0.0783	(6.83)	0.215	(9.83)	0.274	(15.92)
BKK	0.058		0.05		0.0309	(1.045)	-0.0129	(0.556)
BKL	-0.0183	(1.732)	-0.0223	(2.49)	-0.0296	(3.67)	-0.00182	(0.214)
BKE	-0.00241	(0.960)	-0.000589	(0.0978)	-0.00236	(0.74)	-0.00386	(0.721)
BKT	0.00755	(6.090)	0.00517	(5.12)	0.00487	(2.25)	-0.00119	(0.750)
AL	0.367	(42.204)	0.182	(5.26)	0.111	(7.61)	0.0980	(9.63)
BLL	0.15		-0.0144	(0.375)	0.0183	(1.22)	0.0211	(1.70)
BLE	-0.0103	(0.528)	0.0590	(3.25)	0.00494	(2.08)	0.00252	(0.379)
BLT	-0.0136	(14.093)	0.00300	(0.974)	-0.0000065	(0.004)	0.00106	(1.21)
AE	0.00315	(0.160)	0.0720	(4.22)	0.0144		0.0136	(2.40)
BEE	0.015		0.013		0.011		0.01	
BET	0.00134	(0.737)	-0.00484	(3.37)	-0.000238	(5.15)	-0.000181	(0.377)
AT	0.00519	(0.0374)	0.0449	(0.432)	0.0320	(0.507)	0.0610	(1.22)
BTT	0.00331	(0.193)	-0.00216	(0.225)	0.00151	(0.194)	-0.00385	(0.831)
AM	0.564	(28.100)	0.667	(13.38)	0.659	(27.211)	0.614	(31.10)
BKM	-0.0373	(3.502)	-0.0271	(2.56)	0.00101	(0.033)	0.0186	(0.756)
BLM	-0.121	(5.390)	-0.0223	(0.406)	0.00647	(0.34)	-0.0218	(1.15)
BEM	-0.00227	(0.106)	-0.0714	(3.53)	-0.0136	(2.48)	-0.00866	(0.906)
BMM	0.161	(3.341)	0.121	(1.56)	0.0062	(0.148)	0.0118	(0.312)
BMT	0.00376	(2.324)	-0.00332	(0.753)	-0.00462	(1.95)	0.000313	(0.176)

	5. Textile				6. Apparel			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.132	(16.30)	0.143	(19.81)	0.110		0.0591	(4.83)
BKK	0.0547	(6.78)	0.0455	(4.02)	0.0056		0.0056	
BKL	-0.0290	(4.28)	-0.0215	(4.05)	0.0096	(1.53)	-0.0459	(7.57)
BKE	0.00088	(0.925)	-0.00164	(0.446)	-0.0127	(3.97)	-0.0117	(5.11)
BKT	0.00637	(8.26)	0.00504	(7.27)	0.00079	(1.35)	0.00398	(3.56)
AL	0.123	(3.49)	0.105	(8.42)	0.187		0.146	(4.29)
BLL	0.0444	(1.37)	0.0280	(2.24)	0.0248	(4.02)	-0.0505	(1.53)
BLE	0.000033	(0.10)	0.00353	(0.493)	-0.0037	(0.15)	-0.0121	(1.30)
BLT	-0.00286	(0.882)	-0.00113	(1.02)	0.00063	(1.19)	0.00417	(1.37)
AE	0.0155		0.0194	(2.68)	0.0239	(0.87)	0.00396	(0.388)
BEE	0.013		0.0097		-0.0604	(1.80)	0.008	
BET	-0.000139	(6.55)	-0.000514	(0.817)	-0.00087	(0.35)	0.000271	(0.299)
AT	0.0329	(0.916)	0.0284	(0.784)	0.1039	(0.828)	-0.00778	(0.0757)
BTT	-0.000818	(0.184)	-0.0000736	(0.0220)	-0.0133	(0.846)	0.00144	(0.152)
AM	0.730	(18.62)	0.733	(44.64)	0.679	(24.56)	0.791	(19.82)
BKM	-0.0265	(2.20)	-0.0223	(1.99)	-0.00244	(0.40)	0.0521	(7.53)
BLM	-0.0154	(0.43)	-0.0100	(0.626)	-0.0306	(1.02)	0.109	(2.95)
BEM	-0.0139	(14.96)	-0.0116	(1.52)	0.0768	(1.91)	0.0159	(1.80)
BMM	0.0559	(1.34)	0.0440	(1.87)	-0.0437	(0.69)	-0.177	(4.15)
BMT	-0.00337	(0.93)	-0.00340	(2.32)	-0.00056	(0.21)	-0.00842	(2.36)

	7. Lumber				8. Furniture			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.0427	(4.03)	0.0774	(10.355)	0.903	(5.57)	0.104	(10.296)
BKK	0.053		0.015		0.012		0.012	
BKL	-0.0283	(3.260)	-0.0141	(2.326)	-0.0290	(2.49)	-0.0172	(2.392)
BKE	0.00137	(0.950)	0.00470	(1.232)	0.00733	(1.63)	0.000712	(0.211)
BKT	0.00284	(2.828)	-0.000938	(1.576)	-0.00213	(1.27)	-0.00341	(3.818)
AL	0.285	(55.36)	0.172	(7.0737)	0.364	(4.56)	0.193	(5.842)
BLL	0.12		0.0225	(1.108)	0.120	(1.61)	-0.0194	(0.653)
BLE	0.00285	(3.758)	-0.00846	(0.733)	0.00431	(0.161)	0.0324	(2.947)
BLT	-0.00834	(13.99)	0.00193	(0.928)	-0.00815	(1.13)	0.00726	(2.514)
AE	0.0143		0.000219	(0.0156)	0.00688	(0.248)	0.0427	(3.357)
BEE	0.012		0.008		0.0091		0.0087	
BET	-0.000029	(0.671)	0.00131	(1.0674)	0.000497	(0.197)	-0.00259	(2.345)
AT	0.00681	(0.0586)	0.0361	(0.365)	0.0205	(0.151)	0.0481	(0.474)
BTT	0.00361	(0.251)	-0.00223	(0.244)	0.00127	(0.0758)	-0.00208	(0.222)
AM	0.658	(70.04)	0.751	(33.618)	0.539	(7.47)	0.660	(17.842)
BKM	-0.0260	(2.87)	-0.00558	(0.780)	0.00967	(0.934)	0.00444	(0.530)
BLM	-0.0944	(10.75)	0.0000383	(0.00206)	-0.0951	(1.38)	0.00412	(0.119)
BEM	-0.0162	(8.21)	-0.00424	(0.516)	-0.0207	(0.718)	-0.0418	(3.881)
BMM	0.1367	(7.40)	0.00978	(0.514)	0.106	(1.45)	0.0332	(0.784)
BMT	0.0055	(5.63)	-0.00231	(1.154)	0.00978	(1.48)	-0.00126	(0.390)

	9. Paper				10. Printing			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.146	(8.865)	0.141	(12.54)	0.0501	(5.03)	0.174	(13.916)
BKK	0.0276	(1.533)	0.0599	(4.19)	0.071		0.004	
BKL	-0.00941	(0.624)	-0.0212	(1.85)	-0.0421	(4.93)	0.0101	(1.623)
BKE	-0.00918	(0.454)	-0.0147	(2.47)	0.000042	(0.041)	0.000229	(0.308)
BKT	0.00175	(1.162)	0.00228	(2.11)	0.0053	(4.99)	-0.00729	(6.383)
AL	0.167	(18.667)	0.107	(5.70)	0.442	(38.04)	0.204	(6.472)
BLL	0.08		0.0257	(1.23)	0.18		-0.0383	(1.245)
BLE	-0.0206	(0.429)	-0.00159	(0.183)	0.00167	(1.126)	0.000564	(0.129)
BLT	-0.00526	(6.990)	0.0000766	(0.0455)	-0.0110	(9.56)	0.0114	(4.044)
AE	0.0445	(0.947)	0.0473	(5.91)	0.0067		0.00553	(1.396)
BEE	-0.0608	(0.689)	0.033		0.0057		0.00514	(1.293)
BET	-0.0000139	(0.00327)	-0.000670	(0.944)	-0.0000023	(0.084)	0.000102	(0.279)
AT	-0.0175	(0.844)	0.0439	(0.268)	-0.0293	(0.0168)	0.0498	(0.364)
BTT	0.0116	(0.451)	-0.000260	(0.0172)	0.00998	(0.451)	-0.00163	(0.129)
AM	0.643	(15.166)	0.704	(32.69)	0.501	(95.54)	0.616	(21.641)
BKM	-0.00897	(0.319)	-0.0240	(1.53)	-0.0287	(3.46)	0.00586	(0.950)
BLM	-0.0500	(0.983)	-0.00290	(0.120)	-0.139	(16.90)	0.0479	(1.710)
BEM	0.0906	(0.776)	-0.0168	(1.92)	-0.0073	(2.96)	-0.00593	(0.817)
BMM	-0.0317	(0.190)	0.0436	(1.31)	0.1755	(10.75)	-0.0478	(1.696)
BMT	0.00352	(0.873)	-0.00169	(0.899)	0.00579	(9.57)	-0.00424	(1.654)

	11. Chemical				12. Petroleum			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.166	(8.378)	0.195	(14.716)	0.235	(9.373)	0.308	(23.32)
BKK	0.0859	(3.996)	0.094		0.0961	(3.443)	0.061	
BKL	-0.00546	(0.437)	-0.003040	(0.3038)	-0.0242	(1.466)	0.00662	(1.67)
BKE	-0.00470	(0.580)	-0.0319	(4.0694)	-0.0131	(0.973)	0.0248	(3.03)
BKT	0.00548	(3.063)	0.00118	(1.0539)	-0.000331	(0.122)	-0.00622	(5.10)
AL	0.182	(26.583)	0.134	(6.349)	0.0929	(11.508)	0.0663	(19.11)
BLL	0.084		0.0472	(2.174)	0.033		0.023	
BLE	-0.0278	(2.206)	-0.01402	(0.771)	0.0463	(1.921)	-0.0319	(3.21)
BLT	-0.00627	(9.733)	-0.00145	(0.761)	-0.00487	(5.035)	-0.00237	(6.74)
AE	0.0328	(2.270)	0.035001	(1.971)	0.139	(4.373)	0.0453	(3.94)
BEE	0.0479	(1.303)	0.063		-0.0651	(2.541)	-0.0401	(1.86)
BET	0.00368	(2.777)	0.00329	(2.0628)	-0.00596	(2.038)	0.00212	(2.15)
AT	0.00537	(0.0477)	0.0491	(0.555)	0.0186	(0.0986)	0.102	(0.530)
BTT	0.00691	(0.497)	-0.00142	(0.174)	0.0118	(0.503)	-0.00752	(0.421)
AM	0.620	(24.193)	0.636	(23.564)	0.515	(9.632)	0.580	(41.48)
BKM	-0.0758	(3.032)	-0.05899	(6.845)	-0.0588	(1.278)	-0.0924	(9.77)
BLM	-0.0507	(3.109)	-0.03014	(1.164)	-0.551	(1.717)	0.00232	(0.340)
BEM	-0.0154	(0.348)	-0.017006	(1.184)	0.0319	(0.894)	0.0472	(3.68)
BMM	0.142	(2.283)	0.1061	(2.971)	0.0820	(0.883)	0.0429	(4.51)
BMT	-0.00290	(1.267)	-0.00302	(1.252)	0.0112	(2.100)	0.00647	(4.81)

	13. Rubber				14. Leather			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.00878	(0.215)	0.112	(5.367)	0.0340	(1.56)	0.0789	(5.090)
BKK	0.0773	(4.01)	0.051		0.0357	(1.36)	0.039	
BKL	-0.0330	(1.84)	0.00614	(0.420)	-0.0286	(1.83)	0.00231	(0.170)
BKE	0.00034	(0.245)	-0.00363	(0.886)	0.0046	(1.23)	-0.00501	(0.785)
BKT	0.0119	(3.40)	0.00103	(0.582)	0.00558	(2.65)	0.000452	(0.344)
AL	0.356	(18.97)	0.0688	(2.006)	0.227	(32.36)	0.0972	(4.057)
BLL	0.13		-0.0576	(2.508)	0.1		-0.0144	(0.591)
BLE	-0.0025	(2.29)	-0.0124	(1.870)	0.0049	(2.78)	0.0208	(1.652)
BLT	-0.0123	(8.21)	0.0135	(4.928)	-0.00495	(6.68)	0.00692	(3.386)
AE	0.026		0.0177	(1.795)	0.0113		0.0313	(2.528)
BEE	0.0141	(1.78)	0.018		0.008		0.007	
BET	-0.00029	(5.34)	0.000429	(0.539)	0.000024	(0.33)	-0.00186	(1.772)
AT	0.0153	(0.114)	0.0788	(0.759)	-0.0089	(0.077)	0.0297	(0.338)
BTT	0.00455	(0.274)	-0.00369	(0.384)	0.00578	(0.407)	-0.000269	(0.0332)
AM	0.608	(24.61)	0.802	(31.374)	0.727	(41.02)	0.792	(28.546)
BKM	-0.0446	(3.29)	-0.0535	(4.373)	-0.0116	(0.454)	-0.0363	(3.087)
BLM	-0.0944	(5.35)	0.0638	(2.940)	-0.0762	(4.99)	-0.00877	(0.289)
BEM	-0.0118	(1.48)	-0.00199	(0.290)	-0.0174	(3.41)	-0.0228	(1.787)
BMM	0.1509	(5.88)	-0.00834	(0.304)	0.1054	(3.24)	0.0679	(1.644)
BMT	0.00069	(0.302)	-0.0149	(7.011)	-0.00066	(0.37)	-0.00551	(2.288)

	15. Stone				16. Iron			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.0941	(6.173)	0.149	(13.316)	0.131	(11.856)	0.144	(20.72)
BKK	0.0464	(2.500)	0.086		0.0395	(3.069)	0.0530	(5.94)
BKL	-0.0384	(2.747)	0.00326	(0.318)	-0.00244	(0.291)	0.00089	(0.18)
BKE	-0.0473	(3.637)	-0.0418	(5.625)	-0.0219	(2.072)	-0.0724	(4.65)
BKT	0.00879	(6.247)	0.00289	(3.130)	0.00255	(2.282)	0.00143	(2.10)
AL	0.184	(4.290)	0.152	(7.373)	0.114	(28.943)	0.0812	(7.58)
BLL	-0.0205	(0.497)	-0.0453	(1.961)	0.051		0.0251	(2.36)
BLE	-0.0521	(1.418)	-0.00957	(0.631)	0.00135	(0.0395)	0.0544	(6.75)
BLT	-0.000291	(0.0768)	0.00253	(1.369)	-0.00470	(10.706)	-0.0021	(2.23)
AE	0.0352	(0.984)	0.0740	(5.234)	0.0424	(1.089)	0.0842	
BEE	0.06		0.06		0.0266	(0.529)	0.047	
BET	0.00299	(0.934)	-0.000269	(0.212)	0.00247	(0.684)	-0.00045	(0.90)
AT	0.00483	(0.0398)	0.0360	(0.375)	0.0130	(0.0963)	0.0618	(0.542)
BTT	0.00546	(0.365)	-0.000801	(0.0901)	0.00798	(0.480)	-0.00198	(0.188)
AM	0.686	(13.468)	0.625	(24.967)	0.713	(16.430)	0.690	(59.261)
BKM	0.0393	(1.243)	-0.0475	(3.970)	-0.0152	(0.780)	0.0185	(1.04)
BLM	0.111	(1.949)	0.0516	(1.828)	-0.0499	(1.288)	-0.0805	(5.26)
BEM	0.0394	(0.945)	-0.00865	(0.778)	-0.00601	(0.0810)	-0.0290	(1.77)
BMM	-0.190	(1.800)	0.00450	(0.134)	0.0711	(0.606)	0.091	(2.43)
BMT	-0.0115	(2.487)	-0.00516	(2.307)	-0.000326	(0.0759)	0.00109	(1.03)

	17. Non-ferrous				18. Fab. Metal			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.222	(10.67)	0.194	(10.66)	0.106	(0.867)	0.0530	(4.257)
BKK	0.00617	(0.383)	0.0310	(1.87)	0.046		0.046	
BKL	0.00143	(0.0796)	-0.0200	(1.40)	-0.0665	(6.79)	-0.0466	(4.963)
BKE	-0.00835	(1.23)	-0.0138	(2.64)	-0.00210	(1.23)	-0.0149	(2.458)
BKT	0.000496	(0.243)	0.00328	(1.86)	0.0102	(8.33)	0.00487	(4.606)
AL	0.0990	(8.95)	0.107	(11.07)	0.313	(3.61)	0.228	(10.049)
BLL	0.05		0.05		0.0462	(0.596)	-0.0256	(1.216)
BLE	0.0265	(1.63)	-0.00139	(0.147)	0.0133	(1.04)	0.0477	(3.019)
BLT	-0.00203	(1.59)	-0.00238	(2.44)	-0.00681	(0.842)	0.00112	(0.542)
AE	0.0620	(3.79)	0.0342	(3.54)	0.0258	(1.83)	0.0604	(3.640)
BEE	0.038		0.038		0.014		0.014	
BET	-0.00174	(1.14)	0.000975	(1.12)	-0.000404	(0.305)	-0.00354	(2.344)
AT	0.0144	(0.0613)	0.0408	(0.207)	0.0298	(0.413)	0.0426	(0.762)
BTT	0.0110	(0.380)	0.00395	(0.217)	0.000518	(0.0585)	-0.00147	(0.284)
AM	0.617	(29.49)	0.664	(41.45)	0.651	(8.49)	0.658	(26.337)
BKM	0.000757	(0.0379)	0.00278	(0.180)	0.0226	(2.59)	0.0155	(2.281)
BLM	-0.0779	(3.17)	-0.0286	(1.62)	0.00700	(0.102)	0.0245	(1.012)
BEM	-0.0561	(3.33)	-0.0228	(2.65)	-0.0252	(1.97)	-0.0468	(3.191)
BMM	0.133	(2.75)	0.0486	(1.54)	-0.00441	(0.0706)	0.00682	(0.192)
BMT	0.00328	(1.59)	-0.00187	(1.27)	-0.00299	(0.419)	-0.00245	(1.069)

	19. Machinery				20. Ecle. M.			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.1032	(8.43)	0.128	(8.860)	0.153	(8.881)	0.173	(14.5601)
BKK	0.0318	(2.41)	0.0542	(3.544)	0.00622	(0.534)	0.0245	(1.681)
BKL	-0.0553	(6.89)	-0.0456	(4.391)	-0.0268	(1.964)	-0.0297	(2.928)
BKE	-0.00545	(3.38)	-0.00529	(1.256)	0.00242	(0.186)	-0.00315	(0.619)
BKT	0.00572	(4.03)	0.00281	(1.837)	0.00253	(1.571)	-0.000358	(0.335)
AL	0.194	(3.34)	0.0974	(1.977)	0.158	(2.453)	0.0660	(1.986)
BLL	0.00652	(0.135)	-0.0725	(1.676)	0.0254	(0.460)	-0.0417	(1.3996)
BLE	-0.0332	(2.92)	0.0172	(0.830)	-0.00723	(0.158)	0.0269	(2.0173)
BLT	-0.00045	(0.085)	0.00832	(1.841)	0.000124	(0.0211)	0.00884	(2.967)
AE	0.0141		0.0356	(1.516)	0.00920	(0.171)	0.0456	(3.0304)
BEE	-0.0267	(2.04)	0.00531	(0.371)	0.011		0.009	
BET	-0.000073	(0.97)	-0.00221	(1.011)	0.000275	(0.0563)	-0.00295	(2.276)
AT	0.0615	(0.417)	0.0802	(0.725)	0.0385	(0.171)	0.0783	(0.461)
BTT	0.00077	(0.0427)	-0.00252	(0.246)	0.00457	(0.165)	-0.00230	(0.147)
AM	0.689	(12.19)	0.739	(11.281)	0.680	(7.603)	0.715	(16.982)
BKM	0.0288	(2.47)	-0.00331	(0.190)	0.0182	(0.722)	0.00828	(0.664)
BLM	0.0521	(1.09)	0.101	(1.754)	0.00864	(0.112)	0.0445	(1.204)
BEM	0.0355	(2.36)	-0.0172	(0.508)	-0.00619	(0.136)	-0.0327	(2.377)
BMM	-0.116	(2.31)	-0.0804	(0.902)	-0.0206	(0.171)	-0.020084	(0.412)
BMT	-0.0052	(1.00)	-0.00893	(1.474)	-0.00293	(0.355)	-0.00553	(1.468)

	21. Motor				22. Trans. Eq.			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.189	(7.584)	0.216	(16.122)	0.0726	(3.104)	0.0516	(2.819)
BKK	0.459	(2.050)	0.0389	(2.916)	0.0516	(2.120)	0.05	
BKL	-0.0305	(2.088)	-0.0187	(2.553)	-0.0402	(2.214)	-0.0714	(5.015)
BKE	0.000953	(0.363)	0.000570	(0.189)	-0.000185	(0.0541)	-0.00610	(1.027)
BKT	-0.000895	(0.383)	-0.00413	(3.505)	0.00954	(3.977)	0.0104	(6.260)
AL	0.111		0.124		0.333	(9.810)	0.231	(6.959)
BLL	0.00129	(0.128)	0.0219	(4.222)	0.0809	(2.557)	0.0302	(0.876)
BLE	-0.0000851	(0.0501)	-0.000137	(0.0636)	-0.00318	(0.569)	0.00711	(0.545)
BLT	0.00196	(4.933)	0.00105	(6.438)	-0.0130	(3.935)	-0.00185	(0.611)
AE	0.011		0.0109		0.0165	(2.616)	0.0218	(1.688)
BEE	-0.00951	(0.847)	0.000254	(0.0468)	-0.00330	(0.195)	0.008	
BET	0.0000261	(0.319)	-0.0000350	(0.374)	-0.000451	(0.726)	-0.000980	(0.837)
AT	0.0702	(0.399)	0.105	(0.789)	0.0679	(0.903)	0.0545	(0.730)
BTT	0.00252	(0.116)	-0.00454	(0.370)	-0.00888	(0.957)	-0.00434	(0.628)
AM	0.689	(27.577)	0.650	(48.594)	0.578	(13.793)	0.696	(19.515)
BKM	-0.0163	(0.679)	-0.0208	(1.417)	-0.0112	(0.469)	0.0275	(1.974)
BLM	0.0293	(1.255)	-0.00312	(0.247)	-0.0375	(1.186)	0.0341	(1.053)
BEM	0.00864	(0.768)	-0.000688	(0.118)	0.00667	(0.358)	-0.00901	(0.757)
BMM	-0.0217	(0.525)	0.0246	(0.949)	0.0420	(0.923)	-0.0526	(1.358)
BMT	-0.00109	(0.474)	0.00312	(2.656)	0.00390	(0.941)	-0.00753	(2.304)

	23. Precision				24. Mis. Mng.			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.0700	(5.83)	0.08808	(8.986)	0.0159	(0.735)	0.0490	(4.367)
BKK	0.0551	(6.40)	0.0537	(7.0328)	0.0495	(4.53)	0.036	
BKL	-0.0562	(6.96)	-0.0476	(7.995)	-0.0234	(1.93)	-0.0144	(1.545)
BKE	0.00106	(1.45)	0.00104	(0.562)	-0.00382	(1.81)	-0.00706	(3.408)
BKT	0.00583	(4.89)	0.00347	(3.973)	0.0066	(3.30)	0.00297	(3.132)
AL	0.199	(3.62)	0.200656	(7.4299)	0.312	(25.38)	0.177	(6.384)
BLL	0.0368	(0.718)	0.0463	(1.758)	0.12		0.0151	(0.750)
BLE	-0.0018	(1.52)	0.0133	(1.435)	0.000087	(0.04)	-0.00770	(1.658)
BLT	0.00181	(0.36)	0.00181	(0.77006)	-0.0107	(8.84)	0.00205	(0.850)
AE	0.013		0.0273	(2.917)	0.0179		0.0121	(2.009)
BEE	-0.0074	(1.01)	0.0089		0.015		0.015	
BET	-0.000034	(0.72)	-0.00147	(1.823)	-0.000003	(0.06)	0.000487	(0.923)
AT	0.0271	(0.568)	0.0556	(1.471)	-0.0119	(0.089)	0.0379	(0.370)
BTT	0.00152	(0.258)	-0.00336	(0.961)	0.0078	(0.478)	-0.000139	(0.0147)
AM	0.718	(12.25)	0.684	(21.836)	0.653	(49.53)	0.762	(37.539)
BKM	0.00101	(0.011)	-0.00704	(1.0394)	-0.0222	(1.95)	-0.0146	(1.749)
BLM	0.00212	(0.389)	-0.0119	(0.384)	-0.0966	(8.75)	-0.00699	(0.409)
BEM	0.0681	(0.949)	-0.0232	(2.346)	-0.0113	(2.89)	-0.000245	(0.0539)
BMM	-0.0294	(0.489)	0.0421	(1.0878)	0.130	(7.31)	0.00782	(0.400)
BMT	-0.00760	(1.410)	-0.00381	(1.385)	0.00400	(3.13)	-0.00550	(3.140)

	25. Trans.				26. Elec. U.			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.231	(3.846)	0.285	(7.413)	0.472	(13.646)	0.458	(14.33)
BKK	0.0466	(0.637)	0.0546	(1.112)	0.0971	(2.285)	0.111	(4.09)
BKL	-0.0741	(1.598)	-0.0375	(1.256)	0.039	(1.265)	-0.0106	(0.70)
BKE	0.00403	(0.225)	-0.00391	(0.1797)	-0.0538	(6.193)	-0.0729	(5.26)
BKT	-0.000650	(0.119)	-0.00763	(2.256)	-0.0048	(1.299)	-0.0056	(1.62)
AL	0.245	(2.956)	0.332	(5.651)	0.158		0.151	(5.92)
BLL	-0.130	(1.430)	-0.02045	(0.294)	0.0674	(2.276)	0.0516	(1.69)
BLE	0.0463	(1.338)	-0.02105	(1.0179)	0.0456	(0.876)	0.0299	(1.10)
BLT	0.0179	(2.367)	0.0111	(2.0753)	0.0016	(1.508)	0.00219	(0.93)
AE	0.0831	(2.524)	0.0147	(0.6701)	0.141	(2.707)	0.159	
BEE	0.049		0.049		-0.094	(1.803)	-0.196	(2.93)
BET	-0.00212	(0.706)	0.00526	(2.827)	0.00055	(0.118)	0.00080	(0.94)
AT	0.0310	(0.324)	0.0415	(0.578)	-0.1122	(0.499)	-0.00069	(0.003)
BTT	-0.000753	(0.0638)	-0.003297	(0.497)	0.0276	(0.998)	0.00456	(0.217)
AM	0.441	(5.153)	0.368	(5.375)	0.228	(3.563)	0.231	(8.27)
BKM	0.0235	(0.563)	-0.0132	(0.555)	-0.0831	(2.964)	-0.0278	(1.20)
BLM	0.158	(1.576)	0.07903	(0.941)	-0.1592	(1.791)	-0.0714	(1.95)
BEM	-0.0993	(2.973)	-0.02402	(1.0615)	0.1023	(1.930)	0.239	(2.86)
BMM	-0.0819	(0.663)	-0.0418	(0.395)	0.1338	(1.112)	-0.140	(1.30)
BMT	-0.0152	(1.926)	-0.00875	(1.398)	0.0027	(0.436)	-0.0026	(0.91)

27. Whole-sale

	Sam.1-13 coef.	Sam.1-13 t-value	Sam.1-18 coef.	Sam.1-18 t-value
AK	0.257	(12.398)	0.236	(20.70)
BKK	0.0784	(4.192)	0.0891	(5.37)
BKL	-0.0168	(0.724)	-0.0429	(3.34)
BKE	-0.0168	(2.891)	0.0155	(2.42)
BKT	0.0032	(1.666)	0.00541	(4.77)
AL	0.356	(5.973)	0.279	(13.04)
BLL	0.1072	(1.611)	0.0186	(0.691)
BLE	-0.00161	(0.921)	-0.0113	(0.929)
BLT	-0.00284	(1.389)	0.00418	(2.11)
AE	0.029		0.0282	(3.20)
BEE	0.022		-0.0190	(2.14)
BET	0.000049	(0.474)	0.0000908	(0.112)
AT	-0.0325	(0.204)	0.0125	(0.105)
BTT	0.00769	(0.391)	0.000855	(0.0776)
AM	0.357	(5.049)	0.457	(16.50)
BKM	-0.0783	(2.541)	-0.0616	(2.95)
BLM	-0.0887	(1.13)	0.0356	(0.951)
BEM	-0.0173	(3.18)	0.0148	(0.618)
BMM	0.1844	(1.874)	0.0112	(0.159)
BMT	-0.00043	(0.067)	-0.00968	(3.82)

28. Finance

	Sam.1-13 coef.	Sam.1-13 t-value	Sam.1-18 coef.	Sam.1-18 t-value
AK	0.397	(25.548)	0.435	(26.6401)
BKK	0.0396	(1.275)	0.0575	(1.457)
BKL	0.00351	(0.131)	0.007204	(0.273)
BKE	0.000371	(0.220)	-0.05055	(2.449)
BKT	0.000172	(0.097)	-0.004079	(2.725)
AL	0.282	(5.456)	0.239	(4.946)
BLL	-0.0612	(0.766)	-0.0864	(1.0115)
BLE	0.00119	(1.51)	0.0682	(2.0767)
BLT	0.00382	(0.796)	0.008087	(1.816)
AE	0.0079		0.04054	(1.967)
BEE	0.0063		0.05	
BET	-0.000069	(2.281)	-0.003304	(1.789)
AT	0.0420	(0.348)	0.0326	(0.354)
BTT	-0.00542	(0.366)	-0.003203	(0.377)
AM	0.312	(6.309)	0.286	(4.5098)
BKM	-0.0434	(2.661)	-0.0142	(0.499)
BLM	0.0565	(0.750)	0.01104	(0.10054)
BEM	-0.00786	(5.744)	-0.0226	(0.689)
BMM	-0.00515	(0.068)	0.0257	(0.184)
BMT	-0.00392	(0.863)	-0.0007031	(0.121)

	29. Real Estate				30. Service			
	Sam.1-13		Sam.1-18		Sam.1-13		Sam.1-18	
	coef.	t-value	coef.	t-value	coef.	t-value	coef.	t-value
AK	0.858	(117.052)	0.856	(160.29)	0.264	(9.24)	0.231	(16.01)
BKK	0.0126	(1.54)	0.0115	(2.02)	0.03		0.17	
BKL	-0.00251	(0.55)	-0.00391	(1.00)	0.0284	(0.788)	-0.0472	(2.60)
BKE	0.00015	(0.051)	0.000247	(0.227)	-0.00273	(0.520)	-0.0203	(2.63)
BKT	-0.000157	(2.09)	-0.00127	(2.56)	0.00682	(2.40)	0.00914	(7.06)
AL	0.038	(17.17)	0.0118	(1.47)	0.18		0.198	
BLL	0.022		-0.0168	(1.36)	0.0355	(2.72)	0.0805	(7.36)
BLE	0.00165	(0.58)	0.00356	(0.734)	0.0425	(3.12)	0.0547	(2.48)
BLT	-0.00101	(3.87)	0.00157	(2.20)	0.000639	(1.33)	-0.00044	(1.16)
AE	0.0024		0.00394	(1.45)	0.0561	(5.73)	0.0622	(3.98)
BEE	0.002		0.00138	(0.529)	0.02		0.02	
BET	-0.0000076	(0.08)	-0.000151	(0.601)	-0.00309	(3.47)	-0.00352	(2.51)
AT	-0.164	(0.395)	0.00983	(0.0310)	-0.0373	(0.377)	-0.00397	(0.052)
BTT	0.0368	(0.715)	0.00515	(0.176)	0.00592	(0.484)	0.000314	(0.045)
AM	0.100	(15.82)	0.128	(14.82)	0.500	(16.68)	0.508	(21.12)
BKM	-0.0103	(1.31)	-0.00786	(1.64)	-0.0557	(1.38)	-0.103	(4.76)
BLM	-0.0211	(5.16)	0.0171	(1.16)	-0.106	(2.86)	-0.0879	(2.23)
BEM	-0.0038	(0.71)	-0.00518	(0.765)	-0.0598	(4.30)	-0.0544	(2.63)
BMM	0.0352	(3.21)	-0.00406	(0.202)	0.222	(2.73)	0.2448	(3.42)
BMT	0.00256	(3.98)	-0.000155	(0.194)	-0.00437	(1.43)	-0.0052	(2.38)

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