RECENT TRENDS OF INVESTMENT ACTIVITIES IN JAPAN †

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1. Fixed Investment Stabilization

The growing importance of the service sector or softnomization of the economy has a wide variety of influences on corporate investment. This development is, as a matter of course, reflected clearly in changes not merely in the value added or employee composition ratio but also in the share of corporate fixed investment by industry. As indicated in Table 1, the composition ratio of capital spending for the tertiary industry shows an increase of a little over than 10% point from 34.0% in 1970 to 44.1% in 1982. The service trade , among others, registers a noteworthy gain in this ratio from 5.3% to 13.9% during this period.

The increasing weight of the tertiary or service sector in equipment investment does not mean, however, that this sector has been always outpacing the other sectors of the economy in the annual growth rate of capital spending. Fig. 1 illustrates the relation of the yearly fixed investment growth rate of all industries to that of the manufacturing industry. In general, when all industries' fixed investment grows at a high rate exceeding 10% over the year, the manufacturing industry tends to outperform all industries in the growth rate. On the other hand, when all industries' capital spending registers a low growth rate of less than 5% or records negative rates the growth rate of the manufacturing industry is much lower than that of all industries. As a consequence, the regression line representing the fixed investment growth rates for all industries and the manufacturing industry is a slightly slanting line that intersects the diagonal line somewhere between the 5% and 10% marks. This indicates that fixed investment in the manufacturing industry undergoes a significant change in the short term but the contrary is true of capital spending in non-manufacturing industries, of which the tertiary sector forms the majority.

In the long term, corporate investment in the tertiary industry or service sector is increasing at a higher rate than that in the secondary or manufacturing industry. In the short term, the fixed investment growth rate for the former shows a stabilizing tendency with minor swings.

2. Optimal Capital Stock and Capital Formation

We have seen in the last section an empirical fact that corporate investment in plant and equipment in the tertiary or service industries is stable in the short-run. This fact appears to be

† This paper analyzes how an increasing share of service industry has given an influence on investment behavior in Japan. In particular, historical changes in the composition of investment by industry will be shown and then an investment behavior of the tertiary industry will be examined in contrast to that of manufacturing industry. The paper is based on studies by Hirayama, Toyoda and Yokota who are the member of a Ministry of Finance working group studying "Softnomics".

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Table 1 Composition of New Equipment Investment (All Establishments) by Industry
(On construction basis; 1975 prices; %)

	FY '66	FY '70	FY '75	FY '80	FY '81	FY '82
All Industries	100.0	100.0	100.0	100.0	100.0	100.0
Agriculture, Forestry, and Fisheries	12.7	10.6	13.9	13.5	12.0	11.2
Mining	1.4	0.8	0.6	0.6	0.6	0.5
Construction	4.2	4.7	5.3	5.5	5.6	5.5
Manufacturing	42.6	50.0	39.4	37.9	39.2	38.7
Foods	3.2	3.0	2.6	2.4	2.4	2.6
Textiles	2.5	2.5	1.4	0.9	1.0	1.2
Pulp and Paper	1.7	1.9	2.1	1.5	1.1	1.2
Chemicals	6.5	7.6	5.7	4.1	3.9	4.3
Primary Metals	7.7	9.8	9.1	4.3	5.4	6.0
Metal Products	2.3	2.6	2.2	2.5	2.4	2.1
General Machinery	3.5	5.0	3.1	4.0	4.7	4.2
Electrical Machinery	2.8	3.4	1.9	4.7	5.6	5.0
Transport Equipment	4.2	4.8	2.8	4.1	5.0	5.1
Other	8.1	9.2	8.4	8.4	7.7	6.9
Wholesale and Retail	7.1	7.0	10.7	9.6	8.7	8.5
Wholesale	2.0	1.5	1.6	1.8	1.3	1.4
Retail	5.1	5.5	9.0	7.8	7.4	7.1
Banking and Insurance	4.1	2.8	3.3	2.0	2.0	2.0
Real Estate	2.2	2.4	2.3	2.0	2.0	2.2
Traosportation and Communication	10.8	9.2	8.1	6.6	6.7	6.6
Electricity, Gas and WaterSupply	9.4	7.4	8.9	11.2	10.8	10.8
Service	5.5	5.3	7.5	11.1	12.5	13.9
Primary Industry	12.7	10.6	13.9	13.5	12.0	11.2
Secondary Industry	48.3	55.4	45.3	44.0	45.4	44.7
Tertiary Industry	39.1	34.0	40.8	42.5	42.7	44.1

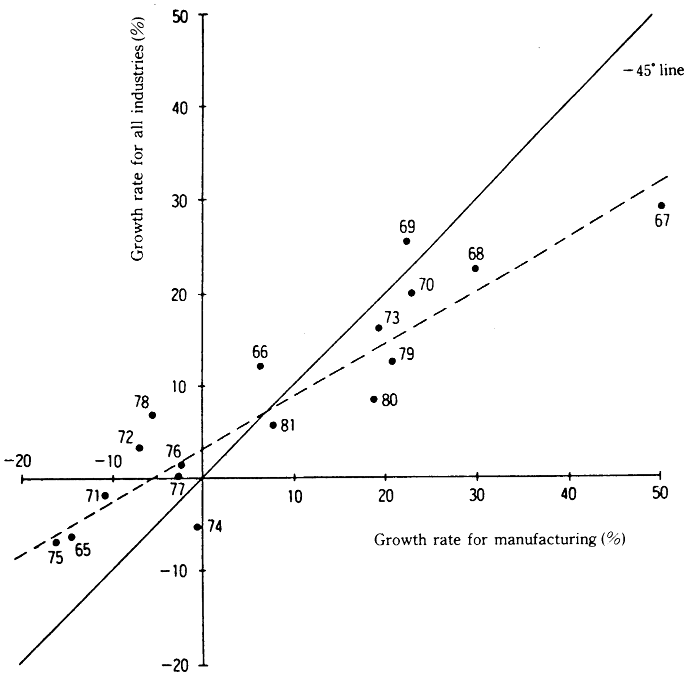
Source: Economic Planning Agency, "Capital Stock of Corporate Firms"

related to a number of factors. (1) Here we would like to consider those in the context of firms' investment behavior. The model we use is a generalized version of the accelerator model, the prototype of the theory of investment.

At a given moment in time, it is almost certain that there is a gap between the optimal stock

(1) The output in the tertiary industry depends more on relatively stable final demand rather than volantile intermediate demand. Particularly, it depends on personal consumption which shows very little short-run fluctuations. Furthermore, there is very limited inventory in the tertiary industry and as for pure service inventory investment and foreign demand do not play any significant role at all. However, we do not go into details of demand factors in this section.

Fig. 1 Relationship of the Fixed Investment Growth Rate Between All Industries and the Manufa turing Industry



Source: The Economic Planning Agency, "Capital Stock of Corporate Firms."
Note: 1)The growth rate as compared with the previous year is on a calender year basi in real terms.
2)The regression line is freehand.

of capital and the actual stock of capital. The fundamental hypothesis of our model is that the wider the gap the greater the firm's rate of capital formation. That is the firm plans to fill a certain proportion of the gap between the optimal and actual stock of capital. This relation can be expressed as follows.

$$K-K_{-1}=\lambda(K^*-K_{-1}) \cdots\cdots (1)$$

The firm fills in the current period a certain proportion λ of the gap between the optimal capital stock K^* and the actual capital stock at the end of the last period k_{-1}. Rearranging Equation (1) gives,

$$K= K_{-1}+\lambda(K^*-K_{-1}) \cdots\cdots (2)$$

The firm performs the amount of net investment $I=K-K_{-1}$as the increment of capital stock from K_{-1} to K. Namely,

$$I=\lambda(K^*-K_{-1}) \cdots\cdots (3)$$

Equation (3) indicates that the wider the gap between the actual and optimal capital stock the greater the volume of net investment(2). It is important to note that this is net investment, and that gross investment unadjusted for depreciation of capital would be expressed as $I+dk_{-1}$. Here d is the rate of depreciation.

It would not be easy to estimate the coefficient of capital stock adjustment λ in our model. First, the optimal capital stock K^* is dependent upon the rental cost of capital ic and the expected level of output. The rental cost in turn is related to the rate of interest i, the rate of depreciation d, the expected rate of inflation μ^*, the rate of investment tax credit τ, and the rate of corporate income tax t(3). Here the expected level of output refers to the permanent level of output and not the current level of output. Consequently, the model would have to involve a distributed lag structure and quite complex. Second, in the case of the tertiary or service industries, either the deflator for the output is unreliable or the deflation itself does not have persuasible logical ground. Furthermore, the rate of utilization of capital equipment in the service sector cannot be defined in the same way as in manufacturing industries(4).

Nevertheless, we would like to leave these difficulties for the moment and proceed to estimate λ in the simplest way possible. The results of the estimation are presented in Table 2. Here we must note that simple comparison among the absolute values of the capital output ratios in the same table would not be meaningful. The values of capital output ratios in the service sector would depend on the definition of capital utilization which is an illusory concept at best. Furthemore, due to the difference in the ratio of value added to output between the service and manufacturing sectors, distinction would have to be made. Also, there are problems associated with the evaluation of the relative prices between services and manufactures. Therefore, here we compare the estimated coefficients of capital adjustment only. It is estimated as 0.053 in the tertiary sector compared with 0.187 in the manufacturing sector.

The extremely low coefficient of capital adjustment in the tertiary sector means that sector adjustment to the optimal capital stock would be carried out very slowly. This appears to be an explanation for the stabilizing tendency of investment in plant and equipment as the service sector expands.

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(2) Equation (3) is a generalized version of the prototype acceleration model of investment which postulates that investment is directly related to the variations in GNP. Suppose that the adjustment to the optimal capital stock can be carried out in one period ($\lambda=1$), then $K=K^*$. Further, assume that the ratio of the optimal capital stock to output is constant, or $K=\beta Y$. β is a constant. Substituting these in Equation (3) yields the following,

$$I=\beta\,(Y-Y_{-1})$$

This is the simplest model of acceleration. Thus, Equation (3) is a considerably generalized version of the acceleration model.

(3) Let us consider the optimal capital stock with the following particular Cobb-Douglas production function.

$$K^*=\frac{\alpha Y}{ic}$$

where α=capital share in output, Y = output, ic=rental cost of capital. Now let us define ic as follows,

$$ic=\frac{(1-\tau)(\iota+d-\mu^*)}{1-t}$$

where t = corporate income tax rate, τ=the rate of investment tax credit, i=interest rate, d=the rate of capital depreciation, μ^*=expected rate of inflation.

Then, the optimal stock of capital is,

$$K^*=\frac{\alpha Y(1-t)}{(1-\tau)(i+d+\mu^*)}$$

3. Corporate Investment and Relative Share

Several studies indicate that corporate fixed investment can be accounted for by the sales level or total profits.[5] If we express this by a specific equation based on the Cobb-Douglas' production function which is frequently used in researches on investment behavior, it becomes as follows:

$$K^* = \frac{\alpha Y}{ic} \quad \cdots\cdots (1)$$

Where Y represents the level of total output (sales), α the relative share of capital and ic the rental cost of capital.

Given that the rental cost of capital ic and the output level Y are constant, the optimum capital stock K^* is dependent on the relative share of capital α. Opposite to this α is the labor's relative share $(1-\alpha)$. Table 3 shows changes in the labor's relative share. The labor's relative share, on the average, rose from 42.9% in 1970 to 55.9% in 1982, showing a 13.0% point increase during this period. A remarkably sharp increase in the labor's relative share is recorded, among others, in banking, insurance and other non-manufacturing industries (excluding real estate business) 2[6].

Other conditions given, such a rise in the labor's relative share decreases the share of capital and cuts down the optimum capital stock of private firms. Unless the rental cost of capital ic declines with a given output, therefore, a gap between the optimum capital stock as conceived by the firm and the existing capital stock $(K^* - K_{-1})$ will be narrowed and the firms' net investment I will be reduced that much.

Table 4 divides the changes in the labor's relative share shown in Table 3 into: a) the changes in the labor's relative share for the entire economy, expressed as the weighted average of the labor's relative share by industry, in response to changes in industrial structure, and b) the time series changes in the labor's relative share within each industry.

Of the aggregate 13.0 increase in the labor's relative share for 1970-82, 1.9 can be ascribable to the category (a) which results from changes in industrial structure. On the other hand, the category (b) that is due to a rise in the labor's relative share within each industry accounts for 11.

Consequently, net investment function is

$$I = \lambda \left(\left[\frac{\alpha Y(1-t)}{(1-\tau)(i+d+\mu^*)} \right] - K_{-1} \right)$$

Dale Jorgenson and others have shown that the variables contained in this equation (except expected rate of inflation) are the explanatory variables in an investment function capable of rational explanation of firms' investment behavior.

Dale W. Jorgenson, "Eonometric Studies of Investment Behavior: A Survey," Journal of Economic Literature 1971.

Charles W. Bischoff, "Business Investment in the 1970's: A Comparison of Models," Brookings Papers on Economic Activity, vol I, 1971.

(4) The rate of utilization of capital at which the capital equipment is judged to be in want is 100% in the manufacturing sector. On the other hand, 100% capital utilization at a retail store would mean a constant queue of customers. The rate of utilization where capital is judged to be in want in this case would have to be considerably smaller than 100%.

(5) See the footnote (3) in the previous section.

(6) In Table 3 the labor's relative share is lower for "other non-manufacturing industries" than for manufacturing. This is because real estate business comes under this category. The output for real estate business includes imputed rent on owned houses, resulting in a considerable drop in the labor's relative share. If real estate business is excluded from the "other non-manufacturing industries" category, the labor's relative share for this category would be much greater than that for manufacturing.

Table 2 Estimated Coefficient of Adjustment of Capital Stock

	Adjustment coefficent λ	Optimal capital output ratio π	R^2	Durbin-Watson
TertiaryIndustry	0.053	1.569	0.9118	1.33
(excluding electricity, gas and water supply)	(0.059)	(1.233)	(0.8666)	(0.85)
Manufacturing	0.187	0.735	0.8947	1.68

Notes: 1) The coefficient of capital stock adjustment was estimated with the following functions.

$$Kt - Kt_{-1} = \lambda(K_t^* - Kt_{-1}) \quad \cdots\cdots i)$$

$$\pi = K_t^*/Pt \quad \cdots\cdots ii)$$

From Equations i) and ii),

$$Kt = \lambda \cdot \pi \cdot Pt + (1 - \lambda)\, Kt_{-1}$$

The last equation was used for estimations.

Kt = Capital stock

K_t^* = Optimum capital stock

λ = Coefficient of adjustment

π = Optimum capital output ratio

Pt = The value of output (including intermediate inputs)

2) The period estimations is 1970—1982.

3) Estimation was undertaken by Mr.Suminori Yokota.

Source: Economic Planning Agency, "Statistics of Capital Stock of Corporate Firms" and "Annual Report of National Income Accounts"

Table 3 Changes in the Labor's Relativ Share

Year	Agriculture, Forestry, and Fisheries	Mining	Manufacturing			Electricity, Gas and Water Supply
				machinery	Excluding machinery	
1970	13.0	41.1	43.4	46.7	41.6	29.1
1975	14.3	49.0	58.7	64.0	55.9	39.6
1980	18.5	29.1	55.5	56.8	54.7	28.2
1982	19.4	33.8	55.7	58.1	53.1	29.5

Year	Banking and Insurance	Other Non-manufacturing Industries		Goverment Services	Total
			Excluding Real Estate		
1970	42.3	40.4	48.3	93.0	42.9
1975	49.4	48.5	57.0	94.9	53.5
1980	56.3	50.6	62.3	93.1	54.2
1982	60.0	53.3	66.4	92.1	55.9

Source: The Economic Planning Agency, "The Annual Report on National Economic Accounting."

Note: $\text{Labor's relative share} = \dfrac{\text{Employees' income}}{\text{Employees' income} + \text{Operating surplus} + \text{Fixed capital depletion}}$

Table 4 Contribution to a Rise in the Labor's Relative Share

	Contribution of changes in industrial structure	Contribution of a rise in the labor's relative share within each industry	Total increase in the labor's relative share
1970—1975	1.5	9.1	10.6
1975—1982	0.7	1.7	2.4
1970—1982	1.9	11.1	13.0

Notes: 1) Figures were obtained by the following formulas:
Contribution of changes in industrial structure

$$=\sum_i (Wit-Wio)\,Zio$$

Contribution of a rise in the labor's relative share within each industry

$$=\sum_i WitZit-\sum_i WioZio-\sum_i (Wit-Wio)Zio$$
$$=\sum_i Wit(Zit-Zio)$$

Where,
Wio: Weight of (Employees' income+Operating surplus + Fixed capital depletion) for the industry i in the initial year
Wit: Weight of (Employees' income+Operating surplus + Fixed capital depletion) for the industry i in the year t
Zio: Labor's relative share for the industry i in the initial year
Zit: Labor's relative share for the industry i in the year t

2) Calculations were made by Mr. Kazuo Toyoda.

1 of the total. The most marked upsurge in the labor's relative share is observed in many tertiary industry sectors, including banking, insurance, and other non-manufacturing industries (except for real estate business).

This suggests that the growing importance of the service sector or softnomization of the economy helps reduce the capital's relative share, which would, in turn, have a negative effect on corporate investment.

As discussed in the previous section using the equation,

$$I=\lambda(K^*-K_{-1})\cdots\cdots(2)$$

first, with the growing significance of the service or soft aspect of the economy, a drop in the adjustment velocity λ would stabilize equipment investment, and secondly, the reduced value of (K^*-K_{-1}) resulting from a rise in the labor's relative share (or a drop in the capital's relative share) would decrease corporate fixed investment.

4. Substitutability between Captial and Labor

The change in shares in the output value of factors of production is related to the elasticity of substitution between capital and labor. Now consider the following CES production function for each industry.

$$V=\gamma[\delta K^{-\rho}+(1-\delta)\ L+(1-\delta)L^{-\rho}]^{-\frac{1}{\rho}} \cdots\cdots (1)$$

$$\rho=\frac{1-\sigma}{\sigma}$$

where V = real output, K = capital stock, L = labor input, γ = efficiency parameter, δ = distribution parameter, and ρ = substitution parameter, σ = elasticity of substitution.

Now given factor prices, profit maximization conditions with respect to factor inputs are $\partial V/\partial K=\iota$(cost of capital) and $\partial V/\partial L=\omega$ (real cost of labor). Thus,

$$\frac{V}{L}=\left(\frac{\gamma^{P}}{1-\delta}\right)^{\sigma}\omega^{\sigma} \cdots\cdots (2)$$

$$\frac{V}{K}=\left(\frac{\gamma^{P}}{\delta}\right)^{\sigma}\iota^{\sigma} \cdots\cdots (3)$$

where $\sigma=1/(1+\rho)$

From Equation (2) we obtain

$$\log\left(\frac{V}{L}\right)=\sigma\log\left(\frac{\gamma^{P}}{1-\delta}\right)+\sigma\log\omega \cdots\cdots (4)$$

Thus, from the data on wages and the average labor productivity σ can be estimated. The elasticity of substitution σ is expressed as follows.

$$\sigma=\frac{\left(\frac{\omega}{\iota}\right)}{\left(\frac{L}{K}\right)}\cdot\frac{d\left(\frac{L}{K}\right)}{d\left(\frac{\omega}{\iota}\right)} \cdots\cdots (5)$$

Equation (5) indicates a percentage change in the labor capital ratio induced by a one-percent change in the wage capital cost ratio. And the share of labor in the output value is,

$$\frac{\omega L}{V}=(1-\delta)^{-\sigma}\left(\frac{\omega}{\iota}\right)^{1-\sigma} \cdots\cdots (6)$$

Consequently, as the wage capital cost ratio rises the labor share rises if $\sigma<1$, and falls if $\sigma>1$.(7)

Table 5 presents the estimate of the elasticity of substitution made according to Equation (4)(8). The elasticity of substitution is smaller than unity in all industries, and it means that as the relative labor cost rises the share of labor increases as well.

Furthermore, comparison between the manufacturing and non-manufacturing sectors reveals that the elasticity of substitution is smaller in the latter. For example, it is 0.5871 in banking and insurance and 0.5128 in other non-manufacturing compared with 0.7402 in the manufacturing

(7) Taking the logarithm of both sides of Equation (6) and differentiating with respect to time yields,

$$\frac{\left(\dot{\frac{\omega L}{V}}\right)}{\left(\frac{\omega L}{V}\right)}=(1-\sigma)\frac{\left(\dot{\frac{\omega}{\iota}}\right)}{\left(\frac{\omega}{\iota}\right)}$$

where • denotes differentiation with respect to time.

(8) Estimating the equation, $\log\frac{V}{L}=\sigma\log\left(\frac{\gamma p}{1-\delta}\right)+\sigma\log\omega$

does not require the time series of capital stock, and therefore it is very convenient to use to estimate σ for the non-manufacturing sector for which the data on the rate of utilization are difficult to obtain. However, the reliability of the estimate also depends on the stability of the efficiency parameter γ throughout the estimation period. Therefore, it is important to note that the reliability of the estimate has a limitation.

sector. This means that for a given increase in the cost of labor the share of labor rises more in the non-manufacturing sector than the manufacturing sector. Also, firms' incentives for investment decline more in the face of a rise in the labor cost in the non-manufacturing (particularly services) sector than the manufacturing sector.

Table 5 Estimation of the Elasticity of Substitution

	Constant term (α)	Elasticity of substitution (σ)	$\bar{R}^2$	F(1,11)
Manufacturing Sector	0.8706 (7.869)	0.7402 (20.850)	0.973	434.7
Machinery	−0.4073 (6.604)	0.9181 (17.243)	0.964	297.3
Excluding Machinery	0.1293 (1.076)	0.7009 (13.193)	0.935	174.1
Electrcity, Gas and Water Supply	−0.4534 (1.376)	0.1826 (0.469)	0.020	0.22
Banking and Insurance	−0.0490 (−0.618)	0.5871 (12.960)	0.933	167.9
Other non-Manufacturing	−0.3383 (−3.383)	0.5128 (11.571)	0.924	133.9

Notes: 1) The equation estimated is $\log\left(\frac{V}{L}\right) = \alpha + \sigma \log \omega$
where V=real output value, L=labor input, ω=labor cost.
2) t-statistics are given in parentheses.
3) The period estimations is 1970-82.
4) Estimation was undertaken by Mr. Kazuo Toyoda.