Regulation and Productivity[1)]

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1. Introduction

Growth in the Japanese economy has been stagnant since the early 1990s, and this has resulted in what has been called the "lost decade." Many analyses of this economic slump have been conducted from a perspective focusing on demand side, but some recent studies have also begun to examine the cause of this economic slump from a perspective focusing on supply side, particularly analyses that place emphasis on productivity[2)]. Most of these studies have indicated that since the real GDP growth rate of the Japanese economy fell to an average of less than 2% in the 1990s, from just under 4% annually in the 1970s and 1980s, one factor in this poor economic growth is the low growth rate in total factor productivity (TFP). The present article considers the causes of the sluggish growth in the Japanese economy from the perspective of productivity, and analyzes the determining factors for industrial productivity. The productivity in the service sector is particularly important since service sector productivity has a huge impact on the economy as a whole.

Many industries in the service sector are regulated, and the argument is often heard that such regulations impede improvements in these industries. The present article, therefore, examines the relationship between productivity and regulations in industry, with a focus on the service industry. The article is structured as follows. As a framework for the discussion on service industry productivity, Section 2 of this paper examines the characteristics of and problems in measuring productivity in the service industry, and introduces studies that have analyzed the factors determining productivity in industry. Section 3 describes the data used, and Section 4 discusses the estimation methods and results from the study. The final section summarizes the findings and briefly mentions some future issues.

2. Productivity in the Service Industry

2.1 Productivity in the Service Industry

Wolff (1999), Nakajima (2001), and others have pointed out the difficulty of defining and measuring output in the service industry, which in some cases makes it virtually impossible to calculate productivity. For example, in the services provided by the banking and insurance sector, money is paid and received at different times, so that the service provided at a particular point in time and the compensation for that service do not correspond. In addition, services such as education and medical care are often provided by the government without going through the market so that, unlike services on the market, output cannot be measured based on market prices. Increased improvements brought about by the added convenience of longer trading hours in the financial, distribution, and entertainment industries does not necessarily lead to increased trading volume in those industries. Hence this cannot be treated as an increase in output, but only as an increase in input that leads to a decline in productivity in that sector[3]. Furthermore, compared with output in the manufacturing industry, it is often difficult to assess the quality of output in the service industry. Another problem is the difficulty of finding an appropriate deflator when calculating the size of real output. In Japan, for example, price indices of products handled are used as deflators for wholesale and retail output, and real prices are determined without regard for the output trends in the industry itself[4]. Even if there is no change in the nominal amount for the commercial margin of personal computer dealers, their real output is said to increase as the price of computers declines.

Wolff (1999) indicated the possibility of considering the number of services provided or the number of people served, such as the number of loans or deposit accounts in the banking industry or the number of passengers transported in the airline industry, as indices of output[5]. However, there are problems with this approach in that these indices are just one of the activities in the given industry, and it is difficulty to make an aggregate calculation when evaluating these numbers in conjunction with other economic activities in the industry. That is, the number of loans and the number of deposit accounts cannot simply be added together.

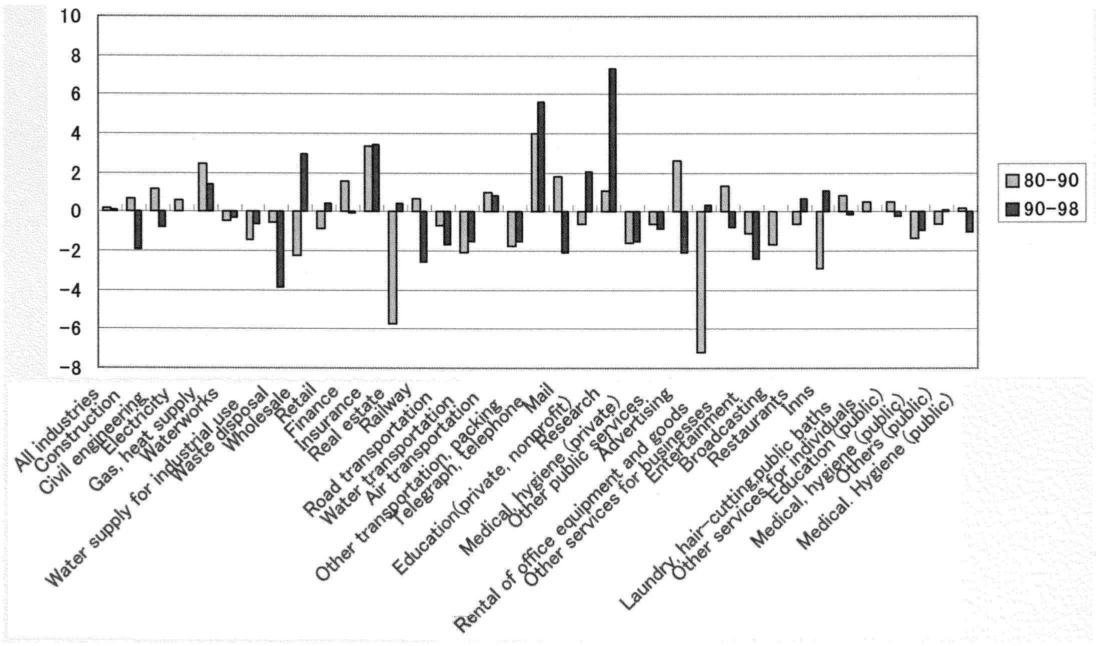
Given the above problems, it is difficult to determine productivity itself in the service industry and as a result, analyses of economic factors affecting productivity are rarely seen.

While aware of the various problems mentioned above in measuring service industry output, Wolff conducted an analysis according to TFP using information from input-output tables in the United States. He used the growth rate in TFP in the manufacturing and service industries[6] as explanatory variables, and conducted a regression analysis with independent variables including per-employee investment for computers or other items, proportions of knowledge and technical workers among all employees, employee educational level, proportion of R&D investment by industry and value added in the given industry, and spillover effect from productivity improvements in other industries. Estimates were made for three periods, 1958-67, 1967-77, and 1977-87, with data from each industry pooled for these periods. The results showed that, compared with the manufacturing industry, computerization and more high-level labor did not have a positive effect on productivity in the service industry; rather, the effect was negative. He concluded that such findings were most likely the result of statistical error regarding output in the service industry.

2. 2 Productivity in the Japanese Service Industry

Accepting that there are various problems as mentioned above in understanding productivity in the service industry, Figure 1 shows the TFP growth rate trends in the service industry[7)] calculated using an output base for the 1980s and 1990s. The TFP growth rates for industries such as telephone/telegraph and research sectors were positive through the 1980s and 1990s, but there are eleven industries, including entertainment industry, for which the growth rate was negative over about twenty years. There were also eleven industries such as construction and civil engineering that had a positive TFP growth rate in the 1980s but a negative rate in the 1990s. In fact, twenty-two of the thirty-six industries in the service sector had negative TFP growth rates in the 1990s. Since service industry's output is dominating the economic activities, the stagnant TFP growth rate in the sector has a huge impact on the stagnant growth rate of the Japanese economy as a whole. In the present article, using a similar method to Wolff (1999), we analyzed the factors contributing to stagnation of the TFP growth rate in the service industry. Unlike Wolff (1999), we also analyzed the TFP growth rate in the manufacturing sector, and also added the government regulations as an explanatory variable, which are thought to have a negative impact on TFP growth rate.

Figure 1. TFP Growth rate by sector (per cent per annum)



3.　Data Used in Estimations

Fukao et al. (2003) calculated four kinds of TFP growth rate indices.　Two of those indices are calculated considering the improved quality of labor and capacity utilization (one uses information on intermediate input and capital stock, and the other, information on production indices and capital stock).　The third kind of TFP growth rate index is calculated with consideration given to improvements in the quality of labor but not the impact of capacity utilization[8], and the fourth kind does not consider either the quality of labor or the capacity utilization ratio.

The TFP growth rate is considered to be influenced positively by IT related and R&D investments. Figure 2 shows a ratio of IT capital stock[9] and other ordinal capital stock. In 1998 the mean value for the manufacturing industry was 11.8%, whereas many other industries, including the service industry, had values much larger than this.　IT capital stock accounted for more than half of the equipment in many service industries.　It was particularly high in the rental of office equipment and goods industry (IT capital stock ratio: 140.9%), as well as in the postal industry (60.0%), insurance industry (57.1%), telegraph/telephone industry (51.7%), broadcasting industry (50.8%), and financial industry (47.5%), indicating that the some of service industries are IT investment intensive.

Figure 2.　Ratio between IT Capital Stock and Other Ordinal Capital Stock

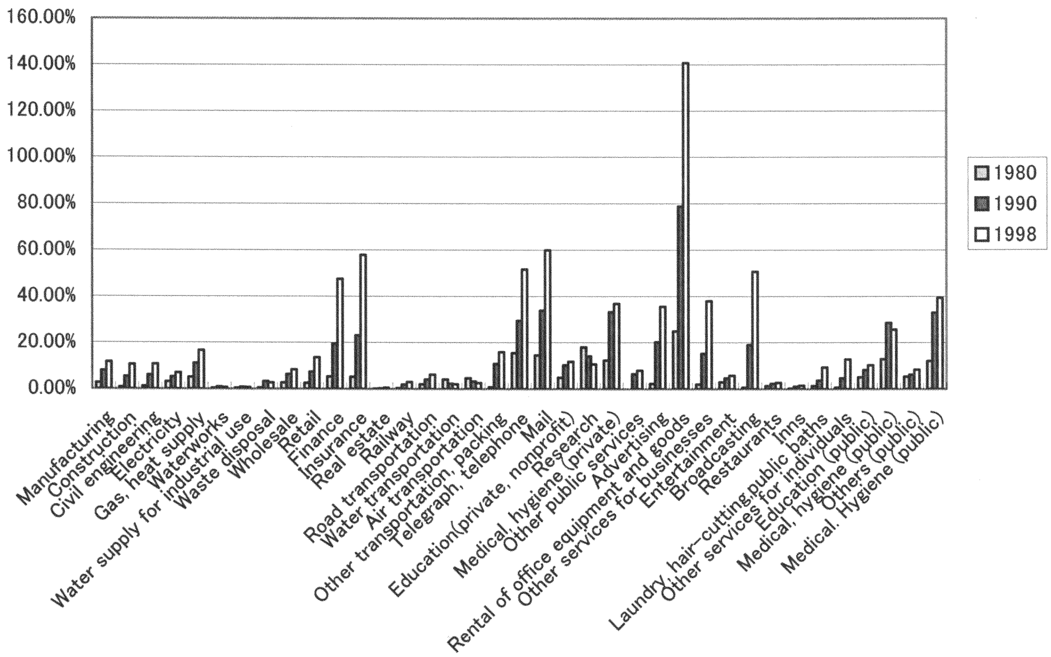
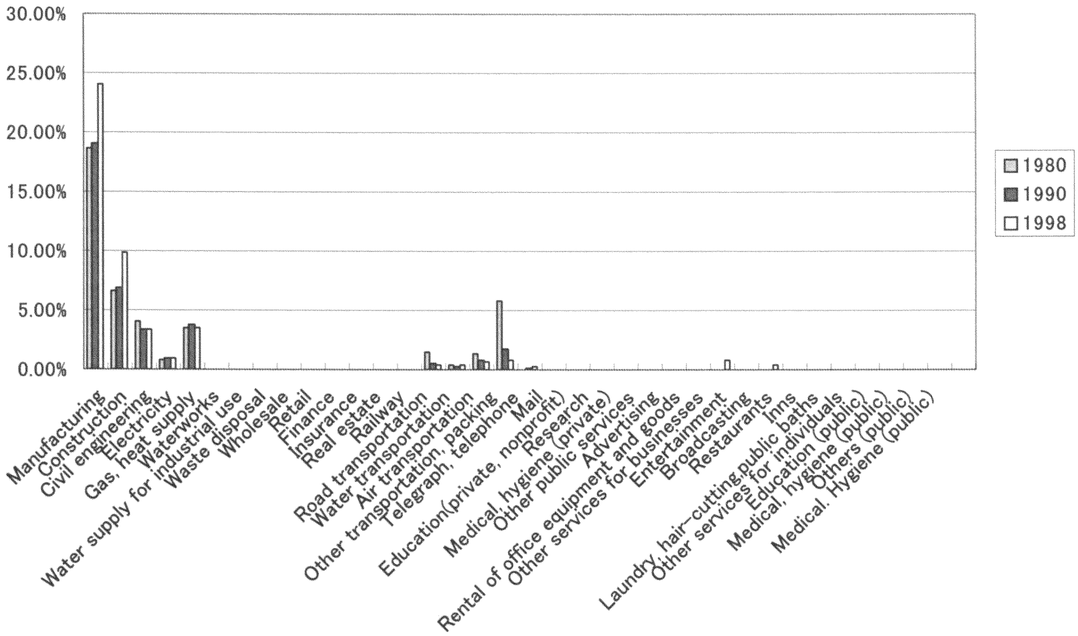


Figure 3. Ratio Between Knowledge Stock and Capital Stock



Next, let us look at trends in R&D investment. Statistics of the nominal value of R&D investment taken from the Survey of Research and Development, from the Statistics Bureau, Ministry of Internal Affairs and Communications, were converted to real values and we calculated the knowledge stock using these values[10]. This survey focused on the manufacturing industry, with a limited look at the service industry. Thus, there are data from only 12 industries that can be used for knowledge stock in the service industry. A comparison of knowledge stock and normal capital stock (here including IT capital stock) for these 12 industries reveals that, against the manufacturing industry level of 24% in 1998, the highest in the service industry was only 9.9% in the construction industry. Among the 12 industries for which the data could be used, 8 had a very small value of less than 1%.

There is no direct way to measure the degree of regulations. Therefore, it is necessary for the researcher to adopt a method in order to derive his or her own regulatory indicator. In our case, we first counted the number of eased regulations. These are legal regulations in various industries that are being relaxed in stages. We counted each time that a regulation was relaxed. The way we counted this was by starting from 0 and adding 1 each time a regulation was relaxed. Therefore, this number continues to grow larger as deregulation progresses. Our count was made from the chronological tables for deregulation in each industry released by the Sumitomo Life Research Institute (1999). However, had we only taken these tables into account, then industries without any regulation or deregulation would be left at zero. Therefore, following that, we counted the number of regulations an industry had first adopted. The data for the initial number of regulations was based on the White Paper on Deregulation Initiative (2000).

By comparing the initial number of regulations to the number of existing ones, we calculated the number of regulations that were relaxed for each industrial classification. The next problem was taking into account both industries with essentially no regulation and those with some regulation. The level of regulation relaxation in non-regulated industries is taken to be the highest value, followed by that in regulated industries that have eased their regulations. The level is taken to be the lowest in regulated industries that have not eased their regulations at all.

We then considered data values between 0 and 1. Non-regulated industries and industries, which used to regulate but whose regulations were completely relaxed, are taken to have a value of 1. Industries which have regulations that have never been relaxed are seen as 0. To express the proportion of deregulation, the number of regulation relaxations in industries constitutes the numerator, and the number of relaxations plus the number of initial regulations constitutes the denominator. Therefore, with greater deregulation, the value moves closer to 1, and with greater regulation the value moves closer to 0.

One problem with this is that the degree of relaxation of regulations cannot always be measured by the number of regulations. In other words, there may be several regulations based on a given law. In addition, the relaxation of a particular regulation does not necessarily indicate that the law has been completely repealed. It may have just been partially amended. Therefore, the denominator is not the number of regulations but the sum of the number of initial regulations plus the number of deregulation.

Using these indicators, we were able to see how each industry is regulated. A point of caution however is necessary. These indicators give the same value to all regulations; that is, each is counted as 1. However, it is to be expected that some regulations will have a stronger impact than others. We therefore prepared two types of data: primary data (RE1) for which the number of regulations was simply counted with no prior information, and secondary data (RE2) in which those regulations thought to have little importance were not considered.

Figures 4 and 5 show RE1 and RE2, respectively. In both the values for relaxation of regulations in non-manufacturing industries are low. This is because in Japan regulations are predominant in non-manufacturing industries. The financial, airline, commerce, and energy industries fall into this category. Figures 4 and 5 differ greatly in the values for manufacturing industries. In Figure 4, the number of regulations is counted directly from the White Paper (2000), but in Figure 5 regulations that are judged to have little impact are not counted. Since regulations judged to have little impact are present in almost all manufacturing industries, in Figure 5 the manufacturing industry is considered to have almost no regulations.

Figure 4. Regulation (RE1)

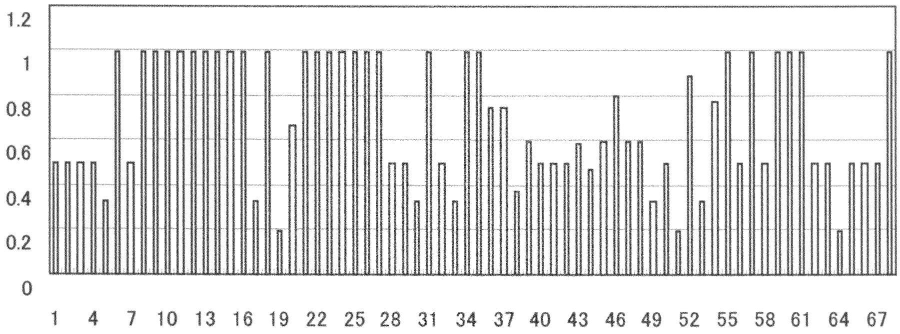
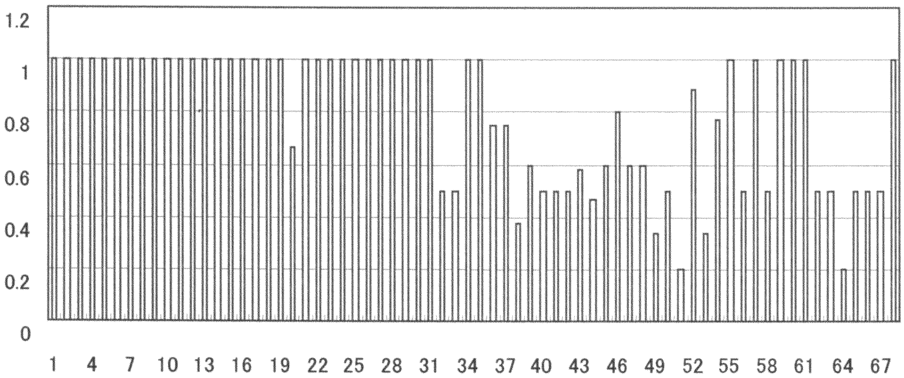
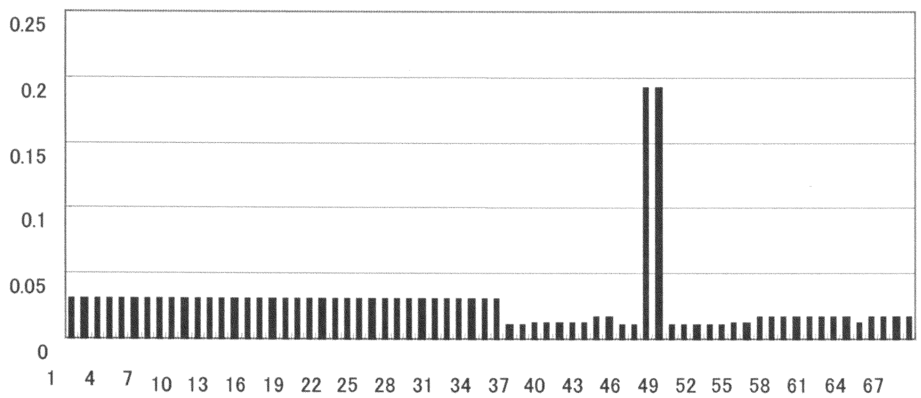


Figure 5. Regulation (RE2)



In the White Paper (2000), data is presented as regulation weight. This weight indicates the degree of regulation in the industry (all industries are classified into thirteen industrial fields), and higher regulation weights mean stronger regulation. For example, the percentage for the fields of construction, finance, and insurance is 100%. In addition, these variables were prepared for the two cases of broadly categorized and narrowly categorized regulations[11)]. The broadly categorized regulation weight is calculated by assuming that all activities are regulated in the industry. That is, the weight is calculated as a share of value added in the regulated industries among the thirteen industry fields. On the other hand, the narrowly categorized regulation weight is calculated by assuming that some activities in the industry are regulated, that is, the share of value added of regulated industrial activities among each of the thirteen industry fields is calculated. Both broadly and narrowly defined weights are prepared for the three time periods: 1985, 1990 and 1995. We then adopted this data as one type of regulatory indicator. In fact, because we wanted to show the relaxation of regulations, we inverted the initial value of the weight, so that the highest weight initially which was taken to be 100% is now considered as 0.01. Since the data for the years other than 1985, 1990 and 1995 are not available, the values for the years up to 1985 are considered the same as that for 1985; the values from 1986 to 1990, the same as that of 1990; and the values for the years after 1990, the same as 1995. Furthermore, because we have detailed industrial classifications, we applied this weight to the detailed industrial classification by assuming that the same weight in the broader classification can be applied to our more detailed industrial classification. With data processed to accommodate these two types of regulation weight values, we used RW1 for the broadly classified regulations and RW2 for the narrowly classified regulations. From Figure 6 it can be seen that there is greater deregulation of the manufacturing industry than non-manufacturing industries.

Figure 6.　Regulation (RW 1)



In addition, these two types of data were multiplied to develop indicators taking into consideration the effects of both. Thus, RE1 multiplied by RW1 becomes RE11, and RE1 multiplied by RW2 becomes RE12. Similarly, RE2 multiplied by RW1 becomes RE21, and RE2 multiplied by RW2 becomes RE22. As a result, four additional variables were created.

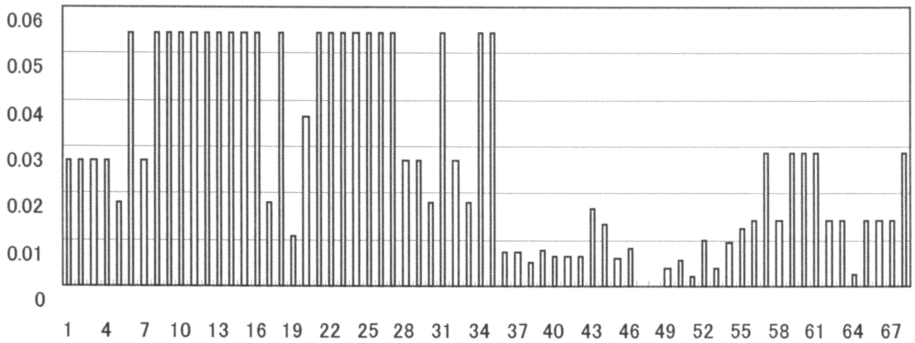
An example is shown in Figure 7, in which RW1 data, a weight for a broad categorization of regulations, is multiplied by the previously prepared RE1 data upon relaxation of regulations. Comparing this with Figure 4 we see that the values for non-manufacturing industries become smaller when we consider the regulation weight.

4.　Outline of Empirical Model and Results

4.1　Outline of Empirical Model

Analyses of productivity, whether microeconomics or macroeconomics, are traditionally one of the main themes in economics, and there are various methods for conducting these analyses. Essentially, the problem of measuring productivity value itself is important, although we did not examine this closely in our analysis. Rather, on the premise of this productivity value, we focused on the effects of the determining factors for productivity and factors other than labor and capital.

Figure 7. Regulation (RE11)



In this empirical model, TFP growth rates are independent variables. As a determinant for the TFP growth rate, IT capital stock is used in this model. IT capital stock is also representative of the effects of the IT revolution of recent years, and is thought to contribute to the efficiency and expansion of industrial activities. Next, knowledge stock was used. The importance of this stock has often been pointed out in several previous studies. Advances in research and development are thought to contribute to reductions in cost and expansion of demand. To control the characteristics of each industry, we also included the capital-labor ratio and size of the industry (Odagiri and Iwata (1986)) as explanatory variables. Several types of regulation indices mentioned above are used for our investigation on the effects of regulations.

Empirical Model

$TFPD = a_0 + a_1\ REGULATION + a_2\ RDY + a_3\ ITY + a_4\ LK + a_5\ S + a_6\ TT$

Where,

TFPD ; TFP Growth rates. These are divided into the following four categories:

TFPDA ; TFP Growth rates (baseline case)

TFPDB ; TFP Growth rates (without consideration of improvement of quality of labor)

TFPDC ; TFP Growth rates (capacity utilization rate adjusted using information of intermediate inputs)

TFPDD ; TFP Growth rates (capacity utilization rate adjusted using information of production indices)

REGULATION ; Indices of regulations. These are divided into the following eight categories:

RE1 ; number of regulations was simply counted with no prior information

RE2 ; number of regulations, but those regulations thought to have little importance were

not considered
RW1 ; inverse number of regulation weight (broadly categorized)
RW2 ; inverse number of regulation weight (narrowly categorized)
RE11 ; RE1 × RW1
RE12 : RE1 × RW2
RE21 ; RE1 × RW1
RE22 ; RE1 × RW2
RDY ; ratio of knowledge stock to value added
ITY ; ratio of IT capital stock to value added
LK ; capital labor ratio
SI ; size of industry (log value of value added)
TT ; time trend

The period in which the estimates were taken is 1975-1998 for the model using RE1 and RE2, and the 3 years of 1985, 1990 and 1995 for the other regulatory indicators.

4. 2　Results of Estimation

The results of the estimations are shown in Table 1. Here, the variables for regulations are the results for RE1 and RE2. First, we will look at the results for the TFP growth rate in the baseline case. The t-values for the parameters for regulations are significant at the 5% level for RE1 and RE2. In the model using RE1, the t-values for the parameters for IT are also significant. In the model using RE1 and RE2, the parameter for industry size is significant. Second, in the results for TFP growth rate in the case that does not consider quality of labor, the parameter for RE1 and RE2 are significant. Similarly, the parameter for IT is significant with the formula using RE1.　The parameter for time trends is also significant.　In the formula using RE2, the parameter for time trends are significant. Third, the results for the growth rate of TFP with capacity utilization rate adjusted on an intermediary goods base were examined.　All variables related to regulations are significant. Similar to the formula using RE1, the parameter for IT capital and industry size are significant. In the model using RE2, the parameters for industry size are significant. Finally, we investigated the results for growth rate of TFP in which the capacity utilization rate was adjusted on a production index base. In this case the results of the estimation are nearly the same as those of the model using the TFP growth rate in which the capacity utilization rate was adjusted on an intermediary goods base.　The reason is that there was not a large difference in the TFP growth rates in both cases.

All the estimation results were derived from the error component model.　From the estimation results overall, significant negative coefficients are obtained for the parameters related to regulations in nearly all the models.　Thus we can conclude that regulations have a robust negative effect on TFP growth rates.　This implies that, as deregulation advances the TFP growth rate will increase.

Table 1. Estimation of TFP Equation (I)

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RE1	0.013845	2.02985	0.013415	1.95612	0.014098	2.05067	0.013766	2.06901
RDY	-2.69E-03	-0.207987	-2.00E-03	-0.154339	-2.06E-03	-0.157335	1.37E-03	0.108606
ITY	0.054293	2.39206	0.048976	2.14696	0.056619	2.47171	0.054661	2.46602
LK	1.83E-05	0.125859	-1.25E-05	-0.08588	6.24E-06	0.042364	1.13E-05	0.079066
SI	2.91E-03	1.70325	2.72E-03	1.57928	2.85E-03	1.65186	2.89E-03	1.72717
TT	-4.00E-04	-1.37625	-4.85E-04	-1.67361	-2.87E-04	-0.961491	-3.47E-04	-1.20462
C	5.79E-03	0.229173	0.017177	0.680094	-3.93E-03	-0.151287	1.47E-03	0.058723

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RE2	0.018596	2.5067	0.017695	2.3662	0.022769	2.22855	0.022319	2.26108
RDY	-1.03E-03	-0.080634	-5.06E-04	-0.03936	-0.020109	-1.22716	-0.015058	-0.951435
ITY	0.027927	1.18168	0.023775	0.998424	0.018922	0.594435	0.018141	0.589914
LK	3.62E-05	0.250552	3.52E-06	0.024226	1.93E-04	1.05133	1.95E-04	1.09943
SI	2.78E-03	1.66765	2.57E-03	1.53395	3.88E-03	1.7055	3.96E-03	1.80122
TT	-4.10E-04	-1.41528	-4.94E-04	-1.70605	-3.16E-04	-1.04893	-3.83E-04	-1.31754
C	3.77E-03	0.149059	0.015368	0.608785	-0.013888	-0.520957	-8.19E-03	-0.318325

Other variables are significant only in the model using RE1 for IT capital, so no solid conclusion can be reached as to whether there is an effect on the TFP growth rate. Similarly, although industry size had an effect on the TFP growth rate, no definite conclusion can yet be reached. For knowledge capital, no significant parameters at all are obtained. Effects are thought to be particularly large in the manufacturing industry in the previous studies, but empirically our results do not support such an effect. One of the reasons that no significant effects of IT or knowledge capital are seen is that, when calculating the TFP growth rate, considerations were already made for the contribution of input related to IT capital and R&D. As a result, only the effect of excess earning is measured.

Next, let us look at the results using RW1 and RW2 as variables for regulations. The results of estimates are listed in Table 2. First, we investigated the results for the growth rate of TFP in the baseline case. The parameters related to regulations are statistically significant at a level of 10%. None of the parameters for other variables are significant. Second, the results for TFP growth rate in the case when quality of labor was not considered were the same as the results for the TFP growth rate in the baseline case. Only the variables for regulations are significant. Third, we investigated the results for the growth rate of TFP when the capacity utilization was adjusted on an intermediary goods base. The results in this case as well are nearly the same as those for the TFP growth rate in the baseline case.

All variables related to regulations were significant.　Finally, we looked at the results for the growth rate of TFP when the capacity utilization rate was adjusted on a production index base. In this case, RW1 is significant at the level of 10%. However, RW2 is not significant. RW1 is significant in all cases of TFP growth rate.　RW2 is not significant in the case of the growth rate for TFP with capacity utilization rate adjusted on a production index base. These estimation results are not significant for any variables other than regulations.　A fixed effect model was adopted for all estimation results.

Table. 2　Estimation of TFP Equation (II)

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RW1	7.19382	1.8491	7.4465	1.91217	7.35483	1.86469	7.1927	1.85279
RDY	-0.042819	-0.300241	-0.042263	-0.296053	-0.083673	-0.578694	-0.01415	-0.099432
ITY	-0.24118	-0.486985	-0.241609	-0.487371	-0.236775	-0.471567	-0.245336	-0.496442
LK	7.50E-04	0.525418	7.74E-04	0.54132	1.60E-04	0.110213	6.10E-04	0.428096
SI	-1.34E-04	-3.16E-03	6.35E-04	0.014922	-6.64E-03	-0.154044	-3.87E-03	-0.091366
TT	-4.14E-03	-1.6313	-4.39E-03	-1.72428	-4.14E-03	-1.60657	-4.33E-03	-1.70919

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RW2	1.7417	2.02607	1.74354	2.02401	3.06319	3.45875	1.24341	1.4499
RDY	-0.048023	-0.335385	-0.047494	-0.331003	-0.113049	-0.766354	-0.019643	-0.137514
ITY	0.140757	0.30322	0.152398	0.327616	0.177772	0.371717	0.124761	0.269406
LK	8.40E-04	0.625271	8.66E-04	0.642741	8.83E-04	0.637924	7.35E-04	0.548178
SI	-0.022519	-0.540692	-0.022456	-0.538052	-0.032339	-0.753685	-0.025685	-0.618198
TT	-1.57E-03	-0.733167	-1.72E-03	-0.801809	-1.57E-03	-0.71168	-1.76E-03	-0.826543

Finally, let us look at the results using RE11, RE12, RE21, RE22 as the variables for regulations. The estimation results are listed in Table 3.　Here we shall first examine the results for the TFP growth rate in the baseline case.　Parameters related to regulations were statistically significant at the 10% level for RE11, RE12, and RE22. RE21 is significant at the 5% level.　No significant parameters are obtained for other variables with the exception of time trends in the estimation formula applying RE21. The results for the growth rate of TFP in the case of not considering labor quality, and the results when capacity utilization rate was adjusted on an intermediate goods base, are the same as the results for TFP growth rate in the baseline case.　Finally, let us look at the results for growth rate of TFP when capacity utilization rate is adjusted on a production index base.　In this case the estimation results for RE11 are significant at 10% and those for RE21 at 5%, but no significant results are obtained for the regulation variables of RE12 and RE22.　A fixed effect model was adopted for all estimation results.

Table 3. Estimation of TFP Equation (III)

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RE11	8.16717	1.78373	8.08185	1.7612	8.07064	1.7371	8.28446	1.8139
RDY	-0.030982	-0.217222	-0.030056	-0.210263	-0.071605	-0.494762	-2.30E-03	-0.016168
ITY	-0.183233	-0.37659	-0.168526	-0.345599	-0.1677	-0.33967	-0.191571	-0.394717
LK	7.64E-04	0.534051	7.74E-04	0.540147	1.63E-04	0.112643	6.28E-04	0.440117
SI	-2.74E-03	-0.064898	-2.83E-03	-0.066788	-9.88E-03	-0.230243	-6.24E-03	-0.147967
TT	-4.23E-03	-1.62719	-4.35E-03	-1.66997	-4.13E-03	-1.56697	-4.46E-03	-1.71913

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RE12	3.35756	1.75898	3.35052	1.75154	6.7178	3.42319	2.28932	1.20374
RDY	-0.055852	-0.399028	-0.054606	-0.389291	-0.119278	-0.828877	-0.029543	-0.211836
ITY	0.19548	0.42137	0.205921	0.442928	0.272014	0.570322	0.16925	0.366166
LK	1.17E-03	1.37543	1.17E-03	1.37407	1.17E-03	1.34011	1.12E-03	1.3232
SI	-0.024194	-0.581167	-0.024164	-0.579204	-0.037363	-0.872983	-0.02637	-0.635758
TT	-1.96E-03	-0.957892	-2.10E-03	-1.02244	-2.07E-03	-0.982363	-2.14E-03	-1.0463

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RE21	10.0607	2.4415	10.0498	2.43387	10.0159	2.39489	10.118	2.46146
RDY	-0.020253	-0.143433	-0.019329	-0.136612	-0.060916	-0.425074	8.48E-03	0.060217
ITY	-0.306034	-0.631885	-0.293883	-0.60556	-0.292073	-0.594188	-0.312578	-0.64699
LK	8.53E-04	0.603127	8.66E-04	0.611145	2.55E-04	0.17728	7.15E-04	0.506808
SI	6.91E-04	0.016617	7.58E-04	0.018188	-6.33E-03	-0.149964	-2.93E-03	-0.070593
TT	-5.46E-03	-2.06862	-5.60E-03	-2.11912	-5.37E-03	-2.00748	-5.67E-03	-2.15404

dependent variable	TFPDA		TFPDB		TFPDC		TFPDD	
	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value	Coeff.	t-Value
RE22	3.35562	1.76628	3.34859	1.75881	6.6869	3.42323	2.30276	1.21655
RDY	-0.056371	-0.402687	-0.055123	-0.392934	-0.120042	-0.834011	-0.030045	-0.215421
ITY	0.209751	0.451246	0.220162	0.472631	0.299709	0.627097	0.179449	0.387479
LK	1.17E-03	1.37841	1.17E-03	1.37705	1.17E-03	1.33455	1.13E-03	1.33102
SI	-0.024414	-0.586416	-0.024383	-0.58443	-0.037769	-0.882336	-0.026538	-0.639795
TT	-1.95E-03	-0.951948	-2.09E-03	-1.01657	-2.04E-03	-0.968333	-2.13E-03	-1.04352

5. Conclusion

This study was an empirical analysis of productivity and regulations. Several variables were applied to regulations, and statistically significant results were obtained for nearly all of them. Thus, the TFP growth rate should be expected to rise as deregulation advances.

The data on regulations used in this analysis will require further improvements. Hence, enhancing data related to regulations remains an issue for the future. Moreover, in this analysis the TFP growth rate used items that had previously been calculated, but the method of measuring TFP growth rate will need to be further refined. Good results were not obtained for IT and knowledge stocks. Refinements will also be necessary, therefore, in the way the model is constructed in the future.

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Notes

1） This is a substantially revised version of Nakanishi and Inui (2003).

2） For example, Hayashi, (2003), Fukao et al. (2003), Cabinet Office (2001, 2002).

3） In the distribution industry, output is taken to be the difference in value between the purchase and sale of goods. In other words, it is assumed that production increases are understood from the value of goods sold. Therefore, even if improvements are made in the convenience of consumption in terms of time, location, or other factors, there is no change in output. For a more detailed discussion, see McLachlan, Clark and Monday (2002). Nishimura (1996) gives a detailed discussion at the problems in Japanese distribution industry statistics.

4） For details regarding this problem, see Section 1 of supplemental discussion in Fukao et al. (2003).

5） Baily (1993) used an output index using the number of services provided in this way to compare productivity in American, European, and Japanese service industries.

6） The total number of industries here is 68. Communications, transport, utilities, etc. are usually classified in the service industry, but in this paper they are classified as manufacturing industries.

7） Here, the capacity utilization rate is not adjusted in the calculation of the TFP growth rate. In the JIP database, the growth rate for capacity utilization rate-adjusted TFP is calculated separately.The TFP used here is not from a value added base but rather from an output base. This is for explicit consideration of the effects of intermediate input. For details on the method of calculating the TFP growth rate, see Chapter 6 of Fukao et al. (2003).

8） This is taken to be the baseline case for the TFP growth rate in Fukao et al (2003).

9） The data here for IT capital stock were prepared using the JIP database, and includes copiers and other office equipment, computers and peripherals, communications equipment, cameras and other optic equipment, scientific equipment, analyzers, testing machines, measuring apparatuses and instruments, and medical equipment.

10） See Fukao et al. (2003) for details on method of constructing knowledge stock.

11） The White Paper on Deregulation Initiative (2000).

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Appendix Industry Code

1	Livestock products
2	Processed marine products
3	Rice polishing, flour milling
4	Other foods
5	Beverages
6	Tobacco
7	Silk
8	Spinning
9	Fabrics and other textile products
10	Apparel and accessories
11	Lumber and wood products
12	Furniture
13	Pulp, paper, paper products
14	Publishing and printing
15	Leather and leather products
16	Rubber products
17	Basic chemicals
18	Chemical fibers
19	Other chemicals
20	Petroleum products
21	Coal products
22	Stone, clay & glass products
23	Steel manufacturing
24	Other steel
25	Non-ferrous metals
26	Metal products
27	General machinery equipment
28	Electrical machinery
29	Equipment and supplies for household use
30	Other electrical machinery
31	Motor vehicles
32	Ships
33	Other transportation equipment
34	Precision machinery & equipment
35	Other manufacturing
36	Construction
37	Civil engineering
38	Electricity
39	Gas, heat supply
40	Waterworks
41	Water supply for industrial use
42	Waste disposal
43	Wholesale
44	Retail
45	Finance
46	Insurance
47	Real estate
48	Housing
49	Railway
50	Road transportation
51	Water transportation
52	Air transportation
53	Other transportation, packing
54	Telegraph, telephone
55	Mail
56	Education (private, nonprofit)
57	Research
58	Medical, hygiene (private)
59	Other public services
60	Advertising
61	Rental of office equipment and goods
62	Other services for businesses
63	Entertainment
64	Broadcasting
65	Restaurants
66	Inns
67	Laundry, hair-cutting, public bath
68	Other services for individuals