EMPIRICAL STUDY ON ASYMMETRIC COST BEHAVIOR: ANALYSIS OF THE STICKY COSTS OF LOCAL PUBLIC ENTERPRISES

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ABSTRACT

This research focused on public sector organizations, especially local public enterprises, and verified their sticky costs using panel data analysis. The results show, contrary to the research hypotheses, that anti-sticky costs are present in local public enterprises. We thought that the impact of the water supply business that accounts for about 60% of the sample was high. Then, we further analyzed the sample data by excluding them, and the result nevertheless indicated the presence of sticky costs. Based on these results, it became clear that in local public enterprises, the degree of sticky costs varies depending on the type of industry. It is suggested that the differences for sticky costs may be affected from not only the differences in the business environment but also in the differences in the cost structure for each type of industry, and the differences in legal regulations, market share rates and pricing methods.

Keywords: asymmetric cost behavior, public sector organizations, local public enterprises, sticky costs, anti-sticky, panel data analysis

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INTRODUCTION

In order to perform management smoothly, it is very important to understand cost behavior. Cost behavior is a theme that has been attracting attention from both the academic and business practices, and it may be said that the grasp of cost behavior is an important research theme in management accounting today.

In traditional cost-behavior research, we tried to grasp cost behavior using the production and working hours in relation to business volume which is the activity amount of the enterprise to break it down into a cost element such as fixed costs and variable costs. In the process, the cost has been linear and proportional to changes in the relevant range, and in direct costing; it has been assumed that the change in cost was proportional.

Many later studies, including Noreen and Soderstrom (1997) and Anderson et al. (2003), have brought attention and made it clear that in sticky costs, the cost does not decrease at the time the sales amount decreases symmetrically; whereas the cost was empirically observed to increase at the time the sales amount increases symmetrically. Anderson et al. (2003) have verified sticky costs using the models that were used to describe the sales of the rate of change that was a proxy for activity variables, the explanatory variables, and selling, general and administrative expenses of the rate of change that was a proxy for cost variables the dependent variable, by published financial data. In Figure 1, with respect to the normal t-1 phase of the slope, from t-1 period to t period it should change proportionately and linearly, but the sticky costs make a smaller slope than the slope towards the period.

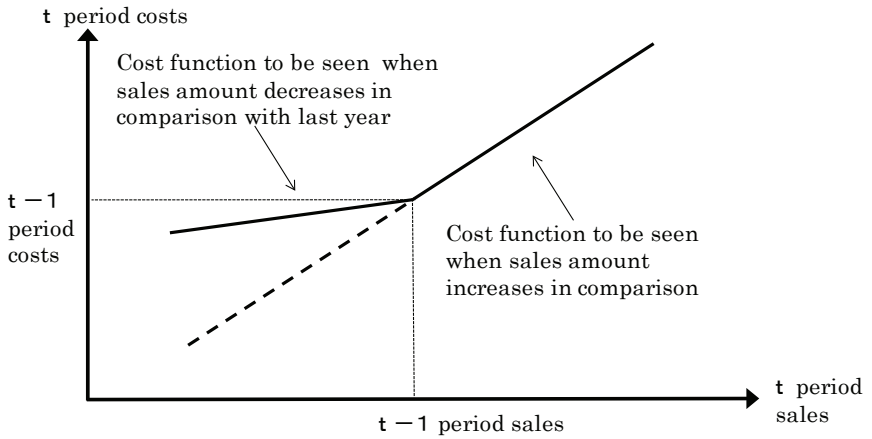

Figure 1: Arranged with Reference to Yasukata (2012)

After Anderson et al. (2003), researchers have attempted to make additional verifications on the basis of cost data in an organization. Subramaniam and Weidenmier (2003) verified sticky costs from the scales of the properties of the business environment and tangible fixed assets, and the aspects that the capacity utilization of those properties is furthermore different between industries.

Hirai and Shiiba (2006) verified whether sticky costs were observed in Japanese firms based on the hypothesis that the cost behavior varied in the country depending on the analytic model of Anderson et al. (2003). As a result of the analysis, they clarified that sticky costs were indeed observed in Japanese firms.

Yasukata et al. (2011) paid, to attention to nonprofit organizations like the National Hospital Organization. As a result of the analysis, they clarified that the secured profit was attained by a positive reduction in materials costs in the decrease phase of medical revenue while sticky costs were seen in expenditure on salary.

Holzhacker et al. (2015) were from the viewpoint of the profit centred corporation, the nonprofit organization, and public sector organizations. They clarified that the reaction of private hospitals to the cancellation of sticky costs was smaller and larger in the decrease phase of earnings, and

in the phase of deterioration of earnings due to the consultation fee control policy.

Most of these prior studies focused on commercial companies, because the structure of the financial statements is different from public sector organizations and as such they have been excluded as research subjects.

In addition to the origin of sticky costs, two opinions - the deliberate managerial decision view and the high adjustment costs view are being carefully examined now. In the deliberate managerial decision view, management results determine the economical possibility that the cost becomes sticky. In other words, if the management has determined that the future economic recovery closes, it maintains the excess capacity.

In the high adjustment costs view, the possibility that an action to reduce activity cost and manage the capacity cost of the manager, in comparison with a decrease in sales amount does not match up with what is being pointed out. In addition, it is thought that sticky costs may be present because the committed capacity cost, caused by past decision making, continues occurring even at the time of a decrease in the sales amount.

In this study, we pay attention to local public enterprises which make financial statements based on business accounting and are available for comparison with the commercial companies based on indications as suggested in Kama and Weiss (2013).We analyze the characteristics and compare with prior studies to detect if sticky costs are present in public sector organizations.

CHARACTERISTICS OF PUBLIC SECTOR ORGANIZATIONS

Current Situations and Issues Surrounding Public Sector Organizations

Today, there are problems such as aging, low birth rate, decline of the workforce and population, and regional economic decline and fiscal inflexibility(1). To supply administrative services in a more stable and

efficient manner continuously, we have to examine efficiency and cost performance, and be conscious of fiscal soundness.

On the other hand, it is difficult to indicate the appropriate level of the quality and quantity of administrative services and the cost of its service objectively. From the viewpoint of cost management, effective administrative services and cost control is required in the public sector organizations in future.

Public sector organizations are currently promoted by the efforts of the compact city wishing to make a further reduction of administrative costs by consolidation of city functions through the integration such as public facilities, and further promoting the efficiency of administrative services. Effort to advance the future of the compact city is required to promote cost management in order to understand cost behavior of public sector organizations.

Institutional Theory Features of Public Sector Organizations

Local public enterprises in public sector organizations

Local public enterprises deal with water supply, industrial water supply, orbit, car transportation, railroad, electricity, gas and hospital business, etc. according to local public enterprise law and cover a wide range of public services. Local public enterprises are leading figures in offering public services (public in nature) and expected to exert economic rationality by incorporating business accounting in its operations (economic efficiency).. In this way, local public enterprises have the mission practice sustainable management and cost optimization by improving economic efficiency and the pursuit of reasonable profits that focusses on profitability. In this regard, this is different in characteristics from pure public service to cover tax.

Local public enterprises in comparison with commercial enterprises

Commercial enterprises are required to earn from the perspective of maximization of profit. However, the continuity of stable business activity is required for local public enterprises, not only in economic terms but also from the viewpoint of improving the welfare of the residents. For this reason, local public enterprises would be subjected to institutional constraints from a variety of stakeholders. We have organized the characteristics as follows:

The first of the features is that a low-profit level is allowed while maintaining a balance between the various stakeholders. It is more important for managers to decide on evading a loss due to management failure than to earn much profit. Furthermore, from the point of view to ensure the continuity of their business which is public in nature, the managers of local public enterprises have to acquire permission from councilors in their low-profit making decisions.

The second feature is, unlike the commercial companies, local public enterprises have to submit a balance sheet and budget to the chiefs who are usually mayors or governors and congress, and there is a need to obtain the approval from them. It means that local public enterprises do not assume limited liability for the maintenance of their business, while also acknowledging the management of independence. So local governments are responsible for maintain the business in the end. Therefore, we can see that some businesses have continued even if they are deficit operations.

RESEARCH HYPOTHESES

In this study, we focused on the public sector organizations that have not been analyzed enough up to now, especially local public enterprises, and we set the following research hypotheses. Most of the empirical studies concerning cost behavior targeted commercial companies, and the existence of sticky costs is verified from the differences in organizational property, capacity, and utilization. First of all, based on prior studies, we think that we should verify whether sticky costs are also present in local public enterprises.

H_1: The sticky costs exist in local public enterprises.

It has been pointed out that in public sector organizations including local public enterprises, financial inflexibility such as mandatory spending like the national debt service expenditure, public bonds and the labor costs, and the ratios of the existing expenditure increases compared to general finances,. Also, it is thought that the declining degree of freedom of the budget makes sticky costs become stronger compared to commercial companies (Anderson et al., 2003).

Moreover, local public enterprises have organizational behavioral traits on both sides of the economy and publicity; and this feature is different from commercial companies that attempt at the maximization of profit. Basing on this feature, we think that there is a difference in decision making concerning the business manager's cost adjustment. Holzhacker et al.(2015) have clarified that cost behavior of public sector organizations was verified from the aspect of the institution theory and economics, and sticky costs appeared to be strong compared to commercial companies(2).

In addition, public sector organizations put a lot of regulatory costs by the adjustment of the budget because they are under government guarantee for funding of financial affairs and the risk is on the management. There is little necessity to consider the distribution of residual income, and the pursuit of profit is not the first objective of public sector organizations. Therefore we hypothesis that:

H_2: Sticky costs in local public enterprises are stronger than in commercial companies.

Anderson et al. (2003) analysed how sticky costs change in two or more years. When sticky cost is found in public sector organizations, it should be examined how it changes after two or more years especially, because the purpose of local public enterprises is not only about publicity but also economic. Public sector enterprises have a distinct feature compared to commercial companies which give priority only to the maximization of profit. In other words, because it is necessary to carry on with an operation from a public interest viewpoint, even if they cannot make a profit, it is believed that sticky costs are not cancelled or decreased even in the mid/long term compared to commercial companies. Therefore we hypothesise that:

H_3: Sticky costs are not cancelled or decreased in public sector organizations in the two, three or four years.

The type of business varies, such as, the water supply, waterworks for industrial use, the orbit, public car transportation, railway, electricity, gas, hospital, drainage, market, the tolled roads , and parking lot maintenance, etc. which is decided in the Local Public Enterprise Law and Municipality Ordinance. As Subramaniam and Weidenmier (2003) pointed out, since

the business environment is different according to the type of business and industry. The size and the capacity of the tangible fixed asset, and the inventory, is different, it is believed that cost behavior is also different. Therefore we hypothesise that:

H_4: Since the business environment in public sector enterprises is different in each type of business, the level of sticky costs is also different depending on the type of business.

ANALYSIS METHODS

Analysis Model

Prior research on commercial companies have largely depended on the Anderson et al. (2003) analytic model. Accounting in public sector organizations, selling general and administrative costs are not legal descriptions while sales corresponds to the revenue from operations. Therefore, in this study, we used the operating expense in which cost of goods sold and selling general and administrative costs are added up instead of only using selling general and administrative costs.

In Subramaniam and Weidenmier (2003), empirically verified cost behavior by using not only the selling general and administrative costs but also the cost of goods sold. Sticky costs were verified by many researches afterwards using operating expense (Günther et al. 2014).

Then we verified whether sticky costs exist in the public sector organizations in hypothesis 1 using the following analytic models used by Anderson et al. (2003).

$$\log\left[\frac{Cost_{i,t}}{Cost_{i,t-1}}\right] = \beta_0 + \beta_1 * \log\left[\frac{\mathrm{Re}venue_{i,t}}{\mathrm{Re}venue_{i,t-1}}\right] + \beta_2 * Decrease\_Dummy_{i,t} * \log\left[\frac{\mathrm{Re}venue_{i,t}}{\mathrm{Re}venue_{i,t-1}}\right] + \varepsilon_{i,t} \quad (5-1)$$

Here,

Cost: the operating expense, Revenue: the operating revenue, Decrease_Dummy: the dummy variable that if the operating revenue decreases from t-1 at t period, 1 is taken in other cases, 0 is taken, log: Naturalized logarithm.

In hypothesis 2, we verify whether sticky costs appears more strongly in public sector organizations than in commercial companies from the sticky costs point of view.

In hypothesis 3, to verify the cost behavior for two or more years, we performed the analysis tabulated for each section using the formula (5-1) of Anderson et al. (2003), and we also performed the analysis using the formula (5-2) of Anderson et al. (2003).

$$\log\left[\frac{Cost_{i,t}}{Cost_{i,t-1}}\right] = \beta_0 + \beta_1 * \log\left[\frac{\mathrm{Re}venue_{i,t}}{\mathrm{Re}venue_{i,t-1}}\right] + \beta_2 * Decrease\_Dummy_{i,t} * \log\left[\frac{\mathrm{Re}venue_{i,t}}{\mathrm{Re}venue_{i,t-1}}\right]$$

$$+ \beta_3 * \log\left[\frac{\mathrm{Re}venue_{i,t-1}}{\mathrm{Re}venue_{i,t-2}}\right] + \beta_4 * Decrease\_Dummy_{i,t-1} * \log\left[\frac{\mathrm{Re}venue_{i,t-1}}{\mathrm{Re}venue_{i,t-2}}\right] + \varepsilon_{i,t} \quad (5-2)$$

Here,

Cost: the operating expense, Revenue: the operating revenue, Decrease_Dummy: the dummy variable that if the operating revenue decreases from t-1(t-2) at t (t-1) period, 1 is taken in other cases, 0 is taken, log: Naturalized logarithm.

If sticky costs continue in the long term, the operating expense is asymmetric for the change of revenue from operations before one term indicated by the expression (5-2),and it is sure to become a value which is not only β2 but also β4 is smaller than 0.

In hypothesis 4, we analyzed the local public enterprises by industries using the formula (5-1).

DATA AND SAMPLE SELECTION

Analysis Period Covered

In this study, we tried to analyze using the financial data of local public enterprises. Furthermore, for comparison with the Anderson et al. (2003) and Hirai and Shiiba (2006) we also used the same period; from 1979 to 1998. There is no bias in the difference in the method of accounting treatment because the review concerning the financial accounting processing, according to the Local Public Enterprise Law revision, was not amended until 2012 after it was initially amended in 1966.

Sample Data

In this study, we performed an analysis centered on a business subject in the application of the Local Public Enterprise Law. We used the data in the income statement for each business found in the "Local Public Enterprises Yearbook". The number of businesses implementing the Local Public Enterprise Law was 2,854 s (57,080 samples) by ten types of business. It was received continuously for 20 years from the fiscal year 1979 to 1998. The 66 businesses (1,320 samples) that did not actually begin and when revenue from operations has not been generated were excluded from the analysis. In addition, the municipal mergers were carried out during the period of analysis in the 19 businesses (380 samples). These were excluded from our analysis since there is a doubt regarding the consistency of business, so we could avoid the bias.

Though the deficit businesses were uniformly excluded and were done in the analysis of Anderson et al.(2003) etc., many settlement of accounts of local public enterprises were in deficit; expenditures were greater than revenue, which is responsible for the necessity of public utilities to engage in social life, such as lifelines and infrastructure in many cases. Therefore, in this study, we excluded only about 373 businesses (7,460 samples) that lacked the balance in all the surveyed period for 20 years. Finally, the analysis object became 47,920 samples in 10 types of businesses and 2,396 businesses with a data of 20 years from 1979 to 1998 (Table 1).

Table 1: Number of Samples and Exclusion Number Passage Table

	Observation (Firm Years) Deleted (and the number of firms)	Observation (Firm Years) Remaining (and the number of firms)
Beginning raw sample data (1979-1998)	– –	57,080 (2,854)
1. Delete observation that are operating revenues = 0 yen because of business preparations	1,320 (66)	55,760 (2,788)
2. Delete observations that aren't securing business continuity because of municipal merger	380 (19)	55,380 (2,769)
3. Delete observations with operating costs > operating revenues through all 20 years	7,460 (373)	49,920 (2,396)
Final observations (Firm Years) remaining	– –	47,920 (2,396)

In addition, we excluded samples which businesses were outliers in the top and bottom 1 % respectively of Cost i, t/Cost i, t-1, and Revenue i, t/Revenue i, t-1 because there was a possibility that the unexpected value (outlier) is included in the1% in the top and 1% in the bottom. As a result, the excluded number of data became 1,036 samples, and the number of data finally analyzed became 44,488 samples (Table 2).

Table 2: Sample Data of Industrial Types after Excluded Outliers

	Sample data				Number of the outliers			Number of the samples after excluded outliers	
	Number of firms (a)	Sample size (1979-1998) (a*20)	Composition ratio	Number of samples "Cost i,t/Cost i,t-1"and "Revenue i,t/Revenue i,t-1"(excluded only 1979 year)	Revenue i,t/Revenue i,t-1	Cost i,t/Cost i,t-1	List-wise case deletion	Number of samples "Cost i,t/Cost i,t-1"and "Revenue i,t/Revenue i,t-1"	Composition ratio
Water supply	1,625	32,500	67.82%	30,875	431	523	761	30,114	67.69%
Industrial water supply	128	2,560	5.34%	2,432	78	83	118	2,314	5.20%
Transportation	36	720	1.50%	684	4	8	10	674	1.52%
Electric power	32	640	1.34%	608	4	1	4	604	1.36%
Gas power	66	1,320	2.75%	1,254	9	6	13	1,241	2.79%
Hospital	467	9,340	19.49%	8,873	75	53	90	8,783	19.74%
Sewerage	24	480	1.00%	456	16	5	19	437	0.98%
Wholesale Market	8	160	0.33%	152	0	0	0	152	0.34%
Toll Road	4	80	0.17%	76	4	7	7	69	0.16%
car parking	6	120	0.25%	114	6	13	14	100	0.22%
Total	2,396	47,920	100.00%	45,524	627	699	1,036	44,488	100.00%

ANALYSIS RESULT

Descriptive Statistics

First of all, the water supply business comprised of 1,625 business samples (about 67%). Then, 9,340 samples (approximately 19%) were in the hospital business, 548 businesses, industrial water supply is 128 business 2,560 samples (approximately 5%), gas business 66 business 1,320 samples (about 2%).

Next, in our sample, especially in the value of the standard deviation, it was characterized that both operating expenses and the operating revenue were larger than the average value. And there were features that showed that the difference between the maximum value and the minimum value was large, and there was a big difference between the median and the mean value. In addition, the operating revenue exceeded the operating expense by the mean value and the median, when the operating revenue was compared with the operating expense. It meant that structural money-losing enterprises (loss firms) didn't exist in the sample data, because businesses in which the operating expense was more than the operating revenue for all the analysis period was excluded, based on prior studies (Table 3).

Table 3: Descriptive Statistics of Sample Data (After Excluding Outliers)

(Scale: 1,000 yen)

	Mean	Standard Deviation	Minimum	Lower quartile
Revenue (Operating revenues)	1,825,251	10,019,753	2,809	171,564
Cost (Operating costs)	1,559,054	7,326,136	2,222	136,560
In Revenue t/Revenue t-1	0.0470	0.0812	-0.2877	0.0007
In Cost t/Cost t-1	0.0478	0.0801	-0.2840	0.0044

	Median	Upper quartile	Maximum	Number of firm years
Revenue (Operating revenues)	407,769	1,249,357	355,330,535	44,488
Cost (Operating costs)	338,988	1,116,223	295,467,927	44,488
In Revenue t/Revenue t-1	0.0323	0.0773	0.3930	44,488
In Cost t/Cost t-1	0.0421	0.0858	0.3876	44,488

Type of industries	Mean			Standard deviation	
	Revenue (Operating revenues)	Cost (Operating costs)	Revenue–Cost	Revenue (Operating revenues)	Cost (Operating costs)
Water supply	1,227,682	981,119	246,563	8,508,912	6,712,921
Industrial water supply	758,354	583,579	174,775	1,235,284	989,192
Transportation	10,572,346	10,306,967	265, 379	25,369,008	23,115,846
Electric power	2,374,254	1,655,826	718,429	1,725,437	1,245,771
Gas power	915,302	820,444	94,858	1,182,181	1,060,343
Hospital	2,447,471	2,545,926	-98,455	2,499,614	2,592,117
Sewerage	25,279,611	15,864,157	9,415,454	58,266,300	31,924,323
Wholesale Market	1,117,203	1,019,061	98,142	1,591,534	1,474,367
Toll Road	760,845	594,971	165,873	494,389	295,988
Car parking	151,833	87,190	64,643	151,932	78,899

Type of industries	Median		Maximum		Minimum	
	Revenue (Operating revenue)	Cost (Operating costs)	Revenue (Operating revenue)	Cost (Operating costs)	Revenue (Operating revenue)	Cost (Operating costs)
Water supply	264,890	205,639	355,330,353	295,467,927	14,850	15,419
Industrial water supply	345,957	275,226	11,326,896	8,042,787	2,809	2,956
Transportation	1,720,389	1,867,155	163,824,708	149,541,551	83,961	73,872
Electric power	2,039,012	1,405,505	9,529,287	7,869,884	158,784	106,467
Gas power	481,267	435,910	7,777,095	6,805,552	64,114	55,944
Hospital	1,494,156	1,571,137	21,032,304	20,502,866	79,612	109,442
Sewerage	3,829,400	3,232,100	340,350,591	194,333,891	82,233	121,626
Wholesale Market	520,297	500,996	6,430,996	6,885,937	101,377	70,401
Toll Road	605,286	530,918	2,127,252	1,482,174	46,833	89,087
Car parking	115,492	65,799	563,130	298,094	4,366	2,222

As shown in Table 3, the amount of operating expenses and revenues differ significantly between types of industries. The situation might be due to several factors including the scale of business and the scale of government financing for each industry. Moreover, it was also found that majority of the businesses were making surplus where sewerage industry recorded the highest. On the other hand, the hospital was the only industry making losses.

In addition, the operating cost composition ratio by types of industry was summarized in Table 4 below. As shown in the Table, operating costs covered in this study are labor cost, depreciation, material cost, power cost, repair cost, interest expenses and others.

Table 4: Comparison of Cost Composition Ratio by Industrial Classification

(%)

	Labor cost		Depreciation		Material cost		Power cost		Repair cost		Internet expense		Others	
	1979	1998	1979	1998	1979	1998	1979	1998	1979	1998	1979	1998	1979	1998
Water supply	24.2	18.7	14.0	22.0	0.0	0.0	5.6	3.5	4.7	7.2	25.5	19.2	26.0	29.4
Industrial water supply	19.1	16.9	18.5	28.1	0.0	0.0	9.8	5.9	4.6	5.3	26.8	23.1	21.3	20.7
Transportation	55.2	42.9	9.5	19.0	0.0	0.0	4.3	2.7	2.8	4.4	21.4	20.6	6.8	10.4
Electric power	36.3	31.6	19.9	21.0	0.0	0.0	0.0	0.0	5.6	10.2	25.2	15.4	13.0	21.8
Gas power	17.5	16.5	11.6	21.3	46.4	31.4	0.0	0.0	4.6	5.7	9.3	8.0	10.6	17.1
Hospital	51.7	47.6	4.0	5.5	25.7	26.6	0.0	0.0	0.9	0.8	3.9	3.3	13.8	16.2
Sewerage	13.5	9.9	16.9	28.4	0.0	0.0	5.1	2.9	2.3	3.9	47.1	40.1	15.2	14.8
Total industries average	36.0	31.6	9.6	15.3	0.0	0.0	3.0	1.8	2.7	3.7	17.9	15.4	30.8	32.2

In Electric power, Gas power and Hospital industries, Power cost is categorized as Others.

Verification Results of the Sticky Costs in the Public Sector Organizations

As shown in Table 5 below, the analysis results were significant at 1%, thus the effectiveness of the model was confirmed. Further, in this study we used panel data analysis, and performed Hausman test, it was revealed that the fixed effects model was suitable (Table 5).

In hypothesis 1, to verify whether the sticky costs exist in the public sector organizations, we tried to analyze referring to the analytic model of Anderson et al. (2003). In our analytic model, we have converted each the relative change from last year of the operating expense (explained variable) and the operating revenue (explanatory variable) into the naturalized logarithm. β1 is equal to the increasing ratio of the operating expense when the ratio of operating revenue from the previous year increased by 1%. And, when the ratio of the operating revenue is decreased by 1%, the estimate becomes the value in which β1 and β2 are added together. In this case, if the sticky costs are confirmed, it becomes $\beta 2<0$ and $\beta 1>\beta 1+\beta 2$, and it means the rate of change of the operating expense becomes asymmetrical at the increase and the decrease of the operating revenue ratio.

Table 5: Verification Results of Model (5-1)

	Predicted sign	Pooled		Fixed-effect		Random-effect	
β_0		0.030	***	0.0317	***	0.0301	***
		65.41		66.18		64.73	***
β_1	+	0.4333	***	0.4081	***	0.4333	***
β_2	–	0.3035	***	0.3440	***	0.3035	***
		20.04		21.06		19.83	
Adj.R^2		0.2508		0.2350		0.2508	
N		44,488		44,488		44,488	
DW		2.1697		2.2374		2.1697	
H-Test		Stastic		degree of freedom		P-value	
		335.04		(2)		0	

upper data indicates coefficient estimates, under data indicates t-statistics, *significant at 10% level,**significant at 5% level,***significant at 1% level, Adj.R2=Adjusted R2,N=Number of Observation, DW=Durbin-Watson ratio, H-Test: Hausman Test

As a result, β2 showed a plus value that indicates sticky costs. So, anti-sticky costs that Anderson and Lanen (2007), Weiss (2010), and Banker et

al. (2014b) had reported is confirmed. Anti-sticky means a decrease in the ratio of the operating expense when the decrease of the operating revenue is higher than the increase of the ratio of the operating expense when the operating revenue is increased (Figure 2). Therefore, sticky costs are not confirmed in this analysis intended for the entire local public enterprises, and hypothesis 1 is not supported. As shown in Table 5, the fixed effect presumption was not greatly different from the estimated result of the cross section, and neither was anti-sticky costs that β2 became the plus value was confirmed. Thus we didn't need to verify research hypothesis 2 and hypothesis 3.

To verify hypothesis 4, we conducted an analysis of the cost behavior by industry from the point of view of the differences of the business environment, cost structure, and capacity. And, we verified the presence and the level of sticky costs (Table 6).

The sticky costs in which β2 took a negative value were the hospital business and electricity utilities industry. In contrast anti-sticky costs in which the β2 indicated a positive value were the water supply business, industrial water supply business, and gas business.

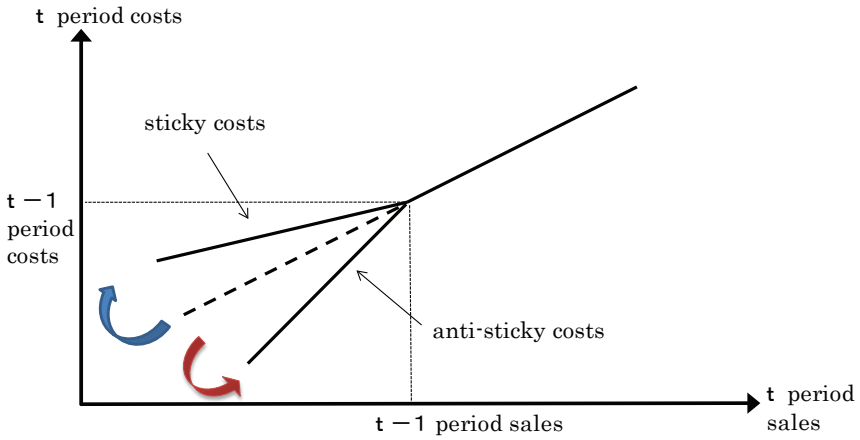

Figure 2

Here, we would like to pay attention to the contrasting results between the water supply business and the hospital business which were found in large numbers in the sample. When we confirmed the cost structure of

the local public enterprises[3], in the cost composition ratio of the hospital business, it was observed to have a lower depreciation and amortization and conversely a higher labor and material cost. On the other hand, in the cost composition ratio of the water supply business, it was observed that depreciation and amortization, repair costs and interest expenses were higher than all the average industries. Similarly, we could confirm that the hospital business was in deficit and the water supply business was conversely in surplus[4]. In this way, in addition to the difference in the business environment, a large difference can be seen in the capacity and cost structure in the water supply business and the hospital business. Further analyses were conducted in this regard.

Among the local public enterprises, especially in the water supply business, the sticky costs pointed out in prior studies showed a contradictory result. We argue for this factor as follows.

First, because the water supply business supplies high quality service and has to be stable and does the management almost exclusively, it has the flexibility of cost adjustment. We think that this factor has contributed to the presence of anti-sticky costs in the water supply business[5].

Second, because price imputation of the cost adequately reflects the management situation by adopting the summary cost method[6] in a water rate system, we think that it is in the financial structure that the sticky costs do not appear easily.

In the hospital business, sticky costs were confirmed similar to prior studies such as Holzhacker et al. (2015). We would like to point out the factors as follows. First, we think that the factors which have caused the existence of sticky costs are the fixed price in the medical treatment fee structure, and the diagnosis and treatment obligation based on law. In the hospital business, the charge for each medical service is provided by a fixed price regulation. Also, according to the diagnosis and treatment obligation based on law, it is necessary to treat the patient at any time even if patient is absent.

Table 6: Results of Model (5-1) by Industrial Classification

	Water Supply			Industrial Water Supply			Transportation		
	Pooled	Fixed	Random	Pooled	Fixed	Random	Pooled	Fixed	Random
β_0	0.0337 ***	0.0353 ***	0.0337 ***	0.0235 ***	0.0243 ***	0.0235 ***	0.0146 ***	0.0149 ***	0.0146 ***
	55.77	56.38	55.13	11.24	11.21	11.10	4.60	4.43	4.60
β_1	0.3867 ***	0.3632 ***	0.3867 ***	0.2613 ***	0.2454 ***	0.2613 ***	0.3532 ***	0.3218 ***	0.3532 ***
	63.46	56.83	62.72	8.63	7.63	8.52	6.43	5.20	6.42
β_2	0.4614 ***	0.5136 ***	0.4614 ***	0.2372 ***	0.2841 ***	0.2372 ***	0.1549	0.1465	0.1549
	23.11	23.91	22.84	3.19	3.49	3.15	1.24	1.05	1.24
Adj.R^2	0.2218	0.2035	0.2218	0.0657	0.0414	0.0657	0.1350	0.1333	0.1350
N	30,114	30,114	30,114	2,314	2,314	2,314	674	674	674
DW	2.2112	2.2762	2.2112	2.2407	2.3079	2.2407	2.0808	2.1768	2.0808
H-test	216.42	(2)	0.00	2.93	(2)	0.23	3.47	(2)	0.18

	Electric Power			Gas Power			Hospital		
	Pooled	Fixed	Random	Pooled	Fixed	Random	Pooled	Fixed	Random
β_0	0.0198 ***	0.0196 ***	0.0198 ***	0.0134 ***	0.0142 ***	0.0134 ***	0.0209 ***	0.0210 ***	0.0209 ***
	6.55	6.29	6.41	7.10	7.28	6.99	33.27	32.06	32.91
β_1	0.5750 ***	0.5733 ***	0.5750 ***	0.7250 ***	0.7118 ***	0.7250 ***	0.6298 ***	0.6233 ***	0.6298 ***
	14.04	13.42	13.75	35.24	33.28	34.68	89.54	84.13	88.57
β_2	-0.3352 **	-0.3658 **	-0.3352 *	0.3605 ***	0.3864 ***	0.3605 ***	-0.2010 ***	-0.2279 ***	-0.2010 ***
	-1.98	-2.04	-1.94	5.35	5.46	5.27	-10.52	-11.05	-10.40
Adj.R^2	0.2721	0.2413	0.2721	0.6585	0.6473	0.6585	0.5678	0.5583	0.5678
N	604	604	604	1,241	1,241	1,241	8,783	8,783	8,783
DW	2.5942	2.6207	2.5942	2.1003	2.1402	2.1003	1.7764	1.8242	1.7764
H-test	1.20	(2)	0.55	8.59	(2)	()	82.01	(2)	0.00

	Sewerage			Wholesale Market			Toll Road		
	Pooled	Fixed	Random	Pooled	Fixed	Random	Pooled	Fixed	Random
β_0	0.0399 ***	0.0414 ***	0.0403	0.0224 ***	0.0227 ***	0.0224 ***	0.0211	0.0215	0.0211
	9.87	10.16	9.15	3.71	3.64	3.63	1.17	1.17	1.15
β_1	0.3314 ***	0.3089 ***	0.3251	0.6106 ***	0.5995 ***	0.6106 ***	0.0205	0.0573	0.0205
	9.03	8.15	8.86	5.42	5.10	5.30	0.07	0.19	0.07
β_2	-0.1497	-0.1387	-0.1475	-0.4122	-0.4092	-0.4122	0.5603	0.5619	0.5603
	-0.79	-0.72	-0.78	-1.15	-1.09	-1.13	1.28	1.27	1.26
Adj.R^2	0.1671	0.1892	0.1616	0.1776	0.1410	0.1776	0.0732	0.0456	0.0732
N	437	437	437	152	152	152	69	69	69
DW	1.8240	1.9642	1.8618	2.1380	2.1416	2.1380	1.5570	1.5670	1.5570
H-test	3.66	(2)	0.16	0.33	(2)	0.85	0.83	(2)	0.66

	Car Parking		
	Pooled	Fixed	Random
β_0	0.0247	0.0240	0.0247
	1.45	1.32	1.42
β_1	0.1862	0.1731	0.1862
	0.91	0.80	0.90
β_2	-0.0274	-0.0770	-0.0274
	-0.07	-0.16	-0.06
Adj.R^2	-0.0043	-0.0424	-0.0043
N	100	100	100
DW	2.0782	2.1044	2.0782
H-test	0.68	(2)	0.71

upper data indicates coefficient estimates, under data indicates t-statistics, *: significant at 10% level, **: significant at 5% level, ***: significant at 1% level, Adj.R^2=Adjusted R^2, N=Number of Observations, DW=Durbin-Watson ratio, H-Test:Hausman Test

Speaking about the medical profession such as specialized physicians and nurses, even when the operating revenue decreases, it tends to evade salary cutting and layoff. In addition, because a severe standard has been installed in the statutory regulation to the execution of the layoff based on worker protection, we think that it is difficult to lay them off.

ADDITIONAL ANALYSIS

We thought that the main cause of the presence of anti-sticky costs is the possibility of receiving the influence of the water supply business which accounted for about 67% of all the sample data. Due to that, we excluded the sample of the water supply business, and we conducted an additional analysis to verify the hypothesis (hypothesis 4 is excluded).

Additional Analysis of Research Hypothesis 1

As a result of analyzing hypothesis 1 using the formula (5-1) based on the data (with the exception of using the water supply business sample data), β2 took a negative value not only in the cross-section analysis but also in the panel data analysis. Therefore, sticky costs were confirmed in the entire local public enterprises, except in the water supply business (Table 7). As a result, we confirmed the result which supported hypothesis 1 that sticky costs existed in all samples, except in the water supply business.

Table 7: Results of Model (5-1) Excluding Water Supply Industry

	Predicted sign	Pooled		Fixed-effect		Random-effect	
β_0		0.0211	***	0.0223	***	0.0211	***
		32.81		33.08		32.61	
β_1	+	0.5715	***	0.5461	***	0.5715	***
		75.29		67.08		74.84	
β_2	–	-0.0730	***	-0.0639	***	-0.0730	***
		-3.47		-2.80		-3.45	
Adj.R^2		0.3692		0.3615		0.3692	
N		14,374		14,374		14,374	
DW		2.0185		2.0925		2.0185	
H-Test		Stastic		degree of freedom		P-value	
		335.04		(2)		0	

upper data indicates coefficient estimates, under data indicates t-statistics, *significant at 10% level,**significant at 5% level,***significant at 1% level, Adj.R2=Adjusted R2,N=Number of Observation, DW=Durbin-Watson ratio, H-Test: Hausman Test

Additional Analysis of Research Hypothesis 2

Hypothesis 2 was verified once again from the confirmation of the sticky costs in the sample except in the water supply business (Table 8). As a result of the analysis in Anderson et al. (2003) and Hirai and Shiiba (2006), β2 shows that the sticky costs had the value of -0.14 in commercial companies in Japan and -0.19 in commercial companies in the United States. On the other hand, in our study, β2 acquired the value of -0.06. Upon retrieving the results, we observed that the value which was acquired in our study was smaller in comparison to both the analyses in prior studies. Therefore, Hypothesis 2 which assumed for the sticky costs to be stronger in local public enterprises than in commercial companies was not supported. We point out the two following points from the viewpoint of publicity.

1. In local public enterprises, especially in high public interest businesses like the water supply business and the gas business, etc., the summary cost method is adopted.

2. Because the ratio of the market monopoly is high, the businesses with high public interest are thought to be setting up the market trend and the demand forecast compared to commercial companies. The local public enterprises which occupy a high market share can predict and plan more accurately future goods and services and setting up market trends and the demand forecasts.

Table 8: Estimated Result of (5-1) and Comparison with Prior Studies

	Public enterprises		Commercial enterprises			
	Local public enterprises		Japanese enterprises		American enterprises	
β_0	0.0223	***	0.0189	***	0.0481	***
	33.08		23.64		39.88	
β_1	0.5461	***	0.6352	***	0.5459	***
	67.08		84.57		164.11	
β_2	-0.0639	***	-0.1398	***	-0.1914	***
	-2.80		-8.95		-26.14	
Adj.R^2	0.3615		0.3927		0.3663	
N	14,374		20,539		63,958	

upper data indicates coefficient estimates, under data indicates t-statistics
*significant at 10% level,**significant at 5% level,***significant at 1% level
Adj.R2=Adjusted R2,N=Number of Observations, DW=Durbin-Watson ratio,
H-Test:Hausman Test

Additional Analysis of Research Hypothesis 3

From the totaled analysis by using the formula (5-1) according to each section and the analysis of two or more years that used the formula (5-2), we verified long-term cost behavior (Table 9). Seeing the result of the cross-section analysis of Model (5-1) (results by the pooled data), a negative value was confirmed to be β2 in a total of four years in the long term. From these results, it can be said that sticky costs would be seen continuously in the long term in local public enterprises. On the other hand, when seeing the result of the cross-section analysis of Model (5-2) (results by the fixed-effect data); positive values were confirmed to be β2 and β4. So we could not verify a consistent result from long term cost behavior.

Table 9: Estimated Results by Total According to Each Period with Model (5-1) And Model (5-2) Excluding Water Supply Industry

Model (5-1)

	2 years			3 years			4 years		
	Pooled	Fixed-effect	Random-effect	Pooled	Fixed-effect	Random-effect	Pooled	Fixed-effect	Random-effect
β_0	0.0344 ***	0.0377 ***	0.0344 ***	0.0465 ***	0.0517 ***	0.0465 ***	0.0542 ***	0.0627 ***	0.0542 ***
	29.86	31.11	29.52	27.03	27.60	26.59	21.09	20.92	20.29
β_1	0.6210 ***	0.5807 ***	0.6210 ***	0.6814 ***	0.6409 ***	0.6814 ***	0.6976 ***	0.6435 ***	0.6976 ***
	74.22	62.41	73.40	78.60	63.50	77.32	61.93	44.52	59.59
β_2	-0.0200 *	-0.0086	-0.0200	-0.0173	-0.0086	-0.0173	-0.0290 *	-0.0108	-0.0290 *
	-1.66	-0.65	-1.64	-1.28	-0.56	-1.26	-1.88	-0.57	-1.81
Adj.R^2	0.4721	0.4602	0.4721	0.5726	0.5582	0.5726	0.5783	0.5444	0.5783
N	6,769	6,769	6,769	5,033	5,033	5,033	2,996	2,996	2,996
DW	2.0000	2.1778	2.0000	2.0575	2.3685	2.0575	2.1694	2.6643	2.1694
H-Test	statistic 108.35	degree of freedom (2)	P-value 0	statistic 67.79	degree of freedom (2)	P-value 0	statistic 41.13	degree of freedom (2)	P-value 0

Model (5-2)

	Pooled	Fixed-effect	Random-effect
β_0	0.0176 ***	0.0199 ***	0.0176 ***
	24.34	25.14	24.18
β_1	0.5481 ***	0.5217 ***	0.5481 ***
	66.64	60.02	66.21
β_2	0.0636 ***	0.0436 ***	0.0636 ***
	8.43	5.48	8.38
β_3	-0.0493 **	-0.0215	-0.0493 **
	-2.28	-0.93	-2.27
β_4	0.0511 **	0.0654 ***	0.0511 **
	2.43	2.90	2.41
Adj.R^2	0.3698	0.3617	0.3698
N	13,466	13,466	13,466
DW	2.0950	2.1840	2.0950
H-Test	statistic 116.87	degree of freedom (4)	P-value 0

CONCLUSION

In this study, we focused on local public enterprises which make financial statements based on business accounting. And we paid our attention to the comparison with commercial companies. Then, we analyzed the characteristics compared with prior studies, whether sticky costs are present in public sector organizations. Sticky costs were not confirmed in the entire local public enterprises and were confirmed anti-sticky by Anderson and Lanen (2007), Weiss (2010), and Banker et al. (2014b).

On the other hand, in the analysis of the cost behavior by industry both sticky costs and anti-sticky costs were confirmed. And we found a diversity of cost behavior in each industry type. We confirmed the two opposing results; both the sticky costs and the anti-sticky costs from each industry. Especially, we thought that the impact of the water supply business that accounts for about 67% of the sample was high. Then, we additionally analyzed the sample data excluding the water supply business.

As a result of the additional analysis, sticky costs was confirmed in the entire local public enterprises in the analyses, except the water supply business, and hypothesis 1 was supported from that result(7). However, in comparison with the commercial companies, sticky costs of the local public enterprises were weaker, and hypothesis 2 was not supported. Also, in the long-term cost behavior, sticky costs were not consistently confirmed, so hypothesis 3 was not supported.

In our study, though we derived our research hypotheses after basing both the deliberate managerial decision view and the high adjustment costs view pointed out by prior studies, there is a possibility that factors other than these are also influential Especially, we thought that local public enterprises were not only influenced by the business environment but also the market monopoly level, capacity selection, worker protection laws and regulations, and charge / pricing methods etc. from the viewpoint of stable service supply for daily necessities. We argue that these points influence cost behavior, especially sticky costs. In addition, we suggest that business managers in charge of local public enterprises are affected by the budgetary discussion systems and a lot of stakeholders who were head of municipalities and local assemblies. Thus, we argue that the peculiar cost

behavior is present in public sector organizations, because the public sector organizations operate in a system different from commercial companies.

Moreover, from our analysis of the cost behavior of local public enterprises, we confirmed for the first time that the striking feature appears in each business in the local public enterprises like the anti-sticky cost in the water supply business and the sticky costs in the hospital business.

Problems and Tasks in the Future of Our Study

Finally, we point out the limitation of our research. We analysed using data of 20 years from the fiscal year 1979 to the fiscal year 1998 to avoid the influence of economic fluctuation on the business and to compare them with prior studies. But we will need to collect most recent data and it will be better to analyze and verify them, too.

In addition, because the operating revenue and the operating expense used for our analysis are data from financial statements, it is indicated that these financial data aren't appropriate for proxy indicators of activity and cost (Anderson and Lanen [2007], Günther et al. [2014]).Therefore, in future research, it is possible to use 'revenue earning water' in the case of the water supply business and 'bed occupancy rate' in case of the hospital business.

Note:

1. According to the material of the government, the government bond ratio doubled to 24.3% in fiscal year 2015 though in the fiscal year 1980 was 12.7%. Moreover, the social security-related expenditure increased to 32.7% in the fiscal year 2015 though it was 18.8% in the fiscal year 1980.

2. In the viewpoint by the institution theory, the organization is pointed out that a system restriction is received by the stakeholder. Additionally, because they are vulnerable to the influence of the normative system from the fact that there is a need to achieve total optimization in terms of the public nature of the request, public sector organizations are compared with the commercial companies.

3. Refer to Table 4.

4. Refer to Table 3.

5. About the market monopoly situation of the local public enterprises, there is a description in 'The local public enterprises yearbook' as follows.

Table note 1

Type of industries	Items	Gland total in Japan (A)	Breakdown of Local public enterprises (B)	(B)/(A) (%)
Water supply	Present water supply population (people)	121,289,000	120,523,000	99.4
Industrial water supply	Quantity of annual total water supply (㎥)	493,000,000	4,897,000,000	99.9
Transportation (Subway)	The annual transportation passengers (people)	4,723,000,000	2,638,000,000	55.9
Transportation (motor transport)	The annual transportation passengers (people)	5,419,000,000	1,453,000,000	26.8
Electric power	annual power generation (kWh)	146,288,000,000	9,618,000,000	0.9
Gas power	Annual gas sales volume (㎥)	22,678,000,000	761,000,000	3.4
Hospital	the number of hospital beds (beds)	1,661,000	236,000	14.2

6. When arranging it based on Nakamura (2012), fare receipts become equal to the summary cost including both operating expenses and the capital charges.

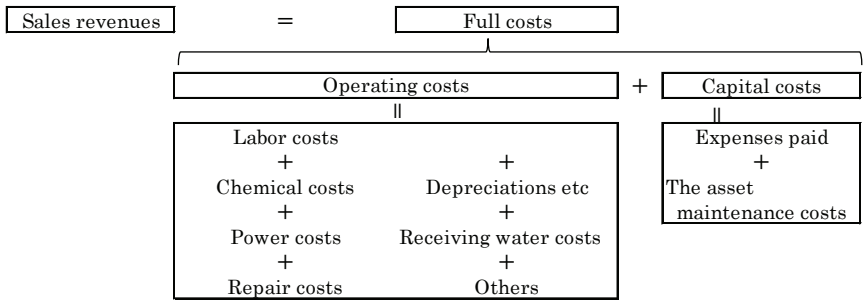

Chart note 1

Arranged with reference to Nakamura (2012)

7. We also excluded the hospital business sample data after excluding the water supply business sample data. After doing so, we analyzed the data once again and the accumulated result was anti-sticky. There is a possibility that the number of samples can influence the result of cost behavior of the entire local public enterprises. It can be said that it is preferable to analyze cost behavior of each business in the future.

REFERENCES

Anderson, M. C., Banker, R. D. & Janakiraman, S. (2003). Are selling, general, and administrative costs "sticky"?. *Journal of Accounting Research*, *41*(1), 47-63.

Anderson, S. W. & Lanen W. N. (2007). *Understanding cost management: What can we learn from the evidence on "sticky costs".* A Working Paper in Social Science Research Network, Rice University.

Balakrishman, R., M. J. Peterson & Soderstrom, N. S. (2004). Does capacity utilization affect the "stickiness" of cost?. *Journal of Accounting, Auditing and Finance*, *19*(3), 682-704.

Balakrishnan, R., Eldenburg, L., Krishnan, R. & Soderstrom, N. (2010). The influence of institutional constraints on outsourcing. *Journal of Accounting Research*, *48*(4), 767-794 .

Balakrishnan, R., E. Labro & N. Soderstrom. (2014). Cost structure and sticky costs. *Journal of Management Accounting Research*, *26*(2), 91-116.

Banker, R. D., Byzalov, D. & Chen, L.T. (2013). Employment protection legislation, adjustment costs and cross-country differences in cost behavior. *Journal of Accounting and Economics*, *55*(1), 111-127.

Banker, R. D. & Byzalov, D. (2014a). Asymmetric cost behavior. *Journal of Management Accounting Research, 26*(2), 43-79.

Banker, R. D., Byzalov, D., Ciftci, M. & Mashruwala., R. (2014b). The moderating effect of prior sales changes on asymmetric cost behavior. *Journal of Management Accounting Research*, *26*(2), 221-242.

Brasch, H. (1927). Zur Praxis der Unkostenschwankungen und ihrer Erfassung. *Betriebswirtschaftliche Rundschau*, *4*, 65-73.

Eldenburg, L., Hermalin, B. E., Weisbach, M. S. & Wosinska, M. (2004). Governance, performance objectives and organizational form: Evidence from hospitals. *Journal of Corporate Finance*, *10*(4), 527-548.

Günther, T. W., Riehl, A. & Rößler, R. (2014). Cost stickiness state of the art of research and implications. *Journal of Management Control*, *24*(4), 301-318.

Hirai, H. & Shiiba, A. (2006). Cost behavior of selling, general, and administrative costs. *Journal of Management Accounting, 14*(2), 15-27.

Holzhacker, M., Krishnan, R. & Mahlendorf, M. D. (2015). The impact of changes in regulation on cost behavior. *Contemporary Accounting Research, 32*(2), 534-566.

Kama, I. & Weiss D. (2013). Do earnings targets and managerial incentives affect sticky costs?. *Journal of Accounting Research*, *51*(1), 201-224.

Nakamura, H. (2012). The cost structure of Japan's water supply business. *Modern Society Research*. No.10.

Noreen, E. & Soderstrom, N. (1997). The accuracy of proportional cost models: Evidence from hospital service departments. *Review of Accounting Studies*, *2*(1), 89-114.

Shust, E. & Weiss, D. (2014). Asymmetric cost behavior-sticky costs expenses versus cash flows. *Journal of Management Accounting Research*, *26*(2), 81-90.

Subramaniam, C. & Weidenmier, M. L. (2003). Additional evidence on the sticky behavior of costs. *Working Paper, Texas Christian University*.

Weiss, D. (2010). Cost behavior and analysts' earnings forecasts. *The Accounting Review*, *85*(4), 1441-1471.

Yasukata, K., Kajiwara, T., Sima, Y., & Kurisu, T. (2011). Nonprofit organization/public organization' empirical analysis of cost fluctuation—The moderate effect of occupancy rate for National Hospital Organization. Journal of Cost Accounting, 35(1), 141–150.

Yasukata, K. (2012). The cost fluctuation analysis of the Japanese enterprises. Tokyo: Chuo-keizai-sha.