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Dissertation

The effects of introducing market principles into the city gas

industry in Japan (Summary)

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(Chapter 1: Purpose and viewpoints)

This paper focuses on the city gas industry, and analyzes the effects on the introduction of market principles.

(The process of deregulation)

In the city gas industry, deregulation started in 1995, and liberalization has been taking place gradually. Table 2-1 and Figure 2-1 show the liberalization scheme and the system of consignment supply.

Schedule	Liberalization range(par year)	Sample customers
March 1995	2,000,000m ³ or more	University hospital, Massive plant, Large scale
		facility
November 1999	1,000,000m ³ or more	Shopping mall, Factory
April 2004	500,000 m³ or more	Large hospital, Standard hotel(City hotel),
		Chemical factory, Metal factory
April 2007	100,000 m ³ or more	Heated swimming pool, Economy hotel(Business
		hotel), Textile factory, Mechanical factory

Table 2-1 The transition of liberalization



Figure 2-1 The system of consignment supply(The case which a firm supplies gas to a big customer)

By this liberalization, a producer can supply gas in the area of a particular utility by means of consignment supply. If a firm pays the consignment supply fee, the firm can use the pipeline, and the firm may provide gas to large customers in liberalized markets. City gas utilities, gas producers, and power companies make use of consignment supply.

(Chapter 2: A study of management efficiency of the city gas distribution utilities by means of DEA)

The purpose of this chapter is to analyze whether city gas utilities could improve performance of management or not. This chapter uses Data Envelopment Analysis (Window models) methodology which is a nonparametrical analysis. This chapter puts three models, and the factors of outputs are the volume of sales, the length of pipelines, and the number of customers, and the factors of inputs are LNG purchase costs, the value of assets, and the number of employees.

This chapter estimated using an available sample of 9 companies observed data. The 9 companies are Tokyo-Gas, Osaka-Gas, Toho-Gas, Saibu-Gas, Hokkaido-Gas, Hiroshima-Gas, Keiyo-Gas, Hokuriku-Gas, and Shizuoka-Gas respectively. The period is 1988-2005. Capital assets might not be accomplished optimal performance of year by year. Hence, this problem is solved by using DEA-Window model, which analyzes the DMU's efficiency by calculating the average of several years. Therefore, this chapter analyzes the management performance of utilities by estimating the average for three years. In addition, this analysis is used BCC model because there seems to be scale economy in city gas utilities. I put three models, and inputs and outputs are as follows.

Table 2-2 Input and output at model 1

Inputs	Raw materials cost	The number of labor	The value of capital assets
Outputs	The amount of sales	The number of customers	-

Table 2-3 Input and Output at model 2

Inputs	Raw materials cost	The number of labor	The value of capital assets
Outputs	The amount of sales	The length of pipeline	-

Table 2-4 Input and output at model 3

Inputs	Raw materials cost	The number of labor	The value of assets
Outputs	The amount of sales	The length of pipeline	The number of customers

"Before liberalization" is defined as the observation until 1995, and "after liberalization" is defined as the observation after 1995. Furthermore, this chapter examines null hypothesis that the average before liberalization and after liberalization are equal. The results are shown in Table 2-6,2-7, and 2-8.

(Deregulation)	Before	After	
Average	0.938	0.975	
S.D.	0.067	0.031	
t-value	-4.923		
5%significant	1.667		

 Table 2-6 Estimation result (Model 1)

S.D.: Standard deviation

Table 2-8 Estimation result (model3)

(Deregulation)	Before	After	
Average	0.971	0.983	
S.D.	0.050	0.023	
t-value	-1.965		
5%significant	1.667		

Table 2-7 Estimation result (model 2)

(Deregulation)	Before	After	
Average	0.951	0.960	
S.D.	0.067	0.049	
t-value	-0.948		
5%significant	1.667		

Model 1(Table 2-6) and model 3(Table 2-8) rejected null hypotheses significantly at 5%. As a result, this chapter verified that the management performance of city gas utilities was improved clearly. Although model 2(Table 2-7) did not rejected null hypothesis, the average value of management efficiency has improved.

The values of standard deviation after liberalization are smaller than that of before liberalization in all models. This means the deregulation improved the performance of utilities. Furthermore, the value of each utility performance tends to concentrate into approximately 1. The reason is that, in addition to the intensification of competition among gas utilities, the other competition between the city gas industry and the power generation industry might be happened after the liberalization started. In short, both the competition among gas utilities and another competition between gas utilities and power companies could improve the management performance of incumbents.

(Chapter 3: A study of vertical integration between manufacturing and sales sectors)

The purpose of this chapter is to analyze vertical integration seen in city gas distribution utilities in Japan. In the real world, there are two types of organizational forms in the city gas utilities: One has only a sales sector, and the other has both a manufacturing sector and a sales sector. The former type purchases natural gas from wholesalers, and provides the gas to its own service area concerned, while the latter type holds vaporizing facilities to transform LNG into natural gas, and provides the gas in its own service area. Each gas distribution utilities select whether to integrate a manufacturing sector or not, based on the market situation and economic activities.

Before practicing an empirical analysis, let me denote the application of transaction costs in city

gas utilities. Figure 3-5 illustrates transaction costs and internal costs in city gas utilities. Transaction costs mean the external costs between firm A and firm B, whereas internal costs mean the costs between a division and another division within a company. If transaction costs are greater than internal costs, firm B(or firm A) should consolidate or acquire firm A(or firm B)(Vertical integration). If transaction costs are smaller than internal costs, firm B(or firm A) should trade with firm A(or firm B). Although I should observe both transaction costs and internal costs directly, it would not be feasible to measure internal costs directly. However, there is the positive correlation between the increase of transaction costs and the incentive for vertical integration, and then the incentive to integrate the manufacturing sector also rise when transaction costs grow.



Figure 3-5 Transaction costs and internal costs

Here, this chapter examines the factors of transaction costs in the city gas industry. According to Williamson(1985), transaction costs include uncertainty, relationship specific assets, and frequency.

Based on Williamson's literature, I suppose three hypotheses.

Hypothesis 1: When long-term uncertainty rises, and then transaction costs also rise. Hypothesis 2: When short-term uncertainty rises, and then transaction costs also rise. Hypothesis 3: When site specificity exists, and then transaction costs decline.

(Equation)

$$e^{x} = aLU_{l}^{b_{l}}SU_{m}^{c_{m}}SS_{n}^{d_{n}}$$

$$\ln e^{x} = \ln aLU_{l}^{b_{l}}SU_{m}^{c_{m}}SS_{n}^{d_{n}}$$

$$x = \alpha + b_{l}\ln LU_{l} + c_{m}\ln SU_{m} + d_{n}\ln SS_{n}$$

x: Transaction costs, LU_l : lth long term uncertainty, SU_m : mth short term uncertainty, SS_n : nth site specificity, α : constant.

Here, dependent variable is defined as the ratio of utilities' product(ratio of the supply produced by using its own facilities out of its whole supply). Independent variables are the ratio of the firm's supply amount out of the whole supply in the city gas industry(Scale), the number of customers(Demand), average sales growth rate(Ave growth rate; absolute value), sales variance(Salevar), stock dummy(Stock), the rate of inventory(Inventory; absolute value), monthly sales variance(Msalevar), site specificity dummy(Site1), and the dummy which purchases gas from wholesalers except for city gas utilities(Site2). The ratio of the firm's supply amount out of the whole supply in the city gas industry, the number of customers, and sales growth rate are the proxy for long-term uncertainty. The sales variance, Stock dummy, the rate of inventory, and the monthly sales variance are the proxy for short-term uncertainty. Site specificity dummy and the dummy which purchases gas from wholesalers except for city gas utilities except for city gas utilities.

The number of observations is 208. Probit model and OLS model (Ordinary least square) are used in this chapter. I used the software of TSP5.1.

Coefficient	Model 1	Model 2	Model 3	Model 4
Constant	0.263(1.102)	1.059(1.017)	1.002(1.015)	1.956**(0.810)
Scale	-0.099(0.871)			
Demand		0.030(0.092)	0.064(0.087)	
Ave growth rate	0.068(0.106)	0.032(0.108)	-0.069(0.088)	0.059(0.105)
Salevar	-0.156*(0.084)	-0.122(0.084)		-0.148*(0.083)
Household rate	-0.181(0.208)	-0.067(0.184)	-0.046(0.183)	-0.153(0.198)
Inventory	0.232***(0.084)	0.244***(0.083)	0.239***(0.083)	0.230***(0.084)
Msalevar				-0.048(0.043)
Stock	2.411***(0.683)	2.037***(0.687)	1.918***(0.678)	2.361***(0.663)
Site1	-1.263***(0.231)	-1.370***(0.217)	-1.345***(0.215)	-1.256***(0.233)
Site2	-0.297(0.352)	-0.343(0.354)	-0.308(0.350)	-0.298(0.353)
R-square	0.31	0.30	0.30	0.31
Log likelihood	-98.319	-98.918	-99.972	-98.331
Observations	208	208	208	208

Table 3-3 Probit model results

(The parentheses: standard deviation t-test***significant at 1%, **5%, *10%)

Coefficient	Model 1	Model 2	Model 3	Model 4
Constant	0.501*(0.281)	1,020***(0.285)	1253***(0.228)	1.284***(0.221)
Scale	-0.044*(0.023)			
Demand		-0.010(0.025))
Ave growth rate	-0.011(0.024)	-0.009(0.029)	-0.003(0.028)	-0.012(0.023)
Salevar		-0.007(0.024)	-0.014(0.024)	

Table 3-4 OLS model results

Household rate	-0.001(0.061)	0.045(0.057)	0.001(0.060)	0.006(0.059)
Inventory	0.059**(0.023)	0.064***(0.024)	0.057**(0.024)	0.057**(0.023)
Msalevar			-0.025**(0.012)	-0.024**(0.011)
Stock	0.374***(0.144)	0.258*(0.145)	0.372***(0.139)	0.368***(0.139)
Site1	-0.388***(0.067)	-0.437***(0.063)	-0.376***(0.068)	-0.378***(0.675)
Site2	-0.194**(0.094)	-0.216**(0.096)	-0.199**(0.095)	-0.193**(0.094)
Adjuated	0.29	0.27	0.29	0.29
R-square				
Log likelihood	-102.250	-104.080	-101.663	-101.850
Observations	208	208	208	208

(The parentheses: standard deviation, t-test ***significant at 1%, **5%, *10%)

Here, let me consider three hypotheses. First, as far as the long-term uncertainty of hypothesis 1 is concerned, the coefficient of the ratio of a certain company's supply out of the whole supply in the city gas industry and the coefficient of the number of customers are not respectively satisfied significant at 5% in all models. Hence, the scale of utility such as the amount of sales and the number of customers might not influence vertical integration.

Second, with regard to hypothesis 2, the coefficient of inventory in all models is satisfied significant at 5% respectively. In model 3 and 4(Table 3-4), monthly sales variance is also satisfied significant at 5%. Third, as regards hypothesis 3, the coefficient of site1 is satisfied significant at 5% in all models. If site specificity for which a utility could purchase gas in the vicinity exists, transaction costs decline, and the incentive of vertical integration might also reduce.

It might be suggested that estimation results do not recognize that long-term uncertainty could impact on the determinant of the choice of vertical integration strongly. On the other hand, site specificity and short-term uncertainty might impact the determinant of the choice of vertical integration significantly.

(Chapter 4: A study of scale economies and price differential)

The purpose of this chapter is to prove price differential of the city gas industry by estimating scale economies.

There are three organizational forms in the city gas industry in Japan. In particular, the organizational forms between utilities which purchase natural gas from wholesalers and utilities which provide natural gas transformed into LNG by using its own facility are quite different. They are respectively trying to pursue their efficiency in a competitive manner. However, the results turned out to be quite different. This chapter estimates scale economies in two types of suppliers and factor analysis on the price of their suppliers, and then considers the influence which the differential of two organizational forms gave to gas price.

To evaluate the effect of the deregulation, I classified city gas utilities as three kinds of organizational forms based on the groups of yardstick regulation.

- 1. "Big supplier" (Utilities which provide natural gas to 150,000 or more customers)
- 2. "Pipeline based supplier" (Utilities which purchases natural gas from wholesalers through pipelines)
- 3. "Vertical integrated supplier" (Utilities which provide natural gas by using vaporizing facilities)

The pipeline based supplier is shown in Figure 4-1 on the right side, and the vertical integrated supplier is shown in Figure 4-1 on the left side.

I researched the authorization prices(Ninka kakaku) in the household sector. Figure 4-1 shows the average authorization prices in the three types of suppliers.



Figure 4-1 The organizational forms



Figure 4-2 The authorization prices of the three types of suppliers (Vertical axis: price, Unit: yen)

This chapter deals with pipeline based suppliers and vertical integrated suppliers, and considers what influence the difference of management forms gives their costs. I have three steps for methodology. First, I estimate the scale economies of two forms by using cost functions. Next, to verify whether the scale of each supplier gives gas price some influence, I practice the factor analysis. Finally, based on the estimation results, I consider the price differential between pipeline based suppliers and vertical integrated suppliers.

Here, I verified scale economies of two types of suppliers, which are pipeline based suppliers and vertical integrated suppliers, by estimating cost functions.

In order to test scale economies(returns to scale), a general model of energy company costs with two outputs and three inputs types is specified as follows.

Long-term Cost function $C = (p_i, Q, Z)$ i = k, l, m k: Capital, l: Labor, m: Energy

- C: Total cost
- Q: The level of output
- Z: The additional output
- *pi*: The price of i-th input(*i=k,l.m*)

The most widely used functional form is the translog function, which is flexible in the sense that it provides a second order approximation to an unknown function at any given point. The translog function is specified in the following form:

$$\ln TC = \alpha_0 + \sum_{i=k,l,m} \alpha_i \ln p_i + \alpha_q \ln Q + \alpha_z \ln Z + \frac{1}{2} \sum_{i=k,l,m} \sum_{j=k,l,m} \beta_{ij} \ln p_i \ln p_j + \frac{1}{2} \beta_{qq} (\ln Q)^2 + \frac{1}{2} \beta_{zz} (\ln Z)^2 + \frac{1}{2} \sum_{i=k,l,m} \gamma_{qi} \ln p_i \ln Q + \frac{1}{2} \sum_{i=k,l,m} \gamma_{zi} \ln p_i \ln Z.$$

In order to estimate more accurately, I impose the restriction on input factor prices. In addition, I apply Shephard's Lemma on the total cost function and the SUR(seemingly unrelated regression) by Zellner(1962) for the total cost function and the input share equations. And moreover, it is worth noting that I normalize the observation on each variable by dividing by its sample mean, before making the natural logarithmic transformation.

The observations of pipeline based suppliers are 447, and the observations of vertical integrated suppliers are 811. I excluded the data which I cannot obtain exactly.

Variable	VI.	pipeline based	Variable	VI.	pipeline based
constant	0.421(11.34***)	0.330(15.80***)	ek	-0.069(-22.65***)	-0.051(-7.90***)
e(energy)	0.338(132.46***)	0.464(59.28***)	lk	-0.075(-24.67***)	0.024(2.25**)
l(labor)	0.332(133.47***)	0.161(20.95***)	qe	-0.0001(-0.07)	0.091(26.96***)

 Table 4-4 Estimation results

k(capital)	0.331(67.91***)	0.375(37.77***)	ql	0.001(0.57)	-0.038(-10.82***)
q(quantity)	$0.729(68.35^{***})$	$0.680(65.71^{***})$	qk	-0.001(-0.25)	-0.053(-7.90***)
f(additional)	0.206(13.39***)	0.146(12.35***)	qf	-0.007(-1.33)	-0.066(-19.60***)
ee	0.131(102.03***)	0.129(27.18***)	fe	0.00005(0.06)	-0.031(-10.63***)
11	$0.137(85.65^{***})$	$0.054(4.55^{***})$	fl	-0.001(-0.94)	0.004(1.20)
kk	0.144(24.41***)	0.026(2.19**)	fk	0.001(0.45)	0.027(7.17***)
qq	0.010(1.78*)	0.052(20.29***)	d1(public)	0.280(8.85***)	0.073(3.69***)
ff	0.012(6.81***)	0.022(12.83***)	d2(LNG)	-0.019(-1.00)	-0.063(-3.00***)
el	-0.062(-28.95***)	-0.078(-11.55***)	observations	(811)	(447)

(parenthesis: t-value, *significant at 10%, ** 5%, *** 1%)

Vertical integrated suppliers $R^2=0.960$, Labor cost: $R^2=0.911$, Energy cost: $R^2=0.954$ Pipeline based suppliers: $R^2=0.963$, Labor cost: $R^2=0.364$, Energy cost: $R^2=0.742$

Here, I calculate scale economies by using the value of estimation results. Let me define scale economies as the growth rate of total cost when sales(Q) and additional revenue(Z) are increased at the same rate.

 $\frac{1}{\varepsilon_1 + \varepsilon_2}$ ε_1 : The elasticity of sales, ε_2 : The elasticity of additional revenue

Table 4-5 Scale economies(returns to scale)

	Returns to scale		
Vertical integrated suppliers	1.07		
Pipeline based suppliers	1.21		

The value of scale economies is the reciprocal of elasticity of sales and additional revenue. According to the definition of scale economies(returns to scale), if there are scale economies, the growth rate of total cost is smaller than that of both sales and additional revenue.

Next, I analyze whether scale economies influence the gas retail price. The methodology is as follows. Let me define the gas retail price as a dependent variable, and carry out factor analysis by means of ordinary least square.

(Function) Ordinary least square

Pr ice =
$$\alpha + \beta_1 * \ln Demand + \beta_2 * \ln Coverage + \beta_3 * \ln Quantity + \beta_4 * \ln Household + \beta_5 * \ln Wholesale + \beta_6 * \ln Public + \beta_7 * \ln HighCalori e$$

Variable	Model-1	Model-2	Model-3	Model-4
Constant	6.193(28.50***)	6.079(28.18***)	10.202(49.75***)	10.088(49.49***)
Customer		-0.033(-2.56**)		-0.030(-2.44**)
Quantity	-0.043(-3.57***)		-0.040(-3.54***)	
Coverage	-0.056(-1.11)	-0.071(-1.39)	-0.063(-1.32)	-0.078(-1.61)
Household	-0.023(-0.65)	0.020(0.615)	-0.075(-2.23**)	-0.034(-1.09)
Wholesale	-0.244(-5.33***)	-0.260(-5.61***)	-0.264(-6.10***)	-0.279(-6.37***)
Public	-0.282(-4.53***)	-0.279(-4.43***)	-0.323(-5.50***)	-0.320(-5.37***)
High-Calorie	-0.178(-3.68***)	-0.197(-4.40**)	-0.144(-3.14***)	-0.161(-3.51***)
(observations)	209	209	209	209
(Adjusted-R ²)	0.436	0.419	0.471	0.455

Table 4-7 Estimation results

(Parenthesis: t-value, *significant at 10%, ** 5%, *** 1%)

Model 1,2: Authorization price, Model 3,4: 50 m³ charge

Both coefficients of the number of customers and the amount of sales are significantly negative. In short, when the scale of suppliers is large, the gas retail price is cheap, and vice versa.

It might be suggested that the organizational form of pipeline based suppliers is significantly different from that of vertical integrated suppliers. And furthermore, if the organizational scale of pipeline based suppliers extended, the gas retail price would not rise outstandingly. The results lead to two implications.

First, if a distribution utility constructs pipelines to other suppliers in the same vicinity, and purchases natural gas from the suppliers through the pipelines, then the distribution utility could keep gas retail price at a lower level. And moreover, when two pipeline based suppliers merge with each other, the gas price could be kept at a low level.

Second, if several suppliers could not tie pipelines to other suppliers because of far distance from these suppliers, then, these suppliers have to construct a vaporizing facility to transform LNG into natural gas. As a result, these suppliers could have difficulty in obtaining the advantage of scale economies. Therefore, the retail price of these suppliers might be kept at a high level, and then the price differential between these suppliers(vertical integrated suppliers) and pipeline based suppliers would be also kept at a high level. It seems that the price differential would be extended gradually if the consignment supply is generalized.

(Chapter 5: A study of the investment in trunk pipelines using property rights theory)

The purpose of this chapter is what a kind of organizational form is the best to increase the amount of natural gas pipeline investments. In Japan, both city gas utilities and natural gas digging companies generally make investments in trunk pipelines, and then these companies usually maintain and manage them without the influence of regulations. With regard to pipeline investments in the city gas industry, there are essentially no economical regulations. Hence, the trunk pipeline investors are making investments based on only market structure and competitive situations. In the real world, the investors such as natural gas digging companies and gas distribution utilities might make investments alone if they can obtain the capital stock to do so. On the other hand, unless the firm can obtain the capital stock to invest alone, the firm would adopt the organizational forms of joint ownership or a subsidiary as the next step.

The organizational forms of joint ownership and a subsidiary might strongly impact the increase of the amount of pipeline investments because there are some cases of a subsidiary and joint ownership in the real world. Therefore, by focusing on an organizational form of a subsidiary, this chapter assumes that the organizational form of a subsidiary enlarges the amount of pipeline investments, and then I will try to prove this assumption by using property rights theory.

Let me denote the model used in this chapter. The purpose of this chapter is to analyze whether the organizational form of subsidiaries is optimal, and I compose the model by adopting both the contribution of Cai(2003) and that of Aghion and Bolton(1992).

Cai(2003)'s accomplishment is as follows. In the condition of substitute between specific and general investment, when a firm makes these two types of investments, the firm increases the amount of general investment, and decreases that of specific investment in order to reduce the bargaining power between itself and other firms. The reason for the decline of bargaining power is that the firm owns the specific assets (specific investments). The best way to avert the ownership of specific assets is to admit the adoption of the organizational form of joint ownership. Because the organizational form of joint ownership can weaken the ownership of specific investments, the firm increases the incentive for specific investments.

In the model of Cai(2003), although there is only specific investments on the first best solution, the firms make both specific and general investments where equilibrium is present. In the city gas industry, specific investments can be defined as pipeline investments in the real world because the firms cannot use the pipelines in other situations, and general investments as tank trucks and storage tanks, which the firms can use to transport multiple firms.

Here, let M_1 denote a digging and importing company, M_2 denote a gas distribution company, and M_3 denote a subsidiary which has been established by investments from both M_1 and M_2 . Although there are many kinds of subsidiaries in the real world, this chapter defines a subsidiary as follows. The subsidiary can make investments in the range of the finance(K) provided from both M_1 and M_2 . Hence, This chapter assumes that the subsidiary cannot borrow additional funds beyond capital stock(K) from several banks and other investors, and the benefit from the investment can be divided into M_1 and M_2 corresponding to the rate of their stock holdings.



Figure 5-4 The model

Here, the benefit of a subsidiary is defined as $b = b(i_1, i_2, e_1, e_2)$, which is included not only monetary returns but also intangible benefits such as reputation, specific human capital, effort, etc. And let the gross surplus of M₁, M₂, and M₃ U_I , U_2 , and U_3 respectively. R and Q mean gross surplus from the specific investment, and r and q mean gross surplus from the general investment. C₁ and C₂ mean the costs of M₁ and M₂.

$$U_{1} = \frac{R(i_{1}) + Q(i_{2}) - r(e_{1}) - q(e_{2})}{2} + r(e_{1}) - C_{1}(i_{1}, e_{1})$$

$$U_{1} = \frac{R(i_{1}) + r(e_{1})}{2} + \frac{Q(i_{2}) - q(e_{2})}{2} - C_{1}(i_{1}, e_{2})$$

$$U_{2} = \frac{R(i_{1}) + Q(i_{2}) - r(e_{1}) - q(e_{2})}{2} + q(e_{2}) - C_{2}(i_{2}, e_{2})$$

$$U_{2} = \frac{R(i_{1}) - r(e_{1})}{2} + \frac{Q(i_{2}) + q(e_{2})}{2} - C_{2}(i_{2}, e_{2})$$

$$U_{3} = b(i_{1}, i_{2}, e_{1}, e_{2}).$$

Here, based on the idea of Aghion and Bolton(1992), this chapter assumes the control rights of assets. There are two types of unilateral control allocations, which are full control by a manager(M_3) and by investors(M_1 and M_2). Therefore, If investors(M_1 , M_2) dominate control rights of the assets, those parties specialize to only specific investment because investors neglect the benefit of U_3 . Meanwhile, in the case where manager(M_3) dominates control rights of the assets, even if the renegotiation would be practiced, the situation in which there is specified the pipeline investments could not be achieved because the manager maximizes its own benefit(U_3).

In conclusion, when the investors $(M_1 \text{ and } M_2)$ commit two kinds of investments (specific and general) to the subsidiary (M_3) , as a result, it might be suggested that the subsidiary makes only specific investments (pipeline investments) if and only if the investors dominate the control rights of the assets.

(Chapter 6: Conclusions)

This chapter described my view about the universal service of the city gas industry and the relationship between pipeline investments and consignment supply.

From the results of chapter 4, the change of situation in the area of energy fields gives us the opportunity to reconsider whether the city gas industry is a universal service or not. If we suppose that the city gas industry is a universal service, we would need to reduce the price differential among gas utilities, and to increase political subsidies for pipeline investments. On the other hand, if we suppose the city gas industry is not a universal service, and that the price differential is a regional problem, then the bankruptcy of gas utilities might occur more often, and the government would still have to do more to promote the introduction of competitive principles.

The length of pipelines in Japan is small compared to the United States and European countries. Nevertheless, Japanese government has introduced consignment supply followed the deregulation in the United States. The political resume of consignment supply forces utilities owning pipelines to lend these pipelines at a reasonable price which the government has decided. Even if utilities and digging companies prefer to invest pipelines, the part of profit from the pipeline investments might be prevented by the political resume of consignment supply. This means the investors would lose the incentive of new pipeline investments, and in fact, the amount of pipeline investments might not be enough compared to the amount of expected investments which investors are seeking. It seems that the source of this serious problem might be to adopt the political resume of consignment supply before the pipeline network becomes too widespread.