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Pricing of Water in Industrial Sector (Case Study of Industrial Sector in Esfahan)

Dr. Mostafa Rajabi

Assistant Professor, Department of Economics, Islamic Azad, University Khomeinishahr Branch, Daneshjou Blvd, Iran

ABSTRACT

Water in industrial sector has been used as an institution in the process of producing and focus is on industrial development in developing countries and accessibility on natural source. This limitation in the conditions of supplying water that has a responsiveness closing by zero necessitates the need of coded pricing and market conditions are not dominant on flowing it and having lateral effects, therefore, coded pricing is analyzed by determining economical price and accordingly considering final price of supplier and price responsiveness and water supply and demand within partial equilibrium.
Obtained results are a sign of responding water, entirely in studied industrial sector (-1.2216) and replacing water and energy in this section. According to coded pricing (1416.49 Rials) that is higher than received consumption price, it is expected that increasing water price lead industrial sector towards replacing cheaper energy rather than water in droughty region of Esfahan and it makes water consumption very efficient.
Category JEL: Q25, C25, L33, L60
KEY WORDS: water pricing, responsiveness, water demand, water supply, final cost

INTRODUCTION

Water as a natural source with a view to flowing has secondary effect that has been introduced as an intermediate public good throughout the world (Dinar and Subramanian, 1997).

Positive and negative effects and the aspect of generalizing and the entity of water supplier that has been regulated by a monopolist lead that its pricing confronts results' market with the error based on the principles and use second optimization method for eliminating these problems.

Therefore, demand side has been studied by using second optimization method and working out a model based coded format, in addition to recognize producing structure and cost of water generator. Because Esfahan province is located in a semiarid area and national great industries have been installed within this area and all water supplies provides from one water shed domain. Thus, the aim of research is to water pricing in industrial sector of Esfahan province through estimating water demand and considering structure of cost of water supplier.

In water supply, in the abundance stage, there is only a flow of extending supply in responding increasing demand (Spooler…).

In second stage of scarcity incidence, managerial attempts in the field of increasing supply and changing economical aims water consumption is taken the lead towards proper usage of water. In third stage, for protecting water resources, demand control is a new technologies and using effective pricing principles. Experimental studies have been done in this field, water supply has supposed in a stage that by using modern technology and minimum cost supplying reliable water can rise. Additionally, performed studies in different areas such as Mexico (Goerrorand Haw, 2000), Morocco (De Chaloand others, 2004) indicate that water suppliers follow determining price and cost based on a type of cost price water demand is classified based on economical sectors and agriculture (irrigating water, demanding for Derange), residential (drinking water and urban services, etc.) and industrial. Different application of water shows that the percentage of increasing water demand as an environmental resource has raising than other ones (Shoen Gold and Zilberman, 2003) this demand growth at industrial sector is due to economic and industrial development in developing countries (Dnjala, 2001, p1, Ferss and Reynaud 2003, p 3 and Kumar, 2004, p1) water demand in industrial sector is

***Corresponding Author:** Dr. Mostafa Rajabi, Assistant Professor, Department of Economics, Islamic Azad, University Khomeinishahr Branch, Daneshjou Blvd, Iran. rajabi@iaukhsh.ac.ir .00989123588963

including intake water (for filtering or water treatment), water recirculation and finally demanding for final treatment and water discharge). Each one of above four sections is expressed as a factor of production in industrial and demanding sides for using it.

Certain feature of water demand in industrial sector and growth of intake water inside this section throughout the world than other ones. The share of demanded water in industrial sector registered 19.5% of all recorded dd. However, level of consuming industrial water in different countries is depending share in industry in Cameron 19%, Mexico 8%, and USA 46%, Japan 18% and France 69% (Fress and Reynaud, 2003).

Whereas developing countries make firm their growth strategies based on developing industrial sector, therefore in the future demanding industrial water has been raised and the practitioners forced to allocate water between different rivals. This problem is more intense in avid and semi-arid countries (GoerrorandTomas, 2002) and deciding relating to the fields of allocation based on correct pricing is more important other areas. In Iran, although physical presentation of water is stable, water consumption share is increasing in industrial.

During first development program, share of industrial added value 2% and industrial productions have stable growth cost equal to 11% while growing water added-value that has been bought in industrial grate working place equals 24% that indicates water demand growth (Sharzeiei and Ghatmiri, 1996, p64) performed studies on water demand is conducted in urban sector and meeting foodstuffs in drinking and agriculture sectors due to the and continuing reliable water (Goerror and Tomas, 2002) and there are few studies and the differences at demand entity in industrial sector (Fredrick and others 1997).

Performed studies about water demand in industrial sector as a product factor include a range of countries such as Mexico (Goerrorand Tomas, 2002), Brazil (Fress and Reynaud, 2003), France (Reynaud, 2003), Kenya (Onjalla, 2001), China (Vang and Lal, 2002). India (Kumar, 2004) and Iran (Sherzeiei and Ghatmiri, 1996)

RESEARCH METHODOLOGY

Research method of this research is based on partial equilibrium analysis and within a micro economy. Whereas the cost as the benefits obtaining from producing and supplying the goods for supplier and the cost for a consuming goods, determining the cost has been expressed by interacting both sides of markets. For reaching the aim of above methods of pricing based on maximizing society welfare, one of pricing types that has been determined by the market is first best and possible under the conditions and if assumed conditions are not obtained, it can be done by second Best. According to the fact that there are cost stability and price support within the conception of short-term final cost, it will not consider long-term and stable-heavy for increasing the capacity and leads to impair and don't provide highest social welfare. Therefore, other solutions should be considered by demand and adapting additional welfare.

This solution can be based on pricing long-middle term of final cost (adapting demand) or using Incremental Marginal cost for taking the opinions about disadvantages. In the view of Alboy (1983), this problem that short-term fluctuations of cost or cost disconnection is aggraded by averaging in time conducts us to practical estimations in pricing and obtains from averaging averaged LRMC is based on "reducing along time" that is possible in different methods. One of average methods is average Incremental cost and it is a guideline that is called "middle-long-term incremental costs" and it expressed by Shanders and others and the focus is on cost stability and prices during a certain time and tries to reduce cost fluctuations during a studied period through averaging. This research is taken into consideration through second Best pricing and coded pricing method by contemplating certain characteristics of supply-demand side as well as demand function' responsiveness of pricing.

In demand side, because water is considered as a producing factor in industrial sector, demand function is obtained from derived demand. This issue regarding accessible information and derivative pattern can construed by maximizing profit function with stable cost and using "Hoteling Theorem" or minimizing producer's cost in the condition of stable production and shepherd Lemma method. Estimating the coefficients has been performed by considering water cost share for producing by "superficially irregular regression

Coded pricing pattern

In a condition that supplier of generation factor (water) interferes in the market as a regulated monopolist and follows maximizing of social welfare through producing at endways point of cost-income, therefore, additional social welfare is equal to applicants one and it can be written:

$$Max\ CS = \int_0^d P_W^d \left(W_D^d\right) dW_D^d - P_W^d . W_D^d \qquad (1)$$
$$St : P_W^d . W_D^d - C_W \left(\equiv Tc\right) = 0$$

Where $P_W^d (W_D^d)$ is production factor demand (water) and generated limitation in the relation (1) is derived from the condition of endways point of water producer institution $(\pi = 0)$andwater consumer's cost is equal to water producer's income and finally equals water producer's cost by forming lagrange's equation, first order condition is as follows:

$$P_W^d - \frac{\partial C}{\partial W_D^d} + \lambda P_W^d + \lambda \frac{\partial P_W^d}{\partial W_D^d} . W_D^d - \lambda \frac{\partial C_W}{\partial W_D^d} = 0 \qquad (2)$$

Because $\frac{\partial C}{\partial W_D^d}$ is final cost of W factor or MC_W from applicant' view, by substituting $\varepsilon_d = -\frac{\partial W_D^d}{\partial P_W^d} \cdot \frac{P_W^d}{W_D^d}$ (demand cost responsiveness) and $\gamma = \frac{\lambda}{1+\lambda}$ as deviation level of cost, we have in relation (2):

$$(P_W^d)_R = MC_W / (1 + \frac{\gamma}{1+\varepsilon_d}) \qquad (3)$$

But in relation (3), maximizing social welfare as agent of production's aim W via placing him in endways point leads MC_W becomes equal to final cost of producer (MC). Therefore, codedpricing includes both demand and supply side and relation (4) will be as follows:

$$(P_W^d)_R = \frac{MC}{1 + \frac{\gamma}{\varepsilon_d}} \qquad (4)$$

For determining P_W^d it requires γ, ε_d and MC that later will be explained.

Calculation ε_d

ε_d Is obtained by existing limitation in information by using Dugan and deriving industrial deriveddemand function for factor W from cost function shepherd lemma. Thus according to the advantage of cost function trans log including existing second order estimation of data quantization their well behavior in the pointview of convexity, uniformity, lack of homogeneity and plurality limitations that are embedded' by homogeneity and symmetry constraints can be written in functions system:

$$S_{it} = \alpha_i + \sum_j \beta_{ij} Ln P_{jt} + \beta_{iq} Ln Q_t + e_{it} \qquad (5)$$

Limitation $\sum_i S_{it} = 1$in relation (5) is an indicator of $\sum e_{it} = 0$ for $i = L, K, W, E$ and presents the relation between errors every time and lead variance-covariance matrix $\left(\sum_n\right)$becomes (n-1) order. The elimination of this problem is possible through omitting one of relations and estimations of parameters of other relations by "Seemingly Unrelated Regression"(SUR) and parameters of omitted relation is obtained apart from homogeneity constraint

$$\varepsilon_{ij} = \frac{S_i S_j + \beta_{ij} - \delta_{ij} S_i}{S_i} \qquad (6)$$

Where $\delta_{ij} = 1$for $i = j$ and $\delta_{ij} = 0$for $i \neq j$

Calculation γ

In relation (4) $\gamma = \dfrac{\lambda}{1+\lambda}$ and λ is budget limit factor in Lagrange' unction relating to maximizing social welfare. Thus regarding synonymy of optimizing present consumer behavior in relation (2) and producer's behavior in industrialand considering W as a production factor, λ and fallow up γ are obtained by minimizing cost function against stable level of production. In this manner,

$$\lambda = \frac{d\,TC}{d\,Q} = MC \qquad (7)$$

Calculation of supplier's final cost

Final cost can be obtained through direct and indirect estimation of cost function and incremental costs method. Direct estimating of final cost function is through assumed relation based on structure of agent cost and assumed purpose is possible for achievable cost function. Indirect estimation, also by considering production function, development path and one cost equation Method of calculating final incremental cost is used in the time that info relating to cost' structure is limited within short and long term programs and through adjusting investing and current costs against adjusting production changes, final cost is approximately calculated. Anyhow, whereas maximizing the welfare conforms to the condition of cost stability and final short-term cost in water section due to sectional great costs is to make demand-side capacity in reacting demand side.

Then in the pointview of Alboy (Alboy, 1983) for eliminating problem of extant disruption among costs, averaging method can be used as a practical estimation for achieving long-term- cost.

Thus, by following Fisher (Fisher, 1990), method of value incremental cost has been applied based on cost discount of opportunity as following for calculating final cost of supplier

$$L\,RMC \approx AIC_t = \frac{\sum_{t=1}^{T} \frac{\left(\Delta C_t + Z_t\right)}{\left(1+r\right)^{t-1}}}{\sum_{t=1}^{T} \frac{\Delta Q_t}{\left(1+r\right)^{t-1}}} \qquad (8)$$

Where C_t is maintenance, exploitation and current cost of agent, Z_t is investment to obtain water, r is discount rate and Q_t is production rate. At the end, present pricing method can be shown for different market conditions (from complete competition to exact monopoly) by range of $0 \le \gamma \le 1$

EXPERIMENTAL RESULT

Required information about data at demand side in the form of time series is gathered from Iran statistics center (1994-2003)[1] and data of supply side is presented by local water org of Esfahan, energy ministry and org of management and planning in country (vice chancel or water resources). Data has seasonally estimated for increasing freedom degree. Also all are measured by persistent prices in the year 1997.

From consumption, cost and price of water[2], energy price, added-value of industrial activity, industrial costs on factor (data value), amounts received value number of workers, payment wage (services compensation), investment generation of stable capital[3] and capital cost[4]. Data relating to supply side is

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1-province information is not complete relating to past years.

2 - Water price is considered based on the reasons like being ordered, step form and paying subsides in droughty period

3- Capital assets are calculated by measuring ratio of capital to production and using acceleration principle indirectly

4 - Capital cost is obtained by dividing added value to capital asset.

including all revenues (incomes obtained from water tariff, annual loss assistance and other incomes) and payments (cost of producing, transferring and distributing) of water supplier.

Extraction of demand function responsiveness

For water demand function responsiveness in industrial sector, by following Wang and Lal (2002) and Goerror and Tomas (2002), estimated coefficients of cost sharing function such as water, labor force (L), capital (K) and energy (E) has been used by seemingly unrelated regression[5].In similar functions system of variables, they are considered and therefore, the results by presenting a long-term relation are as follows:

Table (1) model coefficients through system solution of seemingly unrelated regression

Equation type	Depend variable	Independent variable *						R^2
		LY	LP_e	LP_k	LP_l	LP_w	C	
(1) Equation	S_w	0/00156 (1/617)	0/00096 (-1/370)	-0/00194 (-3/518)	-0/00455 (-5/507)	-0/00043 (-2/075)	-0/0644 (-3/67)	**0/452**
(2) Equation	S_l	0/0723 (1/169)	0/1652 (7/98)	-0/04236 (-3/585)	0/03676 (2/077)	-0/00053 (-0/1198)	-1/1148 (-2/955)	**0/712**
(3) Equation	S_k	-0/016 (-0/258)	-0/14005 (-3/517)	0/0762 (3/354)	-0/0886 (-2/602)	-0/00617 (0/73)	1/904 (2/62)	**0/524**
(4) Equation	S_e	-0/0205	-0/15518	-0/03195	0/05636	0/007122	-0/72473	-

*The numbers that are parentheses are statistic.

According to relation (6), familiar and crossing cost responsiveness are presented by using total mean of cost sharing period for each production factors (supposing that there is a long-term equilibrium relation) and it is presented in table (2).

Table (2): extraction of familiar and crossing responsiveness for water demand in industrial sector

Production factor	**(W) Water**	**Labor force(L)**	**(K) Capital**	**(E) Energy**
(W) Water	-1/2216	-2/2182	-0/2679	0/8987
Unilateral confidence %97/5interval	-1/0447	-1/5054	0/2085	0/0642
Relation type	Responsive	Complementary	uncertain	Substitute

Obtained results are expected for familiar responsiveness and water encounters responsiveness against cost changes. Water relation with work item in industrial sector has been considered by a complementary sign, but it is out of confidence interval and we cannot discuss its complementary. One reason has been studied about statistical problems. The relation of water with energy is a replacement form that is confirmed.

Calculation of coded factor (γ)

According to relation (7) for calculating λ by using cost equation of translog, its results for industrial section are as follows:

LnTC=1.0950+0.699394LnY+3.8667LnPw+9.7157LnPl+0.0316LnPk+8.7936LnPe
(0.06) (4.31) (-1.76) (-2.63) (-0.010) (1.49)
-0.0313(LnPw)^2-0.1535LnPwLnPl+0.008LnPwLnPk-.4271LnPwLnPe
(-1.44) (-0.64) (0.07) (2.48)
-2.4371(LnPl)^2-0.0099LnPlLnPk+5.2554LnPlLnPe-0.2375(LnPk)^2
(-3.81) (-0.03) (4.78) (-3.51)
-0.1396LnPkLnPe-3.0635(LnPe)^2
$R^2 = 0.999$ (-0.28) (-6.11)

By deriving estimating cost function by changing added value (production level) we will have

5 - Coefficients of fourth equation are obtained by congenial limits.

$$\alpha_Y = \frac{\partial LnTC}{\partial Y} = \frac{MC}{AC} \qquad (9)$$

There fore, it is for λ

(10)

$$\lambda = AC * \alpha_Y \quad \frac{\partial LnTC}{\partial LnY} = \frac{dTC}{dY}.\frac{Y}{TC} = \frac{MC(\equiv \lambda)}{AC} = 0.699394$$

WhereAC is average of mean cost during certain period and it will be obtained for λ and γ values

$\lambda = 119/442$ ، (11) $\gamma = 0/991697$

Calculation of final cost of water supplier

For calculating final cost of water supplier, it requires information relating to cost structure of supplier (public corporation of local water in Esfahan). Based on two types of statistics from local water corporation, first data is relating to invest in the plans of increasing water supply and second data is about current costs for continuing reliable water supply. Whereas, such plans have been determined in a certain time and high scale it is necessary to apply the discussions of section (3-3) about averaging and as a practical estimation of long-term cost. All information is reduced to value of first studied year (1995) and opportunism resources 17% (out of participation bond in a period) obtained results is equal to:

$LMRC = 266.58$

Calculation of coded cost:

Having the results relating to ε_d, γ and Mc relation (5) can be obtained for the method of coded pricing in industrial sector

$$(P_w^d)_R = 1416 \; / \; 49$$

Conclusion

Water as a natural resource has a certain condition in supply and production factor in industrial sector and second optimization and coded method have been used for calculating economic efficiency obtain result of measuring method explains that

A- According to interruption of costs relating to make capacity and present statistics, evaluated costs and adjustment discount rate and average are obtained. Accordingly, final cost of supplier is measured by assuming a long-term balance relation that is equal to 266.58.

B- Coded coefficient at industrial sector is as a index of cost deviation from competitive value through defining cost function of industrial sector and measuring final cost that is equal to 0.991697 that confirms regulated monopolist' conditions.

C- Familiar cost responsiveness of water is measured through systemically solution of cost sharing functions and SUR method that is equal to -1.2216 and shows its responsiveness in industrial sector.

D- Crossing responsiveness of water with other production factors in industrial sector of Esfahan presents that the relation water and labor force as two complementary from water and replaced energy and relation between water and capital factor is a result of complementary relation, but regarding unilateral confidence interval, it cannot be expressed in definite state.

Comparison of very price (nearly 800), calculation of cost price for dame and tunnel of Lagan spring (1907 to 4768) and estimation result of this study (1416.49) Rials per cubic meter, increasing current costs is directed towards calculated coded costs according to replace cheap water and energy, water consumption goes to use effectively and in addition to releasing present water resources for other activities of producers at industrial sector, such movements move to increase the welfare and optimization.

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