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Regional Electricity Pricing With Ramsey Approach. Tehran Case Study

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Abstract *In developing countries electricity power is not only used for energy's demand responding, but also an essential element of developing. Furthermore the government pricing has comprehensive effect on economy of developing countries due to huge ratio of their governments. So in these countries the electricity pricing could affect welfare and development simultaneously. Therefore we use welfare maximizing as one of the most prevalent method for optimal price detection. As Ramsey rule (which is derived from welfare maximizing) is used in increasing return to scale situations it would be proper for natural monopoly position (that exist in electricity market). Elasticity and marginal cost is required to use Ramsey rule therefore we use Philippine rule and panel data approach to determine elasticity. We also use average cost and rate of return degree to detect marginal cost. Using these two numbers will eventually result in Ramsey prices. Finally we will drive that electricity prices should increase while steps differences should decrease.*

Key words Optimal pricing, Ramsey model, electricity prices

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1. Introduction

Population growth and industrial improvements in developing countries has made grate connection between electricity section and all other parts of economy. Therefore energy departments invest so immensely in electricity segment that requires much more surveys especially about prices. It would make this requirement more obvious when the whole economy is addicted to subsidies.

Indeed in this survey we aim to find a method that concurs with natural monopoly and does not need utility and expenditure functions. To do that we use Philippine method that only discover variables influence electricity power.

To reach these points we start with Ramsey rule, continue by elasticity estimation by using Philippine equations while our econometrics method for estimation is panel data for reason that we explain in the next parts. Then by deriving marginal cost through average cost and cost elasticity, we will derive Ramsey prices.

2. Literature review

While theoretical bases of Ramsey pricing is ancient but empirical studies are recent. Ming Chang Cheng (2001) has shown that Ramsey prices exceed marginal cost and ensured mark-up existence. Rolf (2002) scrutinized advantages and disadvantages of Ramsey model and evaluated it through both equity and efficiency. Jonatan Sandbathch (2004) has compared Ramsey prices with EPMU method (Equi proportional mark-up) and probed perfect competitive market with imperfect market.

Ingo Vogelsong (2005) discussed distances in electricity transmission and showed spatial requirements for policy making for the first time. Martinez Giralt (2006) discussed R&D in medicine industries and talked about cost definition and moral hazard in insurance companies to develop cost definition from accounting definition to economics definition. Jorje Ford (2008) scrutinized broadband internet by Ramsey rule by driving

elasticity. Eventually Jan Macdonald (2010) used Ramsey prices for sending Email and used time opportunity as a cost of email sending to show how vastly Ramsey model could be used.

3. Methodology of research

In this survey we will use one of the recognized procedures of Ramsey rule that assumes transverse elasticities are zero. We divide the consumers to three parts:

1. Residential consumption;
2. Industrial consumption;
3. General consumption.

The total consumer's surplus and total cost will be:

$$CS^T = \sum_{i=1}^{m}\left[\int_0^{q_i} P_i(q_i)dq_i - p_i q_i\right]$$

$$TC = TC(q_1, q_2, q_3, \ldots, q_m) \qquad (1)$$

Because of increasing return to scale we will have:

$$\sum_{i=1}^{m} q_i MC(q_i) \le TC(Q) \qquad (2)$$

For the supply side Instead of producer surplus we use firm's profit so the total welfare will be:

$$TW = PS^T + CS^T$$

$$TW = \sum_{i=1}^{m}\left[\int_0^{q_i} P_i(q_i)dq_i - p_i q_i\right] + \sum_{i=1}^{m} p_i q_i - TC(q_1, q_2, q_3, \ldots, q_m) \qquad (3)$$

Maximizing above function will lead us to:

$$\frac{P_i(q_i) - MC_i(q_i)}{p_i} = -\frac{\lambda}{1+\lambda}\cdot\frac{q_i}{p_i}\cdot\frac{\partial p_i}{\partial q_i} \qquad (4)$$

By replacing the elasticity's we will have the inverse elasticity's rule:

$$\frac{P_i(q_i) - MC_i(q_i)}{p_i} = \frac{\lambda}{1+\lambda}\cdot\frac{1}{E_i} \qquad (5)$$

As we could see we need mc and elasticity's so next step would be mc and elasticity's estimation.

Econometrics method

In developed countries time series is used to estimate elasticity's, nevertheless in developing countries it doesn't make sense on account of parameter changing among different years due to developing procedures.

In these countries there is no relation between different generation's reactions; Therefore OLS method which uses time series to increase data is not valuable. So in this survey we will use panel data approach to increase data by crosses instead of more number of years.

The first question that should be answered for estimation is which variable could influence electricity's consumptions.

According to Philippine model the energy and utility function will be:

$$x = x(e,g,a)\ ,\ u = u(x,y;z) \tag{6}$$

According to Diton and Mulber for optimal consumption we should take two steps:

1. Minimizing expenditure;
2. Maximizing utility.

By minimizing expenditure and using Shepard lemma we will have:

$$e = \frac{\partial c(p^e, p^g, p^a, x)}{\partial p^e} = e(p^e, p^g, p^a, x) \tag{7}$$

As second step we should maximize utility as below:

$$Max\ u(x,y;z)$$

$$s.t$$

$$c(p^e, p^g, p^a, x) + y = r \tag{8}$$

Solving this equation will result in:

$$x^* = x^*(p^e, p^g, p^a, r; z) \tag{9}$$

Eventually we will have:

$$e = e(p^e, p^g, p^a, x^*(p^e, p^g, p^a, r; z) = e(p^e, p^g, p^a, r; z) \tag{10}$$

As it is clear and Halorson has said the demand for electricity is a function of income, electricity prices and substitution commodity prices. So we should have:

$$\text{LnEx} = a\ \text{LnPe} + b\ \text{LnPg} + c\ \text{Lnr} + \eta \tag{11}$$

Where a is a price elasticity.

Doing the same for firms - for industrial and general consumption – we will have:

$$e = \frac{\partial c(p^e, p^g, p^o, m, \bar{k})}{\partial p^e} = \frac{\partial VC(p^e, p^g, p^o, m)}{\partial p^e} = q(p^e, p^g, p^o, m)$$

$$\text{LnEx} = a\ \text{LnPe} + b\ \text{LnPg} + c\ \text{LnM} + \eta \tag{12}$$

Moreover than elasticity's we need marginal cost to derive Ramsey prices. By using cost elasticity (that is inverse of rate of return degree) and average cost we could discover marginal cost because:

$$E_Q = \frac{MC}{AC} = \frac{1}{\delta} \tag{13}$$

4. Empirical result

The average cost of electricity production in 1390 in Iran has been 898.7 and elasticity of costs has been 1.022676 (that reveals increasing return to scale situation). Using this data will determine that marginal cost has been 878.77294.

To estimate elasticity we used panel data approach by Iran's electricity distribution organization data. The estimation result showed industrial elasticity has been the most. General elasticity had been the second and residential elasticity has been the least.

We could see these results in below table:

Industrial	General	Residential
0.35 (0.00159)	0.24 (0.00274)	0.11 (0.00258)

5. Conclusion

Using elasticity and marginal costs will lead us to Ramsey prices. We solved this equation by using Matlab that the answers were:

Industrial	General	Residential
912.017	927.825	932.783

That revealed:

1. Subsidies abolishing should continue to reach Ramsey prices
2. Comparing these results with others shows we could not ignore spatial differences and regional pricing should proceed.
3. The grate difference between steps is not advised.
4. While some believes industrial consumption is inelastic it conversely revealed that it is the most elastic one.
5. Income policies are still the most important policies.
6. Subsidies abolishing has increased the elasticity.

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