Energy Efficiency of State and Privatized TSOs in Ukraine

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Introduction

The Ukrainian energy system and the efficiency of its distribution companies, called Oblenergos, in particular, have often been discussed in the context of improving energy efficiency. The underlying goal of this research is to find an effective national regulatory framework and also to determine the difference in operating efficiency of state and privately owed TSOs.

The installed capacity of the Ukrainian power industry is dominated by nuclear generation (47%), closely followed by thermal plants (44%). The main renewable source of power is hydropower generation (6%). Other renewable sources such as wind, solar, geothermal, and small-scale hydropower are very modest and account for less than 1% of total power generation. The Ukrainian power system from generation, transmission to distribution is plagued by major structural problems. These include outdated production facilities and the need of major investment in order to restore the production capacity.

Historical Perspective

Ukraine gained its independence in early 1990s and since then the energy sector has been under continuous reformation. During the mid-1990s, Ukraine was the first among the Former Soviet Union countries to liberalize the electricity sector. In 1995, a national government body in charge of regulatory and other activities in the electricity industry was established and named NERC – National Electricity Regulation Commission. Subsequently, in 1997, the Ukrainian wholesale energy market was established.

The energy sector in Ukraine is represented by the United Energy System of Ukraine that sustains the production, transmission, distribution, and supply of power to residential and industrial sectors. As previously indicated power production consists mainly of nuclear, hydro, and thermal power plants. Recently, several solar and wind energy projects have been developed. In 2011, total power generation was estimated to be 193,9 TWh.

Liberalization Period

During the liberalization, the power sector was restructured with the unbundling of generation and distribution in order to increase competitiveness. However, a large share of the sector is still state-owned and new initiatives for full liberalization are being discussed. According to a recent statement by IEA Executive Director Maria van der Hoeven, Ukraine's ongoing efforts to liberalize its electricity markets are in line with the Energy Community Treaty and will require increased investment to achieve energy efficiency (see reference: IAE Ukraine 2012 Energy Policy Review).

The wholesale power market in Ukraine is a single-buyer model with Energorynok being the only buyer. Energorynok purchases electricity at wholesale market prices and sells it to Oblenergos and independent suppliers at a mixed rate. Oblenergos are regional monopolies responsible for distribution and supply to residential and industrial consumers at NERC-regulated tariff rates.

Regulation Framework

According to Jamasb and Pollitt (2001), a number of countries are instituting incentive regulation in order to promote improvement in operations of utility power transmission and distribution companies. There are several benchmarking methods used. Following an analysis of benchmarking methods for distribution utilities, Irastorza (2003) lists several risks regulators should be aware of. Developing a reference for regulators for comparing one utility's costs and other characteristics to other utilities in order to improve utility's efficiency showed several problems. For example, for regional monopolies, costs and qualities are different for legitimate reasons, such as variations in customer base, population density, terrain, and consumption patterns.

Davies, Wright and Waddams Price (2005) stress the importance of privatization and regulation issues for developing countries. However, besides the fact that there are extensive research studies done on the topic of privatization reforms, there is no single measure of reform effectiveness. The main goal of privatization in developing countries is to increase investment thereby improving quality and reducing network losses. There are other issues to address, such as the control over monopoly power and large regulator's profits after privatization. Newbery and Pollitt (1997) highlight the conditions for effective regulation: setting adequate tariff levels and being independent from political pressures with clear objectives

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and procedures for dispute resolution and licensing issues. Hooper and Medvedev (2008) sum up the discussion stating that for transitional economies, energy efficiency improvements can be reached by a combination of higher prices and regulatory and policy reforms.

TSOs Regression Analysis Model

The Ukrainian electricity industry is a mixed system of public and private ownership. This paper's focus is on the difference between public and private distribution company operations. According to Irastorza (2003), in order to compare utility performance, different methods can be used. Most often studies are based on average methods, frontier methods (DEA, COLS, SFA) but also a method of ordinary least squares (OLS). Regulators use this regression analysis to estimate the differences in productivity among utilities companies. This method is used to distinguish between efficient and inefficient companies along a regression line of average efficiency. The risks associated with this method reflect the sensitivity of results to functional specification. Choices of variables or residuals may measure not only inefficiencies but also factors unexplained by a model.

In studies conducted by Jamasb and Pollitt (2001), distribution efficiency is analyzed with a variety of variables. The outputs of distribution utilities are measured by energy delivered through network lines to the consumer nodes, and losses are measured in transmission (Edvardsen and Førsund, 2003).

In this research the output variable, operating costs (OPEX in thousand UAH), are used as a dependent variable. Ukraine is known for high energy losses in the network. On average energy losses in the Ukrainian network are 2 - 2.4 times higher compared to the average rates in developed countries (see reference: The Ukrainian electricity system). These losses are included in the model.

The model also includes capital and labor costs for power line and transformer operation. Peak load is included in the model as are geographical factors that can influence utility performance.

In sum, the independent variables included in the model are:

AREA – Served area (square meters)
CONNECT – Number of connection points (units)
LOSSES – Energy losses in network (%)
MAXLOAD – Maximum load in a period (MWh)
LABCOST – Labor costs per person (UAH)

There are also two dummy variables included in the model. These variables represent the unique characteristics of each distribution company including its ownership type.

DUMMY HILL – dummy variable, which is equal to 0 if the area is flat, and equal to 1 if the area is with hills.

DUMMY PRIVATE – dummy variable, which is equal to 0 if the ownership is state, and equal to 1 if the ownership is private.

Data is taken from NERC on 25 national utility companies for the 2002 – 2006 time period. The research data consists of 125 data points. The descriptive statistics for the dataset are provided in Table 1.

	Average	Median	Standard Deviation	Minimum	Maximum
OPEX	105,817.4	84,027.0	76,172.9	21,169.0	503,225.0
AREA	23,640.2	24,600.0	6,637.2	8,100.0	33,625.0
CONNECT	769,419.8	627,842.0	380,332.4	324,442.0	2,014,882.2
LOSSES	19.1	17.9	8.2	0.1	35.2
MAXLOAD	936.5	562.0	895.2	253.0	4,301.0
LABCOST	980.4	949.4	191.8	611.9	1,993.0

Table 1: Summary Statistics. Number of Units - 125

The regression analysis results are presented in Table 2. As we see from the table, adjusted R squared is equal to 87%. It is a valid model because the dependent factor of operational expenditures is explained by 87% of the independent variables, such as area served, number of connection points, losses in the network, maximum load, and labor costs. The Durbin Watson statistics is not close to 2, which indicates there is autocorrelation between residuals. The dummy variable of ownership has an insignificant impact, but there are indications that operational expenditures tend to decrease in the case of private ownership.

Conclusion

Regulatory mechanisms should be designed to fit the ownership structure to which they are applied. Since liberalization and the change of ownership structure, different regulatory frameworks have been used in Ukraine for analyzing the operations of distribution companies. The quality of data and the choice of model framework are critical in the analysis of regulation and efficiency of distribution company operations under different types of ownerships.

Data used for the research in this paper is analyzed using the ordinary least square method (OLS). The results suggest that OLS can be used for benchmarking by the regulatory body to compare utility performance. Regulators can use this regression analysis in order to distinguish between efficient and inefficient companies operations. Results of this study suggest that privately owned distribution companies have a lower rate of operational expenditures. However, further analysis is needed to define the most effective regulatory framework for efficiency of distribution companies in Ukraine.

Method: Panel Least Squares
Cross-sections included: 25
Total panel (balanced) observations: 125

Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-3.882	1.123482155	-3.455289956	0%
CONNECT	0.570	0.082789093	6.882431345	0%
MAXLOAD	0.266	0.054269075	4.903586632	0%
AREA	0.506	0.086493774	5.852085206	0%
LABCOST	0.412	0.112710069	3.653884006	0%
LOSSES	-0.831	0.283340352	-2.934045378	0%
DUMMY_HILL	0.243	0.05958182	4.070984159	0%
DUMMY_PRIVATE	-0.079	0.046183707	-1.714842038	9%

R-squared	0.881218872	Mean dependent var	11.58370616
Adjusted R-squared	0.874112309	S.D. dependent var	0.5778013
S.E. of regression	0.205007688	Akaike info criterion	-0.269678328
Sum squared resid	4.917293819	Schwarz criterion	-0.088666249
Log likelihood	24.85489553	F-statistic	124.0007087
Durbin-Watson stat	0.954305361	Prob(F-statistic)	4.64E-51

Table 2: Regression Analysis by Method of Least Squares

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