HOW WE CAN RESTORE THE BALANCE IN THE ROMANIAN ENERGY MARKET

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Abstract

National Power System is a complex system that includes a number of subsystems with different structures and components. With market power relations between subsystems SEN is performed on a commercial basis. Units of the system must create information systems and specific research in order to follow the dynamic environment by adopting specific strategies trends and evolution.

The introduction of competition in the production and distribution of electricity requires a rethinking of business activity in the energy system units. Claims liberalized energy market participants flexible behavior imposed by the existence of competition and the need to adapt to all the changes that occur constantly.

Market mechanism should introduce competitive pressure from increasingly large on companies in the sector, directly or through contracts and tariffs. In a competitive environment the producers will have to reduce their costs given that the installed capacity exceeds consumer demand. Energy suppliers are obliged to diversify their services and will be encouraged to find the most appropriate level of security in energy supply. Entering the competition implies responsiveness to consumers.

Keyword: mathematical model, balance, energy market
JEL Classification: C6, E2, E3, L7

I. Introduction

The year 2010 was crucial for the Romanian energy market, as EU directives forced to open 100% of the energy market and liberalization.

This paper aims to analyze the electricity market equilibrium in the context of liberalization and introduce a programming language for modeling economic equilibrium. GAMS, generalized algebraic modeling "is a modeling language that was

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originally developed for linear and nonlinear programming. From that time was very requested GAMS scale economic projects and modeling operations. The goal is the analysis of electricity market liberalization in the context of software using GAMS we determined the overall balance of the electricity market, divided into the three main sectors: hydro, thermal and nuclear.

The analysis of general market equilibrium is observed that the market has values close to 1, which represents the equilibrium value, but indicate applying energy policies to stimulate or reduce the effects of component.

II.1 Description of the general equilibrium model

The basic model is a general equilibrium model for the Romanian energy system, as part of the national economic system.

The base model contains the following 12 equations:

$$y(-\Pi^{Y}) = 0 \quad \Leftrightarrow y(-p_{Y} + CU_{Y}) = 0 \tag{1}$$

$$EL(-\Pi^{EL}) = 0 \quad \Leftrightarrow EL(-p_{EL} + CU_{EL}) = 0 \tag{2}$$

$$CR(-\Pi^{CR}) = 0 \quad \Leftrightarrow CR(-p_{CR} + CU_{CR}) = 0 \tag{3}$$

$$P_{Y}\left[Y - \frac{\partial \Pi^{CR}}{\partial P_{Y}} CR\right] = 0 \tag{4}$$

$$P_{EL}\left[EL - \frac{\partial \Pi^{CR}}{\partial P_{EL}} CR - \frac{\partial \Pi^{Y}}{\partial P_{EL}} Y\right] = 0 \tag{5}$$

$$P_{L}\left[\overline{L^{CR}} - \frac{\partial \Pi^{Y}}{\partial P_{L}} Y - \frac{\partial \Pi^{EL}}{\partial P_{L}} EL - \frac{\partial \Pi^{CR}}{\partial P_{L}} CR\right] = 0 \tag{6}$$

$$P_{K}\left[\overline{K^{CR}} - \frac{\partial \Pi^{Y}}{\partial P_{K}} Y - \frac{\partial \Pi^{EL}}{\partial P_{K}} EL\right] = 0 \tag{7}$$

$$P_{AF}\left[\overline{AF^{CR}} - \frac{\partial \Pi^{Y}}{\partial P_{K}} Y\right] = 0$$

(8)

$$P_{TERMO}\left[\overline{TERMO^{CR}} - \frac{\partial \Pi^{EL}}{\partial P_{TERMO}} EL\right] = 0$$

(9)

$$P_{HIDRO}\left[\overline{HIDRO^{CR}} - \frac{\partial \Pi^{EL}}{\partial P_{HIDRO}} EL\right] = 0$$

(10)

$$P_{NUCL}\left[\overline{NUCL^{CR}} - \frac{\partial \Pi^{EL}}{\partial P_{NUCL}} EL\right] = 0 \qquad (11)$$

$$V^{CR}\left[P_{K}\overline{K^{CR}} + P_{L}\overline{L^{CR}} + P_{AF}\overline{AF^{CR}} + P_{RE}\overline{RE^{CR}} - \frac{\partial \Pi^{CR}}{\partial P_{Y}} CR - \frac{\partial \Pi^{CR}}{\partial P_{EL}} CR - \frac{\partial \Pi^{CR}}{\partial P_{L}} CR\right] = 0$$

(12)

- Signal conditions of the model are in the form of inequality, as follows: Conditions for variables related to profit:

  $-\Pi^{Y} \geq 0$, $-\Pi^{EL} \geq 0$, $-\Pi^{CR} \geq 0$ (13)

- Conditions for variables related to amounts:

  $Y \geq 0$, $EL \geq 0$, $CR \geq 0$ (14)

- Pricing conditions for variables:

  $P_{Y} \geq 0$, $P_{EL} \geq 0$, $P_{L} \geq 0$, $P_{K} \geq 0$, $P_{AF} \geq 0$, $P_{TERMO} \geq 0$, $P_{HIDRO} \geq 0$, $P_{NUCL} \geq 0$ (15)

Detailing the general equilibrium model equations (1) - (12) has been structured as follows:

- A point to explain the return null equations (1), (2) and (3);

- B explains the equations of equilibrium and markets goods input (4), (5), (6), (7), (8), (9), (10) and (11);

- Section C explains the equation of balance of income representative consumer (12).

II.2 Explanation of zero profit equations for the basic model

In any area where is a strictly positive profit amount must be zero, or if the profit is negative if the quantity produced in the sector to be zero, ie halt production activities. A.1. Zero profit condition for the aggregate good production Y - equation (1)

A.2. Zero profit condition for the production of electricity good EL - equation (2)
A.3. Zero profit condition for the representative consumer satisfaction CR - equation (3)
Customer satisfaction is representative shaped sector with a new production.Similar cases previously considered in the manufacturing of goods Y and EL, the profit recorded in the manufacturing sector representative associated customer satisfaction is expressed as the difference between the value of a unit of satisfaction and unit cost of production of consumer satisfaction representative.

II.3 Explain the equilibrium equations markets for goods and factors of production base model

The economic significance of the basic model equations numbered from (4) to (11) is the following: for any good or factor of production with a strictly positive price, excess supply is zero (there is equality between the quantity demanded of the good produced and / factor), or if there is excess supply over demand, the price of that good / factor is zero.

B.1. Asset market equilibrium condition for aggregate Y - equation (4)

B.2. Asset market equilibrium condition for electricity EL - equation (5)

B.3. Factor market equilibrium condition for the labor L - equation (6)

B.4. Factor market equilibrium condition for capital K - equation (7)

B.5. Market equilibrium condition for other inputs used to produce goods AF aggregate Y - equation (8)

B.6. Factor market equilibrium conditions for RE energy resource - the equations (9), (10), (11).

II.4 Explain the equation of equilibrium income representative consumer base model

For any strictly positive consumer income that you spend on buying goods produced in the economy, the difference between the initial endowments of production factors and consumption value is zero, otherwise the consumer's income is zero. The basic model of general equilibrium representative consumer disposable income derived from endowments value factors of production (capital, labor, three subcategories of energy and other inputs used to produce aggregate good Y). Eating performed in order to obtain a representative consumer satisfaction is maximized for aggregate asset purchase Y, a good power consumption EL and labor factor L in the form of free time.

Last equation model (12) is provided that the product of the consumer's disposable income and the difference between the total value of production factors and the amount of use made be zero.

III.1 Description of input data

Input data for general equilibrium model that we presented above have been taken from official sources, the main source being Romanian Statistical Yearbook, 2011 edition, where data were extracted and processed for 2010. For input we used the energy sector belonging to the 2010 report published by the National Regulatory Authority – ANRE.

Input data for general equilibrium models are organized national accounts matrices, matrices that have basis in the literature on the King (1985). The main categories of data input to the model based on the general equilibrium are as follows:
1. Data entry on the demand for goods in the economy are considered by consumer representative:
a common electricity demand it;

B. aggregate demand in the economy good Y;

C. Application of the production factor labor L, consumed directly by the consumer representative without being used as input to any production process (be construed as free time consumed).

2. Input data on inputs / inputs used in the production process in the economy considered are:

A. inputs used to produce electricity good EL;

B. aggregate inputs used to produce goods in the economy Y.

3. The input data for the production of goods in the economy are considered:
A power good output EL;

b good aggregate production in the economy Y.
4. Input data on production factors endowment economy are considered the representative consumer:

a production factor endowment of labor L;

b endowment with production factors capital K;

c production factor endowment of energy resources RE;

d provision of other inputs AF, used to produce aggregate good in the economy, Y.
Input data results were obtained from processing raw data has been directly taken from official sources.

III.2. Summary of input data for the base model matrix of national accounts
The input data for the base model were generally summarized in a single table, the model matrix of national accounts, Table 1:

Table 1

Matrix of national accounts for the basic model of general equilibrium

Bunuri şi factori de producţie	**SECTOARE DE PRODUCTIE (Valoare tranzacţii, milioane lei)**			**DOTĂRI**	*TOTAL PE LINII*
	Y	**EL**	**C**	**CR**	
PY	*428.893,88*		-355.448,83		*73.445,05*
PEL	-35.468,35	*43.006,42*	*-40.847,38*		*-33.309,31*
PC			904.792,62	-904.792,62	*0,00*
PL	-154.234,08	4.671,05	-508.496,41	*671.234,59*	*13.175,15*
PK	-115.272,00	16.330,70		*123.350,30*	*-8.252,40*
PAF	-117.879,45			*117.879,45*	*0,00*
PTERMO		-8.121,23		3572,80	*-4.548,43*
PHIDRO		-320,89		320,89	*0,00*
PNUCL		-1.015,38		1.015,38	*0,00*
TOTAL column	*6.040,00*	*-18.881.73*	*0,00*	*12.580,79*	*40.510,05*

The analysis table can be seen balances or imbalances in the economy resulting from the analysis considered the request input, production and provision of goods and factors of production in the economy model:

1. of the total column Y is observed that there is an imbalance in the production of aggregate good Y: output value is exceeded the value of all inputs used in the production process, the difference is the result of the year in total gross national economy in 2010, stating existence of very small profit in this sector aggregate considered;

2. EL column of all I noticed that there is an imbalance in the production of electricity good EL opposite sign as in the case of the manufacturing sector of the good Y, so the value of inputs used in production exceeds production; disequilibrium can be explained by massive capital inflows in 2009-2010 in the energy necessary works and comissioning of hydroelectric Lotru-Ciunget changing the equilibrium between the input and output value;

3. Column C of all I noticed that there is imbalance in the production of consumer satisfaction, representative explained that the construction of the model, so aggregate values for aggregate consumption good Y, the best power consumption and leisure EL even lead output value for the representative consumer satisfaction;

4. of the total CR column I noticed that there is an imbalance between the consumption conducted by consumer representative and value factors of production facilities thereof; difference can be explained by excess production factor endowment of labor, which is modeled perspective dual use: productive purposes to produce both substantial economic goods and consumer purposes to the satisfaction of leisure;

5.the total on line PY noticed that there is a good market imbalance aggregate Y: it consumes less than the economy produces;

6. the total on line PEL show that there is a power imbalance EL property market, the same sign as in the case of good Y, so the consumer is required to produce less than the economy;

7. of the total PL line I noticed that there is an imbalance in the market labor production factor L: representative consumer endowment with him than using the factor L in the economy considered to produce two goods or as free time this is explained by considering the input data pattern of migrants and unemployed, two sources of disequilibrium of the factor market equilibrium;

8. of the total PK line I noticed that there is an imbalance in the production factor market capital K: Rifle representative consumer in the economy by this factor of production are lower than uses this factor in production, this imbalance is due to foreign capital and foreign loans entered into the national economy in 2010, noting that the market imbalance labor factor L is opposite to the imbalance factor K, which is specific less developed economies (number of migrants in search of better working conditions and better paid and capital deficiency);

9. of the total AF line I noticed that there is imbalance in the market of other factors of production used to produce aggregate good Y: is considered representative consumer endowment of this factor of production coincides exactly with the use of this factor in order to produce good Y;

10. the total on line PTERMO I noticed that there is an imbalance in input markets type thermoelectric energy resource: consumer representative facilities with this factor of production are lower than uses this factor to produce electricity, this imbalance is the fact that part of this type of energy resource is imported, so it is not wholly owned by the representative consumer in the economy;

11.of all lines PNUCL PHIDRO and I noticed that there are imbalances of these inputs markets: consumer representative facilities with these inputs do not match the values used to produce electricity, unlike thermal energy resource type, resources hydro or nuclear type not imported at all in 2010 in order to produce electricity.

IV. The model results

The results GAMS / MPSGE to allow steady state analysis of the relative prices of factors of production and goods considered in the model, but also allow other elements of economic analysis considered related to the consumption and production.
Table 2 Results obtained

Basic Indicator Results	Results equilibrium model, the basic model
Production level in the aggregate good Y	*0.859*
Level electricity production in the EL	*1.376*
Representative consumer satisfaction level CR	*1.025*
Aggregate asset price Y	*0.978*
The price of electricity EL	*1.211*
Labor factor price PL	*0.980*
Capital factor price PK	*1.108*
Aggregate price of other inputs PAF	*0.852*
Price factor type thermal energy resource PTERMO	*5.347*
Price factor hydro energy resource type PHIDRO	*2.352*
Price factor nuclear energy resource type PNUCLEAR	*2.352*
Representative consumer income levels VCR	*917,370*

To interpret the results we found one reference value so obtained for the equilibrium values subunit recommend economic policies / energy measures implemented to increase the level indicator, and if the equilibrium values obtained supraunitary advocates measures to reduce the level indicator. Indicator representative consumer's income is reported on endowments of production factors assessed value vector quantities through input matrix and equilibrium prices of factors.
In the analysis we found the following results:

- There is a shortage in the production of aggregate good Y and requires the application of an economic policy which involves the application of measures to increase the production of the good Y, measures such as subsidies to producers to support production.
- There is a surplus in electricity production asset EL and requires the application of an energy policy that involves the application of measures to reduce the level of production of goods or directly export EL surplus to be developed in the economy.
- The equilibrium of the representative consumer has a value close to the reference value, which means that it has met the needs of the economy analyzed.
- Asset price Y has a value very close to the value 1, which means that you can still apply economic policies aimed at increasing the price to the equilibrium value
- The price of electricity he has a good over-unit value and requires the application of an energy policy that involves the application of measures to reduce its level, measures to subsidies for investments in technology manufacturers.
- Labor factor price PL has a value very close to the value 1, which means that you can still apply economic policies aimed at increasing the price to the equilibrium value.
- The price of capital factor K has a value very close to the value 1, but over-unit which means that economic policies should be implemented aimed at lowering the price until equilibrium value.

- The price of other inputs PAF has a value less than unity which means that economic policies should be implemented aiming to increase the value of the equilibrium price
- Price factor thermal energy resource type has a value of over-unit and requires the application of an energy policy that involves the application of measures to reduce its level due to the type of energy resource exhausted.
- Price factor hydro energy resource type has a value of over-unit and requires the application of an energy policy that involves the application of measures to reduce its level since the country has a significant hydroelectric potential that can be realized through better management of existing dams and alto build dams, so necessary investment project.
- Price factor nuclear energy resource type has a value of over-unit and requires the application of an energy policy that involves the application of measures to reduce its level to a steady value

V. Conclusions

Modern energy policies seek competitive energy market opening. In this context, we can say the energy sector need to adapt to the requirements of the changes taking place in Europe and worldwide. The energy sector must be placed in a new frame with the current energy policy.
The paper was considered the most modern and latest technical mathematical models in computer science. To move from classical computer -based log processing in modern computer -based artificial intelligence.
In the market economy requires that each economic unit of the National Energy System seek to capitalize on the market as well the services they provide. Between the costs and profits of units creates an inverse relationship. Concern for maximizing the rate of return is a concern for finding solutions to reduce production costs. The analysis matrix can be observed accounts balances or imbalances in the economy considered results from the analysis of the input data on demand
Inputs, production and provision of goods and factors of production in the study economy. It was identified an imbalance in the production of the aggregate good Y, the production value is exceeded the value of all inputs used in the production process, that there is imbalance in the production of consumer satisfaction representative, I noticed that there is an imbalance between the consumption conducted by consumer representative and value factors of production facilities with its, the difference can be explained by excess production factor endowment of labor, which is modeled from the perspective of dual use. As a conclusion of market imbalance is observed aggregate market good Y and good electricity market, but also to an imbalance in the market the main factors of production.

Notations:

Π^{Y} profit resulting from the production of the aggregate good Y;
Π^{EL} - profit resulting from the production of electricity good EL;
Π^{CR} - profit resulting from the production of consumer satisfaction representative CR;
CU_{Y} - unit cost of producing good Y aggregate;
CU_{EL} - unit cost of producing electricity good EL;
CU_{CR} - unit cost of producing representative consumer satisfactio;
P_{Y} - aggregate asset price Y, used for producing representative consumer satisfaction;
P_{EL} - EL electricity price of the goods used as aggregate factor in producing good Y and also used for producing representative consumer satisfaction;
P_{CR} - value of one representative consumer satisfaction obtained;
P_{L} - price of production factors labor L, used in the production of aggregate good Y EL has good power and also used for producing representative consumer satisfaction;
- P_{K} price of production factors capital K, used in the production of good Y and good aggregate electricity EL;
P_{AF} - the price of other inputs AF aggregates used in the production of aggregate good Y (other than labor L, capital K, electricity EL);
P_{TERMO} - production factor price type thermal energy source used to produce electricity good EL;
P_{HIDRO} - price factor type hydro energy resource production, factor use in producing electricity good EL;
P_{NUCL} - the price of production factor nuclear energy resource type used in producing electricity good EL;
Y - the amount of output produced from aggregate good Y;
EL - the amount of output produced from electricity good EL;
CR - satisfaction for the representative consumer;
$\overline{L^{CR}}$ - the amount of labor factor L in the endowment representative consumer;
$\overline{K^{CR}}$ - the amount of capital K factor which is the representative consumer endowment;
$\overline{AF^{CR}}$ - the quantity of other inputs used in the production of good Y AF and are the representative consumer endowment;
$\overline{TERMO^{CR}}$ - the amount of energy resource type thermal factor, which is the representative consumer endowment;
- $\overline{HIDRO^{CR}}$ the amount of factor type hydro energy resource, which is the representative consumer endowment;
$\overline{NUCL^{CR}}$ - the amount of energy resource type nuclear factor, representative

consumer in the endowment;

V^{CR} - representative consumer disposable income.

"This work received financial support through "The Routes of academic excellence in doctoral and postdoctoral research - READ "co-financed from the European Social Fund through the program Operational Human Resources Development 2007-2013, contract no. HRD / 159 /1.5/S/137926. "

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