

Pysar, Nadiia; Dergacheva, Victoria

## Article

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## Kontakt/Contact

ZBW – Leibniz-Informationszentrum Wirtschaft/Leibniz Information Centre for Economics  
Düsternbrooker Weg 120  
24105 Kiel (Germany)  
E-Mail: [rights\[at\]zbw.eu](mailto:rights[at]zbw.eu)  
<https://www.zbw.eu/>

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## **Determination of Parity Price for Gas and Electricity in Terms of Estimation of Household Incomes and Energy Costs**

**Nadiia Pysar<sup>1\*</sup>, Victoria Dergacheva<sup>2</sup>**

<sup>1</sup>Vasyl Stefanyk Precarpathian National University, Ivano-Frankivsk, Ukraine, <sup>2</sup>Igor Sikorsky Kyiv Polytechnic Institute, Kyiv, Ukraine. \*Email: [diserdiser72@gmail.com](mailto:diserdiser72@gmail.com)

### **ABSTRACT**

The paper is concerned with comparing household incomes in Ukraine and European countries, estimating households' gas and electricity costs, as well as determining parity prices for these goods in Ukraine for 2016. The calculation of parity prices for electricity and gas was carried out by the share of household's electricity and gas costs in the respective country to its income level and by the absolute need of the corresponding household for electricity and gas in the respective country. The determination of the parity price for gas and electricity relative to household incomes and energy costs is an attempt to come up with a decision on the need to increase or decrease prices for these goods in Ukraine compared to other countries and to assess their relationship to household incomes in order to avoid fuel poverty in Ukraine. An investigation of this problem enables to focus on comparing prices and electricity and gas costs with household incomes using a sales comparison approach and determine the need to increase or decrease prices in Ukraine to the level of European prices for similar goods. This approach to determining the parity price for energy resources can be used for any other country taken as a basis for analysis and calculation.

**Keywords:** Energy Efficiency, Pricing, Parity, Law of One Price, Market Conditions, Liberalization, Common Energy Space

**JEL Classifications:** B41, R13, O15, N3

### **1. INTRODUCTION**

In the context of formation of the Common European Energy Space, the establishment of parity prices for energy resources is instrumental in the liberalization of the competitive energy market. Today, the pricing policy in Ukraine is somewhat different from that in Europe as Ukrainian electricity market goes through the liberalization stages. Electricity costs for the ultimate consumer remain clearly regulated. The National Energy and Public Utilities Regulatory Commission of Ukraine imposes tariffs according to the category of electricity consumers along with the weighted average tariff. In Europe, the regulation was abandoned with the price imposed by the market as a function of supply and demand. Thus, the average electricity prices for European households are approximately 8 times higher than those in Ukraine.

The policy of European integration primarily means building markets according to European regulations. Given the stated goals for reforming Ukrainian energy market, prices for electricity, gas

and other energy resources shall match market prices. However, given the lowest household incomes in Ukraine among all European countries and high energy consumption of households, the increase in energy prices in Ukraine to the level of prices for similar goods in European countries can result in "fuel poverty" in Ukraine.

With this in mind, the investigation and determination of the parity price for gas and electricity in terms of estimating household incomes and energy costs is a necessary and relevant objective given the need to build a socially-oriented market-based economy in Ukraine. However, the bringing of residential tariffs to the market level enhances incentives for the introduction of energy-efficiency measures.

### **2. RECENT LITERATURE REVIEW**

Among the latest publications in the search for a single price for gas, oil, electricity and assessment of the degree of market

liberalization, it is noteworthy to mention the following researchers: Bahmani-Oskooee et al. (2015) verified parity prices of the six largest oil-exporting countries by the selection method and Fourier analysis. The results support the parity in all six countries, except Russia, and indicate nonlinear interconnection of exchange rates in the countries concerned. Barrett and Li (2002) presents a new approach to analyzing the spatial price based on the estimation of maximum likelihood of the amount distribution model, including price, transfer fee and data on trade flows. This method enables to distinguish between market integration and competitive market equilibrium. The authors (Fan and Wei, 2006) established the degree of market-based economy in China through the law of one price for the overwhelming majority of goods and services. Propose to investigate the degree of market integration by the law of one price by authors (Góes and Matheson, 2015). According to Growitsch and Nepal (2009), one of the major objectives of liberalization of European electricity markets is to create competitive and efficient electricity sales markets. In this paper, the author assesses the overall performance of German wholesale electricity market through cointegration analysis and error correction modeling. Kulikov and Pak (2014) consider the law of one price for 13 Eurozone countries using a methodology based on the non-structural linear regression with spatial effects in the geographical measurement of goods and Bayesian estimates. Lee and Park (2015) analyze the goods market in terms of large and unstable deviations from the law of one price as part of flexible prices. Dehnavi et al. (2015) investigate the problems of liberalization and competition in gas markets, as well as the problems of price variance from the law of one price.

Searby (2014) believes that one of the most common standards of value is “fair market value.” He attempts to define the market approach to estimation as the asset value at market prices for comparable assets. The market-based estimation is expressed on the basis of the relevant asset characteristic, for example, its profit, sale or net asset value. Gupta (2016) investigates the competition in the oil market and states that businesses in non-competitive industries have less bearing on the decrease in oil price compared to those in highly competitive industries. Olsen et al. (2015) determine the extent to which the law of one price (integration) applies, as well as the role of each individual market in determining prices in 11 major natural gas markets, six from the USA and five from Canada. The degree of integration varies with the region. Geographically adjacent markets are typically more integrated than those located far from one another. Nick and Tischler (2014) investigate the degree of gas market integration using the threshold cointegration approach, which corresponds to the law of one price.

The above scientific works consider the methodological bases for assessing market liberalization, degree of competition of the energy market and integration into a common energy space through compliance with the law of one price. However, given the importance of research for Ukrainian energy market, estimates of parity prices of Ukrainian and European energy markets are not presented in scientific discourse. Inadequate attention is paid to the methodology for determining the parity price for energy resources. This forms the basis of this paper. Performance indices largely

depend on the adequacy of statistical data as each country has its own approaches to gathering various statistical data.

### 3. METHODOLOGY

All energy prices are stated in UAH; therefore, the price for gas and electricity in the EU countries was converted into UAH at the rate of 1 EUR = 32.40 UAH. Since in the EU energy indices, in particular for gas, are given in kWh, these units were converted into cubic meters by the formula: 1 kWh = 0.09231 cubic meters. Comparison of the level of purchasing power in Ukraine and the EU countries was carried out through the ratio of indices of average annual household incomes of the selected EU countries and Ukraine according to Eurostat for 2016 in EUR. The investigation of parity prices for gas and electricity offers three approaches:

1. Parity by household income, according to which the amount of gas (in cubic meters) that can be purchased for the average monthly salary by each country and the amount of electricity (in kWh) that can be purchased for the annual household income are determined at prices of the respective country. According to this approach, in Ukraine and any respective country the parity of prices exists where the product of Ukrainian energy resource price for the calculated amount of the energy resource hypothetically purchased for the salary in the respective country is approximately equal to the average monthly salary (to these calculations) in Ukraine. If in Ukraine the calculated annual parity income relative to the consumed energy resource is lower than the actual one, the price for the corresponding energy resources should be increased, and if higher - decreased;
2. Parity by share of energy costs at one household income, %. According to this approach, the price for energy resources in Ukraine is calculated as the product of share of household energy costs in the respective country to the income of Ukrainian household. The higher the share of costs, the higher the estimated price for energy resource and vice versa. Hence the need to increase or decrease Ukrainian energy costs towards finding parity between countries is assumed;
3. Parity by absolute electricity costs of the respective household in the respective country. Here, the parity price in Ukraine relative to another country is defined as the ratio of absolute household costs of that country to the average amount of electricity consumed by Ukrainian household. If the parity price is higher, prices should be increased and vice versa.

### 4. RESULTS AND DISCUSSION

The pricing policy in Ukraine is somewhat different from that in Europe as Ukrainian electricity market has not yet gone through liberalization. Therefore, a comparison of ultimate gas and electricity prices in Europe and Ukraine enables to determine the market need for an increase or decrease in the current price of energy resources in relation to a particular country.

Despite the increase in prices, the ratio between the cost of “blue fuel” paid by European and Ukrainian residents is now significantly different (Table 1). Given the stated goals of the Ukrainian energy

Table 1: Parity price for gas and electricity

European countries	Average annual income of households, EUR, 2016	Natural gas price, EUR/cu m, 2016	Electricity price in European countries, EUR/kWh, 2016	Difference in parity price for gas by income	Difference in parity price for electricity by income	Parity prices by share of electricity consumption, UAH	Parity prices by share of gas consumption, UAH	Parity prices by absolute electricity costs, UAH	Parity prices by absolute gas costs, UAH
1	2	3	4	5	6	7	8	9	9
Ukraine	3,378	0.24	0.03	1	1	1.28	6,879	1.28	6,879
Bulgaria	3,147	0.33	0.09	0.67	0.31	1.96	0.28	1.83	0.26
Lithuania	5,644	0.41	0.12	0.97	0.42	0.83	1.06	1.38	1.77
Hungary	4,722	0.38	0.12	0.88	0.35	1.19	6.92	1.66	9.67
Estonia	8,647	0.35	0.12	1.76	0.64	0.81	0.51	2.07	1.30
Croatia	5,726	0.39	0.13	1.04	0.39	1.71	2.79	2.90	4.72
Malta	13,572	-	0.13	0	0.93	0.66	0.00	2.67	0.00
Romania	2,448	0.34	0.12	0.52	0.18	1.48	5.69	1.07	4.12
Slovakia	6,951	0.47	0.15	1.06	0.41	1.03	4.86	2.13	10.00
The Czech Republic	7,838	0.59	0.14	0.94	0.49	1.11	4.45	2.57	10.32
Poland	5,905	0.47	0.14	0.89	0.38	0.92	2.66	1.61	4.65
The Netherlands	22,745	0.85	0.16	1.91	1.26	0.36	4.48	2.45	30.16
Latvia	6,374	0.43	0.16	1.05	0.36	0.98	1.15	1.85	2.17
Finland	23,650	-	0.16	0.00	1.31	0.99	0.00	6.93	0.00
Slovenia	12,327	0.59	0.16	1.48	0.68	0.92	0.87	3.36	3.17
Luxembourg	33,838	0.44	0.17	5.46	1.77	0.32	1.61	3.22	16.17
France	21,720	0.71	0.17	2.17	1.14	0.74	1.69	4.76	10.90
Cyprus	14,020	-	0.16	0.00	0.78	1.16	0.00	4.83	0.00
Greece	7,504	0.69	0.17	0.77	0.39	2.05	0.88	4.56	1.96
Austria	23,694	0.71	0.2	2.37	1.05	0.66	1.19	4.61	8.34
Great Britain	21,136	0.53	0.18	2.84	1.04	0.63	2.76	3.94	17.29
Sweden	25,202	1.2	0.2	1.49	1.12	1.59	0.05	11.83	0.35
Spain	13,685	0.9	0.23	1.08	0.53	1.02	1.63	4.14	6.59
Italy	16,247	0.88	0.23	1.32	0.63	0.60	4.58	2.87	22.05
Portugal	8,782	0.87	0.24	0.72	0.33	1.47	0.79	3.81	2.05
Ireland	22,407	0.72	0.23	2.22	0.87	0.85	1.34	5.67	8.89
Belgium	22,293	0.56	0.27	2.83	0.74	0.88	2.28	5.78	15.04
Denmark	28,659	0.78	0.31	2.62	0.82	0.67	0.77	5.66	6.53
Germany	21,263	0.68	0.3	2.22	0.63	0.84	2.35	5.31	14.80

Calculations of the author in Table 1 consist of an analysis of the information base: All-Ukrainian Information and Statistical Information of European Institutions in the Field of Natural (2017), Mean and Median Income by Household Type (2017), Socio-Demographic Characteristics of Households in Ukraine (2017), Electricity Consumption by Industry, Transport Activities and Households/Services (GWH) (2017), Electricity Prices in Europe (2017).



market reformation, the prices for energy resources should be brought to market prices and the level required to achieve parity of import price. In Ukraine, prices are formed with account for the use of gas of different origin. The corresponding volume of domestic gas production covers only 70% of household needs (direct supplies and gas for heat production), with the remaining 30% being imported from other countries. Today, part of the business selling gas to households remains unprofitable, and household gas prices are subsidized mainly using small profits from sale of Ukrainian gas and other activities. Returning prices to the previous level would mean an increase in losses.

The increase in the budget and trade balance deficit can only be stopped by leveling household prices. Along with the increase in utility prices, it is also necessary to improve the quality of services due to market competition. In Ukraine, however, the increase in prices for energy resources due to disproportionate increase in energy prices and household incomes brings about poverty of Ukrainian households.

In the EU countries, the average PPP GDP is 36,326 US dollars, which is approximately 4 times higher than that in Ukraine. In particular, in Italy, France and Germany the average PPP GDP is respectively 4, 4.5 and 5.3 times higher than that in Ukraine [13].

Below is a table that is based on the statistical data of references 14-20 and characterizes the methodology for determining the parity price for gas and electricity in terms of estimation of household incomes and energy costs.

The calculation data in Table 1 (columns 4 and 5) enable to obtain information on the price of energy resources in Ukraine relative to each country if Ukraine had household incomes similar to those in other countries. Or, how much household incomes in Ukraine should be increased or decreased to achieve similar energy prices parity in order to avoid fuel poverty in Ukraine. For example, having compared household incomes in Ukraine and Luxembourg, we calculated that gas prices relative to this country should be reduced by a factor of 5.5 since household incomes in Ukraine are 10 times lower than those in Luxembourg, where gas prices are only 1.8 times higher than Ukrainian ones. When it comes to Poland, we could raise gas prices by 0.11% as Polish household incomes exceed Ukrainian ones by 1.8 times considering the fact that gas prices in Poland are 1.9 times higher than Ukrainian ones.

According to the second approach (see columns 6, 7 in Table 1), it appears that if Ukrainian households had the same share of energy costs as in a particular European country, that energy price would be acceptable relative to the Ukrainian household incomes. For example, if the share of gas costs in Hungarian household incomes is 0.07%, the gas price in Ukraine should be 1.19 UAH given the same share of gas costs in Ukrainian household incomes. In this case, we equated the volume of energy consumption.

According to the third approach (columns 8, 9 in Table 1), it becomes clear what price for energy resources would be acceptable for Ukraine in order to avoid fuel poverty, if Ukrainian household income had the amount of energy costs similar to that in other

countries. In this case, the comparison considered the prices of energy resources in different countries. For example, if Ukrainian households had similar absolute energy costs as the average Italian household, Ukrainian households would pay 2.87 UAH for electricity against 1.28 UAH/kWh, i.e. the electricity price relative to Italy can be increased by another 1.59 UAH.

## 5. CONCLUSION

As a result, the growth of purchasing power parity of Ukrainian households is expedient together with the increase in prices. Otherwise, Ukrainian households are under the threat of ending up in the category of poverty, which will mean an increase in spending on targeted subsidies in Ukraine. In addition, the market will face a non-payments crisis, and consequently, a shortage of funds for the purchase of fuel and underinvestment of the industry. Increase in energy prices is only one of the prerequisites for creating competitive, transparent and efficient markets. Market prices will allow to accumulate adequate resources for upgrading the infrastructure, implementing innovations, as well as increasing domestic production.

The government should encourage business initiative as the development of small and medium-sized businesses is a way to achieve simultaneous growth of economy and household incomes while restraining inflation on consumer goods. Another tool for reforming the energy market is incentives for energy efficiency, i.e. reducing energy consumption and costs. To consume less and pay more for high quality services is the basis of a rational economy in current conditions. Ukraine's monopolists should be replaced by a whole industry of customer services, which means competition that is required to form a fair price for energy resources.

Thus, any monetary authority (the National Bank of Ukraine or any other strategic investor) can use the methodology for calculating the parity price for gas and electricity from the perspective of forecasting social and economic development. It is also important to consider the divergence of difference between the fundamental assessment of a currency pair and its market valuation. The greater the divergence, the higher the grounds for changing the direction of the exchange rate for the respective currency pair.

The effectiveness of the parity price model provides for the real exchange rate stabilization in the long-term horizon period, but does not deny the significant short-term deviations from its average equilibrium value for the period under review. As part of anti-inflationary monetary policy, methods can be used that are aimed at adapting to inflation rather than attempting to fight against it. These methods include adaptation policy that is implemented through indexation of incomes. The increase in prices caused by inflation inevitably entails a decrease in real household incomes, especially those households who cannot protect themselves from depreciation of money. In this regard, there is a need for full or partial indexation of incomes through the raise in wages of public-sector employees, retirement benefits, cash payments and household savings considering the increase in prices. The indexation itself does not eliminate inflation, but only mitigates

its adverse effect, although it can become a formidable inflation factor if implemented in the context of the budget deficit that is financed by money emission.

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