DEMAND OF NATURAL GAS BY THE HOUSEHOLDS

[1]Associate Professor PhD Radev Yuli,
[2]Assistant Professor PhD Boiadjiev Martin

[1]Mining and Geology University 'St. Iv. Rilski',
dep. Economics and management, Sofia, Bulgaria
[2]Mining and Geology University 'St. Iv. Rilski',
dep. Oil and Gas, Sofia, Bulgaria

Abstract. *The article presents empirical analysis of demand of natural gas in 12 countries from European Union (EU), including Bulgaria. The ultimate goal is to assess the short-term and long-term elasticities of demand in different countries and in Europe as a whole. These elasticities have to give a plausible picture of changing consumption of natural gas by the households and to allow determination and interpretation of the key indicator of the organization of gas sector – the relative price elasticity.*

JEL: C23; C50; L95; R22.

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As independent variables in the dynamic log-linear model are involved the lagged demand of natural gas from previous periods, the duration of heating season (with the Heat Degree Days indexes), the (real) price of natural gas, the prices of substitutes of natural gas – fuel oil and electricity, and the income. The results received prove the existence of common characteristics, but also of structural differences, in consumption of gas by the households in different countries. They underline the advantages of shrinkage heterogeneous estimators as well as of the methods of fixed effects in the processing of Time Series-Cross Section (TSCS) data and in the assessment of elasticities of demand.

The assessments of elasticities of demand to the price of gas and the income in short-term perspective present inelasticity, which further (in long-term) changes toward explicit expression of elasticity. The lower values of own-price elasticity and cross-price elasticity, as well as the slow pace of adjustment, are logical outcomes of restricted technological opportunities for substitution of natural gas with other energy sources in short-term. The empirical results confirm the expectations for a value of the relative price elasticity of about 4-5.

Section 1 discusses briefly the econometric model, the methods for estimation of the parameters and data used. Section 2 presents some final results, section 3 is for generalizations, inferences and conclusions.

This article is inspired by Maddala at al. (1997) and Nilsen at al. (2005).

1. Specification of the model and techniques for assessment

Econometric analyses of consumption of natural gas by the households in Europe attracted interest for several reasons. On the first place we will note the scale of reforms in gas sector as a result of deregulation and increasing demand and supply of natural gas. The second reason stems from the fact that most empirical analyses are made before deregulation and institutional changes. The third reason comes from the contemporary appraisal methods, and especially – from the iterative shrinkage estimators, which with their reliable assessments of elasticities, became the most precise instrument for analyzing of energy demand on the base of TSCS data (Maddala at al., 1997, Baltagi at al., 2000).

The empirical analysis presented here gives an answer of one more challenge. It assesses directly the key indicator of organization structure of gas sector, the relation between long term price elasticity and short term elasticity.

In the empirical research are included the main European consumers of natural gas, as well as some countries from Central and Eastern Europe (CEE), using the southern part of the gas route Russia-Europe. A total 12 countries were analyzed, numbered as follows: Austria (1); Finland (2); France (3); Germany (4); Greece (5) Spain (6); Italy (7); United Kingdom (8); Poland (9); Romania (10); Chez republic (11); Bulgaria (12). The results from the research give an opportunity for deducting important conclusions and generalizations about new Europe and for comparative analysis of the years of transition in CEE. In this sense a certain merit of this research is the obtained representative picture for Bulgaria.

The observations of the different countries vary from 9 to 25 years in dependence on the data availability and the traditions of the household gas sector (having in mind the short history of this sector in Bulgaria and Greece). The combined TSSC data from the anticipated 240 yearly observations provide information for the prices of natural gas and its substitutes to the final consumers, private income and the index of the days from the heating season (HDD – Heating Degree Days). The private disposable income in the model is presented by the consumer expenditures per capita, the fuel oil presents petroleum products, and HDD is an indicator of the energy amount, necessary for heating.

The different variables are bounded into the dynamic log-linear model:

$$y_{G,i,t} = \beta_{0,i} + \beta_{y,i} y_{G,t-1,i} + \beta_{G,i} p_{G,t,i} + \beta_{E,i} p_{E,t,i} + \beta_{F,i} p_{F,t,i} + \beta_{m,i} m_{t,i} + \beta_{z,i} z_{t,i} + \varepsilon_{t,i}, \quad (1)$$

for each t=1,2,…T_i (the number of the years, specific for each country) and i=1,2…12 (the number of the countries), where $y_{G,t,i}$ = ln(residential natural gas consumption per capita in year t), $y_{t-1,i}$ = ln(residential natural gas consumption per capita in year t-1), $p_{G,t,i}$ = ln(residential real price of natural gas), $p_{E,t,i}$ = ln(residential real price of electricity), $p_{F,t,i}$ = ln(residential real price of fuel oil), $m_{t,i}$ = ln(real income per capita), $z_{t,i}$ = ln(real heating degree index), and $\varepsilon_{t,i}$~N(0, ψ_i^2) is error term (ψ_i^2>0).

The dynamic structure of the model, which allows embracing of the evolution of energy consumption and distinguishing of short-term and long-term effects on the demand, is achieved through the lagged value of the demand of gas by the households. This variable takes account of the changes in the gas consumption by the households, ordinarily provoked by the movements in the prices of alternative energy sources. The gas infrastructure requires large investments in long-term and expensive assets therefore adjustment of the consumption, especially by households, should be accomplished at a lower pace.

The consumption of natural gas is expressed in ton oil equivalent per thousand capita (toe/thous.cap). HDD index usually has free dimension and participates in the model with the number of the days in the heating season during for which the average temperature is lower than 17 grads. In the entire equations symbol T is substituted by T_i, because time series are not balanced. For achieving a larger flexibility in the model, it an expand version of the equation (1) should be constructed with the price of natural gas $p_{G,t-1,i}$ as additional lagged variable with $\beta_{G,-1,i}$ being its respective coefficient.

In the monograph Theory of disequilibrium (Radev, 2011) the advantages and shortcomings of alternatives methods for assessment of such kind of models are considered in details. The emphasis of this theory is placed on the assumption for homogeneity/heterogeneity of the parameters in different cross sections. This problem is a serious challenge for the model. The potential differences between cross sectionnal data of energy demand in single country is an argument against the homogeneous estimators, while the restricted numbers of time observations in each country shake the faith in the individual regressions. In earlier researches of Maddala at al. (1997) and Baktagi at al. (2000) it was argued that the individual regressions for different cross sections increase the degree of flexibility, but very often inaccurateestimates, such as positive values of price elasticities or excessively large differences (taking into account the joint energy and economic perspectives) between different countries. On the other side the models with homogeneous parameters retain the highest degree of freedom, but lead to loss of information, imposed homogeneity between cross sections and failure to recognize the potential structural differences between the countries.

The subjectivism in the preferences and unadjusted interpretations of the parameters estimates and confident intervals are avoided by using eleven alternative estimators. However, the attention is focused to the intermediate in respect to heterogeneity estimators of fixed effects (FE) and of random effects (RE), to the model of random coefficients (RCM), and mostly - to the more innovative iterative shrinkage estimators of Maddala. Shrinkage estimators are the balance between homogeneous and heterogeneous methods and present the best way for overcoming of the problem with restricted observations over the time. For the higher reliability of the results received these methods become the main instrument for assessment of regressions based on the TSCS data.

In this specific case the shrinkage estimators give opportunities for simultaneously accounting for the common characteristics in development of energy consumption in Europe as well as for the structural differences in different countries. With these individual, and gravitating over the common average, assessments of elasticities the relative price elasticities should be determined in most correct way and on this base there should be made plausible conclusions about organizational structure of gas sector in Europe and the preferences towards spot trading and/or long-term contracting.

The first six out of the applied 11 methods are homogenous estimators: (1) Ordinary Least Square (OLS); (2) Generalized Least Square with the first order autoregressive error term (GLS-AR1); (3) Random Effects (RE); (4) Random effects with the first order autoregressive error term (RE-AR1); (5) Fixed Effects (FE); (6) Fixed Effects with the first order autoregressive error term (FE-AR1).

Besides them five heterogeneous methods are used: (7) Random Coefficient Models (RCM), which presented a common estimate for the whole database, determined by the two-step procedure of Swamy (1970); (8) Individual OLS on each country; (9) Individual GLS-AR1 on each country; (10) Iterative shrinkage estimators using country specific OLS estimates as initial values (Shrinkage, OLS); and (11) Iterative shrinkage estimators using country specific GLS-AR1 estimates as initial values (Shrinkage, GLS-AR1).

The processing of TSCS data is performed by the software product STATA 8.1 Intercooled, and the compatible with this product GLLAMM and WinBUGS, necessary for computing of shrinkage estimates.

In addition to the previous research of energy demand the statistical data gives a preliminary picture for the ranges, in which the elasticities in respect with the gas price and income change their values. There is no doubt that when the investments in heating infrastructure are undertaken, the opportunities for technological substitutions among alternative energy sources are very restricted in short-term. The large investment expenditures make the switch to other fuel exceptionally expensive, therefore the ex-ante expectations are for further increase in the values of own and cross price elasticities (in long-term). But do the empirical results prove that?

2 Analysis of final results

The empirical results from our study are represented in tables 1 and 2. In table 1 are illustrated the estimates of all seven parameters (incl. of the intercept β_0) in the model of demand of natural gas by the households, computed through the announced 11 estimate methods. As it is well known, the parameters of independent variables correspond to the short term elasticities. The estimates of individual for different countries parameters, provided by the heterogeneous estimators, are presented with their maximal, average and minimal values. For Bulgaria a special comment is accomplished. Shrinkage estimations, performed with the programme GLLAMM[1] on the base of the initial OLS and GLS-AR1 individual assessments, don't provide reliable values, so the formula BLUP[2] (Best Linear Unbiased Prediction) is preferred:

The overview of the results shows that, as in the previous similar energy research, the present regression analysis concentrates the explanation power mainly in the lag-consumption, the heating days and in the price of natural gas. High values of the parameter of lagged consumption β_Y (varying from 0.813 to 0.967 provided by the homogeneous estimators and from 0.320 to 0.662 provided by the heterogeneous estimators) indicate very slowly adjustment. Setting aside from the short-term dynamics, the parameter β_Y get a picture for the half-life of consumption of natural gas by households

[1] The method GLLAMM (General Latent Linear and Mixed Models) maximizes marginal log-probability of the algorithm Nuton-Raphson in the version of STATA.

[2] In the formula BLUP $\hat{\beta}_i$ is the shrinkage estimate of cross section i, $a_i = \sigma_i^2/n_i(\sigma^2 + \sigma_i^2/n_i)$ is the share, σ_i^2 variation of cross section i, σ^2 is the total variation, $\hat{\mu}$ is the common average estimate, and b_i is the estimate of cross section i.

(τ, $\tau = \frac{\ln 0.5}{\ln \beta_Y}$). The half-life varies from 3.35 to 20.66 years across the homogeneous estimators and from 0.61 to 1.68 years across the heterogeneous estimators.

All heterogeneous methods, as the FE methods, provide positive and statistical significant parameters of HDD index at 5% level of significance. These results are expected, having in mind, that HDD usually is associated with increasing demand of natural gas.

In similar way, though at a lower level of significance, heterogeneous methods and FE-AR1 methods give the expected values, with negative sign of the parameters of gas price.

Table 1 Estimates of parameters (short-term elasticity)

Estimator		β_Y	β_G	β_F	β_E	β_m	β_z	β_o
OLS		0.967 (184)$^{1\%}$	0.030 (1.14)	-0.052 (-2.51)$^{5\%}$	-0.040 (-1.26)	0.015 (0.95)	-0.130 (-4.42)$^{1\%}$	1.618 (5.33)$^{1\%}$
GLS-AR1		0.967 (180)$^{1\%}$	0.033 (1.22)	-0.052 (-2.50)$^{5\%}$	-0.041 (-1.30)	0.014 (0.87)	-0.126 (-4.21)$^{1\%}$	1.588 (5.15)$^{1\%}$
RE		0.966 (163)$^{1\%}$	0.027 (0.95)	-0.050 (-2.28)$^{5\%}$	-0.034 (-1.03)	0.014 (0.85)	-0.128 (-3.85)$^{1\%}$	1.567 (4.78)$^{1\%}$
RE-AR1		0.963 (125)$^{1\%}$	0.061 (1.67)$^{10\%}$	-0.051 (-1.81)$^{10\%}$	-0.066 (-1.53)	0.006 (0.29)	-0.085 (-2.02)$^{5\%}$	1.292 (3.02)$^{1\%}$
FE		0.939 (37)$^{1\%}$	0.005 (0.11)	-0.006 (-0.15)	-0.036 (-0.79)	-0.001 (-0.00)	0.297 (1.86)$^{10\%}$	-1.790 (-1.44)
FE-AR1		0.813 (22.14)$^{1\%}$	-0.049 (-0.81)	0.019 (0.40)	-0.061 (-1.06)	0.139 (1.79)$^{10\%}$	0.162 (3.42)$^{1\%}$	-0.130 (-0.90)
RCM		0.461 (4.68)$^{1\%}$	-0.042 (-0.41)	-0.017 (-0.19)	-0.069 (-0.60)	0.998 (1.34)	0.582 (2.93)$^{1\%}$	-3.842 (-1.29)
OLS (ind.)	Min Avg Max	-0.274 0.320 0.679	-0.628 -0.083 0.268	-0.439 0.007 0.756	-0.661 -0.055 0.378	-0.295 1.308 9.007	-0.347 0.672 1.434	-30.993 -4.624 3.278
GLS (ind.)	Min Avg Max	-0.250 0.358 0.677	-1.061 -0.142 0.273	-0.426 0.006 0.756	-0.658 -0.053 0.315	-0.304 1.312 8.801	-0.303 0.723 1.778	-31.272 -4.679 2.238
Shrinkage OLS	Min Avg Max	0.519 0.662 0.784	-0.191 -0.026 0.151	-0.251 -0.020 0.081	-0.373 -0.076 0.083	-0.169 0.266 0.828	-0.042 0.253 0.563	-0.667 -0.211 0.023
Shrinkage GLS-AR1	Min Avg Max	0.373 0.608 0.744	-0.219 -0.043 0.200	-0.326 0.025 0.194	-0.437 -0.055 0.160	-0.215 0.400 1.018	-1.403 0.374 1.349	-1.089 -0.326 0.16

In brackets s are presented the corresponding t-statistics at level of significance 1%, 5%, 10%.

Both the homogeneous and heterogeneous methods reveal negative values and/or low significance of the parameters of prices of fuel oil and electricity. These results confirm the conclusion of Bohi and Zimmerman (1984, p.151), that "the effects of cross elasticities are very small or negligible". It is noteworthy, that the authors seek an explanation of this thesis in the shortcomings of the model of partial equilibrium, and not in the lack of cross price effects.

The preferences to the methods of fixed or random effects are determined through the test of Hausman (Nilsen at al., 2005). The question is about the presence of significant correlation between invisible (for each country) random effects and the repressors. If correlation doesn't exist, the method of random effects is better, and vice versa, if such correlation do exists, the preferences are for fixed effects method. The test statistics of Hausman is 13.69, the critical value in table of coefficients of Pearson for 6 degrees of freedom at 5% significant level is 12.59, which is lower than the test value. So the hypothesis that the different effects are not correlated with the other repressors is rejected in the favor of the method of fixed effects. The F-test of null hypothesis (test of the fixed effect method for equalizing of specific for the cross sections effects) points F(6,173)=1.90. Since the critic value in F-table is 1.84 at 5% significant level, the alternative hypothesis is accepted, i.e. there exist specific for the different countries effects.

The software used can compute only the common average of the heterogeneous RCM method. The test statistics for the constancy of the parameters, however, is 357.54. The critical value according to the criteria of Pearson with 77 degrees of freedom is 108.77 at 1% level of significance therefore the null hypothesis is rejected in favor of heterogeneity of the parameters of the slope. The last results assert the thesis of Maddala at al. (1997), that the null hypothesis for the constancy of parameters of the slope in different cross-sections often is rejected.

Short-term and long-term elasticities in respect to price of the gas (price elasticity), in respect to prices of fuel oil and electricity (cross elasticities) and in respect to income are summarized in the table 2.

Table 2. Estimates of short term and long term elasticities

Estimators		β_G	$\beta_G/1-\beta_Y$	β_F	$\beta_F/1-\beta_Y$	β_E	$\beta_E/1-\beta_Y$	β_m	$\beta_m/1-\beta_Y$
OLS		0.03	0.909	-0.052	0.054	-0.04	-1.212	0.015	0.455
GLS-AR1		0.033	1.000	-0.052	-1.576	-0.041	-1.242	0.014	0.424
RE		0.027	0.794	-0.05	-1.471	-0.034	-1.000	0.014	0.412
RE-AR1		0.061	1.649	-0.051	-1.378	-0.066	-1.784	0.006	0.162
FE		0.005	0.082	-0.006	-0.098	-0.036	-0.590	-0.001	-0.016
FE-AR1		-0.049	-0.262	0.019	0.102	-0.061	-0.326	0.139	0.743
RCM		-0.042	-0.078	-0.017	-0.032	-0.069	-0.128	0.998	1.852
OLS (ind.)	Min	-0.628	-0.493	-0.439	-0.345	-0.661	-0.519	-0.295	-0.232
	Avg	-0.083	-0.122	0.007	0.010	-0.055	-0.081	1.308	1.924
	Max	0.268	0.835	0.756	2.355	0.378	1.178	9.007	28.059
GLS-AR1 (ind.)	Min	-1.061	-0.849	-0.426	-0.341	-0.658	-0.526	-0.304	-0.243
	Avg	-0.142	-0.221	0.006	0.009	-0.053	-0.083	1.312	2.044
	Max	0.273	0.845	0.756	2.341	0.315	0.975	8.801	27.248
Shrinkage OLS	Min	-0.191	-0.397	-0.251	-0.522	-0.373	-0.775	-0.169	-0.351
	Avg	-0.026	-0.077	-0.02	-0.059	-0.076	-0.225	0.266	0.787
	Max	0.151	0.699	0.081	0.375	0.083	0.384	0.828	3.833
Shrinkage GLS-AR1	Min	-0.219	-0.349	-0.326	-0.520	-0.437	-0.697	-0.215	-0.343
	Avg	-0.043	-0.110	0.025	0.064	-0.055	-0.140	0.400	1.020
	Max	0.200	0.781	0.194	0.758	0.160	0.625	1.018	3.977

As a whole the short-term elasticities are very low, tend to zero and are with low level of significance. In some countries heterogeneous estimates of these elasticities are with positive values, which unfortunately are projected in long-term horizon. Inclusion of a lag price of natural gas in the model doesn't change this fact. Although all the estimators provide wide ranges of the values of cross price elasticities, the positive signs, however, are indicators, that electricity and especially the fuel oil are substitutes of the natural gas.

The homogeneous assessments of elasticities in respect to income and gas price vary relatively widely. Long-term price elasticity for example takes values from -0.262 to 1.649, and long-term elasticity in respect to income from -0.016 to 0.743. The estimations through the FE methods (FE and FE-AR1), with specific (for different countries) dummy variables for fixed effects, are distinguished from the other homogeneous estimations. The method FE-AR1 gives the most precise measurement of changing sensitivity of household consumption of natural gas in respect to income and gas price. Only this homogeneous method provides price elasticity different from zero and with previously expected positive sign. By the way, the formula BLUP (2) is constructed on the base of the standard deviation and common average estimates, received through the method FE-AR1. Both FE estimators provide long-term price elasticity between 0.082 and -0.262, while with the other homogeneous methods these results are in the range 0.794 -1.649. As for the cross elasticities in respect to price of fuel oil, again only FE-AR1 method gives the expected positive values.

Heterogeneous estimators represent large variations of individual for each country assessments. Furthermore, these assessments vary essentially between different countries, and often are with untypical signs and values. Long-term price elasticities, provided by the OLS method, for example vary from -1.588 to 0.364, while the long-term elasticities in respect to income from -0.356 to 9.343. Long-term GLS-AR1 elasticities in respect to gas price range in the interval $2.113 \div 0.327$, and these in respect to income in the interval $-0.364 \div 13.315$. Although the GLS-AR1 estimator is reliable than OLS, the both methods provided very wide variations of the elasticities in different countries.

As compared to pure heterogeneous methods, shrinkage estimators provide more plausible values of short-term and long-term elasticities, which are found in much closer intervals. Shrinkage

OLS assessments of long-term price elasticities vary between -0.445 and 0.492, and of long-term elasticities in respect to income between -0.556 и 1.930. According to the shrinkage GLS-AR1 method long-term price elasticities vary in the range $0.219 \div 0.200$, and the long-term elasticity in respect to income in the range $0.343 \div 3.977$. The interpretation of elasticities and t-statistics indicate that the individual GLS-AR1 estimates are more reliable than the individual OLS estimates, and the shrinkage GLS-AR1 estimates are more reliable than the shrinkage OLS estimates.

The close range of estimates provided by the shrinkage methods are due to the common normal probability distribution, with common average and covariance matrix of parameters (Maddala at al., 1997).

As in other investigation of shrinkage elasticities (Maddala at al., 1997; Nilsen at al., 2005), the present study provides positive price elasticities and negative elasticities in respect to income in long-term perspective, and price elasticities close to zero in the short-term perspective.

The empirical results for Bulgaria are similar to these for the other investigated countries. The positive values of price elasticities can be explained with the short history of consumption of natural gas by the household sector and relatively low demand in this sector during the time of transition toward market economy.

3. Generalizations and conclusions

This paper presents an empirical analysis of demand of natural gas (toe per thous. capita) by the households in Bulgaria and 11 other countries from European Union for the last twenty years. It was used dynamic log-linear model, which estimates short-term and long-term price and other elasticities. As independent variables in the model are involved the lagged consumption, the real residential prices of natural gas, fuel oil and electricity, personal income and the climate. The elasticities are computed in respect to the first four of them. The model may be extended with inclusion of lagged price of natural gas. The income is presented through the private consumption expenditures per capita, and the influence of climate through the indicator “heating degree days”, HDD.

Because of potential structural differences between different countries it was necessary to be provided individual for each country assessment. The individual models ensure more flexibility, but as in the previous research, they often provide inconsistent results, such as positive price elasticities. The main challenge for such heterogeneous estimation is the information about energy demand, which ordinary is published on yearly base for different countries, and in short time series of observations.

Therefore some econometric analyses, assuming a homogeneous between different countries, combine the time series and cross-sections in TSCS data. This allows an estimation of unified generalizing values of the parameters for all the countries analyzed in the research. The methods of fixed effects (FE) and random effects methods (RE) to some degree mitigate the strong assumption for complete homogeneous, although, the estimates of parameters of slow and elasticities are the same for all countries.

In terms of heterogeneity of parameters the shrinkage estimators, including RCM, occupy an intermediate position. These estimators shrink the specific parameters toward common probability distribution, but even after that the individual estimates remain heterogeneous. In this way the estimates comprise the structural differences between economically linked countries.

The homogeneous estimators give very high values of parameter of lagged variable, which means slow speed of adjustment and large difference between short-term and long-term elasticities. The methods OLS, GLS-AR1, RE, and RE-AR1 are compromised to high degree namely because of low statistical significance and incorrectness of this parameter (close to 0). The high homogeneous estimates of the parameter of adjustment as a rule are received at the presence of significant structural differences between different countries and lead to upward biased estimates of elasticities in long-term perspective. It is probably meant Bohi, when he states, that: “The advantages of homogeneous analyses are rather illusion then reality” (Bohi, 1981). The method of fixed effects, however, differed from other homogeneous methods, being the single method providing high estimates of own-price elasticity with the preliminarily expected negative sign.

The heterogeneous methods show even slower speed of adjustment. These methods give some positive price elasticities, wide variations of assessments and low t-statistics. Their advantages, however, are the simplicity and easiness in processing of the data.

The high investment expenditures in heating installation make relatively expensive the switching over the alternative fuels. Therefore the opportunities for substitution of the natural gas with other energy sources in short-term plan are strongly restricted, while the elasticities of demand are higher in long-term perspective.

As it was anticipated the methods of fixed effects and the shrinkage methods provide most plausible estimations. In more cases the results with both methods have a good statistical significance and identify the structural differences of consumption of natural gas in different countries. In contrast to the individual OLS and GLS-AR1 methods the iterative shrinkage estimators of Maddala defined a close ranges and more sensitive estimates of the own-price elasticity.

The cross-price elasticities through the both estimators are very low, which is an indicator for low sensitivity of demand of natural gas against the prices of substitutes. The cross-price elasticities through the shrinkage method take values, close to zero. The low cross-price elasticities, as the mixed signs, are expected and are met in the previous studies of energy demand. Although the elasticities in respect to prices of fuel oil and electricity vary in different countries, ultimately both energy sources, and particularly the fuel oil, are accepted as substitutes of natural gas.

The most important result from this investigation is that all the estimators provide elasticities in respect to the gas price and income in short-term plan close to 0, i.e. the demand against these variables is sincerely inelastic. However, in the long-term perspective there is a tendency toward relatively explicit expression of sensitivity, especially notable in respect to income.

The difference between long-term and short-term elasticities predetermines the comparatively high values of the main indicator of organizational structure of gas sector, the relative price elasticity. The method FE-AR1 provides relative elasticity 5.34, while the homogeneous methods between 1.85 and 30.3. Through the shrinkage OLS estimator the same indicator varies between 2.07 and 4.63, and through the GLS-AR1 between 1.59 and 3.9. These values confirm the thesis, that after temporary setback in the periods of liberalization the interest of the traders to the long term contracts steadily is increasing.

Being more flexible or with increasing duration, the long-term contracts remain an integral part of the trade with natural gas.

The present econometric study give an opportunity to be made important conclusions and generalizations about the gas sector in the United Europe, but each of the empirical results may have its own specific interpretation.

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