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ENERGY SAVING INCENTIVES AND INSTITUTIONAL ENVIRONMENT: A CROSS COUNTRY ANALYSIS PART 2 [*]

We suggest as a hypothesis that the main reason why energy efficiency of production in Russia is substantially lower than in developed economies is the weakness of energy saving incentives brought about by shortcomings of institutional system. To demonstrate this we present a theoretical model of energy consuming economic sector and show that the higher is transaction costs caused by facing firms the lower is a probability that any energy saving measures would be undertaken as a respond to a energy price rise. We included into regressions for energy intensity coefficients for 77 World economies constructed for a period of the middle of the previous decade institutional variables which made it possible to estimate demand for energy price elasticities differentiated by individual economies. Average of these indices for CIS economies (by its absolute values) showed itself to be almost four times lower than that for OECD countries.
Keywords: energy intensity, energy conservation, World economies, price elasticity, institutions, Cournot competition

Model analysis: energy consuming sector under price shock

Now consider a β – fold rise in the energy price with $\beta > 1$. The proper reaction of a firm, which we term «the adjustment project», is adjusting its cost to the new price combination by substituting any other production factors for energy. We assume that firms take this course if transaction cost of adjusting is low, and avoid it if the expect transaction cost to be high. Thus, each of the firms considered has to solve the following problem:

$$\max\left\{P^e \cdot F(E,\ldots) - p_E \cdot E - \sum_{i\in I} p_i \cdot X_i - tc\cdot\varphi\left(\frac{E}{F(E,\ldots)} - e^0\right)\right\}, \quad (7)$$

$$P^e = G - H\cdot\left(\sum_{l\in L} Q_l^e + F(E,\ldots)\right), \quad (8)$$

where in addition to previous designation, p_i - denotes the price of a non-energy factor i, X_i – stands for the input of the non-energy factor i, the initial output energy intensity being $e^0 = \frac{E^0}{Q^0}$, $e^0 = \frac{E^0}{Q^0}$, Q_l^e is an output expected by the firm considered from another firm l, I is a set of indices denoting all the used non-energy factors, L – set of indices designating all the firms other than a considered one. Thus, the sum $\sum_{l\in L} Q_l^e$ means the expectation of a given firm about the outputs of all $(n-1)$ oth-

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ers and, so, P^e is expected output price depending on this expectation. Function $\varphi(\ldots)$ is a Dirichlet type function with $\varphi(x)=1$ if $x > 0$ and $\varphi(x)=0$ in other cases, and the variable $tc=(0,h)$ has only two values – of low and high levels of transaction cost. For simplicity, we assume that low transaction cost does not affect the company's activity at all and it is therefore taken to be zero. If it is high, its level is designated by *h*, and it is high enough to stop an adjustment project (specifically by the implicit fraction).

After the increase in the energy price, the general set of the firms breaks into two subsets. The first one includes *k* firms, which face low transaction cost and thus implement the adjustment projects. The second subset consists of $(n-k)$ firms facing high transaction cost and therefore rejecting adjustment behavior.

For convenience of the further discussion, we provide a solution for the situation when transaction costs are high for all the *n* firms. In this case, all the firms experiencing a rise in the energy price also face a rise in the cost per unit of output, indicated by Δc_1. Thus, the cost per unit of output when a firm faces high transaction cost is $c^1=c+\Delta c^1$. In this case, the equilibrium solution Q^1, $Y^1=n\cdot Q^1$, P^1 differs from the initial one as follows: $Y^1< Y^0$, $Q^1< Q^0$, $P^1> P^0$ due to the new unit cost c^1 is higher than initial level *c*.

Now consider a case when $k<n$ and, so, *k* firms adjust their production factors combinations to new the price structure. Each of them reduces the energy intensity of its output by Δe and the cost per unit of output by Δc^2, thus, its unit cost is $c^1-\Delta c^2=c+\Delta c^1-\Delta c^2$ [1].

Designate by $\Delta Q^+(k)$ the output increment from the level Q^1 of a firm, which implements the adjustment project , and by $\Delta Q^-(k)$ from this level for the company rejecting it, the argument *k* in brackets means that *k* firms implement the adjustment project. The increment of the solution with respect to the level $\left(Y^1,Q^1,P^1\right)$ can be calculated as follows:

$$\Delta Q^+(k)=\frac{(n-k+1)\cdot\Delta c^2}{H\cdot(n+1)}, \tag{9}$$

$$\Delta Q^-(k)=\frac{-k\cdot\Delta c^2}{H\cdot(n+1)}, \tag{10}$$

$$\Delta Y(k)=\frac{k\cdot\Delta c^2}{H\cdot(n+1)}, \tag{11}$$

$$\Delta P(k)=\frac{-k\cdot\Delta c^2}{n+1}, \tag{12}$$

where $\Delta Y(k)$ and $\Delta P(k)$ stand for the increments of the total sector output and the market price correspondingly, given that *k* firms undertake the adjustment project. It would be natural to assume that $Q^1(k)+\Delta Q(k)\geq 0$ for each *k*, which is guarantied if

$$G-c^1-n\cdot\Delta c^2=G-c-\Delta c^1-n\cdot\Delta c^2\geq 0. \tag{13}$$

This condition seems fairly natural. For instance, if firms' production functions have unit elasticity of substitution with α standing for energy intensity parameter, then

$$\Delta\tilde{n}^2=\left[(\beta-1)\cdot\alpha-(\beta^\alpha-1)\right]\cdot\tilde{n},$$

with β, as before, standing for the index of energy price increase [2].

Our basic assumption is that the number of the firms facing low transaction cost *k* is strongly dependent on the quality of institutions: the higher the quality, the higher the number *k* is. We assume it is zero if institutions are very bad and provide for no incentives for adjustment to energy price change and it is close to *n* if institutions provide for strong incentives.

PROPOSITION: Let *n* symmetrical firms having production function of type (1) [3] operate in a given sector and the sector demand function be as (4). Let the sector to reach Cournot equilibrium.

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[1] Obviously a condition $\Delta c^1-\Delta c^2>0$ holds.

[2] Under α = 0,2 doubling of *real* energy price (β = 2) leads to the value of Δc_2 = 0,0513.

[3] Sector index *i* is omitted.

After an increase in the price for the energy factor $p_{E,}$ each firm solves the problem (7)–(8), k firms face low transaction costs associated with the implementation of adjustment projects, and $(n - k)$ firms face high transaction cost. Then the final value of the sector energy intensity, measured as

$$\frac{\sum_{j=1}^{n} E_j}{Y}$$

is the lower, the higher k is.

PROOF: Let the energy intensity of a firm before the price shock be e^1, then after the energy price increase, the firms, which undertake adjustment projects have energy intensity e^2 with $e^2 < e^1$ which holds true by the property of the production function. The value of energy intensity of the firms not undertaking adjustment projects stays e^1. Thus, the value of the sector energy intensity under condition that k firms undertake adjustment projects $e(k)$ is:

$$e(k) = s(k) \cdot e^2 + (1 - s(k)) \cdot e^1 \tag{14}$$

with $s(k)$ is a share of the firms undertaking adjustment projects in total sector output. At the same time, obviously, the value of the sector energy intensity derivative by s is negative because $e^2 < e^1$. So, it is necessary to prove that $\frac{ds(k)}{dk} > 0,$ which is not obvious since the rising number of the firms implementing the project reduces individual outputs of these firms (due to the equation (9)).

Construct the value $\frac{s(k)}{1 - s(k)}$:

$$\frac{s(k)}{1 - s(k)} = \frac{k \cdot Q^1 + (n - k + 1) \cdot \dfrac{k \cdot \Delta c^2}{H \cdot (n+1)}}{(n - k) \cdot Q^1 - (n - k) \cdot \dfrac{k \cdot \Delta c^2}{H \cdot (n+1)}}. \tag{15}$$

Indicate $\theta(k) = k \cdot Q^1 + \frac{k \cdot (n - k) \cdot \Delta c^2}{H \cdot (n+1)}$ and substitute for into (15):

$$\frac{s(k)}{1 - s(k)} = \frac{\theta(k) + \dfrac{k \cdot \Delta c^2}{H \cdot (n+1)}}{n \cdot Q^1 - \theta(k)}. \tag{16}$$

Due to the condition (4) the derivative of $\theta(k)$ with respect to k is positive:

$$\frac{d\theta(k)}{d(k)} = Q^1 + (n - 2k) \frac{\Delta c^2}{H \cdot (n+1)} = \frac{G - c^1 + (n - 2k) \cdot \Delta c^2}{H \cdot (n+1)} > 0. \tag{17}$$

Taking into account (17) one can find that the numerator in (16) grows and at the same time the denominator reduces as k increases. Thus, the value $\frac{s(k)}{1 - s(k)}$ is a function growing by k. The latest fact can be true if and only if $\frac{s(k)}{1 - s(k)} > 0.$ This means that $\frac{de(k)}{dk} < 0$ and the proposition is proved.

At this point, we conclude that the weak institutional environment could be considered an important factor undermining the efficiency of energy use. Weak incentives for change of technologies may result from the high cost of market operation. We assume that the value h may be associated with both the market performance itself and its interaction with the government including the quality of the policy measures and the degree of corruption. As we specified before, this value probably includes some monetary component, such as bribes and higher taxes, and the non-monetary component are additional attempts of entrepreneurs for establishing and maintaining agreements.

Another important suggestion we make based on the theoretical framework discussed in this section is a dependence of the demand for energy price elasticity prevailing in a given economy on the quality of institutions. In the model considered, we showed that the sector demand for energy reaction to the energy change is the stronger, the more firms react adequately to the change in the real energy price and, therefore, the stronger the economic institutions are. Thus, it is to be expected that in a given national economy the reaction of the aggregate demand for energy from the production sphere as a whole will demonstrate the same property. For this reason we advance a hypothesis, which will later be tested in the next section of this paper, that the price elasticity of the energy demand of the production sphere is a function dependent on the quality of economic institutions. More specifically, we construct a model of energy intensity of production sector for a particular economy and, therefore, specify the price elasticity of output energy intensity. This coefficient in general differs from the former one.

The first index, at list given the production function with constant returns to scale, captures only the substitution effect. The second one except for the substitution effect allows for wealth effect, i.e. the demand change due to change of the output.

First, if the technology considered actually has constant returns to scale it allows only for the substitution effect of the real price change. Secondly, if some inputs of the production factors cannot change – which is a short-term case – output and total cost change may vary not equally and, therefore, the output energy intensity may change not only due to substitution of other factors for energy, but also due to the variation of the production scale. Moreover, in this situation substitution effect itself may be weaker than in the long run because a certain component of the energy input may be a quasi-fixed factor.

Specification

We use the following specification:

$$\ln(e) = \beta_0 + \beta_1 \cdot DISTE + \beta_2 \cdot INST \cdot \ln\left(\frac{P}{p_E}\right) + \beta_3 \cdot \ln\left(\frac{P}{p_E}\right) + \varepsilon \qquad (18)$$

though the variable *INST* may designate different institutional variables from their total list presented in the part 1. We used in our analysis both several individual variables and their combinations but present in our paper the most satisfactory version of this variable being a sum of two institutional indices – Government Effectiveness and Control of Corruption:

$$INST = GE + CC. \qquad (19)$$

The variable of a combined influence of the real energy price and institutions $INST \cdot \ln\left(\frac{P}{p_E}\right)$ is called the interaction term, which we use following Polterovich and Popov [1]. If it proves significant, one could suggest that the institutions affect energy intensity through the price system. On the other hand, a simple transformation in (18) helps to see that the value $\beta_2 \cdot INST + \beta_3$ is the price elasticity of output energy intensity as a function of the institutional strength index, which fit our theoretical model.

Estimation Results:
What are the Main Reasons for High Transaction Cost?

We estimated the model (18) keeping (19) for 5 years: 2002 trough 2006. The reason why we omitted the year of 2001 is absence of institutional indices for it in the World Bank databases. The main results are presented in the Table 1.

Using in the regression a variable of seasonal temperature fluctuation which we consider a good reflection of climate severity rather than a mean annual temperature one is caused by the fact that the first indicator works better in all the regressor's combinations we tried. We address this phenomenon to two things. First, it represents better technologic specifics brought about by the climatic conditions in the country: equipment should fit to both low and high temperature regimes; on the other hand more enduring technologies are more energy intensive. Secondly, the variable of seasonal temperature fluctuation is at the same time a measure for a geographical continentality of the countries taking into account that the economies located more distantly from the sea shores incur additional (energy) cost of the world economic integration.

Table 1

Estimated Energy Intensity of Production in the World Countries
(dependent variable: ln[Energy Consumption in production sphere per a unit of GDP PPP],
White covariance matrix method)

Variables	2002, 75 observ.	2003, 77 observ.	2004, 74 observ.	2005, 75 observ.	2006, 77 observ.
Constant term	–0,1718 *t*–Value = –1,30	–0,1665 *t*–Value = –1,25	–0.1511 *t*–Value = –1,26	–0.2771 *t*–Value = –2,30	–0,2872 *t*–Value = –2,49
Variable of climate conditions: *DISTE*	0,0025 *t*–Value = 4,84	0,0023 *t*–Value = 4,30	0,0019 *t*–Value = 3,97	0,0021 *t*–Value = 4,48	0,0022 *t*–Value = 4,15
Real energy price for previous year: $\ln(P/p_E)_{-1}$	0,5155 *t*–Value = 5,13	0,4592 *t*–Value = 4,95	0,4429 *t*–Value = 4,94	0,2536 *t*–Value = 2,56	0,2841 *t*–Value = 2,67
Interaction term: $\ln(P/p_E)_{-1} \cdot INST$ *	0,1153 *t*–Value = 3,29	0,1005 *t*–Value = 2,49	0,1133 *t*–Value = 2,76	0,1124 *t*–Value = 2,96	0,1239 *t*–Value = 2,54
R-squared	0,4835	0,4231	00,3979	0,3189	0,3343
F-value	19,75	18,90	16,40	10,96	8,73
Root MSE	0,38297	0,39872	0,36507	0,36192	0,37684
Hausman test, Chi2 **	0,00, Prob>chi2 = 0,9999	0,03, Prob>chi2 = 0,9984	0,76, Prob>chi2 = 0,8582	0,27, Prob>chi2 = 0,9661	0,90, Prob>chi2 = 0,8246

* Combination of Government Effectiveness and Control of Corruption indices.

** Instrumental variables are logarithm of import cost of oil in the previous year for the real energy price variable and in addition a combination of latitude degree and infant mortality variables for the interaction term; IVS and OLS models are compared for the samples of economies for which is the data on import cost of oil accessible.

Table 2

Coefficients of Price Elasticity of Production Energy Intensity by the Economies and the Groups Economies of the World

	2002	2003	–2004	2005	2006	In average
World in Average, 118 economies	–0,546	–0,519	–0,506	–0,278	–0,317	–0,433
OECD, 26 economies *	–0,889	–0,838	–0,910	–0,596	–0,666	–0,780
Former Socialist, 27 economies	–0,451	–0,436	–0,406	–0,212	–0,243	–0,349
East Europe and Baltic, 14 economies	–0,559	–0,540	–0,551	–0,322	–0,362	–0,467
CIS, 11 economies	–0,318	–0,308	–0,234	–0,082	–0,102	–0,209
Russian Federation	–0,374	–0,374	–0,320	–0,124	–0,128	–0,264

* Without new members.

Endogeneity of regressors problem is expected to be present with respect of use in the regression of both the institutional and energy price variables which could be affected with the energy intensity one. Trying to soften it for the real price of energy factor we used in the regression a variable for the previous year rather than for current one: $\ln\left(\frac{P}{p_E}\right)_{-1}$ instead of $\ln\left(\frac{P}{p_E}\right)$. Besides this a proper method to treat the problem of endogenity is application of IVLS estimator in addition to OLS employing Hausman test. A serious difficulty here is existence of consistent instrumental variables for energy price. The only possible one which we could imagine was crude oil import cost for corresponding economies. We applied the data from IEA database containing statistics on only 25 OECD countries. Thus the sample used to test the problem was of only this dimension what, of cause reduced the reliability of the estimates which we obtained. Nevertheless we present the results of Hausman test suggesting that the effective model should be preferred. Institutional index was instrumented with the help of latitude degree and infant mortality variables.

In order to confirm or even strengthen the results described using the data for the last year of the period under consideration we constructed similar regressions for two economic sectors – goods production and services (see Table A2 in Appendix). Since using transaction term in these cases provided for less convincing results, we present the estimations for both regressions which still include this variable and ones with the use of only institutional index – without its combining with the price variable. As an institutional variable we chose Control of Corruption index. One more distinction is a climate variable. For energy intensity in services sector it found itself insignificant and thus was removed. In the regressions for goods production sphere a variable of mean annual temperature provided for more robust estimations.

As it could be seen, significance of institutional variables is still well preserved and for the services sector proves o be even higher than for overall energy intensity. However, transaction term visibly loses its explanation power in the regressions for the goods production sector. This fact has a transparent explanation: share small and medium-sized enterprises in services sector is essentially higher than in goods producing one. At the same time small and medium-sized business, at least in economies with not good enough institutions, suffer from overregulation and corruption considerably higher than large enterprises. Thus, the implicit transaction cost burden for it is higher as well.

We provide our calculations of price elasticity of production energy intensity both by the groups of the economies (Table 2) and for each country from the sample (Table A1 in Appendix). One can see that these results confirm our theoretical assumption: the better the institutions the stronger consumption of per output unit responds to changes in real energy price. Particularly, in CIS countries, adjustment of energy demand to changes in real energy prices is to be regarded as weak: the absolute value of average price elasticity coefficient of energy intensity is about one third of that in OECD countries; in the East European and Baltic countries this value is also visibly lower than in the developed countries though not so crucially (it is “only” one half of the OECD level). This fact means weak incentives of firms for energy conservation and, thus, serves an important reason for the higher energy intensity of production.

Conclusion

The energy intensity in the most of the world countries was falling down during the last decades of the previous century. At the same time in former socialist economies it stays essentially higher than the developed countries. In order to explain this phenomenon we suggest a theoretical model of an economic sector including a certain number of firms, which consume energy and face the necessity of implementing energy conservation projects under the condition of uncertain transaction cost associated with this implementation. The high transaction cost completely stops the project but low transaction cost does not affect the behavior of the firms. We show that the inadequate institutional environment leading to a high probability for a firm to be faced with adverse external conditions resulting in the high transaction cost brings about the lack of incentives for energy conservation. Thus, under such a condition, the substitution effect of energy price change is weaker than in tough market environment. This fact means that higher transaction costs worsen the incentives for energy conservation.

Our econometric model permits one to calculate energy price elasticity of production energy intensity, which is a value similar to price elasticity of conditional demand for energy. Analysis showed that two institutional variables from their common list provided in [2; 3] have high significance levels. They are – “government effectiveness” and “control of corruption”. Using the estimates results we provided coefficients of energy price elasticity of production energy intensity both by the groups of the economies and for each economy from the sample. We show that the average of these coefficients for the group of CIS economies is about four times lower than that for the OECD economies (by their absolute values); in the East European and Baltic countries this value is also visibly lower than in the developed countries though not so crucially (“only” approximately two times). This fact means weak incentives of firms for energy conservation and, thus, serves an important reason for the higher energy intensity of production.

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Appendix

Table A1

Estimated Coefficients of Price Elasticity of Energy Intensity
in the Years of 2002–2004

	2002	2003	2004	2005	2006	In average
Albania	–0,352	–0,339	–0,317	–0,103	–0,148	–0,252
Algeria	–0,355	–0,361	–0,315	–0,163	–0,173	–0,273
Angola	–0,244	–0,234	–0,125	–0,001	0,021	–0,117
Argentina	–0,385	–0,409	–0,388	–0,182	–0,223	–0,317
Armenia	–0,412	–0,392	–0,356	–0,178	–0,186	–0,305
Australia	–0,947	–0,924	–1,045	–0,688	–0,768	–0,874
Austria	–0,978	–0,924	–1,008	–0,658	–0,738	–0,861
Azerbaijan	–0,298	–0,290	–0,189	–0,066	–0,077	–0,184
Bangladesh	–0,315	–0,280	–0,173	–0,015	–0,031	–0,163
Belarus	–0,288	–0,263	–0,156	–0,023	–0,038	–0,154
Belgium	–0,931	–0,861	–0,928	–0,604	–0,677	–0,800
Benin	–0,362	–0,378	–0,329	–0,084	–0,149	–0,261
Bolivia	–0,382	–0,356	–0,288	–0,076	–0,133	–0,247
Bosnia and Herzegovina	–0,351	–0,353	–0,327	–0,148	–0,171	–0,270
Brazil	–0,487	–0,502	–0,474	–0,219	–0,247	–0,386
Bulgaria	–0,513	–0,480	–0,497	–0,281	–0,288	–0,412
Cameroon	–0,296	–0,328	–0,214	–0,020	–0,056	–0,183
Canada	–0,991	–0,938	–1,021	–0,688	–0,785	–0,884
Chile	–0,829	–0,752	–0,851	–0,547	–0,590	–0,714
China	–0,457	–0,431	–0,385	–0,166	–0,217	–0,331
Colombia	–0,409	–0,413	–0,422	–0,218	–0,259	–0,344
Congo	–0,242	–0,236	–0,179	0,015	0,010	–0,127

Table A1 continued

	2002	2003	2004	2005	2006	In average
Costa Rica	–0,664	–0,621	–0,596	–0,337	–0,361	–0,516
Croatia	–0,585	–0,531	–0,558	–0,328	–0,355	–0,471
Cyprus	–0,769	–0,720	–0,729	–0,463	–0,537	–0,644
Czech republic	–0,661	–0,612	–0,624	–0,417	–0,456	–0,554
Denmark	–1,025	–0,978	–1,112	–0,746	–0,869	–0,946
Dominican Republic	–0,430	–0,383	–0,318	–0,133	–0,158	–0,284
Ecuador	–0,309	–0,316	–0,242	–0,051	–0,052	–0,194
Egypt	–0,428	–0,401	–0,371	–0,157	–0,154	–0,302
El Salvador	–0,406	–0,424	–0,397	–0,184	–0,233	–0,329
Eritrea	–0,443	–0,378	–0,281	–0,111	–0,086	–0,260
Estonia	–0,695	–0,696	–0,751	–0,481	–0,547	–0,634
Ethiopia	–0,349	–0,318	–0,274	–0,064	–0,127	–0,226
Finland	–1,053	–0,990	–1,101	–0,758	–0,869	–0,954
France	–0,859	–0,820	–0,876	–0,576	–0,630	–0,752
Gabon	–0,413	–0,374	–0,272	–0,100	–0,087	–0,249
Georgia	–0,303	–0,312	–0,327	–0,161	–0,223	–0,265
Germany	–0,954	–0,865	–0,933	–0,639	–0,718	–0,822
Ghana	–0,446	–0,421	–0,390	–0,202	–0,269	–0,346
Greece	–0,679	–0,636	–0,661	–0,372	–0,406	–0,551
Guatemala	–0,385	–0,355	–0,302	–0,087	–0,111	–0,248
Haiti	–0,150	–0,140	–0,036	0,071	0,064	–0,038
Honduras	–0,352	–0,348	–0,290	–0,102	–0,117	–0,242
Hong kong	–0,830	–0,801	–0,909	–0,627	–0,727	–0,779
Hungary	–0,700	–0,651	–0,678	–0,407	–0,454	–0,578
Iceland	–1,012	–0,992	–1,105	–0,783	–0,851	–0,949
India	–0,450	–0,443	–0,417	–0,206	–0,246	–0,352
Indonesia	–0,314	–0,318	–0,282	–0,103	–0,133	–0,230
Iran	–0,419	–0,395	–0,317	–0,106	–0,129	–0,273
Ireland	–0,895	–0,839	–0,898	–0,628	–0,694	–0,791
Israel	–0,740	–0,697	–0,740	–0,450	–0,556	–0,637
Italy	–0,712	–0,668	–0,649	–0,364	–0,386	–0,556
Ivory coast	–0,308	–0,274	–0,123	0,045	0,037	–0,125
Jamaica	–0,453	–0,431	–0,413	–0,187	–0,257	–0,348
Japan	–0,755	–0,741	–0,789	–0,526	–0,632	–0,689
Jordan	–0,534	–0,544	–0,544	–0,294	–0,342	–0,452
Kazakhstan	–0,288	–0,294	–0,218	–0,085	–0,111	–0,199
Kenya	–0,310	–0,310	–0,257	–0,049	–0,090	–0,203
Korea, south	–0,668	–0,616	–0,640	–0,422	–0,461	–0,562
Kuwait	–0,654	–0,616	–0,631	–0,391	–0,414	–0,541
Kyrgyz republic	–0,344	–0,320	–0,231	–0,034	–0,052	–0,196
Latvia	–0,597	–0,587	–0,597	–0,365	–0,419	–0,513
Lebanon	–0,438	–0,403	–0,346	–0,164	–0,132	–0,297
Lithuania	–0,622	–0,616	–0,629	–0,385	–0,404	–0,531
Luxembourg	–1,022	–0,919	–1,041	–0,680	–0,748	–0,882
Macedonia	–0,373	–0,391	–0,382	–0,168	–0,223	–0,308
Malaysia	–0,649	–0,611	–0,655	–0,396	–0,444	–0,551
Malta	–0,738	–0,732	–0,783	–0,477	–0,583	–0,663
Mexico	–0,517	–0,480	–0,442	–0,212	–0,256	–0,381
Moldova	–0,339	–0,318	–0,214	–0,086	–0,095	–0,210

End of the Table A1

	2002	2003	2004	2005	2006	In average
Morocco	–0,494	–0,465	–0,447	–0,214	–0,247	–0,373
Mozambique	–0,391	–0,356	–0,322	–0,143	–0,158	–0,274
Namibia	–0,532	–0,505	–0,476	–0,267	–0,320	–0,420
Nepal	–0,427	–0,399	–0,277	–0,061	–0,100	–0,253
Netherlands	–1,007	–0,935	–1,040	–0,698	–0,774	–0,891
New Zealand	–0,986	–0,957	–1,101	–0,720	–0,807	–0,914
Nicaragua	–0,370	–0,362	–0,331	–0,097	–0,073	–0,247
Nigeria	–0,236	–0,248	–0,156	–0,023	–0,033	–0,139
Norway	–0,999	–0,940	–1,047	–0,710	–0,811	–0,901
Pakistan	–0,351	–0,343	–0,253	–0,083	–0,119	–0,230
Panama	–0,482	–0,455	–0,446	–0,227	–0,254	–0,373
Paraguay	–0,248	–0,249	–0,178	–0,016	–0,040	–0,146
Peru	–0,437	–0,420	–0,345	–0,133	–0,179	–0,303
Philippines	–0,436	–0,413	–0,357	–0,176	–0,180	–0,312
Poland	–0,620	–0,587	–0,558	–0,336	–0,368	–0,494
Portugal	–0,811	–0,757	–0,787	–0,498	–0,525	–0,676
Romania	–0,460	–0,436	–0,415	–0,220	–0,257	–0,358
Russia	–0,374	–0,374	–0,320	–0,124	–0,128	–0,264
Saudi Arabia	–0,540	–0,486	–0,435	–0,219	–0,253	–0,387
Senegal	–0,506	–0,423	–0,415	–0,215	–0,202	–0,352
Singapore	–1,031	–0,978	–1,107	–0,744	–0,832	–0,938
Slovak Republic	–0,586	–0,587	–0,635	–0,411	–0,443	–0,532
Slovenia	–0,714	–0,693	–0,747	–0,465	–0,536	–0,631
South Africa	–0,633	–0,596	–0,637	–0,413	–0,432	–0,542
Spain	–0,890	–0,834	–0,854	–0,562	–0,551	–0,738
Sri Lanka	–0,480	–0,443	–0,399	–0,178	–0,230	–0,346
Sudan	–0,268	–0,214	–0,123	0,067	–0,003	–0,108
Sweden	–1,013	–0,954	–1,058	–0,708	–0,815	–0,909
Switzerland	–1,022	–0,951	–1,080	–0,724	–0,826	–0,920
Syria	–0,379	–0,320	–0,234	–0,048	–0,060	–0,208
Tajikistan	–0,263	–0,246	–0,152	–0,011	–0,043	–0,143
Tanzania	–0,355	–0,351	–0,327	–0,129	–0,181	–0,269
Thailand	–0,497	–0,482	–0,481	–0,277	–0,280	–0,403
Togo	–0,295	–0,257	–0,143	0,004	0,048	–0,129
Trinidad and Tobago	–0,548	–0,544	–0,539	–0,287	–0,299	–0,443
Tunisia	–0,642	–0,592	–0,575	–0,301	–0,349	–0,492
Turkey	–0,472	–0,471	–0,458	–0,272	–0,303	–0,395
Ukraine	–0,322	–0,328	–0,250	–0,142	–0,142	–0,237
United Kingdom	–0,980	–0,917	–1,012	–0,663	–0,750	–0,865
United States	–0,939	–0,870	–0,964	–0,609	–0,657	–0,808
Uruguay	–0,677	–0,620	–0,629	–0,408	–0,443	–0,555
Uzbekistan	–0,271	–0,254	–0,159	0,013	–0,028	–0,140
Venezuela	–0,283	–0,265	–0,202	–0,046	–0,073	–0,174
Vietnam	–0,382	–0,377	–0,300	–0,134	–0,144	–0,268
Yemen	–0,346	–0,330	–0,221	–0,068	–0,075	–0,208
Zambia	–0,313	–0,299	–0,236	–0,067	–0,104	–0,204
Zimbabwe	–0,263	–0,234	–0,132	0,058	0,048	–0,105

Table A2

Estimated Energy Intensity of Production in Separate Economic Sectors in the World Economies, (2004, 72 observations, White covariance matrix method)

Variables	Dependent variable: ln[Energy Consumption per a unit of Value Added in goods production sphere]		Dependent variable: ln[Energy Consumption per a unit of Value Added in services sphere]	
	Using interaction term	Using institutional variable	Using interaction term	Using institutional variable
Constant term	0,1900 *t*–Value = 1,37	0,1760 *t*–Value = 1,48	0,0708 *t*–Value = 0,80	0,0548 *t*–Value = 0,75
Mean annual temperature: *MEATE*	–0,0025 *t*–Value = –3,60	–0,0027 *t* –Value = –3,60		
Real energy price: $\ln(P/p_E)$	0,5017 *t*–Value = 5,25	0,4075 *t* –Value = 4,90	0,5022 *t* –Value = 4,56	0,4243 *t* –Value = 5,07
Interaction term: $\ln(P/p_E)\cdot CC04$	0,1996 *t*–Value = 1,85		0,2029 *t* –Value = 3,58	
Control of Corruption Index: *CC04*		–0,1145 *t* –Value = –2,10		–0,1503 *t* –Value = –4,36
R-squared	0,3295	0,3439	0,3501	0,4604
F-value	14,52	14,83	12,36	14,84
Root MSE	0,45613	0,45121	0,31151	0,28384
Hausman test, Chi2 *	1,79, Prob>chi2 = 0,6164	0,60, Prob>chi2 = 0,896	0,46, Prob>chi2 = 0,7932	0,27, Prob>chi2 = 0,8756

* Instrumental variables are logarithm of import cost of oil for the real energy price and in addition latitude degree for the interaction term. IVS and OLS models are compared for the samples of economies for which is the data on import cost of oil accessible.

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СТИМУЛЫ К ЭНЕРГОСБЕРЕЖЕНИЮ И ИНСТИТУЦИОНАЛЬНЫЕ УСЛОВИЯ: ОПЫТ МЕЖСТРАНОВОГО АНАЛИЗА ЧАСТЬ 2

Наша гипотеза состоит в том, что главной причиной значительного отставания России от передовых стран по энергоэффективности является слабость стимулов к энергосбережению, обусловленная недостатками институционального механизма. Чтобы это продемонстрировать, мы строим теоретическую модель энергопотребляющего сектора экономики и показываем, что чем выше транзакционные издержки, вызванные недостатками рынка и регулирования, тем ниже вероятность осуществления энергосберегающих мероприятий в ответ на рост цены энергии. Включение для 77 стран мира на период середины предыдущего десятилетия в регрессии для коэффициентов энергоемкости институциональных переменных позволило нам построить коэффициенты эластичности спроса на энергию по цене, дифференцированные по различным экономикам. Такие показатели (по абсолютной величине) для стран СНГ оказались почти вчетверо ниже, чем в странах ОЭСР.

Ключевые слова: энергоемкость, энергосбережение, экономики мира, эластичность по цене, институты, конкуренция по Курно.