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Reducing Energy Intensity and Institutional Environment: A Cross Country Analysis

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ABSTRACT

The article analyses the way the quality of institutions affects the performance of energy saving policies. Based on the analysis of dynamic panel data for 69 countries over the period from 2002 to 2012, using Arellano-Bond approach, we have shown that the elasticity of energy consumption by price of energy depends on institutional factors. We also demonstrated that absolute values of the said indicators are higher in OECD than CIS countries over the whole data sample, which is explained by a higher quality of institutions. Similar valuations and calculations have been produced for the industrial sector as well as the production sphere. The energy consumption in the industrial sector has proved to be more sensitive to the quality of institutions than in production sphere as a whole. We have also performed a general analysis of trends of GDP energy consumption for a number of countries pointing out that a growth of energy prices enhances energy saving processes.

Keywords: Energy Intensity, Cross-country Analysis, Arellano-bond approach
JEL Classifications: D02, E02, Q43

1. INTRODUCTION

Energy is known to play a key role in sustainable economic development as it influences both production and social welfare. Limited energy resources cause energy price growth which, in its turn, could result in increased producer's costs, growing inflation and hampered economic growth and social welfare if such changes are not accompanied with energy saving. Economic energy efficiency and climate change regulations are ultimately considered a key factor of energy security, such as lower dependence on the world energy markets, and form development strategy policy in many economies around the world (IPCC, 2014).

Sharp rises in world energy prices in the 1970s and 2000s made many economies create and develop energy-efficiency measures, try to reduce their dependence on the energy imports and lower emissions of harmful substances resulting from fuel combustion (Energy Efficiency Market Report 2016; International Energy Outlook 2016; Bashmakov, 2013). Such measures depend mostly on the government, which is supposed to provide a background for technological and market opportunities stimulating energy saving behavior. According to the Energy efficiency market report-2016 (Energy Efficiency Market Report, 2016), a larger list of regulating instruments and their influence on energy saving behavior resulted in the fact that public energy policy has been the key driver of efficiency improvements in recent years. There were special institutions created to maintain energy efficiency, and together with using fiscal tools and broadening minimum energy performance standards (MEPS) they helped to reduce energy intensity, given the substantial fall of primary energy prices. As a result, investments into energy saving were growing.

Apart from government regulation, we believe that the role of market signals which could boost energy saving is still substantial. Firstly, renewable energy sources are still more expensive than the traditional ones, and their usage can raise the price of energy for the consumers. Secondly, prices for traditional energy resources can grow due to the increasing returns to scale in fuel extraction. Thirdly, the most important aspect is that energy prices are still one of the crucial factors in regulating economies. As tax regulation and tough requirements for environment protection can influence energy prices, and policy regulation becomes effective when economy is sensitive to price signals.

The underlying hypothesis of our research is that while measuring the price elasticity of energy intensity we should take into account the quality of institutions. We presume that price elasticity of energy efficiency is dependent on market economy institutions – with a high degree of government regulation, the impact of price factor is greater and vice versa. Thus, we estimate the price elasticity of energy intensity for different economies considering the institutional factors.

Our analysis is based on statistical data that cover 27 former socialist economies, the OECD countries and some countries of Asia, Africa, and America during the period of 2002-2010. The scope of our analysis includes not only production sphere (apart of energy consumption of households) but also the industrial sector as its separate component. Separate consideration of the industry sector is relevant on account of available statistical data required for model parameter evaluation. Verification of hypothesis both for production sphere and for the industrial sector allows us to test the validity of obtained results. In our regression model, we consider energy consumption in production industry only, rather than household energy consumption. We apply both panel data analysis and dynamic panel data analysis using lagged instrumental variables.

We find that the energy saving policy that regulates energy prices is more effective in the OECD countries due to the developed institutions. The elasticities we obtained for these countries are the highest in absolute value. It means that the energy intensity is more sensitive to price change, which increases the regulation effectiveness, such as taxes and subsidies, influencing the general level of energy prices on the market. During 2002-2010, the average value of elasticity for the CIS countries was lower in absolute value by 35% than that in the OECD countries, with the Baltic countries and the countries of Eastern Europe being behind the developed countries by about 20%. It can be explained by weaker incentives for economic agents to reduce energy consumption in the latter countries as compared to the developed countries during the period considered. At the same time, the regulation applied in order to encourage the use of energy saving technologies was not effective enough due to the low dependence of energy consumption on changing energy prices.

In addition, our regression includes the climate severity index as we assume that the more severe the climate, the higher the level of the economy's energy intensity. We found that this was statistically significant but at the 10% level, unlike in the previous research by (Suslov and Ageeva, 2005; Suslov, 2013) based on cross-country analysis, it demonstrated the significance at the 1% level. So in this research it is used as a control variable.

Separate evaluation of model parameters for production sphere and for the industrial sector allowed comparison of obtained results. Thus, we determined that institutional environment has an impact on energy consumption in both cases but the impact is greater when we consider the industrial sector for various countries. Price elasticity of energy consumption for both production sphere and the industrial sector depends on institutional environment, which amplifies the price factor and, thus, making improvement of institutions another one of requisite factors of energy saving policy.

The rest of this paper is organized as follows. Section 2 provides a literature background followed by some trends in energy intensity during the end of the 20^{th} – beginning of the 21^{st} centuries in Section 3. Section 4 is devoted to the initial data analysis, Section 5 describes the methodology of our analysis, Section 6 discusses the results obtained and Section 7 concludes.

2. LITERATURE REVIEW

Recently, a growing number of studies has been devoted to assessing energy consumption elasticity of price and income. A well-known approach to the analysis of the relationship between the output, energy consumption, and other production factors is based on the application of a translog cost function (Hudson and Jorgenson, 1974; Berndt and Wood, 1975). It gives an advantage of estimating the coefficients of long-term price elasticity of energy demand. However, it is hardly suitable when we try to estimate particular features of the objects analyzed. The translog cost function approach does not allow us to test the significance of separate factors responsible for individual countries' differences and can only show their aggregate impact on the energy intensity of production at best.

Another well-known method of measuring energy demand elasticity is based on specifying energy demand functions derived from the Koyck distributed lag scheme (Common, 1981; Kouris, 1983; Haas and Schipper, 1998). This approach has been widely applied to estimate world economies, which resulted in a wide range of empirical estimations (Welsch, 1989; Beenstock and Dalziel, 1986; Hunt et al., 2003). The use of lagged energy demand variables allows for estimations of both short- and long-run coefficients of income and price elasticity. In their work, Espey and Espey (2004) used various methods to assess the households' short- and long-term electric power demand elasticity of price and income. Finally, the authors concluded that dynamic models, which include a temporary component of elasticity, give lower values than other models. Some scholars considered only households' energy demand (Espey and Espey 2004; Schulte and Heidl, 2017), while others considered economies' energy demand (Jamil and Ahmad, 2011).

Schulte and Heidl (2017) used a wide range of tools to analyze price elasticity demand in different countries, and they concluded that it was higher in developing economies. Their paper also discussed the importance and significance of the GDP growth rate and the capital market growth for the country's energy demand.

Growing concerns about climate changes, environment and security of energy supply, which can be partly solved through smoothing the consequences of volatility in energy prices on international markets, cause policy makers to search for energy efficiency policy instruments to stimulate energy saving behavior. Recent years have demonstrated that price signals alone cannot influence energy saving behavior. In their work, Oikonomou et al. (2009) discuss the dependence of energy saving behavior on such factors as income, climate, instance effort, etc. Eyre (2013) considers it misleading to use price mechanisms as the only regulating instrument. In his opinion, such instruments are to include taxes and cap and trade systems which can influence both the price and the carbon content of energy. Gillingham et al. (2009) also demonstrate that the price is not the only factor to reduce energy intensity. They emphasize that government regulation should take into account market failure and list such examples of government control instruments such as information programs, loan programs, real-time pricing, and market pricing.

Limited use of price signals alone is also due to the fact that price elasticity is not always enough to reduce energy intensity by means of the price, which is discussed in Hunt et al. (2003). The authors consider that additional non-price measures can be more efficient. A similar conclusion is derived by Hepburn (2006). The author discusses possibilities of using with price based mechanism also the political and institutional factors to reduce the economy's energy intensity.

The list of possible non-price signals is growing, which creates new opportunities to use other instruments to stimulate energy saving behavior. Li et al. (2013) analyzed energy intensity in China and singled out three types of factors - economic structure, energy consumption structure, and technological progress. Goldemberg and Prado (2013) focused on the second group of factors. They showed that energy intensity can be decreased as a result of unprecedented reduction of the energy intensity of service. Huang et al. (2017) in their work considered technological factors using 30 Chinese provinces as an example during the period of 2000-2013. The authors used panel data and showed that out of the four factors considered the most significant one was R and D.

Our research focused on such an economic structure factor as the institutional component. Recently, the problem of institutional strength influence on economic outcomes has attracted researchers' special attention (Tanzi and Davoodi, 1997; Wei, 1997; Kaufmann et al., 1999; Chong and Calderon, 2000; Kaufmann et al., 2008; McArthur and Sachs, 2001). They prove that there is a strong correlation between the quality of institutions and policies and the quality of institutions and per capita income. Some variations in transitional economies during the transformational period in their economies are determined by the countries' ability to maintain effective government institutions and develop market institutional frameworks (Popov, 1998; McArthur and Sachs, 2001; Transition Report, 2006). In addition, the transformation decline degree is associated with distortions in the fixed capital, production, and trade patterns accumulated before the reforms (De Melo et al., 1997). Institutional transformations being a way out of economic recessions and causing further development, transitional countries demonstrated an urgent need to work out an effective strategy and methods for market transformations given a theoretical model of corruption influencing energy efficiency (Polterovich, 1999, 2004). Fredriksson et al. (2004) found a strong correlation between the corruption variable and the energy intensity of production sectors in the OECD economies over the period of 1982-1996.

Correlation between institutional and biogeographical conditions analyzed by O. Olsson showed that the latter play a very important role (Olsson, 2003). Therefore, some medical and biogeographical components may be used as instrumental variables for calculating institutional strength indices. An example of such a variable is the distance of the country from the equator, as suggested by Hall and Jones (1999).

In our analysis we also tried to analyze how climatic conditions could influence the energy-saving behavior. We refer to recent publications by Bloom and Sachs (1998), who investigated the impact of the mean temperature and some other biogeographical factors on the agricultural production in developing economies.

We focused our analysis on the energy price elasticity demand and assume that the higher its absolute values are in a certain economy, the better market price mechanisms can operate due to stronger agents' reactions to price signals. At the same time, a question arises as to what extent these values could be affected by government policy measures undertaken within special energy saving programs. Given a weak reaction of businesses to price signals, could any government be able to strengthen energy saving activities?

We believe that government regulation measures are more effective when market mechanisms operate better because their influence is realized mostly through strengthening energy saving incentives. On the other hand, there are a lot of arguments supporting the idea that the total volume of energy saved when costs rise happens due to the market price mechanisms rather than the government policy. For example, having summarized the experiences of economies' reactions to the price shocks of the 1970-80s, Sweeney (Sweeney, 1984) formulated it as follows, "The extent to which government-sponsored energy conservation programs or other nonmarket forces have reduced the demand for energy is unknown. However, at least 80% and probably much more of the demand reductions can be attributed to price and economic activity changes."

3. ENERGY INTENSITY PUZZLE

Energy intensity decrease became the dominating trend in the world after the energy crisis. During 1983, the average level of GDP energy intensity in the OECD[1] economies decreased by 14% with another 11% decrease by 2000, which totals in 1/3. At the same time, leading energy saving countries, such as Ireland and Denmark, showed 45-50% decrease, Germany, the UK and the USA – more than 40% and the Netherlands – about 40% (Figure 1).

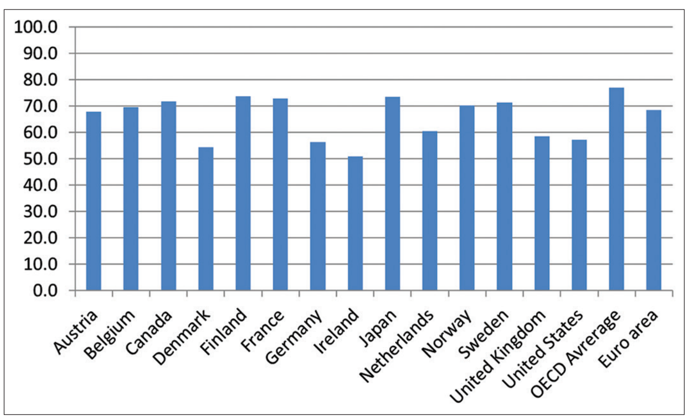
Such impressive results are known to have been a result of not only market forces caused by rising energy prices, but also of special measures of government policy aimed at better energy saving.

1 OECD economies without former socialist states and the new members after 1996.

According to Sweeney, about 80% of general energy saving in the USA can be attributed to price rise (Sweeney, 1984). We believe that the measures were caused by the price rise as well, but we assume that they were more effective when the market mechanisms worked better. The success of such measures, their high level and quality of development and implementation largely depend on the quality of bureaucracy.

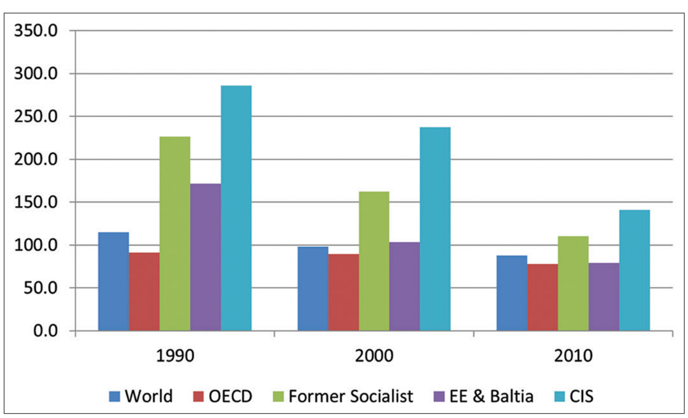
The data available for the countries with socialist economy (National Economy of the USSR, 1970-1990) show that in the 1970s-1980s they decreased energy intensity as well. However, the official statistics in socialist economies is known to overestimate the output growth indices resulting in low reliability of the data on energy intensity dynamics at the macroeconomic level (Suslov, 2013). The decrease in the energy intensity in former socialist economies was evidently not as high as in the developed economies. As a result, they were far behind market economies, especially the OECD countries, in terms of energy intensity. In the early 1990s, when the economic reforms were launched, the GDP energy intensity in transitional economies significantly exceeded the levels of market economies (Figure 2). As for the CIS economies, the average level of their GDP energy intensity in 1990 was 2.85 times as high as the average level in the world and 3.14 times as high as that in the OECD economies. Despite low energy prices in the 1990s, the imperative for energy efficiency growth, which was created previously, made the energy intensity decrease, especially in the Eastern Europe and Baltic countries, by 40%. It can be attributed to relatively successful economic reforms and the growth of domestic energy prices up to the level of outside markets due to the liberalization of external trade. The CIS economies had a higher average decrease in energy intensity than the international trend, but lower than in other transitional economies. We refer it to inconsistent reforms in some of the countries, where output contraction did not lead to the shutdown of outdated production capacity, which increased semi-fixed energy costs significantly and resulted in the growth of the GDP energy intensity instead of the expected decrease.

Figure 1: Change in the GDP energy intensity in selected OECD economies, 2000 to 1973%



Source: IEA data

Figure 2: GDP Energy intensity in the world economies, USA in 2005=100



Source: IEA data

During the next decade, 2001-2010, the energy intensity in the CIS economies decreased most, on average by more than 40%, while the corresponding international value was 11%, in the OECD economies 13% and in the Eastern Europe and Baltic countries 23%. We suppose that the former socialist economies showed such results due to, apart their growing energy prices, developing institutions and some regulating policy measures taken aimed at the growth of energy efficiency and energy saving, the advantage of catching-up development as they could use the experience and technologies of leading countries and a relatively cheap energy saving due to their higher level of energy intensity. Another favorable factor was a scale effect due to fast economic growth and increased capacity utilization.

As a result of such impressive decrease in specific energy costs per GDP unit, their level almost equaled the level of leading economies, from 2.7 times in 2000 to 1.8 times in 2010, which is still quite high.

Higher energy inputs in former socialist economies may partially be attributed to the inclement climatic conditions: in this part of Eastern Europe and the Asian part of the former Soviet Union average annual temperatures are significantly lower and the amplitude of seasonal variations is much higher than in Eastern Europe itself. However, as our analysis showed (Suslov and Ageeva, 2005), this factor fails to account for the entire difference in the levels of energy intensity. We assume that a significant factor affecting the level of specific energy consumption is the quality of economic institutions, which determines the key aspects of the economic system performance.

Table 1 presents key data concerning the GDP energy intensity in some groups of the countries in 2002-2010. We see that the mean and standard deviation over the period differ strongly in various groups of the economies with the greatest standard deviation observed in the CIS countries and former socialist economies. Despite considerable divergences in values and some fluctuations of the indicator, we assume that the key factors determining energy price elasticity are similar. We also assume that climatic conditions and institutional factors, regardless of the level and fluctuations of energy intensity, can influence energy intensity. It explains why 69 countries can be put together as one group.

Table 1: GDP energy intensity in groups of countries, 2002-2010 (kg of oil equivalent per PPP $)

Group of the countries	Minimum	Maximum	Mean	Standard deviation
OECD (22 countries)	0.048	0.205	0.0992	0.033
Eastern Europe and Baltic countries (15 countries)	0.053	0.265	0.128	0.043
CIS (11 countries)	0.056	0.641	0.221	0.113
Former socialist economies (28 countries)	0.053	0.641	0.169	0.089
World (69 countries)	0.046	0.641	0.125	0.072

4. DATA AND METHODOLOGY

4.1. Data

Our sample is chosen so that it complied with the requirements for data homogeneity. Availability of the energy price statistics narrows the number of the countries analyzed and the periods that could be included into our research. As we are interested in the long-run differences between the economies in dynamics, we applied the panel data and dynamic panel data analysis. In order to be able to compare the indicators, we use PPP income variables. As we consider a production factor only, we removed the residence energy consumption from our consideration. The total number of the samples studied counts 69 economies, including the OECD and CIS countries, economies from Asia, Africa, and America, during the period of 2002-2010.

Data collection was based on the following information:

- E^1 is energy consumption by production sectors and is calculated as a total energy supply less households' consumption and non-energy use over 2002-2010 (data presented in the International Energy Agency Database);
- E^2–energy industry own use and industry consumption (without energy use for transport) over 2002-2010 (data presented in the International Energy Agency Database);
- e^1 is production energy intensity calculated as a ratio of E^1 to GDP PPP. The latter variable was calculated on the date of World Bank Database for 2002-2010;
- e^2-is industry energy intensity calculated as a ratio of E^2 to industry value added.

Its calculation was like this: Industry value added was determined on the basis of World bank data (in constant 2010 USD). The index included industries of ISIC division classification from 10-45[2]. The index E^2, calculated based on IEA data, spanned the same divisions for comparable calculations. Thus, according to the classification ISIC Rev.3.1., calculation of E^2 and Industry value added spanned the industries of mining and quarrying, manufacturing, electricity, gas water supply, and construction.

DISTE is a seasonal temperature fluctuation calculated as a difference between the mean temperature values in January and July over 2002-2010; it is measured in tenths of degree centigrade; the data was obtained from the National Centers for Environmental Information, National Oceanic and Atmospheric Administration.

INST is a common designation of an institutional strength index obtained from the project "Governance Matters V, Governance Indicators for 1996-2010" available at the World Bank dataset at http://www.worldbank.org. The following variables are included into this database (Kaufmann et al., 1999; Kaufmann et al., 2008) and were tried directly in our regressions for 2002-2010. In our analysis, we used both individual variables and their combinations, but present here are the most satisfactory versions of these variables, which are the sums of two institutional indices – Government Effectiveness and Control of Corruption, both of them measuring quality of the governance and business collaboration:

$$INST = GE + CC \, , \quad (1)$$

Where *GE* (Government Effectiveness) is the quality of bureaucracy and credibility of the government's commitment and *CC* (Control of Corruption) measures the perception of corruption.

The first index represents evaluation of quality of provided social services and the government's ability to pursue selected targets, the second one – a perceived degree to which government power is used in the interest of private structures and how much this power is controlled by elites. Despite the fact that the both indices are closely correlated, their combination turns out to be more robust than each of them apart. They are, obviously, complementary, which is significant from the point of view of economy's sensitivity to price signals. The higher a level of corruption, the greater an implicit part of transaction costs in firms that carry out investment projects. The lower quality of government-provided services and less consistent its policies, the higher are explicit transaction costs and less effective are the institutions designated to promote energy saving.

P is the average output price calculated as a ratio of nominal GDP in USD to PPP GDP obtained from the World Bank Database. As this indicator is used in panel regressions, it is corrected using the dynamics corresponding to the US inflation. Starting with the 2nd year of the period evaluated, every price index is multiplied by the US inflation index in the previous year.

p_E is end-use average energy price for industry calculated using the statistical data available from two sources: (1) IEA Database – end-use prices for industry for different energy products; (2) Transition Report, EBRD, 2010 – electricity tariffs in transitional economies.

Calculation for variables *P* and p_E for use in the specification model is done as follows. Assuming $\overline{p}^{i}_{j,2002}$ is the price of *j*-th type of energy in the base year of the period under review in economy *i* in USD for the respective period and $\overline{P}^{i}_{2002}$ is the average price level in country *i* also in the base year, measured in parts to one. First, we produce basic relative variables of prices, normalized to US level:

$$p^{i}_{j,2002} = \frac{\overline{p}^{i}_{j,2002}}{\overline{p}^{usa}_{j,2002}} \, ,$$

2 https://www.investmentmap.org/industry_classification.aspx

$$P_{2002}^{i} = \frac{\bar{P}_{2002}^{i}}{\bar{P}_{2002}^{usa}}.$$

Then we calculate the common average price of energy for every economy *i* as an average geometric value of relative prices of all energy carriers that we have information on. The multitude of indices of such energy carriers for the base year and country *i* will be denoted as J_{2002}^{i} while the number of elements it comprises – as k_{2002}^{i}. Thus, the average price of energy for country *i* will be:

$$p_{E,2002}^{i} = \left[\prod_{j \in J_{2002}^{i}} p_{j,2002}^{i}\right]^{1/k_{2000}^{i}}$$

For the following years we shall first calculate the indices of price change to the previous year:

$ind_{j,t}^{i} = \frac{\bar{p}_{j,t}^{i}}{\bar{p}_{j,t-1}^{i}}$ - for prices of energy types,

$IND_{t}^{i} = \frac{P_{t}^{i}}{P_{t-1}^{i}}$ - for average price levels.

Then we calculate average indices of energy prices in the same way as for calculation of average price of the base year:

$ind_{E,t}^{i} = \left[\prod_{j \in J_{t}^{i}} ind_{j,t}^{i}\right]^{1/k_{t}^{i}}$, t=2003,…, 2010, where J_{t}^{i} and k_{t}^{i} - the multitude of energy carrier indices, which have price data for year *t* and country *i* as well as the corresponding numbers of contained elements

In the final stage, we arrive at the prices used in the model itself in the following manner:

$$p_{E,t}^{i} = p_{E,t-1}^{i} \cdot ind_{E,t}^{i},\ t=2003,\ldots, 2010,$$

$$P_{j,t}^{i} = P_{j,t-1}^{i} \cdot IND_{,t}^{i},\ t=2003,\ldots,2010.$$

4.2. Methodology

The institutional conditions influencing businesses' behavior concerning investment projects vary enormously among the countries and groups of countries analyzed. Our approach and model specification were based on the assumption that these differences could influence the price signal efficiency for energy saving behavior. Supremacy of the rule of law, corruption control, the quality of the economic policy and of government turn to be important in terms of describing the investment climate. We believe that they are responsible for additional stimulus to reduce energy consumption apart from the price regulating instruments (e.g., taxes, subsidies, green payments). In case of weak property rights, poor regulating policy or high corruption, investors face additional risks. If the quality of general economic institutions is very low, the implementation of investment projects in different areas including energy saving may involve high transaction costs caused by the bureaucracy, such as additional reconcilement, permissions, regulation, corruption rent, and difficulties in financing. All of it cannot encourage energy-saving behavior. Due to poor control and principal agent problems, different methods that could stimulate energy-saving behavior, such as emission taxes, mandatory MEPS, motivation/information, advice, energy audits, benchmarking, financial and tax incentives, etc. fail to work. The government policy aimed at energy saving may be inefficient as well because of high transaction costs not covered by the government. In addition, not all the transaction costs can be monetary or explicit, which is not considered in business plans.

Our working hypothesis is that energy saving efficiency directly depends on the quality of institutions. We analyze the reaction of businesses to changing energy prices. If the price grows, investment into new energy saving technology may become profitable when cost reduction due to saving energy covers all the project expenses including transaction costs. Bad institutional environment results in higher transaction cost (often including a significant implicit component) what prevents energy saving, decreases the efficiency of measures and can even freeze investments into energy saving.

Usually, authors distinguish between the concepts of energy efficiency and energy saving For instance, Oikonomou et al. (2009) state it like this, "Energy efficiency concerns the technical ratio between the quantity of primary or final energy consumed and the maximum quantity of energy services obtainable (heating, lighting, cooling, mobility, and others), whilst end-use energy saving addresses the reduction of final energy consumption, through energy efficiency improvement or behavioural change" (Oikonomou et al., 2009). We believe that growing energy prices change the characteristics of energy consumers related to both these concepts. First of all, energy consumption reduces due to energy saving activities realized through behavioral change. Such changes take minimal effort if any as they are related to changing habits rather than making investments. Then, during a long period that can last up to several years, according to (Sweeney, 1984), technologies start to change when the technical ratio between the quantity of primary or final energy consumed and the maximum quantity of energy services obtainable meet the new price structure.

We noticed that rises in energy prices played a certain role in shaping the modern system of energy saving and energy efficiency support, including the mandatory MEPS, energy efficiency market, etc., which were to boost the reaction of energy consumers to the energy price rise. On the other hand, policy measures might dominate over the energy price dynamics, which happened in 2013-2015, when such measures, together with developing institutions that supported energy saving, prevented decrease in energy efficiency on transport, which might have been caused by the oil price crash of 60% (Energy efficiency market report, 2016). At the same time, we assume that energy price rise as a driver of energy efficiency and energy saving has not lost its significance yet. In any case, further growth in energy efficiency and positive changes in energy saving policy cannot happen without effective markets with efficient basic institutions.

Our theoretical assumptions are based on the concept of transaction costs that energy-consuming firms bear when they implement energy saving projects. Poor market functions and weak regulation thereof lead to higher costs as compared to smoothly functioning market mechanism. Additional costs may take the form of explicit expenses caused by loss of time and money looking for partners, financing, infrastructure connection as well as implicit ones arising from bureaucratic bargaining and corruption. In (Suslov, 2013) there is a model of competitive economic sector with a Cournod market structure. It is demonstrated that in response to price of energy increase the average elasticity of price energy consumption among firms of this sector is the higher in absolute terms, the lower the level of transactional costs related to implementation of available energy saving projects aimed at compensation of energy costs growth of the said firms.

The conception in question is as follows. Let us assume that a typical firm in an energy sector encounters the growth of initial energy price p_E by value Δp_E. Meanwhile all n firms of this sector, which are considered symmetrical, have access to an energy-saving project that allows to bring down the initial level of energy spend E by value ΔE and that requires expenditures of non-energy factor equaling ΔC with the price of p_c. As we are interested in the substitution effect itself let us simply assume that there is no income effect or, which is the same, that we are considering a conditional function of demand for the energy factor and that the firms' volume of output does not change no matter whether they take on the project or not. However, implementation of the project might incur additional transaction costs TC.

In order to decide whether to implement the project or not the manager of a firm must compare costs of both cases, that is to choose:

$$\min\{[\Delta p_E \cdot E], [\Delta p_E \cdot E - (p_E + \Delta p_E)\cdot \Delta E + p_C \cdot \Delta C + TC]\},$$

Where the part in the square brackets denotes the growth of the firm's costs in case of refusal to implement the project, whereas another part in the square brackets further on is the growth in case the project is accepted and being implemented. Thus, the project is implemented if:

$$p_C \cdot \Delta C + TC < (p_E + \Delta p_E)\cdot \Delta E .$$

Assuming that $pc\,\Delta C+TC<(p_E+\Delta p_E)\,\Delta E$ is true. In this case, if the volume TC is not high or, in other words, the level of transaction costs related to the project is low, the project will be implemented by all firms and if the latter is high, it will be rejected as impractical.

Now, to simplify this line of reasoning let us assume that the TC value takes one of only two values – the low level of TC^L, which makes the project profitable, and TC^H, which leads to rejection. Further, we presume that in certain economic circumstances out of n firms in the considered sector k of them come up against low transaction costs and consequently implemented the project, while n-k of them – against high ones and rejected the project. Then, the total energy use over the sector goes down by $k\,\Delta E$. It is now easy to calculate the elasticity of the conditional demand for energy consumption function at its price ε:

$$\varepsilon = -\frac{(k\cdot\Delta E)}{\Delta p_E}\cdot\frac{p_E}{(n\cdot E)} = -\frac{k}{n}\cdot\frac{\Delta E}{\Delta p_E}\cdot\frac{p_E}{E},$$

It is obvious that its absolute level will be higher, the more the $\frac{k}{n}$ ratio, which also point out the likelihood for a firm to encounter low transaction costs, denoted as $prob$, $prob = \frac{k}{n}$. The said value, in general terms, depends on investment climate in the economy: the better it is, the less likely an economic agent will encounter a high level of transaction costs. In fact, we are talking about the quality of economic institutes that determine bureaucratic burden on firms, adequacy of laws and their execution, access to financing, development of infrastructure and information systems. The faults of institutional environment create barriers for business, facilitate corruption and shadow economy. What is more, weak institutions slow down stimuli of energy saving behavior – due to the problem of control and moral hazard.

We denote factor $INST$ as a measure of institutional environment. The higher this indicator, the better institutions there are and we affirm that the value $\frac{d(prob)}{d(INST)}$ >0. Then the absolute value energy consumption elasticity is the function of measure of institution quality $|\varepsilon| = f(INST)$, and in this case the inequation $\frac{df}{d(INST)} > 0$ holds true.

We propose that the indicated dependence between the elasticity of energy consumption at the price of energy and the quality of institutional environment is to some degree characteristic for most sectors of economy as long as they are part of market relations and consequently the firms there being sensitive to price changes. A special case is the sector of energy production and processing where the income effect from energy price growth may be positive and lead to increase of supply. However, the energy consumption of extraction and processing of energy resources being quite high will also open way to high levels of substitution effect. Reducing costs related to higher energy expenditures will require substantial investment and consequently implementation of vast investment projects that may come up against institutional barriers and related hurdles of informational, infrastructural and financial nature.

We believe that the administrative sector also wants to reduce costs in as much as budget constraints of its organizations are rigid. The existence of 'soft' budget constraints signifying that the state is willing to cover rising costs of budgetary organizations is also an institutional phenomenon characteristic of economies with bad institutions and unstable financial systems. In such a case, impact of price shocks on energy cost reduction will be less than in economies with stable financial systems.

4.3. Specification

We considered two models – one for energy consumption of production sphere in general and another for energy consumption in industrial sector, while using their common specification:

$$\ln\left(e_{it}^k\right) = \beta_0 + \beta_1 \cdot DISTE_{it} + \beta_2 \cdot INST_{it} \cdot \ln\left(\frac{P}{p_E}\right)_{it} + \beta_3 \cdot \ln\left(\frac{P}{p_E}\right) + u_{it} \quad (2)$$

Combined influence of real energy price and institutions is calculated as $INST \cdot \ln\left(\frac{P}{p_E}\right)$, which is an interaction term used after Polterovich and Popov (2003). If it proves to be significant, one could suggest that institutions affect energy intensity through a price mechanism. On the other hand, a simple transformation in (2) helps to see that

$$e_{it}^{k} = \exp(\beta_0 + \beta_1 \cdot DISTE_{it} + \varepsilon_{it}) \cdot \left(\frac{P}{p_E}\right)_{it}^{(\beta_2 \cdot INST_{it} + \beta_3)}$$

$-(\beta_2 \cdot INST + \beta_3)$ is energy intensity elasticity of price for a particular economy, being a function of an institutional strength index with $\beta_2, \beta_3 > 0$ that is the same as our arguments. Thus, direct calculation of elasticity variables based on model valuation parameters helps clarify the use of logarithms despite the fact that price variables are relative.

Variable *INST* is convenient as it has a negative value for the economies with poor institutions and has a higher absolute value for worse cases, being opposite for the economies with effective institutions. Thus, the absolute value of the elasticity value is less than coefficient β_3 in case of poor institutions and greater than it in case of effective institutions. Using this variable, we see that the reaction of energy consumers to the energy price rise is shaped under the influence of both market and government institutions because the variable combines the institutional indices of government effectiveness and control of corruption. The former index is related to the management quality at the level of the government, while the latter mostly characterizes the market, and both of them indicate the interaction of the government and businesses. In our opinion, our approach is also proved by the results obtained by other scholars, for instance in (Fredriksson et al., 2004).

Hence, if the price variable and the interaction term of the equation are of sufficient significance, the elasticity of price of energy intensity for each economy at any particular moment will depend on the quality of institutions. The concept of ‘energy efficiency elasticity’ as such differs from the ‘energy demand elasticity of price’ as it does not consider the income effects and measures only substitution effects, which obviously describes the results of energy saving much better.

5. RESULTS AND DISCUSSION

In order to calculate the elasticity of energy consumption by price, we considered 69 countries over the period from 2002 to 2010 that differ from each other by their level of economic and social development. The number of countries included in the sample is due to restricted available statistics, particularly as for data on relative energy prices. Based on country data, we evaluated model parameters (equation 2) and calculated the elasticity of energy consumption by price for energy as dependent on the institutional factor both for production sphere (model 1) ad for industry (model 2). Based on evaluation of ratios for model 1 we have calculated price elasticity for energy for every year while using the value of institutional factor for each country.

The Hausman test for the fixed and random effects models, where the null hypothesis says that the model with random effects is more preferable than one with fixed effects (Greene, 2008), helped us to choose the most appropriate model. The test looks to see if there is a correlation between the unique errors and the regressors in the model. The null hypothesis is that there is no correlation between the two. We reject the null hypothesis considering the use of the model with fixed effects more preferable. To test that the OLS estimates are non-biased and consistent after the base specification we also made the dynamic panel data analysis to remove unobserved heterogeneity modeling of a partial adjustment mechanism (Durlauf et al., 2009).

Cross-sectional dependence is quite common for macro panels with long time series (over 20-30 years), despite it we used the Pasaran CD (cross-sectional dependence) for our micro panel (69 countries and 9 years). This test helped us to identify whether the residuals are correlated across entities (Hoechle, 2007). Based on the estimations, we couldn’t reject the hypothesis that the residuals are not correlated, which favors the results. To solve the problem of group-wise heteroskedasticity, we used the Huber-White sandwich estimator, which allowed us to obtain the heteroskedasticity-robust standard error.

The results obtained from the regression equation are given in Table 2.

Thus, we showed that according to equation (2) the energy intensity relative price elasticity is equal to -(0.303+0.0302×INST) and depends on the quality of institutions in the economy considered, namely indices GE (Government Effectiveness) and CC (Control of Corruption). The higher the indices, the better the institutions are and the higher the absolute energy efficiency price elasticity. Hence, if the price grows, the energy intensity decreases more significantly. In other words, the higher the INST value, the more effective the price signals are for the economy’s energy-saving behavior, and the rise of temperature excursion in January and July by 0.1 results in the growth of energy intensity by 0.003%.

For model 2, the industrial sector, we have determined that energy

Table 2: Estimated energy intensity in production sector and in industry sector in the world countries (fixed effect)

Variables	Model 1[1]		Model 2[1]	
	Coef.	z-value	Coef.	z-value
	Dependent variable: ln (Energy consumption in production sector per a unit of GDP PPP)		Dependent variable: Ln (Energy consumption in industry per a unit of industry value added)	
DISTE	0.003***	1.97	0.0022*	5.44
$\text{Ln}\left(\frac{\text{P}}{\text{P}_\text{E}}\right)$	0.303*	9.34	0.727*	6.35
$\text{Ln}\left(\frac{\text{P}}{\text{P}_\text{E}}\right) \times \text{INST}$	0.0302**	2.77	0.0383**	2.73
Const	−1.921*	−29.07	−1.41*	−15.31

*: Stands for 1% significance level, **: Stands for 5% significance level; ***: Stands for 10% significance level, [1]Model 1 considers indicators for production sphere, Model 2 – for industry

consumption elasticity for energy price is also dependent on the institutional factor. Its impact is greater than for the model for the economy's production sphere. The elasticity of energy consumption for relative price of energy for production sphere based on obtained results has the following formula: - (0.727+0.0383×INST). When comparing this with its results for the production sphere, one may notice that the ratio of significance of institutional environment differs only slightly, whereas the values of elasticity by price, which do not depend on the quality of institutions, are quite distinct from each other. Industrial energy consumption without the institutional factor is much more sensitive to change of relative price for energy as compared to the production sector as a whole – the ratio to the factor of relative price in the model is 0.727 and 0.303 respectively.

Appendix 1 shows the energy intensity price elasticity with the institutional factor obtained on the bases of panel data for each of the 69 countries. The results for different groups of countries shown in Table 3 below demonstrate that the absolute elasticity for the OECD countries is higher than that for the CIS, Eastern Europe and former socialist economies. In addition, we see that the absolute elasticity for the OECD is higher than the world level, which indicates that the price factor is a very efficient instrument for decreasing energy intensity. In other words, the governments' regulating measures that increase the energy price for industries (through taxes or penalties) are more effective in the OECD economies than world-wide average. Taking into account the specificity of our calculating the energy intensity elasticity, i.e. with the institutional factor in view, we conclude that the most effective energy policy in these economies is due to the high quality of institutions.

Table 3: Estimated energy intensity in production sector and in industry sector in the world countries (Arellano-bond estimations)

Variables	Model 1[1]	Model 2[1]
	Coeff.	Coeff.
Lne (lag 1)	0.721*	0.971*
Lne (lag 2)	0.126	0.019
Diste	0.002	0.001
$\mathrm{Ln}\left(\frac{P}{P_E}\right)$	0.621*	1.28*
$\mathrm{Ln}\left(\frac{P}{P_E}\right)$ (lag 1)		0.03
$\mathrm{Ln}\left(\frac{P}{P_E}\right)\times \mathrm{INST}$	0.02**	-0.01
$\mathrm{Ln}\left(\frac{P}{P_E}\right)\times \mathrm{INST}$ (lag 1)		0.6802*
Constant	-0.361*	-0.041
Arellano-bond test for AR (1) in first differences	z = -1.72, Pr>z = 0.086	z=-1.82, Pr>z = 0.069
Arellano-bond test for AR (2) in first differences:	z = 0.94, Pr>z = 0.345	z=0.53, Pr>z = 0.598
Sargan test of overid. restrictions: (Not robust, but not weakened by many instruments)	Chi^2 (52)=62.02, $Prob>Chi^2$=0.161	Chi^2 (52)=541.45, $Prob>Chi^2$=0.000
Hansen test of overid. restrictions (robust, but weakened by many instruments)	Chi^2 (52)=45.58 $Prob>Chi^2$=0.723	Chi^2 (52)=64.30 $Prob>Chi^2$=0.936
Hansen test excluding group	Chi (2)=10,29 $Prob>Chi^2$=0,173	Chi (2)=65,14 $Prob>Chi^2$=0,242
Difference (null H=exogenous)	Chi^2 (14)=14,49 $Prob>Chi^2$=0,414	Chi^2 (14)=-0,84 $Prob>Chi^2$=1

*: Stands for 1% significance level, **: Stands for 5% significance level, [1]Model 1 considers indicators for production sphere, Model 2 – for industry

The values of elasticity by price with account of institutional factor for the industry over the countries we have considered demonstrate higher values in comparison with those represented in Table 4. This fact may be explained in our view by the higher sensitivity of agents in this sector to price change as well as greater uniformity of industrial producers versus the larger production sphere in the countries under consideration (Table 4). The attachment 2 presents calculations for elasticity for every country's production sector from 2002 to 2010.

In order to take into account the AR(1) process and solve the problem of endogeneity and unobserved heterogeneity we also estimated the dynamic panel data. Both energy price and institutional factors are highly significant, results are presented in Table 3.

Similar to the case of model with fixed effects, the institutional factor – a $\mathrm{Ln}\left(\frac{P}{P_E}\right)\times \mathrm{INST}$ is positively significant which confirms our assumption about the importance of including the institutional variable into the model. At the same time, the climate intense index did not demonstrate its significance in dynamic panel data.

In the dynamic panel data, we used explanatory factors lags, namely relative energy price and $\mathrm{Ln}\left(\frac{P}{P_E}\right)\times \mathrm{INST}$, during two periods as instrumental variables. The Arellano-Bond tests for AR(1) and AR(2) reject the hypothesis about autocorrelation of the first or second order. The Sargan test rejects the endogeneity hypothesis, but the Hansen test accepts it. It may happen that the Sargan test erroneously rejects a true hypothesis in case of heteroskedasticity, but we emphasize it that both the Sargan test and the Hansen test couldn't reject the null hypothesis about the quality of instrumental variables.

The significance of institutional factor both in the short and long term for production sphere and industry testifies to the stable nature of obtained results and, thus, supports our original supposition on importance of its consideration for calculation of price factor contribution to regulations in energy consumption.

6. CONCLUSION

Using dynamic panel data and model with fixed individual effects, we show that the quality of market institutions influences the level

Table 4: Energy Intensity Price Elasticity values for groups of countries

Group of the countries	2002	2003	2004	2005	2006	2007	2008	2009	2010
World	−0.330	−0.333	−0.333	−0.331	−0.333	−0.332	−0.332	−0.332	−0.332
OECD	−0.402	−0.402	−0.402	−0.397	−0.397	−0.396	−0.395	−0.395	−0.395
CIS	−0.250	−0.256	−0.254	−0.256	−0.259	−0.258	−0.260	−0.259	−0.258
FSE	−0.275	−0.281	−0.281	−0.281	−0.283	−0.280	−0.283	−0.282	−0.282
Eastern Europe and Baltia	−0.311	−0.317	−0.320	−0.319	−0.318	−0.315	−0.317	−0.318	−0.318

Table 5: Values of energy consumption elasticity over price for groups of countries for industrial sector[2]

Group of the countries	2002	2003	2004	2005	2006	2007	2008	2009	2010
World	−0.762	−0.765	−0.765	−0.763	−0.765	−0.764	−0.765	−0.763	−0.764
OECD	−0.853	−0.852	−0.853	−0.846	−0.847	−0.846	−0.844	−0.844	−0.844
CIS	−0.661	−0.668	−0.665	−0.667	−0.672	−0.670	−0.673	−0.671	−0.670
FSE	−0.679	−0.687	−0.687	−0.688	−0.689	−0.686	−0.671	−0.689	−0.673
East Europe and Baltica	−0.737	−0.745	−0.748	−0.747	−0.747	−0.742	−0.746	−0.746	−0.747

of energy intensity in both short-run and long-run perspectives. The significance of factors obtained during the panel data analysis helped us to calculate the energy intensity elasticity for 69 economies during the period of 2002-2010. The estimates are non-biased and consistent as the explanatory factors are highly significant both in model with fixed effects and dynamic panel data.

Empirically, we show that the energy intensity is influenced by not only the price factor, but also by the quality of institutions, such as government effectiveness and control of corruption. High quality of institutions increases the energy intensity sensitivity to energy price changes, which boosts the efficiency of price-based instruments.

The energy intensity price elasticities for the OECD economies calculated according to our model appeared to be the highest in the absolute value, which indicates the greatest energy intensity sensitivity to the price rise and improves the effectiveness of regulation measures, such as imposing emission taxes (Table 5). During 2002-2010, the average elasticity for the CIS economies was 40% lower in the absolute value than that for the OECD economies, with Eastern Europe and Baltic economies being 20% behind the developed economies. We believe that this fact means weaker business sector agents incentives to decrease energy consumption for the agents in the CIS, Eastern Europe and Baltic economies as compared to the developed countries. The regulation aimed at intensifying the use of energy saving technologies in those economies was not effective enough due to the low sensitivity of energy consumption to energy price changes.

We believe that our analysis provides a useful insight for policy making decisions on energy-saving policy. Policies that impose the cost (in the form of taxation, for example) appear not to be effective when they are influenced by market factors, such as the quality of institutions. Similar conclusions were stated in (Gillingham et al., 2009), where the authors emphasized the importance of market mechanisms for providing the stimuli to economic agents for energy-saving behavior.

Our analysis of energy consumption trends from 1991 to 2010 for countries and group of countries of the world shows that over periods of growing prices for energy, efforts to save energy intensified, while in times of lower energy prices, such efforts slacked off without stopping completely. This corresponds perfectly with the statement that special policy measures and institutional development have been the key drivers of efficiency improvements in recent years (Energy Efficiency Market Report, 2016).

The results obtained seem to be of particular importance for the economies with weaker institutions, which have to take into account the institutional factors and be aware of lower efficiency of the measures stimulating energy-saving behavior if they try to decrease the energy intensity without improving the quality of institutions.

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APPENDIX 1

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010
Albania	−0.26	−0.26	−0.27	−0.26	−0.26	−0.27	−0.28	−0.28	−0.28
Armenia	−0.28	−0.28	−0.28	−0.28	−0.28	−0.27	−0.28	−0.29	−0.28
Azerbajian	−0.24	−0.25	−0.25	−0.25	−0.25	−0.25	−0.25	−0.25	−0.24
Austria	−0.43	−0.43	−0.43	−0.41	−0.42	−0.42	−0.41	−0.41	−0.41
Belarus	−0.25	−0.25	−0.24	−0.24	−0.25	−0.25	−0.25	−0.25	−0.25
Belgium	−0.41	−0.40	−0.40	−0.40	−0.39	−0.39	−0.38	−0.39	−0.40
Bosnia and Herzogovine	−0.26	−0.27	−0.28	−0.28	−0.28	−0.27	−0.27	−0.27	−0.27
Bulgaria	−0.30	−0.30	−0.31	−0.31	−0.30	−0.30	−0.29	−0.30	−0.30
Canada	−0.43	−0.43	−0.42	−0.42	−0.42	−0.42	−0.42	−0.42	−0.42
China	−0.28	−0.29	−0.29	−0.28	−0.29	−0.29	−0.29	−0.29	−0.29
Chile	−0.38	−0.38	−0.38	−0.38	−0.38	−0.38	−0.38	−0.38	−0.39
Colombia	−0.28	−0.29	−0.30	−0.29	−0.30	−0.30	−0.30	−0.29	−0.29
Costa Rica	−0.33	−0.33	−0.32	−0.32	−0.32	−0.32	−0.32	−0.33	−0.33
Croatia	−0.32	−0.32	−0.32	−0.32	−0.32	−0.32	−0.32	−0.32	−0.32
Czech Republic	−0.34	−0.34	−0.34	−0.35	−0.34	−0.34	−0.34	−0.34	−0.34
Cyprus	−0.38	−0.37	−0.37	−0.37	−0.38	−0.38	−0.39	−0.37	−0.38
Denmark	−0.44	−0.44	−0.45	−0.44	−0.45	−0.45	−0.45	−0.45	−0.44
Ecuador	−0.25	−0.25	−0.26	−0.25	−0.25	−0.25	−0.25	−0.25	−0.26
El Salvator	−0.26	−0.28	−0.28	−0.28	−0.29	−0.29	−0.29	−0.30	−0.30
Estonia	−0.34	−0.35	−0.36	−0.36	−0.37	−0.36	−0.36	−0.36	−0.36
Finland	−0.44	−0.45	−0.45	−0.44	−0.44	−0.44	−0.44	−0.44	−0.44
France	−0.39	−0.40	−0.40	−0.40	−0.39	−0.39	−0.39	−0.39	−0.39
FYR Macedonia	−0.26	−0.27	−0.28	−0.28	−0.29	−0.29	−0.30	−0.30	−0.30
Germany	−0.42	−0.40	−0.41	−0.41	−0.41	−0.40	−0.40	−0.40	−0.40
Georgia	−0.24	−0.27	−0.27	−0.28	−0.30	−0.30	−0.30	−0.30	−0.31
Greece	−0.34	−0.34	−0.34	−0.34	−0.33	−0.33	−0.32	−0.32	−0.31
Honduras	−0.25	−0.26	−0.26	−0.26	−0.26	−0.27	−0.26	−0.26	−0.26
Hungary	−0.35	−0.35	−0.35	−0.35	−0.35	−0.34	−0.34	−0.33	−0.33
India	−0.28	−0.29	−0.29	−0.29	−0.29	−0.29	−0.29	−0.29	−0.29
Indonesia	−0.26	−0.26	−0.26	−0.26	−0.27	−0.28	−0.28	−0.27	−0.27
Ireland	−0.39	−0.40	−0.39	−0.40	−0.40	−0.40	−0.40	−0.40	−0.39
Israel	−0.38	−0.37	−0.37	−0.36	−0.37	−0.36	−0.37	−0.36	−0.36
Italy	−0.34	−0.34	−0.33	−0.33	−0.33	−0.32	−0.32	−0.32	−0.32
Japan	−0.36	−0.38	−0.38	−0.38	−0.39	−0.38	−0.39	−0.39	−0.40
Kazahstan	−0.24	−0.25	−0.25	−0.26	−0.26	−0.26	−0.26	−0.27	−0.26
Kyrgyz Republic	−0.26	−0.26	−0.25	−0.24	−0.24	−0.24	−0.25	−0.24	−0.25
Latvia	−0.32	−0.33	−0.33	−0.33	−0.33	−0.33	−0.32	−0.33	−0.33
Lithuania	−0.32	−0.33	−0.34	−0.33	−0.33	−0.33	−0.32	−0.33	−0.33
Luxembourg	−0.43	−0.41	−0.42	−0.41	−0.41	−0.41	−0.41	−0.42	−0.42
Malta	−0.36	−0.36	−0.36	−0.35	−0.37	−0.37	−0.37	−0.36	−0.36
Moldova	−0.26	−0.26	−0.25	−0.26	−0.26	−0.26	−0.26	−0.27	−0.26
Mongolia	−0.30	−0.29	−0.28	−0.27	−0.27	−0.27	−0.27	−0.26	−0.26
Montenegro	−0.30	−0.30	−0.30	−0.30	−0.29	−0.29	−0.30	−0.30	−0.30
Netherland	−0.43	−0.43	−0.43	−0.42	−0.42	−0.42	−0.42	−0.42	−0.42
New Zealand	−0.43	−0.43	−0.44	−0.42	−0.42	−0.42	−0.42	−0.43	−0.43
Norway	−0.43	−0.42	−0.43	−0.42	−0.43	−0.42	−0.42	−0.42	−0.42
Pakistan	−0.26	−0.27	−0.26	−0.26	−0.27	−0.27	−0.26	−0.25	−0.25
Panama	−0.29	−0.29	−0.29	−0.29	−0.29	−0.30	−0.30	−0.30	−0.30
Paraguyua	−0.23	−0.23	−0.23	−0.24	−0.24	−0.24	−0.25	−0.25	−0.25
Poland	−0.33	−0.33	−0.32	−0.32	−0.32	−0.32	−0.33	−0.33	−0.33
Portugal	−0.38	−0.37	−0.37	−0.37	−0.36	−0.36	−0.37	−0.37	−0.36
Romania	−0.28	−0.29	−0.29	−0.29	−0.29	−0.29	−0.29	−0.28	−0.29
Russia Federation	−0.26	−0.27	−0.27	−0.27	−0.26	−0.26	−0.26	−0.26	−0.26
Singapore	−0.43	−0.43	−0.44	−0.43	−0.43	−0.44	−0.44	−0.44	−0.44
Slovak Republic	−0.32	−0.33	−0.34	−0.35	−0.34	−0.33	−0.34	−0.34	−0.33
Slovenia	−0.35	−0.36	−0.36	−0.36	−0.36	−0.36	−0.37	−0.37	−0.36
South Africa	−0.33	−0.33	−0.34	−0.34	−0.33	−0.32	−0.32	−0.32	−0.32
Spain	−0.40	−0.40	−0.38	−0.39	−0.36	−0.36	−0.36	−0.36	−0.36
Sweden	−0.43	−0.43	−0.43	−0.42	−0.42	−0.43	−0.43	−0.43	−0.43
Swithzerland	−0.43	−0.42	−0.43	−0.42	−0.43	−0.43	−0.43	−0.43	−0.42
Tailand	−0.30	−0.31	−0.31	−0.31	−0.30	−0.30	−0.30	−0.30	−0.30
Tajikistan	−0.23	−0.24	−0.24	−0.24	−0.24	−0.24	−0.24	−0.24	−0.24

Country Name	2002	2003	2004	2005	2006	2007	2008	2009	2010
Turkey	−0.28	−0.30	−0.30	−0.31	−0.31	−0.31	−0.31	−0.31	−0.31
Uruguyua	−0.34	−0.35	−0.34	−0.35	−0.34	−0.35	−0.36	−0.36	−0.36
Ukraine	−0.25	−0.26	−0.26	−0.26	−0.27	−0.26	−0.26	−0.25	−0.25
Uzbekistan	−0.24	−0.24	−0.24	−0.23	−0.24	−0.24	−0.25	−0.25	−0.24
UK	−0.42	−0.42	−0.42	−0.41	−0.41	−0.40	−0.40	−0.40	−0.40
US	−0.41	−0.40	−0.41	−0.40	−0.39	−0.39	−0.39	−0.39	−0.39