

The impact of the crisis on the energy demand and energy intensity in Central and Eastern European countries

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Abstract

The purpose of our paper is to analyze the impact of the recent crisis on the oil and electricity demand and the energy intensity of different Central and Eastern European countries, namely the Czech Republic, Hungary, Poland and Slovakia. Furthermore, we would like to reveal whether there is a lag in the adjustment of energy consumption. In analyzing energy intensity, we use motor gasoline, diesel oil and electricity consumption data and ignore coal and natural gas data. By so doing, we avoid failures arising from changing coal/gas consumption due to changing weather conditions. Our results show that the crisis did impact energy consumption and reveal that the improvement of energy intensity halted in 2009, implying that the economic players did not immediately adjust their energy consumption according to their economic activity. The gasoline and diesel intensity, however, deteriorated (increased) only in the Czech Republic and in Hungary. In Slovakia and Poland there were no significant changes.

Keywords: oil consumption, energy intensity, crisis, Central and Eastern Europe

JEL codes: Q4, Q41, Q47, Q48

1. Introduction

The idea of this paper came when we considered how the energy intensity of different countries are affected by crises like the one beginning in 2008 and unfolding in 2009 and 2010. Certainly, it is known that crises do have an impact on energy consumption but it is not very clear whether it affects the efficiency of energy use presented by the energy intensity index. Furthermore, it is not clear whether different economic players immediately adjust their energy

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consumption in line with their economic activity or whether there is a certain time lag in the adjustment process.

Through our analyses, we would like to get a better understanding of energy consumption and energy consumption adjustments in the years when crises unfold. It will help energy companies to plan revenues, and state officials to plan energy tax revenues and environmental costs. Moreover, we might figure out how fast and how well economic players responded to the crisis unfolding in 2009-2010 in terms of modification of their energy consumption.

There have not been any papers investigating energy consumption based on the most recent crisis of 2008-2010. This was mainly due to the lack of up-to-date data. In the late months of 2011, the International Energy Agency published the energy consumption data for the year 2010. This makes an analysis of the effects of the crisis possible.

In the first part of our paper we present some considerations about energy consumption and adjustment lags; in the second section we present the energy consumption data of the past years of the Czech Republic, Hungary, Poland and Slovakia. In the third section, we analyze the energy intensity changes. Here, we take into account the intensity of use of different energy sources. In the last section we conclude.

2. Literature review and methodology

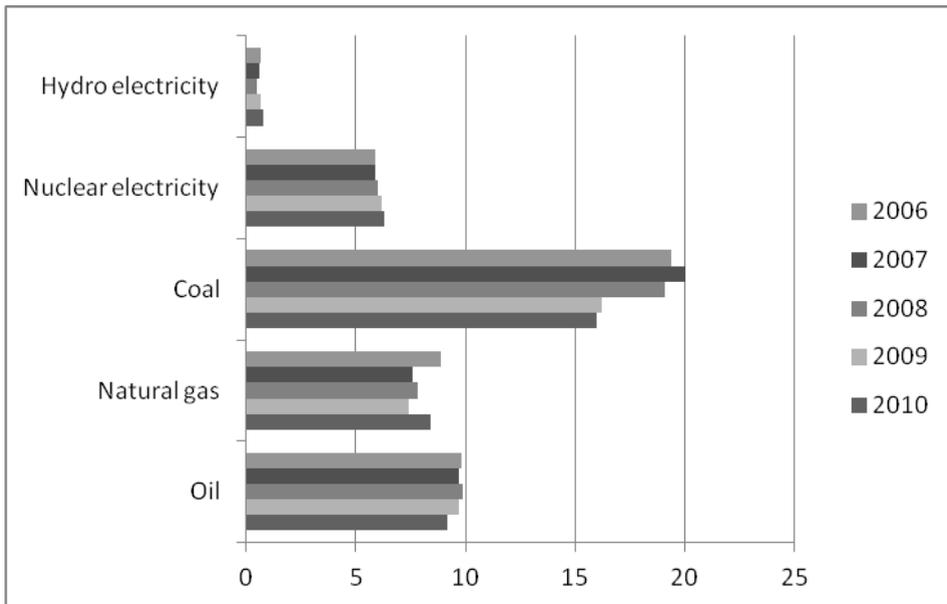
The index of energy intensity shows the amount of energy needed to produce one unit of gross domestic product in a certain country. This index is a basic measurement tool and thus, we will not go into detail about it. For this, see e.g. Bhattacharyya (2011), where he presents some simple as well as more sophisticated demand analysis methods. In one of them (see Bhattacharyya, 2011, p. 68.), he adds that total energy demand in period t is often not only the function of the real price of energy and the output of the economy but also of the energy consumption of the previous period. In another paper, Bhattacharyya and Blake (2009) found that for several countries, the lagged factor is of high importance.

Thus, without going into detail about the lagged factor, we accept it as an important element in the analysis of energy demand. Furthermore, in our analysis, we will try to show whether the adjustment lag exists in the analyzed Central and Eastern European countries. These countries are the Czech Republic, Hungary, Poland and Slovakia. We chose them due to the fact that the most recent publication of the International Energy Agency related to energy data for 2010 include only OECD countries and thus, there is a lack of detailed (gasoline or diesel oil consumption) information for Romania or Bulgaria. For data consistency purposes, we did not intend to use different data sources. Thus, where possible, we use data from one single data source in each calculation.

3. Energy consumption trends in the CEE region

In the figures below, we presented the consumption data for the main primary energy sources for the different countries. Some thoughts should be mentioned here. First, coal consumption is mainly related to electricity production. Natural gas consumption is often a function of electricity consumption and heat energy needs. The latter depends on the average temperature of the heating season, thus it is not the most appropriate data presenting the response of economic players to the crisis. The most appropriate data showing the response to the crisis is oil consumption. The reason for this is that roughly 62% of crude oil is used up in the transport sector, another 10% is consumed in the industry (steel, iron industry etc.) and another 16% makes up non-energy use, like petrochemical feedstocks (IEA, 2010). It means that the highest part of oil consumption is related to economic players (households, enterprises), and represents a function of economic activity and not of other, non-economic factors like weather conditions.

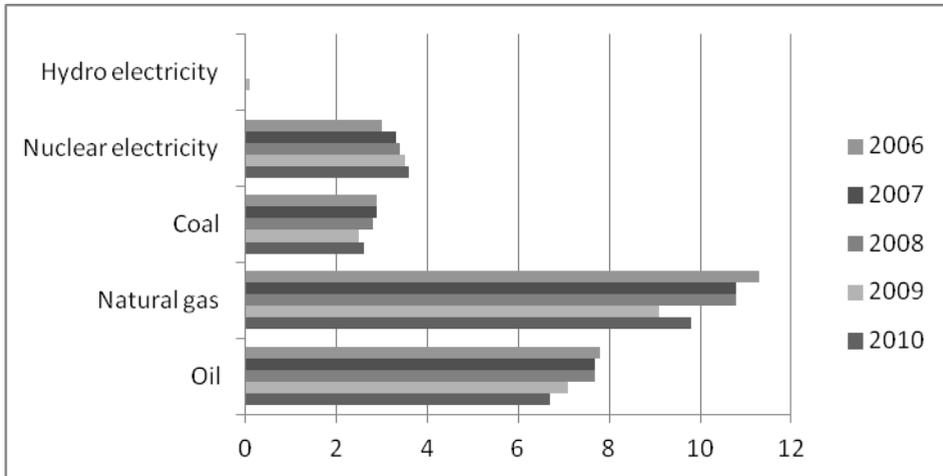
Figure 1. Energy consumption data of the Czech Republic (mtoe¹)



Source: BP (2008, 2009, 2011)

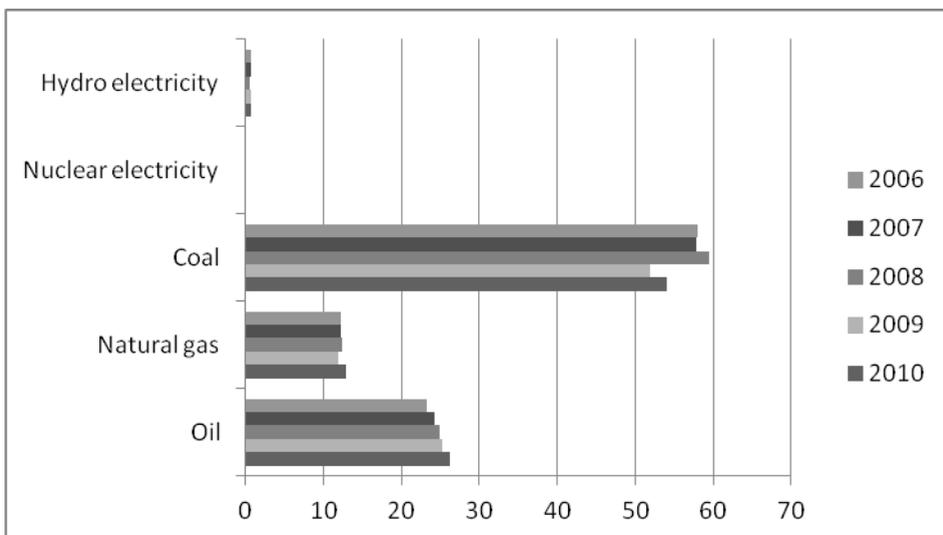
As can be seen from the figure above, coal consumption declined significantly, oil consumption diminished slightly in the Czech Republic in 2009-2010.

¹ mtoe: million tons of oil equivalent.

Figure 2. Energy consumption data of Hungary (mtoe)

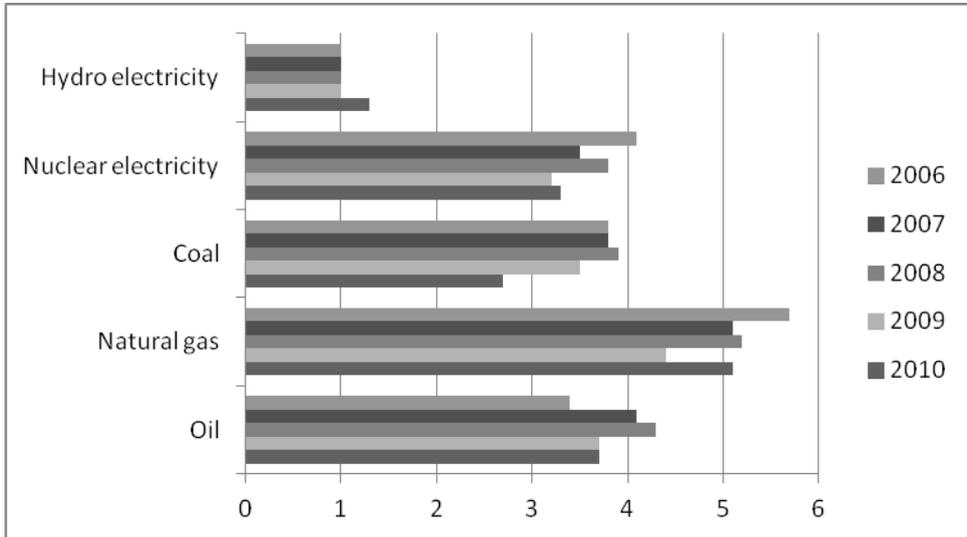
Source: BP (2008, 2009, 2011)

In Hungary, oil consumption declined in 2009 and 2010, whereas coal use in the core year of the crisis, 2009 declined slightly and increased again in 2010.

Figure 3. Energy consumption data of Poland (mtoe)

Source: BP (2008, 2009, 2011)

In Poland, only coal consumption declined significantly during the crisis, oil consumption continued its way upward.

Figure 4: Energy consumption data of Slovakia (mtoe)

Source: BP (2008, 2009, 2011)

In Slovakia, both oil and coal consumption declined in 2009 and 2010, implying that the economic players adjusted their coal and oil consumption in line with the effects of the crisis.

However, a simple analysis of energy consumption does not reflect the efficiency of energy use. For instance, it might have occurred that energy consumption declined and, at the same time, GDP expanded. Energy consumption data would in this case wrongly show that it declined due to the crisis. Therefore, changes in energy consumption have to be compared to the changes in gross domestic product. This is done in the next section.

4. Analysis of the energy intensities

Having seen the impact of the crisis on the energy consumption of some countries in the CEE region, now let us turn to the efficiency of energy use. We are going to choose the energy intensity index to measure how efficiently energy is used in the relevant countries but mainly in order to see whether it has changed in the crisis years.

Energy intensity shows the amount of energy needed to produce one unit of gross domestic product. As total primary energy consumption equals to total primary energy supply (TPES), the index can be written as²:

² We could have used the term „total primary energy consumption” but such a term is not common in energy statistics. Instead, TPES is used and it refers to the same amount

Energy intensity = total primary energy supply / gross domestic product.

Table 1. Energy intensity time series of different countries (toe/thousand USD)

TPES/GDP	2004	2005	2006	2007	2008	2009	2010
Czech Republic	0.72	0.67	0.63	0.59	0.56	0.55	0.55
Hungary	0.46	0.47	0.44	0.43	0.44	0.44	0.45
Poland	0.48	0.47	0.46	0.43	0.41	0.39	0.41
Slovakia	0.76	0.74	0.66	0.57	0.56	0.53	0.53

Source: IEA, 2011a

We consider the year 2009 as the core year of the crisis. That was the period when the global economic output and the Central and Eastern European countries were mostly affected, stock indices plummeted and exchange rates fluctuated. As you can see, the continuous (and, in the Czech and Slovakian case, fast) improvement of energy intensity in the years before 2009 halted in 2009-2010. It means that the economic players could not further improve the efficiency of energy consumption. However, these data might be misleading. Total primary energy supply (TPES) includes all the energy sources consumed in an economy (e.g. in the agriculture, by households, in electricity production etc.) and the use of several of them is related to weather conditions. Heat energy demand is not affected by the performance of the economy but by how cold winter is. Therefore, as TPES includes the general heat energy sources: coal, wood and natural gas, the general energy intensity index might be affected by the average temperature of the heating season. A colder winter might increase energy supply/consumption and thus, energy intensity.

To find a more accurate index, it is desirable to separate TPES into different energy sources. If, for instance, we take motor gasoline or diesel oil consumption instead of TPES, we exclude the influence of weather conditions (as only few if any people use gasoline or diesel to heat flats or houses). In our next table you will find how much gasoline was necessary to produce one unit of GDP in the past years in the above-mentioned countries.

The data in Table 2 imply different conclusions for the countries in discussion. In the Czech Republic, gasoline consumption in 2009 increased by 1.05%, although gross domestic product decreased by more than 4%. In 2010, however, gasoline consumption dropped by 12.3% whereas GDP increased by 2.3%. It seems that, in the case of the Czech Republic, there was a lag in the adjustment of gasoline consumption to the economic output. One might think

but from a supply point of view. Note, however, that „total final (energy) consumption” (TFC) does not equal to TPES. The former means the energy consumed by end users, therefore it does not include e.g. losses in electricity production. TPES and total primary consumption include these losses, as well.

that the price changes of gasoline might have affected gasoline consumption.

The average 2009 and 2010 gasoline prices differed by 16% (IEA, 2011c). Due to the low price elasticity of gasoline demand, for a drop of 12% in demand, a huge increase in gasoline prices would have been necessary. Therefore, the drop in gasoline demand is rather related to the changes in disposable income (or GDP) of the relevant consumers.

Table 2. Gasoline intensity in different countries 2006-2010 (kg per thousand USD)

Gasoline TFC. / GDP	2006	2007	2008	2009	2010
Czech Republic	27.65	27.21	25.51	26.90	23.07
Hungary	24.84	25.35	25.89	27.75	24.15
Poland	19.57	18.42	17.65	17.68	16.58
Slovakia	21.55	20.45	20.46	20.15	19.21

Source: IEA, 2011a, 2011b

The case of Hungary is similar to a great extent. While motor gasoline consumption stagnated between 2008 and 2009, in 2010 it dropped by 12%³. In the same year (2010), GDP increased, whereas in 2009, it dropped. Again, a lagged adjustment of gasoline consumption seems to be apparent.

In Poland and Slovakia, motor gasoline consumption changed in line with the GDP and therefore no significant changes in gasoline intensity can be observed.

Gasoline is mostly consumed in the transport sector as well as in the households and not in the industry or agriculture sectors. Based on this, we can say that the Czech and Hungarian households did not immediately adjust their gasoline consumption when the crisis hit the economies with its highest power. However, a year later, in 2010, these households reduced their consumption by a higher rate than the GDP-reduction of 2009.

Now, see the relevant data for diesel intensity.

Table 3. Diesel oil intensity in different countries 2006-2010 (kg per thousand USD)

Diesel TFC / GDP	2006	2007	2008	2009	2010
Czech Republic	54.67	53.84	52.08	54.96	49.81
Hungary	47.99	49.94	51.22	54.91	53.23
Poland	47.06	48.27	49.65	49.38	51.43
Slovakia	42.21	43.32	44.26	41.09	48.86

Source: IEA, 2011a, 2011b

³ Gasoline price increased by 19% between 2009 and 2010 (IEA, 2011c). For this, see the argumentation about the Czech Republic.

Again, in the Czech Republic, the steadily declining diesel intensity of 2006-2008 increased in 2009 and dropped in 2010. The reason for this (see the 2009 case) was that while the Czech GDP declined in 2009, diesel oil consumption slightly increased. Furthermore, similarly to the case of gasoline, a significant drop (8%) in diesel consumption accompanied by a slight increase in GDP can be observed in 2010.

Truly, similar things happened in Hungary, too⁴. Diesel consumption responded late to the changed economic output. Unlike in the Czech Republic and Hungary, diesel consumption in Poland and Slovakia responded fast and appropriately to the changes in GDP.

A significant difference between gasoline and diesel consumption is that diesel is consumed in the commercial transport of goods⁵, too. Profitability-driven enterprises are expected to respond to output changes faster than car owners using their cars for personal purposes. For this expectation, however, we cannot find any evidence: both gasoline and diesel consumption responses occurred late in the Czech Republic and Hungary but quickly in Poland and Slovakia.

If you have a look at the electricity intensity table, you will see that the crisis – with the exception of Hungary – did not change earlier trends. In the case of 3 of our countries, the amount of electricity necessary to produce one unit of GDP continued to decline. In Hungary, however, it increased.

Table 4. Electricity intensity in different countries 2006-2009

Electr. TFC / GDP	2006	2007	2008	2009
Czech Republic	0.78	0.74	0.73	0.72
Hungary	0.54	0.54	0.57	0.59
Poland	0.52	0.51	0.49	0.47
Slovakia	0.84	0.79	0.75	0.74

Source: IEA, 2011a

5. Concluding remarks

1. We can conclude that the recent crisis did have an impact on the energy consumption of the analysed countries. However, it is in line with our expectations.
2. In general, we can say that the improvement in energy intensity (TPES/GDP) was halted or even regressed due to the crisis in 2009-2010. It means that the economic players could not further improve the efficiency of their energy

⁴ In 2010 in Poland and Hungary, diesel prices increased at a rate of 17 and 18%, respectively. (IEA, 2011c)

⁵ Trucks and ships are generally driven by diesel oil.

use or the improvement in 2009 and 2010 was altogether much smaller than in the previous years.

3. In the case of the Czech Republic and Hungary, the diesel and gasoline intensity was affected, too. Gasoline and diesel consumption declined only a year after GDP growth rates were hit and turned into negative. Our calculations revealed that in 2009, the core year of the current crisis, the economic players of the Czech Republic and Hungary could not or did not adjust their diesel and gasoline consumption. However, in 2010 they reduced their relevant consumption accordingly or even stronger. It means there was a lag in the adjustment of gasoline and diesel consumption in both countries. In terms of forecasting (in energy companies or the state administration) it means that a crisis like the current one is not expected to have immediate effects on the gasoline and diesel consumption, and thus, on company or state revenues in the Czech Republic and Hungary.
4. However, it is not the case in Poland and Slovakia. Diesel and gasoline consumption quite immediately responded to the changed economic output of both countries.
5. Our calculations revealed that the diesel and gasoline consumption adjustment process is much faster in Poland and Slovakia than in the Czech Republic and Hungary. In the latter countries, economic players might have suffered more from the decline in their operational efficiency as they have not immediately reduced their energy costs in line with their reduced economic output. Due to the lack of up-to-date and detailed data, an analysis at the disaggregated level (transport sector, agriculture etc.) was unfortunately not possible. This could be the topic of a future research paper.

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