THE EFFECTS OF THE GLOBAL ECONOMIC CRISIS ON THE MARKETS FOR FOSSIL AND RENEWABLE FUELS

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Abstract: The 2008/2009 world economic crisis had significant impact on oil and fuel markets. This crisis has been developed from the meltdown of the American mortgage and financial market and spread throughout the global economy. As each country reacted differently to the crisis, the changes in the fuel market have also shown significant geographic variation. In our present research, the changes of the US, German and Hungarian fuel markets were analysed, looking for answers to the reasons behind different crisis reactions. We examined the tendency of fuel consumption, the changes of gasoline and diesel price elasticity and the possible effects of the crisis on the regulatory system.

Keywords: global economic crisis, fuel market, biofuels

1. Introduction

Crude oil is a key core pillar of the modern economy, thus activity on the crude oil market are in close connection and interaction with events in the global economy. This was also true during the 2008/2009 world economic crisis. Under the early stress of the global market recession, prices rose to a great extent and accelerated the process of collapse, before then falling to their lowest level. They only began to recover with the first post-crisis economic boost. *Figure 1* illustrates the tendency of crude oil prices.

This tendency is being slightly modulated by the presence of a higher rate of biofuels, both in the national and global markets (*Figure 2*). These, as substituting products, considerable subsidy and compete with fossil fuels. The figure clearly demonstrates that the recession particularly affected the bioethanol trade; turnover from biodiesel was diminished to a much lesser degree. In one respect, the reason for this development was that ethanol is present aon the global market in a significantly higher volume. From another aspect, biodiesel's biggest exporter, Brazil, is flexibly handling the incorporation of bioethanol, while regulating – considering world economic tendencies – the quantity of bioethanol getting into the world market.

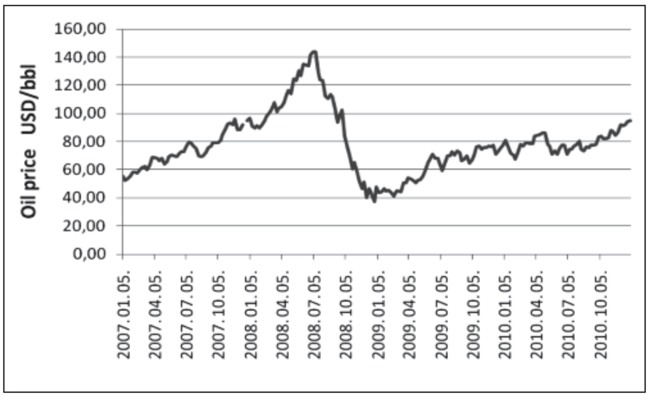

Figure 1: Crude oil prices between 2007 and 2010
Source: Energy Centre Ltd, 2011

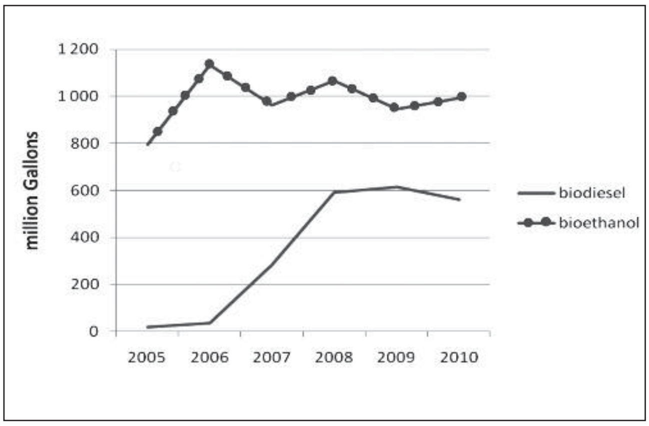

Figure 2: Development of biofuel trade
Source: FAPRI, 2011

Regulation system

Markets for biofuels are strongly regulated by developed countries. The regulation is primarily for environmental protection purposes; therefore, it mostly finds expression in minimal incorporation quotes, tax allowances and penalties that are to be paid in cases of non-observance of quotas. We essentially verified that regulation increasingly inclines towards the latter system-completing with requirements for the motor industry and sustainability – as support for increased biofuels turnover imposes a significant burden on the budget. Below, we introduce the regulation systems of major world market operators.

The market for traditional biofuels is basically determined in Brazil by the incorporation rate, which must be directly changed by 20–25% annually; in the U.S.A by the RFS (Renewable Fuel Standard, 2007) modified by the EISA (Energy Independence and Security Act, 2010); and in the EU by the renewable fuels rate expected for 2020 by regulation no. 2009/28/EC.

The EU law limits the emission quantity of various biofuels during their life cycle (over the applicable agricultural/industrial technologies), in case of import biodiesel the sustainable requirements for production, too. In pursuance of this limitation, biofuels are only included in requirement fulfillment and can only be supported from 2011 (in the case of factories launched before 2008, from 2013) if their production and utilization decrease the emission of GHGs by at least 35% compared to fossil energy sources. By means of the currently applied general technologies, this drop exceeded 35% can be reached only by the utilization of rape (–38%) and corn (–47–49%). In the case of biofuel imports in the EU, social (work safety) criteria have already been specified that make it difficult for exporter countries (e.g. Brazil) to export biofuels to the EU (Popp et al, 2010).

Table 1 shows the most important expected results for the near future.

Table 1: Expectation on biofuels

Expected quantity	2010		2012		2020 (EU)	2022 (US)
	total biofuel	2nd gen. biofuel	total biofuel	2nd gen. biofuel	total biofuel	2nd gen. biofuel
EU (energy %)	5.75	–	–	–	10	–
USA (million l)	–	25	–	1893	107.47*	3785
Expected green-house gas emissions	1BE[2]	1BD[3]	1BM[4]	2CE[5]	2FTD[6]	2DME[7]
EU (g CO_2eq/MJ)[1]	24–70	37–68	15–23	13–25	4–6	5–7

Source: IEA, 2010; 2009/28/EC Directive; Coyle, 2010
Symbols: * million tons
1: depends on raw material and technology,
2-4: 1st generation biofuels (2: bioethanol, 3: biodiesel, 4: biomethane)
5-7: 2nd generation biofuels (7: cellulose based ethanol, 8: Fischer-Trops diesel, 9: dimethyl-ether)

In Brazil, the obligatory incorporation rate of biodiesel was increased from 2% of year 2008 to 3% in 2009. Tax allowance on biodiesel production fluctuates between 0-100%, depending on the kind of raw material, the kind of territory and the type of holdings (family or joint) producing biodiesel. In the U.S.A., there is a 0,12 USD/l tax allowance on corn-based fuel production while on new generation biofuels there is 0,27 USD/l tax allowance(Coyle, 2010), while in the EU, figures vary, as the allowance is not differentiated per fuel.

Regulation on biofuels has an impact on the motor industry, too. Fulfillment of the specifications of the RFS would be possible by raising the current 10% incorporate norm; however, this increases the risk to the motor industry too, which gives warranties on its cars only up to 10%. In the EU, in the case of diesel, only 7% of biofuel can be incorporated to the standard fuel, while for petrol, this figure is 10% (and 15% ETBE). However, this has not been published in national legislation yet. As of June 2010, a mere four Member States (Austria, France, Germany and the Netherlands) had complied. Naturally, E-85 and B-100 standards also exist, which can safely be used only with FFV functioning at an extremely low rate.

2. Materials and methods

2.1. Objectives

Following objectives were settled in the course of our examinations:

1. searching for possible correlations between increase of real GDP and oil utilization
2. analyzing relation between fuel prices and consumption at national level
3. examining price elasticity on fuel demand
4. analyzing the affects of the possible changes resulted in regulation systems on biofuel market

2.2. Target areas

We chose three countries: the U.S.A, Germany and Hungary, as target points of the analyses. The reasons for our choice are as follows:

1. The global financial and real economy crisis started in the U.S.A and most bioethanol is produced there (Popp et al 2010), thus it has an important role in biofuel sector
2. Germany is the leading EU and European biodiesel producer and consumer; its market actions determine the biofuel market of all Europe, especially as concerns those Central-Eastern European biofuel producing countries with commercial relationships with Germany
3. Hungary is the typical example for indirect effects of the crisis on the biofuel market, and its ethanol market development is in contrast with American and German tendencies.

2.3. Databases and methodology

We used the databases of the EIA (Energy Information Administration), the BAFA (Bundesamt für Wirtschafts- und Ausfuhrkontrolle), Energy Centre Ltd, the Hungarian Customs and Finance Guard, EUROSTAT and FAPRI. We prepared analyses using MS Office 2010 Excel and SPSS Statistics 17 programs.

In the course of our research, we applied Pearson's correlation analysis and price elasticity calculation of demand; their methods are briefly introduced as follows:

- Pearson's correlation: Values of r correlation coefficient can fluctuate between –1 and + 1 depending on the strength and direction of the relation. If r=0, linear relation between X and Y can be excluded, though non-linear relation between variables can be existed as r is inadequate to measure that. The definition of Pearson's correlation coefficient (r) in a supervised n sample, takes place as follows (Malhotra, 1999):

$$r = \frac{\sum (X_i - \overline{X})(Y_i - \overline{Y})}{\sqrt{\sum (X_i - \overline{X})^2}\sqrt{\sum (Y_i - \overline{Y})^2}}$$

- Price elasticity of demand: we examined the price sensitivity of fuel demand by defining the curve elasticity. Price elasticity gives the percentage change in quantity demanded in response to a one percent change in price. Calculation is by the means of the following formula, where Dg is the demand, Pg is the fuel (on the basis Brons et al, 2007):

$$\varepsilon D_g = \frac{\delta D_g}{\delta P_g} * \frac{P_g}{D_g}$$

3. Results and discussion

3.1. Correlation between the change in real GDP and consumption of petroleum products

As we explained in the introduction, interaction can be observed that is expressed both in prices and consumption. As GDP is the most widely accepted indicator of economic increase, we compared its alterations in the cases of the U.S.A and selected European countries to changes which occurred in petroleum products consumption. *Table 2* contains starting data of correlation analysis.

The performed correlation analysis has shown significant and relatively strong (r= 0.604 – 0.694) correlation between real GDP and change in petroleum products consumption in 2007 and 2009. It can be stated that strong correlation is not typical of that two indicators as developed countries are striving for the reduction of CO_2-emission-by this means among others- petroleum utilization thus less growing or decreasing petroleum utilization can be realized by growing real GDP. However, the world economic crisis diminished the economic operation insomuch as it resulted in the reduction of petroleum consumption in an expressly verifiable and provable way.

3.2. Analysis of fuel prices and consumption in chosen countries

Since fuels are rather inelastic to price, it is difficult to present an obvious correlation between the prices and consumption within a country; however, in the case of the international outlook, it can be proved that in those countries (e.g. the U.S.A, Canada) applying lower fuel prices, fuel consumption per capita is basically higher than in typically more expensive countries such as EU Member States (Litman, 2011).

Table 2: Consumption of petroleum products in selected countries (1000 bbl/day)

Country	2007	Change % 06/07	Real GDP growth rate 06/07 (%)	2008	Change % 07/08	Real GDP growth rate 07/08 (%)	2009	Change % 08/09	Real GDP growth rate 08/09 (%)
United States	19964.6	–0.12	1.90	18788.2	–5.89	0.00	18096.1	–3.68	–2.60
Czech Republic	206.6	–0.48	6.10	208.6	0.97	2.50	203.7	–2.35	–4.10
Hungary	159.9	–1.24	0.80	160.9	0.63	0.80	156.9	–2.49	–6.70
Poland	510.4	3.78	6.80	533.9	4.60	5.10	533.9	0.00	1.70
Romania	223.2	4.35	6.30	205.1	–8.11	7.30	176.9	–13.75	–7.10
Slovakia	61.9	5.09	10.50	63.4	2.42	5.80	59.7	–5.84	–4.80
France	1857.3	–0.85	2.40	1874.3	0.92	0.20	1769.5	–5.59	–2.60
Germany	2448.9	–8.21	2.70	2546.1	3.97	1.00	2415.2	–5.14	–4.70
Italy	1650	–3.16	1.50	1602.1	–2.90	–1.30	1517.1	–5.31	–5.20
Nether-lands	671	–1.11	3.90	654	–2.53	1.90	626.9	–4.14	–3.90
Spain	1426.7	1.45	3.60	1383.3	–3.04	0.90	1312.4	–5.13	–3.70
United Kingdom	1555.7	–3.66	2.70	1530.6	–1.61	–0.10	1493.9	–2.40	–4.90

Source: OPEC, 2010; EUROSTAT, 2011, own calculations

It can be stated as a whole that fuel prices in the three examined countries followed the tendency of petroleum prices during the analyzed period; primarily exchange rate fluctuations (USD – EUR; USD – HUF) are responsible for the small extent of deviation in tendencies. Fuel consumption per capita loosely followed the prices, although the above-mentioned territorial differences (the U.S.A vs. the EU) can be clearly seen in *Figure 3*.

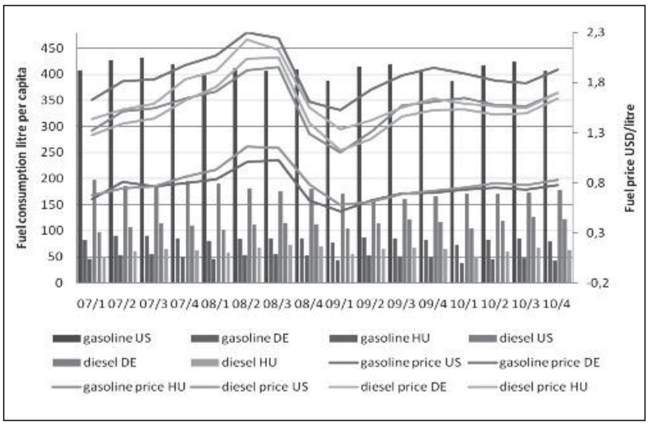

Figure 3: Fuel prices and consumption in the USA, Germany and Hungary
Source: EIA, 2011; BAFA, 2011; VPOP, 2011; Energy Centre Ltd., 2011

Figure 3 clearly demonstrates that, while in the U. S. A, a decrease in consumption per capita was primarily significant in 2008, in Germany and Hungary, due to the delayed arrival of the crisis, significant decline took place in 2009.

3.3. Evaluation of biofuels consumption

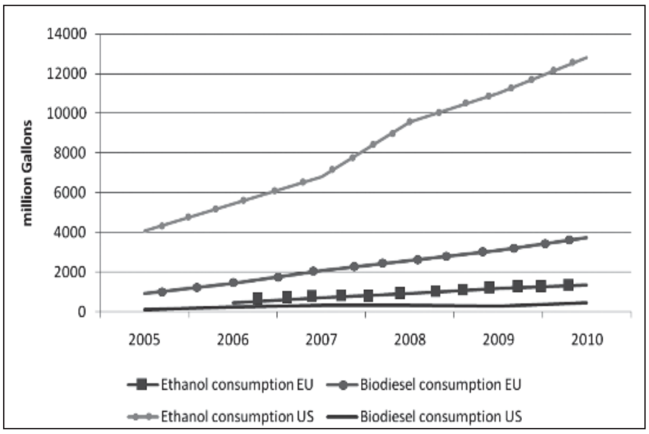

Figure 4: Biofuel consumption of the EU and the USA
Source: FAPRI, 2011

On the whole, biofuel consumption independent of the crisis shows a growing tendency both in the U.S.A and in the EU (*Figure 4*); however, significant fluctuation was experienced in consumption at a monthly level during the crisis.

Major fluctuation was experienced on the German market, whereas the Hungarian ethanol market for most of the examined period has shown steep growth (the reasons for this are discussed in details under chapter 3.5.). Biodiesel and plant oil consumption were the most unstable in the examined period (*Figure 5*). This instability was due to the extremely high oilseed prices, which had just increased the net cost of biodiesel when petroleum prices hit their historical low. In this way, significant state support was not able to compensate for the price difference either.

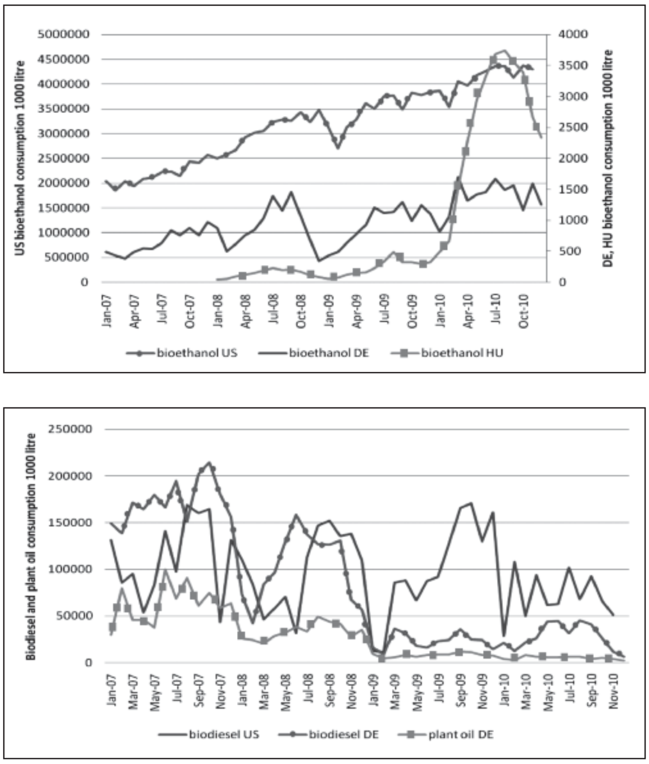

Figure 5: Monthly bioethanol and biodiesel consumption in the examined countries
Source: EIA, 2011; BAFA, 2011; VPOP, 2011

3.4. Price elasticity of fuel demand

As fuel prices do not correlate with consumption, price elasticity of demand is the only indicator by which their effects can be quantified. *Tab. 3* contains price elasticities of demand. It is remarkable that values for elasticity are mostly different from bibliographic data (–0.1 – –0.38; Goodwin et al, 2004; Dahl, 2011). The reason for these significant deviations is the chaos caused by the crisis, which disarranged petroleum prices and exchange rates.

Table 3: Fuel price elasticities in the USA, Germany and Hungary

Year	gasoline price elasticity			diesel price elasticity		
	US	DE	HU	US	DE	HU
2008	-0.25	0.71	0.22	-0.58	3.05	2.99
2009	0.01	0.84	1.16	0.27	-0.66	-1.04
2010	0.04	-0.10	-0.71	-0.18	0.02	0.81

Source: own calculations

Furthermore, the crisis has bankrupted several enterprises and has caused significant increases in unemployment, thus reducing the purchasing power in the household sector. The combined effect of many special factors has disarranged the traditional price-consumption relationship on the fuel market.

3.5. Effects of alteration in regulation systems on biofuels market

The most important change in the U.S.A was that on 13 October, 2010, the incorporation rate of bioethanol was increased by 15% for cars and vans manufactured in 2007 and after this date. This change affected approximately 1/3 of the entire fuel consumption (TÓTH, 2010). Change on regulation practically had no impact on examined period as it was carried out at the end of that given period. As the regulation system was practically unchanged in the period 2007-÷2010, fluctuations in the American biofuel market were due to the economic situation.

Development of regulation was completely foreseeable in Germany, too. Bioethanol is tax-free, whereas the tax allowance on biodiesel dropped from 0.3994 EUR/l to 0.3034 EUR/l in the examined period. It can also be stated that the regulation system did not change in a drastic or unforeseeable way, thus biofuel fluctuation can be traced back to the market conditions. (See chapter 3.3.).

The Hungarian regulation system has changed several times during the crisis. Regulation for biofuels was not affected (these were only changed in 2010 (CVII. law of 2010), but due to the crisis, the excise duty rate and VAT rate were increased. Therefore, the excise duty on fuel has risen from HUF 130.5 to HUF 120, duty on diesel rose from HUF 88.9 to HUF 97.35 (SZARVAS, 2010). Considering that the excise duty is also the basis of VAT, the effect of price increase was more significant-in case of petrol it was HUF 20.6, regarding diesel it was HUF 10.6. This sudden price increase greatly influenced turnover of E-85 in the country (*Figure 5*) as fuel content of E85 is excise duty free.

Figure 6 illustrates the content of fuel prices in the examined period. It can be clearly seen that lower fuel prices in the U.S.A are primarily due to the lower tax rates. The fact that the tax ratio in Hungarian fuel prices did not grow, in spite of the increasing tax rate, is due to the growth of petroleum prices and the HUF-USD exchange rate.

4. Conclusion

Usually, there is no close correlation between the consumption of petroleum products and the change in real GDP, although the interaction between the economy and petroleum market is well known. However, the crisis influenced the economic processes in 2009 to such an extent that the often only suspected, but hardly or not at all provable correlation, became obvious

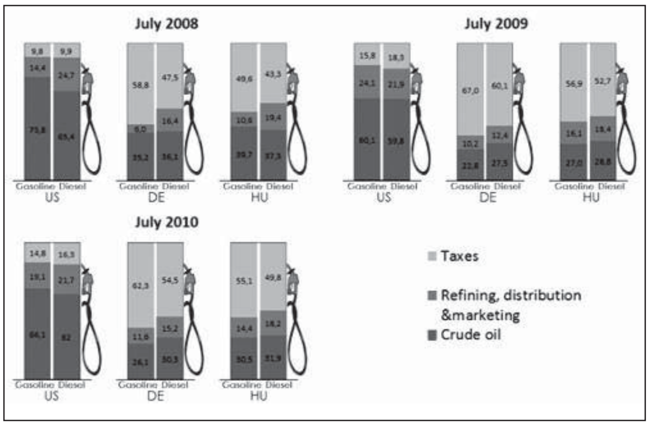

Figure 6: Composition of fuel prices
Source: EIA, 2011; own calculations

Fuel prices, as usual, obviously followed the evaluation of the world price of oil during the examined period and small differences are caused by exchange rate (EUR-USD; HUF-USD) fluctuations. The per capita consumption only loosely followed the evaluation of prices. This is due to two main reasons. On the one hand, fuels are traditionally inelastic products; price has little effect on demand in the short term; on the other hand, fluctuations caused by the crisis suppressed all other effects.

Demand for biofuels, despite the crisis, has shown steady growth in the USA, rather than in the EU, but there were very significant monthly fluctuations. These were mainly due to such an increase in raw material prices which made the substantial part of renewable fuels non-competitive - even with significant state subsidies.

Hungary is an exception in this tendency: where the increase of excise duty rate and VAT-rate occurred within a short time and led to a record increase in fuel prices, this caused an explosive growth in demand for E85 fuel market.

In the analyzed period, the price elasticity of fuel demand greatly deviated from the bibliographic data. The reason for this variation is the chaos caused by the crisis, which disarranged petroleum prices and exchange rates. Furthermore, it has bankrupted several enterprises and caused a significant increase in unemployment, thus reducing the purchasing power in the household sector. The combined effect of many special factors has disarranged the traditional price-consumption relationship at the fuel market.

The biofuel market was not directly affected by the renewable fuel regulation systems of the examined states, since their changes occurred at the end of the analyzed period. However, in the near future, they will become significant direct determinant factors.

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