THE EFFECTS OF INCREASE IN PRODUCTION OF BIOFUELS ON WORLD AGRICULTURAL PRICES AND FOOD SECURITY

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Abstract

A rapid development of biofuels production observed all over the world in the recent decade has caused numerous consequences. Unfortunately, some of them have rather unexpectedly appeared to be not neutral to world food security. In the paper we briefly highlight key drivers of biofuels production and discuss some supporting as well as opposing arguments presented in the literature with regard to this development. Then, we focus on the transmission mechanism showing how increasing production of biofuels may influence agricultural markets and prices and eventually have an impact on food security. Finally, based on results of our own analysis using the World Bank and the FAO data we provide some empirical evidence that further policy driven development of the biofuels production can exacerbate its negative effects on food security. Especially, we point out emergence of visible linkages between energy and agricultural prices and underline increasing volatility of the latter ones. Due to market interconnectedness between biofuel and agro-food sectors, a strong increase in production of biofuels has contributed to higher levels and greater volatility of agricultural prices. As a result of such development, food affordability in many countries has lowered, hence, the overall world food security has worsened. In conclusion, to avoid distorting effects of biofuel policies, we recommend a flexible approach to the mandates including their removal since production of biofuels should compete for resources as being economically viable activity.

Keywords: Biofuels, agricultural prices, food security

Introduction

The last decade witnessed an unprecedented growth of the world biofuel production. Global biofuel production has increased more than five times, from less than 20 billion liters per annum in 2001 to over 100 billion liters per annum in 2011. Majority of the total biofuels is produced in the form of ethanol (well above 80%) and the rest constitutes biodiesel. The sharpest annual increase in world biofuel production accounting for over 20 million liters took place in 2007 through 2008. In 2008, about 15% of global corn production (mostly in the US) equivalent to about 5.7 percent of total global corn and coarse grain production and 18% of sugar cane (mostly in Brazil) was used to make ethanol fuel, whereas about 10% of global vegetable oil production (mostly in the EU) was used to make biodiesel (HLPE, 2013). More or less at same time the world experienced a sharp rise in agricultural commodity prices. Prices of globally traded grains, oils and fats were on average from 2 to 2.5 times higher in 2008 and 2011–12 than average prices between 2002 and 2004. Annual averages of sugar prices were from 80 to 340 percent above their levels in 2000–04. Additionally, the observed price movements exhibited volatility and spikes, which had not been noticed since the 1970s (HLPE, 2011).

Grains are the staple food of most people in the developing countries, therefore, considerably higher grain prices can severely reduce food affordability and consequently expose additional large part of the world population to malnourishment or hunger. As presented in a vast number of studies many various factors can be pointed out as responsible for market tensions leading to higher world agricultural and food prices. A list of the most critical ones includes (Figiel and Hamulczuk, 2012):

- impacts of climate change on agriculture;
- world population growth and increasing urbanization;
- increasing and more inelastic food demand;
- growing demand for land in developing countries;
- transmission of price volatility from energy to agricultural markets;
- low inventories and the slow rate of restocking at the household, state, regional and international levels;
- exchange rates and currency movements by affecting domestic commodity prices;
- speculative influences related to the interests of financial investors; and
- short-sighted agricultural public policies in response to food price increase (protectionism, trade restrictions, etc.).

Quite often production of biofuels is perceived as a very much desired in the context of searching for alternative, renewable energy sources and treated as pro-ecological or environmentally friendly. Until recently other aspects of a rapid development of biofuels production have drawn relatively little attention. In fact, promoted strongly by policy actions production of biofuels supposed to be free from significant negative side effects. But, there are more and more research showing that production and use of biofuels driven by policy mandates and renewable energy goals around the world should be added to the above list as a major factor causing upward and volatile movements of agricultural prices.

Main goal of the paper is to contribute to policy discussion on implications of continued development of production of biofuels forced by regulations and supported by subsidies. Our objectives are:

- critically discuss rationale for biofuel policies;
- describe the transmission mechanism causing fluctuations of agricultural prices due to increasing production of biofuels and highlight its estimated price effects; and
- present results of our own analysis of changes in movements of the world agricultural prices and related consequences for global food security.

Rationale for biofuel policies and their outcomes

In general, biofuel policies were assumed as desired response to arising energy security and environmental challenges. Rationale for biofuel policies is quite manifold and includes such elements as:

- increased world demand for energy and related high energy prices;
- attempts to lower crude oil import and diversify energy sources driven by energy security concerns;
- low agricultural commodity prices and looking for alternative use of crop production surpluses;
- improvement o farmers' incomes and development of rural areas;
- environmental arguments such as reduction of greenhouse-gas emissions.

High oil prices exceeding $130 per barrel in 2008 and the fact that much of the world's oil production occurs in politically unstable regions motivated a number of governments to ensure that their economies are less dependent on oil imports. Theoretically, biofuels can serve as a substitute for fossil fuels and reduce oil imports. Because they can be produced

domestically in many countries, it was presumed that development of such production may improve the energy security of oil-importing countries.

Another important aspect of the biofuel policies rationale is creation an additional demand for crop production, what in effect should lead to improvement of farm incomes and enhancement of rural development. Theoretically, farmers may enjoy higher prices, even if supply rises in response to higher prices, so long as supply increases less than demand. Higher crop prices can contribute to improved farmers' welfare, but also may lead to expansion of land used to grow plants for production of biofuels even on infertile soil and under drought conditions.

Developing countries could have a comparative advantage in producing biofuel plants largely due to lower opportunity costs of marginal land. As estimated countries in South America and sub-Saharan Africa could quadruple their agricultural land base to accommodate bioenergy crops. Such transition from subsistence farming to commercially oriented farming could greatly boost incomes in poor countries. But the problem is that net welfare effect of increasing biofuels production on the poor depends on the impact of rising food prices. The landless poor would not benefit from energy cash crops, but instead could suffer from higher food prices (Sexton et al., 2009).

In many developed countries concern about global warming has seemed to be a very appealing justification for development of fuels that emit less greenhouse gas than oil. Initially, it was quite widely believed that carbon is stored during energy-crop growth and later emitted during the combustion of biofuels in a carbon-neutral cycle, therefore, production of bioufels can significantly contribute to reduction of greenhouse-gas emissions.

This view has soon proven to be too simplistic leading to controversies regarding the actual greenhouse-gas savings when considering greenhouse-gas emissions of an energy source throughout the entire process, including production (soil tilling, gas and diesel-powered farm equipment, emissions from fertilizer production and other inputs), conversion of the energy crop to biofuel, transportation of fuel to market, and fuel consumption. No matter of controversies, which have arisen around this issue greenhouse-gas savings associated with the first generation of biofuels, primarily ethanol from corn and sugar cane, and biodiesel from soy and palm oil are rather modest. Hence, increased production of biofuels can only partially help solve the problem (Sexton et al., 2009).

Motivations for implementing biofuel policies may have been weighed differently in particular world regions and countries, but overall they have resulted in adoption of policies based on such incentives as mandatory blending, tax reductions, and investment subsidies. The United States, the European Union (EU), Australia, Canada and Switzerland spent at least $11 billion on biofuel subsidies in 2006 (GSI, 2007). Additional factors driving production of biofuels such as the MTBE ban in the US, which left maize-based ethanol as the only viable octane enhancer fuel substitute, the medium-term (2020) EU targets leading to expectations of large-scale oilseed-based biodiesel use and imports, and the adoption of flex-fuel engines for new cars in Brazil should also be mentioned. The direct outcome of biofuel policies has been a fast expansion of ethanol and biodiesel productions. However, achieving these policy goals was accompanied by rather unexpected various effects such as, for instance, substantial changes in behavior of world agricultural and food prices.

Impact of biofuels production on the world agricultural prices

At first glance production of biofuels and prices of agricultural commodities can be considered as seemingly unrelated. However, there appeared to be a very clear market transmission mechanism affecting agricultural prices by development of biofuels production. This mechanism is cyclical in nature and it can be described as the following sequence of several causalities between prices, demands and incomes (Msangi et al., 2012):

- rise in oil and energy prices leads to increases in prices of energy intensive goods and biofuels demand;
- increase in demand for biofuels turns into increase in feedstock and food prices;
- both increase in prices of energy intensive goods and increase in feedstock and food prices cause decrease in economic growth and households incomes;
- lowering economic growth and households incomes reduce food and nonfood demand as well as energy demand;
- decrease in energy demand entails lower energy prices what leads to decrease in prices of energy intensive goods;
- lower prices of energy intensive goods translate into increase in economic growth and households incomes and consequently into increase in energy demand, what closes the cycle as it results in rising prices of energy.

The described mechanism provides theoretical framework to analyze how increase in production of biofuels can change agricultural market fundamentals. For our analysis the key feature of this mechanism is emergence of a more direct interdependence between energy and agricultural and food prices. An empirical evidence supporting this theoretical supposition is presented in figure 1.

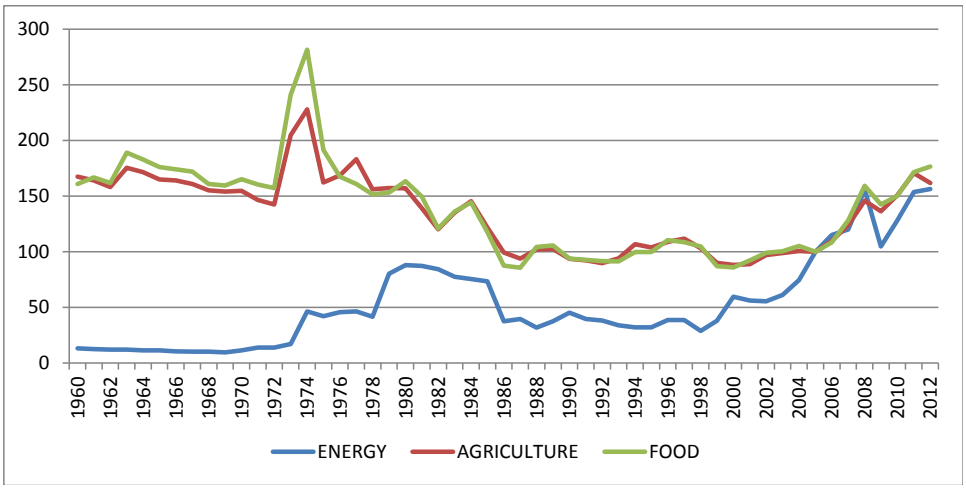


Figure 1. Convergence of the Agricultural and Food Prices with the Energy Prices
Source: Own calculations based on the World Bank Data

As it can be easily noticed indexed prices of agricultural commodities and food prices have moved very much together in the analyzed period of 1960-2012. Energy prices have seemed to behave sort of independently until the 2005. Afterwards, they started to rise sharply and a growing convergence between their changes and changes of agricultural and food prices became apparent. Beginning in 2008 agricultural and consequently food prices started to exhibit very high levels, which have not been observed since the 1970s.

Various studies clearly suggest that biofuel policies contributed to the increased levels of agricultural and food prices (e.g. FAO, OECD, 2011, HLPE, 2013, Msangi et al., 2012). Medium-term projections using Aglink-Cosimo model, which is a dynamic partial-equilibrium model of the global agricultural sector, showed that removal of the biofuel supports by the EU and the US would lead to very significant reduction of the world prices of such commodities as coarse grains, corn, oilseeds, vegetable oils and wheat (Davies, 2012). This simply means that biofuel policies shifted world agricultural prices upward. It has to be emphasized that under higher price regime stocks are lower and prices become more sensitive to shocks in supply. This is where additional problem arises, namely, increase in volatility of world agricultural prices. Behavior of the monthly US hard red wheat prices from January 1990 through May 2013 presented in figure 2 can serve as a good example.

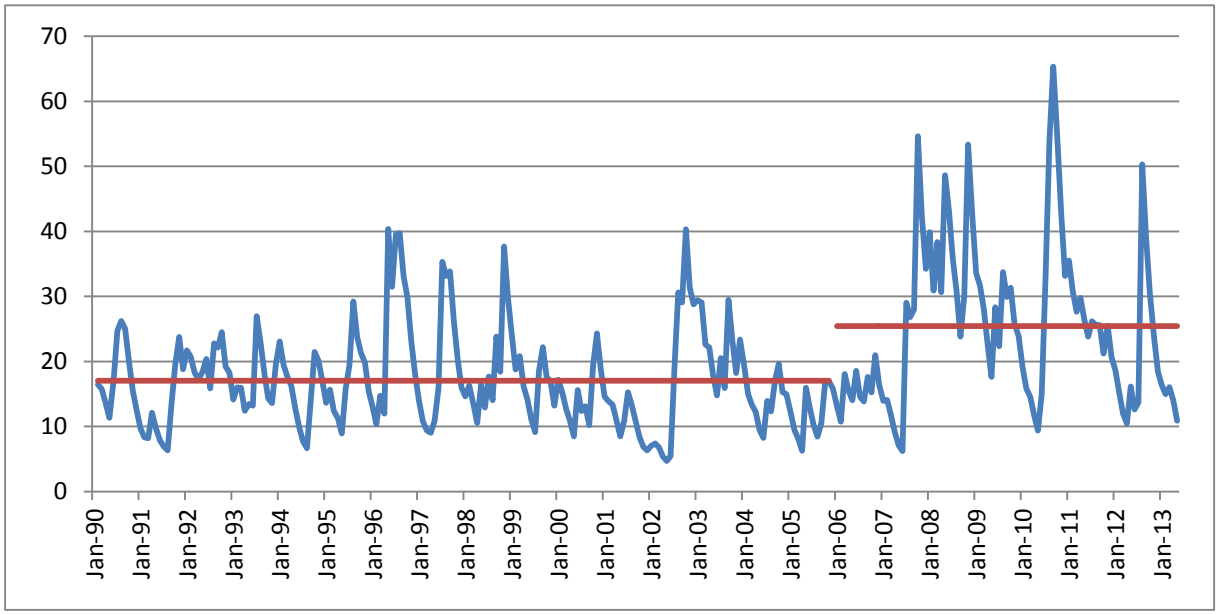


Figure 2. Annualized unconditional volatility of the monthly US hard red wheat prices
Source: Own calculations based on the World Bank Data

Annualized unconditional volatility of these prices, calculated according to a formula described by Figiel and Hamulczuk (2010), since 2006 has been fluctuating in much wider range than in 1990-2005. Its average value accounting for 25.4% is considerably higher comparing to as much as 17% for the earlier period. Respective pictures for other major world agricultural commodities are not much different (FAO, OECD, 2011, HLPE, 2011). It needs to be realized that rising price volatility constitute greater price risk exposure for various participants of agricultural markets (farmers, traders, processors, etc.) and generates higher transaction costs.

Food security in the context of agricultural price levels and volatility

According to the FAO definition food security means that aggregate food supply is large enough to feed the total population for their active and healthy life. Food security can be viewed from two main perspectives. The first, is related to territorial distinction between country, regional and global food security. The second, is connected to time horizon considered. Short run food security depends mainly on volatility of food supply, whereas, long run food security is determined by trends in food demand and supply, increase in population, decrease in arable land, farming technology, and alternative uses of agricultural products. Various indicators are used to evaluate food security. As elaborated by the FAO the determinants of food security include availability, physical access, economic access, and utilization. Similar in nature is the Economist Intelligence Unit (GFSI) approach, which covers a number of indicators grouped into three categories: affordability, availability, quality and safety.

Discussing interconnectedness between increasing production of biofuels and food security we focus on agricultural price levels and volatility aspects. Particularly, we are interested in the impact of changing behavior of agricultural prices on global food security. Food prices are reflection of agricultural commodity prices due to derived demand, so, any significant upward movement or shift in volatility of the latter is eventually transmitted to the levels or volatility of the former ones.

In order to highlight how global food security is affected by the recent increases in levels and volatility of world food prices in figures 3 and 4 values of the food price level index and domestic food price volatility index, respectively, calculated for the whole world are

presented. These indices are one of indicators used by FAO to evaluate food security from an economic access point of view. In other words, levels and volatility of food prices determine food affordability, hence, changes in these indices contribute either positively, or negatively, to overall food security assessment. The average value of the food price level index rose to 1.42 in 2008-2012 from 1.34 in 1991-2007. In case of the domestic food price volatility index its average value went up from 10 in the period of 1995-2006 to 13.5 in the period of 2007-2012. The observed increases in these indices clearly inform about worsening world food security in recent several years.

Figure 3. Values of the Food Price Level Index for the World in 1991-2012
Source: Own calculations based on the FAO Data

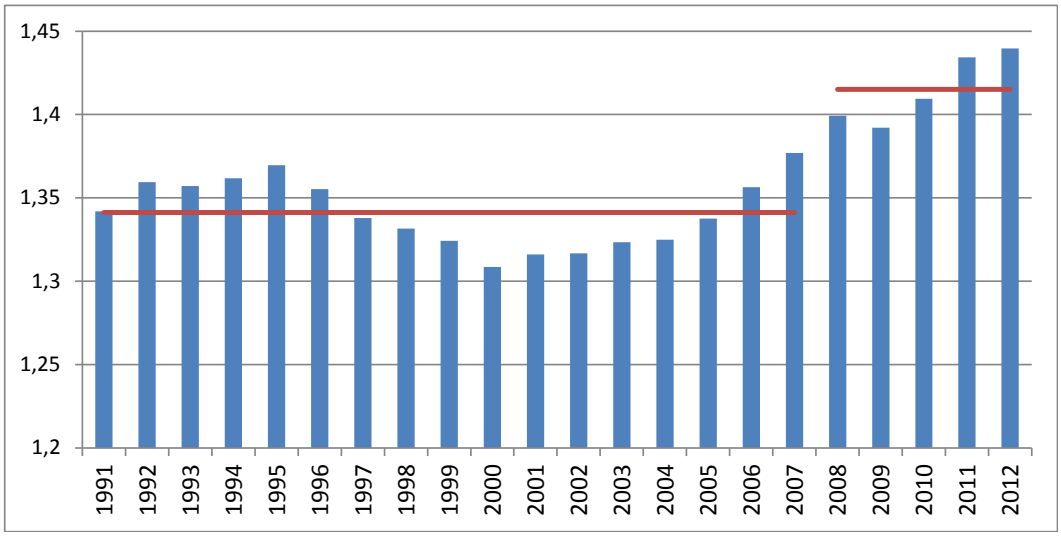
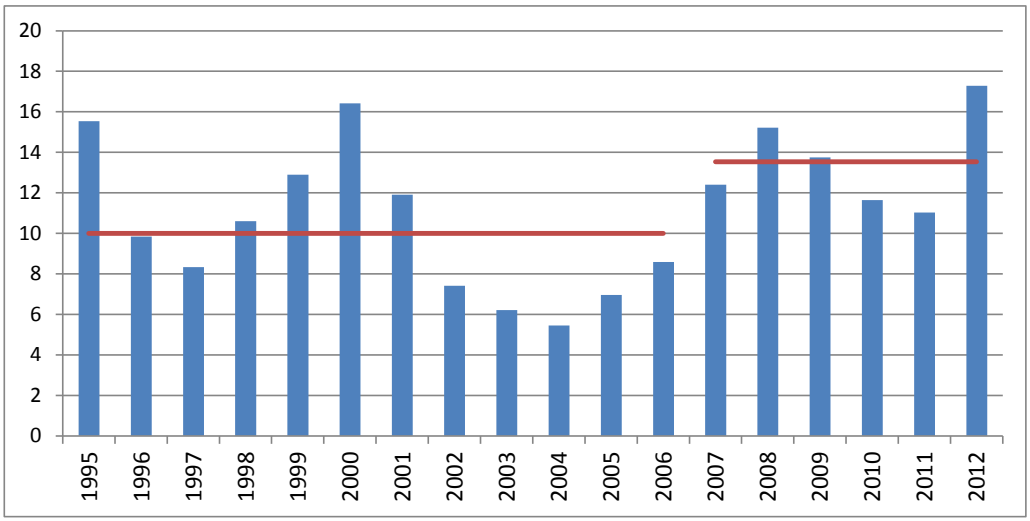


Figure 4. Values of the Domestic Food Price Volatility Index for the World in 1995-2012
Source: Own calculations based on the FAO Data



Such changes may be subjectively seen as minor or major ones depending upon a particular country or a world region economic situation. In particular, impact of that type of changes is strictly related to spending on food as a share of all household spending. According to the Economist Intelligence Unit this share ranges from about 20% in the OECD countries to over 50% in Sub-Saharan Africa and South Asia. Of course, consumers in countries or regions with higher spending on food suffer economically much more from increases in prices of agricultural commodities caused by a rapid development of world biofules production. Moreover, because consumers in richer countries and regions are not seriously hit by rising and more volatile agricultural prices, as opposed to consumers in poor and less developed

countries, policy makers in developed countries do not seem to appreciate the global problem. According to the GFSI 2012 ranking top ten most food secure countries (among 105 in total) are: the United States, Denmark, Norway, France, the Netherlands, Austria, Switzerland, Canada, Finland, and Germany. All these countries are well developed and heavily involved in supporting development of biofuels production.

Conclusion

Discussed outcomes of biofuel policies and their impacts on global food security deserve critical assessment based both on theoretical premises and empirical evidence. A rapid increase in world production of biofuels has had significant effect on both agricultural producers and consumers. In the developed countries driven by policies increase in production of biofuels resulting in higher agricultural and food prices supports to certain extent farmers' incomes doing relatively little harm to consumers. In the less developed and developing countries the effect is quite opposite, namely, many farms, especially subsistence ones, cannot really benefit from this new production opportunities, but lots of additional consumers fall below the poverty line. So, world food security has worsened due increased production of biofuels.

Most of the biofuel policies were designed and launched in conditions of incomplete knowledge and uncertainty over their impacts on food prices and food security. Adopted in various countries have proven to be shortsighted as their instruments neglected side effects. Especially, upward shifts and increased volatility of agricultural prices seem to have been an underestimated aspect of biofuels production development. Therefore, rationale for biofuel policies, which until recently seemed to be obvious, needs to be revised if global food security is concerned. To avoid distorting effects of biofuel policies, a flexible approach to the mandates including their removal, as well as, elimination of tax reductions and subsidies are recommended since production of biofuels should compete for resources as being economically viable activity.

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