THE CHANGING DYNAMICS BETWEEN BIOFUELS AND COMMODITY MARKETS

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ABSTRACT: The recent development of the biofuel industries coincides with significant increases in prices of basic commodities such as food and feed. Against popular perception, it appears that there is not a straightforward causal relationship between the two; there are a number of factors that determine the level and strength of the impact of the biofuels sector on other commodities. For the case of markets of agricultural raw material these factors include the amount of feedstock claimed by the biofuels industry, its relative purchasing power, the responsiveness of the agricultural sector to price incentives and availability of substitutes. For consumer food markets we must additionally consider the relative share of agricultural input costs in the retail food price and the demand elasticity. Based on the analysis of these factors and estimates of other studies that attempted to quantify the price impacts of biofuels on crop prices, we conclude that the impact of biofuels is relatively small, especially when compared with other causes that triggered the recent price increases. We end the paper with a recommendation for future efforts in curbing food price inflations while keeping ambitious biofuel targets and suggest a shift in focus of the debate around the social costs of biofuels.
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1 INTRODUCTION

After a few decades of steady decrease in real terms, prices of agricultural commodities and food have recently skyrocketed causing unrest in the worst hit countries and concern in many others. By February 2008, world agricultural prices had risen by an average of 70% in dollar terms in less then two years, with the strongest increases concerning wheat (+93% for EU) [1].

Simultaneously, the biofuel industry has been developing fast, claiming ever more crops as feedstock for production of bioethanol and biodiesel. At first glance, the correlation between the two phenomena would seem obvious and it was often touted as the explanation for the food price increases. However, upon closer inspection it becomes clear that the relationships between biofuels and agricultural commodity prices are not so straightforward. Extended periods of price diversion between bioethanol and maize prices, as can be observed in Fig. 1, show there may be other factors at work in shaping the dynamics of the interactions between the two.
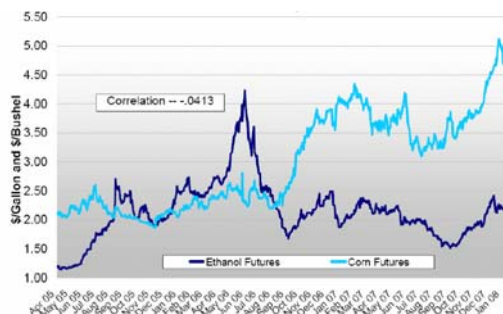

Figure 1: CBOT ethanol futures vs CBOT, [2]

This paper aims at exploring these mechanisms and their role in determining how big the impact of the additional demand for feedstock from the developing biofuels sector can be. We start with an explanation of the possible approaches to the problem and then go on analyzing in more detail the factors determining the relationship between biofuels, agricultural commodities and food. After that we provide a summary of results of several studies attempting to quantify the price impacts of biofuels on crops and finally we discuss other underlying factors of food price increases to put the role of biofuels into perspective.

2 APPROACHES TO IMPACT ASSESSMENT

2.1 The top-down approach

Quantifying the impact of the biofuel's industry demand for agricultural commodities such on their price can be done in different ways. The traditional top-down approach starts with the goal of a given share of biofuels in total transport fuels (e.g.10% as in the EU target), selects a path to achieve this target (number of mtoe derived from different types of biofuels), calculates the amount of feedstock required to produce this amount of biofuels and finds possible sources (e.g. marginal land, export diversion, import etc) and finally predicts the impact on prices (e.g. [6]).

Such an approach is likely to underestimate both the price effect (at least in the short term) as well as the biofuel production volumes. In reality, the biofuel industry will seek to achieve the same as every other industry – a least-cost production chain, within the frame conditions provided by government interventions and policies. The first feedstocks that will be consumed by the biofuels industry will be the cheapest available and will not likely come from marginal lands with lower yields.

2.2 The bottom-up approach

This is why a bottom-up approach that starts by considering price dynamics of feedstock markets and approximate their impact on production levels of biofuels might deliver a more realistic picture. Such an approach

starts with relative production costs (using the cheaper feedstocks as the starting point) and goes on to assess the break-even point of viability – what is the maximum level the biofuels industry can pay to remain profitable (considering of course the price of oil and level of government support). Based on this the production levels likely to be achieved by the biofuels industry are estimated. This approach also takes into consideration the cyclical nature of markets, where high feedstock prices restrict production and thus relax the impact on prices (e.g. [10]).

This approach, often employed by agro-economic models, shows that it is prices that determine production levels rather the other way around, except under a biofuel obligation system where the quota needs to be met under any price circumstance.

3 BIOFUELS – COMMODITY MARKETS RELATIONSHIP DETERMINANTS

The impact of biofuels on commodity markets cannot be generalized as it depends on a number of factors determining the level of this impact. Those factors are different for different types of markets; feedstock (input) markets will be affected differently than consumer (e.g. food) markets.

3.1 Factors determining the impact on feedstock markets

Agricultural raw material that is used as input in other production processes, most notably by the food and feed industries could experience an increase in prices due to additional demand by the biofuel sector. However, how much feedstock costs will actually increase depends on a number of factors discussed below.

3.1.1 Relative feedstock consumption

The first and most important determinant of the relationship between a type of biofuel and its feedstock is how much of the total feedstock available is claimed by the biofuel industry.

In this respect, there are wide differences between biofuel types. On one hand, there is the example of cereal-based bioethanol industry in Europe, which consumes only about 1,4% of total cereal end-use in the EU. Clearly, a sector that consumes such a small proportion of the total cereal use cannot cause an almost 100% price increase and in fact no price correlation could be observed between the two. On the other hand, the examples of European rapeseed oil-based biodiesel, where approximately 60% of European rapeseed oil is used for biodiesel production, and sugar cane-based bioethanol in Brazil, which consumes about half of the country\s sugar cane crop, show clear signs of price correlation. The US ethanol industry, claiming approx 20% of total US maize production seems to be a situation in between. Based on those examples it cannot be concluded at what point price correlations start and if they do, whether this is a temporary or sustained relationship.

3.1.2 Biofuel's sector purchasing power

The durability of the relationship depends to a large extent on the relative purchasing power of the sectors competing for the same raw material. In the case of foodstuffs, markets are often highly concentrated with clear market leaders who set the price of the raw material, while the biofuel industry is mostly a price-taker. As Fig. 1 also shows, the price of ethanol has not promptly followed increases of feedstock price, thus squeezing the margins of producers. This can also be illustrated with a simple calculation for the example of the EU bioethanol industry (see Table I).

Table I: Ethanol feedstock costs vs ethanol price

Feedstock type	Wheat
Feedstock price (May 2008) [3]	316$/t
Feedstock volume required for production of 1 unit (t) of biofuel	3 t
Total feedstock cost	950$/t
Ethanol price (Feb 2008) [4]	1200$/t
Difference	250 $/t
Conversion costs [5]	280 $/t

Considering that feedstock costs represent around 60% of total production costs for bioethanol in Europe and that with high oil prices the processing and distribution part of the costs have also gone up, it is obvious that the bioethanol sector will not be able to afford such expensive feedstock for a prolonged period of time on its own and that the financial viability of the ethanol sector in Europe also depends on the level of government support. With governments switching from a support-based system towards obligation-based systems, it will be the consumers at the pump that will ultimately be subsidizing the production of ethanol at such high costs.

3.1.3 Responsiveness of the feedstock (agricultural) sector to market signals

In a completely free market situation, farmers all over the world should respond to global increases in prices for agricultural commodities by planting more crops, even as the costs of the marginal land units put into agricultural use increase. This is in fact happening in many countries (US is predicting increased production of cereals and oilseeds and so are Argentina, Brazil and the EU) [6]. However, output increases have been hampered by export-limiting measures adopted by governments of some important agricultural exporters in an effort to curb domestic inflation, disincentivising farmers in those countries now unable to sell their crops at the higher world prices. Therefore, even though the next harvesting season is predicted to reach record levels, it could have been bigger still in a situation without such export interferences.

3.1.4 Availability of substitutes

Many basic agricultural commodities are highly substitutable among themselves, which means industries will turn to cheaper of the many options, when the one they normally consume increases in price. An increased demand for the substitute will also raise its price causing spill-over effects into markets of agricultural commodities that are not directly consumed by the biofuel industry (or in negligible quantities). The example of rising barley prices as farmers increasingly turn to it as a substitute for wheat in animal diet is rather
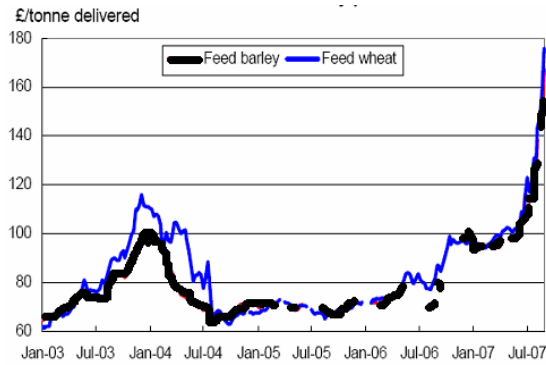
representative (see Fig. 2).

Figure 2: UK wheat and barley prices [7]

3.1.5 Price impact estimates

Several studies attempted a quantification of the impact that the biofuels industry would have on agricultural commodity markets if they develop to reach higher shares in total transport fuel demand, all else equal. Their results vary significantly, mostly due to the differing assumptions on future productivity levels, but also due to different consideration of the mechanisms discussed above.

Table II summarizes the results of six such studies, starting with those focusing on regional biofuel industries (EU, US) and then widening the scope to include major transport fuel consumers and the world.

Table II: Summary of studies estimating price impacts of biofuels on agricultural commodities

Sour.	Reg	Biof %	Price impact on	
			Bioeth feedst.	Biodiesel feedst.
EC DG agri (2007) [8]	EU-27	10% by 2020	+ 3-6% on 2006 cereal	+ 8-10% rapeseed, + 15% sunflow. seed
Banse et al (2008) [9]	EU	11% by 2010	+2% cereals, +6% sugar	+8% oilseeds
Elobeid et al, (2006) [10]	US	20% by 2015	+58% maize	
OECD AGLINK (2006) [11]	US, Can, EU, Bra	10% by 2014	+ 60% sugar, + 4% cereals	+2% oilseeds, 20% veg oil
Msangi et al., 2007 [12]	China, USA, EU, India, Bra	20% by 2020	+25-40% corn, +40-65% sugar, +15-30% wheat	+ 40-75% for oilseeds
FAO, 2005 (@2030 simulat) [13]	World	Not spec.	+2,8% on maize (for every additional 10 mio t of maize used for ethanol)	

The first obvious observation is that none of the studies predicts price effects of the magnitude of the price increases of agricultural commodities we have witnessed in the past two years. The effects predicted are of the order of a few percents to a maximum of some 75% in the case of very high share of total transport fuels coming from biofuels in all major transport fuel consuming countries, *ceteris paribus*.

The second obvious implication is that the impact of biofuels is likely to grow as more countries adopt specific targets. National biofuels policies must therefore always take into consideration the global outlook for biofuels deployment.

3.2 Factors determining the impact on consumer (food) markets

Possible price impacts by biofuels on food production costs cannot be directly translated to an increase in consumer prices. The two main reasons for this are described below.

3.2.1 The relative share of feedstock costs in retail price

To understand how an increase in the costs of inputs translates into price increases, we must take a look at the price structure of food commodities (and its link to actual production costs). The share of production costs in retail prices has been steadily decreasing, while the shares of distribution, marketing and margins have been increasing over time. Out of the production costs, the share of agricultural input costs in food retail price has reached particularly low levels in the past few years. In Western Europe, plant products on average account for only 9% of the retail price but the share of cereal costs in a loaf of bread is only around 4% [14]. So even an increase of 100% in wheat prices, if everything else stays equal, should only cause an increase in retail prices of bread of 4%. Animal products are more affected by price increases since feed costs account between 20% and 70% of total meat production costs depending on the type of livestock (but on average only 25% of meat retails price). It is interesting to repeat at this point that the share of feedstock costs in total production costs of first generation biofuels is between 50% and 80%. Again, the proportion of feedstock costs in retail fuel price will be smaller then the share of feedstock costs in total production costs, but it will not resemble the disproportions of feedstock costs in food prices.

Although we can expect the situation in developing countries to be somewhat different, the higher share of agricultural inputs in retail food prices is most likely to come from lower costs of capital and labor, rather than higher share of feedstock inputs.

Again, we can observe that even significant increases in prices of agricultural commodities cannot cause a proportionate increase in food prices due to the pricing structure of food. There are many other additions to the production costs of food which have a stronger impact on its prices. The one that has recently witnessed a strong increase is transport costs, which is felt very strongly by food importing countries.

3.2.2 Elasticity of demand

Elasticity of demand indicates the extent to which demand volume responds to changes in prices. It also indicates the ability of an industry to transfer the increase in production costs it faces to its customers (consumers). In this respect, it classifies more as a factor determining the level of impact on agricultural prices. However, it is the reason behind demand elasticity being a certain level that allows for food price increases to leave consumers relatively unaffected.

Food demand elasticity is very low in developed countries averaging 0,3 [13] which means that a 10% increase in food prices translates into a 3% reduction in consumption of the pricier food. Such inelastic demand is made possible by the fact that we spend a relatively small amount of our incomes on food (The EU average being 12% of total household expenditure [15]). For the food industry this means that its profitability is not going to be highly impacted by increases in production costs, since most of them can be transferred to the consumers who will not be buying much less, while for the consumers this means their consumption patterns can remain largely unchained because their incomes allow that. Average figures of course underestimate the impact of food price increases on the poorer households in developed countries, and of course the situation in developing countries where the average price elasticity of food demand is 0,75 since the population is much more vulnerable to food price increases, whatever the causes.

4 CAUSES UNDERLYING RECENT FOOD PRICE INCREASES

Based on the above analysis, we can conclude that the impact of biofuels on prices of agricultural material is at the most of the order of a few percents while retail food prices that consumers pay in developed countries are affected by a fraction of a percent. The level of impact is not likely to jump up a few orders of magnitude even when the targets set for biofuels are reached, particularly when the increases are spread out over the years so that markets can respond.

A better understanding of the level of impact that biofuels had on recent increases of agricultural commodities can be provided by putting them into the context of its other causes:

- Adverse weather effects: The combined cereal supply shortfall in North America, Europe and Australia in 2006 was 60 Mt, which is 4 times larger then the 17Mt increase in cereal use for ethanol in these countries.

- Energy prices: The share of energy in total crop production costs is 25% in developed countries and 43% in developing countries [11]. This means that with oil prices doubling in two years, agricultural production costs have increased by 50% and 80% in developed and developing countries respectively due to increased cost of fertilizer use, processing and distributing the crops.

- After the downturn of financial markets the interest of hedge funds and sovereign wealth funds has turned to agricultural commodity markets. By pouring their considerable financial resources into agricultural markets they significantly increased their liquidity and thus volatility.

- Market expectations (nervousness) leading to hoarding by some importing countries with large foreign exchange reserves.

- The already mentioned exporting countries measures to curb domestic inflation (e.g. increased export taxes or downright export bans).

5 CONCLUSIONS AND POLICY RECOMMENDATIONS

It is a combination of factors that has caused the recent increase in prices of agricultural commodities and food with biofuels being one of the minor causes. Because of the limited transmission of an increase in prices of agricultural inputs to retail food prices, any future debate on food vs fuel should focus more specifically on agricultural raw material and bearing in mind that reducing biofuel production is not likely to reduce food prices significantly.

However, if ambitious biofuels targets are to be maintained into the long-term, measures to curb food inflation could focus on:
- increasing yields in developing countries,
- reducing the share of fossil fuels in total crop production costs and
- further liberalization of agricultural markets (while taking into consideration the possible externalities).

As for the debate around the economic and social cost of biofuels, an additional focus should be put on how costly maintaining biofuel targets can become in view of the possible sustained high feedstock prices and who will bear such costs.

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