An Analysis of the Impacts of Expanded Biodiesel Production on the Markets for By-Products

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A soybean based biodiesel production increase of 750 million gallons is introduced for all scenarios in CARB. Assuming a standard conversion yield of 7.7 pounds of vegetable oil per gallon of biodiesel, the increased biofuel production will demand (from the original shock) an additional 5,775 million pounds of soybean oil. To put this figure in perspective, domestic consumption of soybean oil (reported by ERS/USDA) was 17,153 million pounds (average) for the marketing years 2003 and 2004. The same source shows average exports of soybean oil of 1,130 million pounds (about a fifth of the biodiesel needs) for the same period.[1]

Given the high level of commodity aggregation in GTAP, it is difficult to assess the impact of the increased demand for vegetable oils (in particular soybean oil), and the interaction with the jointly produced protein meal. We explore here the implications of the expanded biodiesel production on the markets for byproducts, based on the limited information available. Biodiesel by-products in GTAP are essentially protein meals. Taheripour et al., (2008)[2] write (p. 2-3) "Finally, in the third and fourth data bases we remove the “no byproduct assumption” by introducing Distillers Dried Grains with Solubles (DDGS) as a byproduct of ethanol-1 production process and biodiesel byproduct (BDBP), soy and rapeseed meals, into the data base."

To assess the magnitude of the shock on the market for protein meal (soybean meal in this case), we calculate the implied size of the expansion of supplies as more soybeans are crushed to satisfy the expanded demand for soybean oil in the U.S.. This is then compared to the size of the soybean meal market globally and in the U.S.. Results are shown in Table 1. Clearly, price induced effects as a result of the increased demand for soybean oil will mitigate the impact as this oil is substituted for relatively cheaper sources, and perhaps for oils from seed with proportionally less meal such as rapeseed and palm. Additionally, the increase in vegetable oil prices will ration the demand for other uses of vegetable oil.

The resulting additional domestic demand for soybean oil is likely to be met by a combination of expanded domestic crushing, lower exports, and perhaps some imports given the size of the shock relative to the export position reported above. Reduced soybean oil exports by the U.S. imply that other countries will need to expand their crushing activities and soybean meal supplies. Regardless, the increase in soybean oil

[1] We focus in 2004 here, as it is the reference year used for the CARB analysis.

[2] Taheripour, F., D. K. Birur, T. W. Hertel and W. E. Tyner. 2008. "Introducing Liquid Biofuels into the GTAP Data Base" GTAP Research Memorandum No. 11.
https://www.gtap.agecon.purdue.edu/resources/download/3939.pdf

biodiesel production significantly expands the supply of protein meal. In the new equilibrium, however, the soybean meal price should decrease disciplining the global supply expansion, and increasing consumption.

Table 1. Quantities of feedstock needed and co-products produced.*

Biodiesel Volume (million gallons)	750
Pounds of veg. oil per gallon of biodiesel	7.7
Veg. oil needed (million lbs)	5,775
Veg. oil in soybeans (lbs/bu)	11.34[a]
Soybeans needed (million bu)	509
Meal produced per bushel (lbs/bu)	44.12[a]
Meal produced as co-product (1000 mt)	10,194
World soymeal production (1000 mt)	127,959[b]
U.S. soymeal production (1000 mt)	35,364[b]
U.S. soymeal domestic consumption (1000 mt)	29,196[b]
U.S. soymeal exports (1000 mt)	6,337[b]
Expansion of world meal supply due to biodiesel (%)	8.0%
Expansion of U.S. meal supply due to biodiesel (%)	29%
Expansion of U.S. meal production as a proportion of domestic use (%)	35%
Expansion of U.S. meal production as a proportion of exports (%)	161%

* Yields and world volumes numbers are for the 2000-2004 period, as GTAP takes 2004 as the base year. [a] Average yield for the 2000-2004 period based on ERS/USDA data. [b] Average for the 2000/01-2004/05 marketing years based on ERS/USDA data

Impacts on the International Markets for By-Products

While the level of commodity aggregation prevents a detailed analysis, some insight on the impacts of the biodiesel expansion on global by-product markets can be obtained through the price changes of the CARB scenario analysis (see Table 2). The protein meal price seems to only change in the U.S., according to the results from this scenario. Does this imply that all the expanded supplies are absorbed in this country without changes in the trade of meal with the rest of the world? Or are the expanded supplies to other countries matched with increased demand from the livestock sector as to maintain prices unchanged in the rest of the world?

The origin of the shock in the U.S., and the resulting meal price decline would hint that livestock production in the U.S. expands as less expensive feed becomes available. This should have the impact of expanding meat supplies putting downward pressure on prices and demand of meal by the rest of the world. Hence, demand for meal should decline in countries not experiencing a price decline for the feed. Additionally, if the U.S. reduces their soybean oil exports as a result of the expanded domestic consumption, vegetable oil production would increase in other countries, expanding the supply of the jointly produced meal. Thus, it is not evident why the biodiesel expansion would not result in a decline of protein meal prices in other regions. This also seems to be at odds with

historical price relationships of soybean meal (a widely traded commodity) in different markets. As an example, the correlation coefficient of the soybean meal prices in the U.S. and the EU is 0.98 for the 1990-2004 period.[3]

Given the absence of price effects for meal in other regions, it seems that the shock in the protein meal market is contained within the U.S.. If this is the case, however, the 1% price decline seems too small to find domestic buyers for the initial 29% supply expansion of meal (see Table 1).[4] On the other hand, if the relatively modest price change is reflecting a high export demand elasticity, the expanded U.S. exports should lead to price declines in other regions, which is not consistent with the results presented in Table 2.

Table 2. Percent change in biodiesel by-products prices by region from Scenario A

Region	**%Change**
USA	-1.069
CAN	0.084
EU27	0.013
BRAZIL	0.041
JAPAN	0.029
CHIHKG	0.086
INDIA	0.017
LAEEX	0.048
RoLAC	0.036
EEFSUEX	-0.003
RoE	0.016
MEASTNAEX	0.008
SSAEX	-0.003
RoAFR	0.012
SASIAEEX	0.028
RoHIA	0.092
RoASIA	0.025
Oceania	0.013

[3] Prices used are Decatur (Average wholesale 48% protein) , and Hamburg FOB Ex-Mill for the EU, both series extracted from the USDA series "Oilseeds: World Markets and Trade". Converted by the authors to real terms with base year 2000. For nominal prices the correlation is 0.96.

[4] Adjustments in the vegetable oil markets are likely to reduce the expansion in the supply of meal from this initial value.

Impacts on Pasture Areas

Lower meal prices should affect the market for meat differentially. Prices of meats that are based largely on feed (such as poultry and pork) should decline more than those where pasture plays a larger role in production (e.g., beef). The differential price decline should lead consumers to substitute away from beef towards poultry and pork, reducing beef demand. Additionally, countries that base their beef production on pasture, do not see the same cost reduction as those countries that make intensive use of feed to fatten cattle.[5] Thus, given the lower beef prices, beef supplies and pasture use should decline relatively more in pasture-fed based countries. This does not seem to be reflected in the results (see Table 3). The interplay of all these effects are difficult to assess given the level of aggregation of the output. However, and for the case of scenario A, it seems that larger pasture reduction areas are obtained in countries/regions that make intensive use of confinement.

Table 3. Livestock landcover results for Scenario A

	Baseline	New Equilibrium	Difference	% Change
	1000 ha			
USA	231,718	231,591	-127	-0.055%
CAN	20,359	20,347	-12	-0.057%
EU27	64,006	63,991	-15	-0.023%
BRAZIL	181,047	181,022	-25	-0.014%
JAPAN	413	413	0	-0.022%
CHIHKG	286,377	28,6365	-12	-0.004%
INDIA	11,798	11,797	-1	-0.007%
LAEEX	216,206	216,190	-16	-0.007%
RoLAC	128,955	128,947	-8	-0.006%
EEFSUEX	345,643	345,615	-28	-0.008%
RoE	22,442	22,438	-4	-0.018%
MEASTNAEX	168,698	168,692	-7	-0.004%
SSAEX	617,143	617,102	-41	-0.007%
RoAFR	126,019	126,013	-6	-0.005%
SASIAEEX	6,536	6,535	-1	-0.014%
RoHIA	50	50	0	-0.028%
RoASIA	126,460	126,458	-2	-0.001%
Oceania	287,854	287,843	-11	-0.004%

In summary, more detail is needed to determine if there is a problem in how the soybeans sector was split out from other oilseeds. The CARB results for soybean products as we understand them are not consistent with how soybean meal is produced and traded around the world.

[5] This is reinforced by the lack of protein meal price changes in the rest of the world.