Soybean Co-product Economics: Why livestock producers should use biodiesel to haul their soybean meal

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Recent trends in oil and meal prices

Soybean oil and meal prices have reached historic levels this marketing year with soybean oil rising above 50 cents per pound and soybean meal topping $325 per short ton. Since the price of soybeans is directly driven by the value of these two co-products, we have seen similar increases in soybean prices[1]. While soybean producers are enjoying these higher soybean prices, the oil and meal users are not. There have been statements made in the press and other venues (usually by those sympathetic to meal users) that the increased soybean oil demand for biodiesel production has not only driven up oil prices, but it has also caused meal prices to skyrocket. This is not true since increases in soybean oil demand will actually cause meal prices to decrease with all other things held constant.

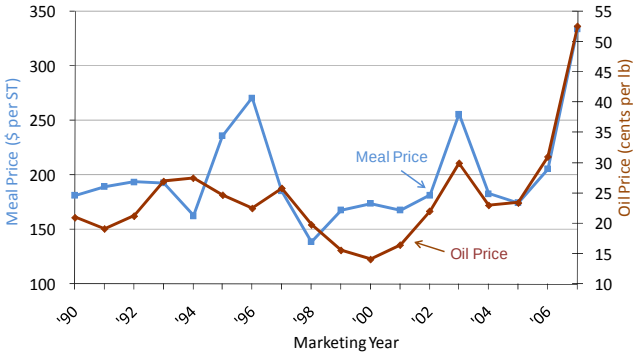

Figure 1. Soybean Oil and Meal Prices

There is no doubt that biodiesel has recently played a dramatic role in the soybean oil market with soybean oil use for biodiesel production around 15 to 16% of total domestic disappearance the past two full marketing years. At the same time, soybean meal prices have also risen sharply. To the casual observer, it may appear that there is a cause and effect with these parallel price increases in soybean oil and meal. However, the blame for high soybean meal prices is misplaced; meal and oil are co-products in soybean crushing. This means that high soybean oil demand causes more soybeans to be crushed and more meal to be produced. If nothing else is changing, then the larger meal supply would lower meal prices.

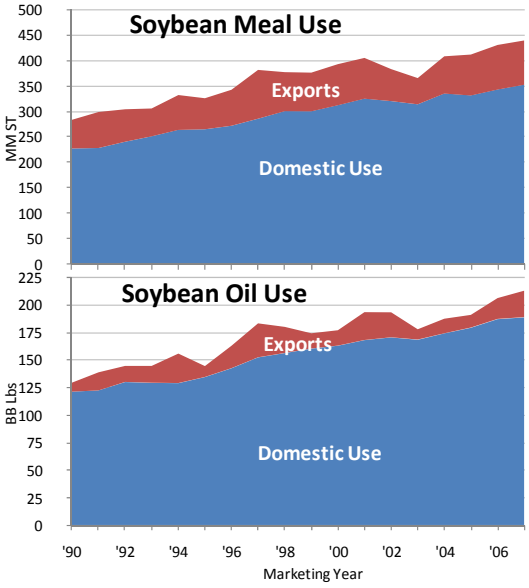

Figure 2. Soybean Oil and Meal Use

[1] For an explanation of how soybean, oil and meal prices are related, see the Appendix.

Therefore, one would ask why soybean meal and oil prices are rising at the same time. In recent years, there has been a simultaneous increase in demand for both soybean oil and meal, along with macroeconomic factors such the devaluation of the dollar, whereas a cheaper dollar increases the demand for exports, causing US soybean meal and oil prices to rise. As seen in Figures 1 and 2, the domestic uses of oil and meal have increased steadily while their prices have spiked at the end of this time period. The fact that meal use continued to increase even though prices were significantly higher implies a strong demand for soybean meal. Additional explanations for the high meal prices include concerns about soybean supplies, higher relative cost of protein substitutes in livestock rations, and a strong inflow of speculative capital into commodity futures contracts, thus inflating market values. Therefore, all these reasons have contributed to the rise in meal prices, outweighing the impact of higher soybean oil prices.

Economics of co-products

As previously mentioned, if there are no other forces impacting the markets, increases in soybean oil demand would actually cause meal prices to decline. It might not be necessarily intuitive why this would happen, but a basic economic rule of thumb applies to a co-product relationship like that of soybean oil and meal. To understand this, one must first remember there is a fixed physical relationship between the volume of beans crushed and the volume of oil and meal produced from that crush. If more soybeans are crushed to meet increased oil demand, more meal will be produced as well. When this happens, simple supply and demand economics kick in, and the price of meal will decrease because of its increased supply.

The basic rule of thumb is with all other things being equal, if the demand for one co-product increases, it will drive the price of that co-product up while driving the price of the other co-product down. The following example shows how this process works. If soybean oil demand increases due to biodiesel use, the following will happen:

1. The price of soybean oil increases since there is more demand with a given level of supply
2. This leads to more crush to meet the oil demand, thus increasing the demand for soybeans which in turn leads to higher soybean prices
3. The increased crush also produces more soybean meal. Since it is assumed that meal demand does not change in this example, the increased supply causes the price of meal to decline.

The same thing works in reverse if meal demand increases or decreases with no change in oil demand.

Illustration: What would happen to meal prices if oil demand for biodiesel were reduced from current expectations?

It is important to recognize that the economic impact of a demand change on soybean producers, processors and end-users cannot be predicted with complete precision. However, the general economic outcome and an expected range of results can be calculated based on historical price responses to changes in demand. These relationships could be used to estimate what might happen to soybean meal

prices with lower soybean oil demand[2], assuming that there are no other factors influencing the soybean complex.

To show why lowering soybean oil demand would be bad for meal users, let's suppose the opposite of FAPRI's forecast of higher biodiesel use and see what happens. In round figures, projections from FAPRI suggest that soybean oil utilization for biodiesel will increase to about 7.5 billion pounds by 2012. This represents roughly 3.5 billion pounds over what is currently being used for biodiesel production. For purposes of this scenario, it is assumed that the soybean oil utilization for biodiesel remains at current levels of about 4.0 billion pounds per year. Based on this assumption and the assumption that nothing else changes, a soybean supply and demand model is employed to estimate the impact of this reduced soybean oil demand on meal prices.

Table 1 summarizes the impact of the reduced soybean oil demand on each of the domestic sectors with all other economic factors held constant. The table also shows average results for net sector returns for soybean producers and processors from MY09[3] through MY18. As indicated, the lower demand for soybean oil increases meal prices by $33 per short ton in the early years up to $85 in the later years.

In general, the oil end-user is the only sector that is better off. The lower demand decreases soybean oil prices by a range of 9 to 23 cents per pound, and as a result, the oil end-users enjoy lower input costs. However, this also decreases soybean prices; the annual net returns for the production sector would be about $1.4B lower than if there was the greater soybean oil demand for biodiesel use. Processing margins tighten in this scenario, and the processing sector's annual net returns would be decreased by an annual average of $35M due to the lower soybean oil demand.

Table 1. Summary of Impact from Decreased Oil Demand from MY09 through MY18

Sector	Demand	Supply	Price	Net Sector Returns	Implications	Comments
Oil End-user	Decrease		Decreases in the range of 9 to 23 cents/lb		Oil end users are happy with lower prices, including remaining biodiesel producers	
Soybean producers		Decreases	Decreases in the range of 25 cents to 53 cents per bushel	Average annual sector returns are reduced by $1.4B	Soybean producers are worse off in general	Based on historical responses, lower prices would lead to reduced acreage
Processor		Crush decreases due to lower oil demand		Average annual sector returns are reduced by $35M	Processors are worse off in general	Processing margins are tightened
Meal End-user	Remains constant	Decreases	Increase in the range of $33 to $85 per ST		Meal end-users are worse off	

[2] For an explanation of how these relationships work, see "Price elasticities, joint products, and international trade" by Nicholas E. Piggott and Michael K. Wohlgenant in *The Australian Journal of Agricultural and Resource Economics*, 2002, 46:4, pp 487-500. (http://www.ag-econ.ncsu.edu/faculty/piggott/SelectedPublications.html)

[3] MY represents Marketing Year. For soybeans, the marketing year begins in September in the year in which the crop is produced whereas the marketing year for oil and meal begins in October.

The export markets for soybeans, oil and meal also adjust to the change in prices. Lower soybean prices lead to an increase in soybean exports. Soybean oil exports rise due to the lower soybean oil prices. On the other hand, higher soybean meal prices prompt lower meal exports. In this example, lower domestic soybean oil demand would shrink overall export sales by an average of $2.5B annually.

So what does reduced domestic oil demand mean overall?

There has been a lot of debate about the impact of the recent increase in biofuel production from corn and soybeans on the markets. Biofuel production has influenced prices, but due to many factors occurring simultaneously, the degree to which demand for soybean oil for biodiesel production has impacted meal prices is difficult to disentangle. However, the scenario described above clearly indicates that if demand for soybean oil for biodiesel production is moderated from current projections with no other factors impacting the soybean complex:

- Soybean oil prices would decrease significantly due to lower demand for oil; oil end-users would benefit from the lower oil prices
- Soybean supply and prices would decline because of the reduced oil demand; soybean producers would realize lower returns
- Processing margins would tighten
- Soybean meal prices would increase significantly because of the smaller meal supply; therefore, meal end-users would pay higher prices for protein
- While the volume of oil and soybean exports would increase and the volume of meal exports would decline, net export sales of soybeans, meal and oil would decline overall

Given this outcome, it makes economic sense for soybean meal users to fill up with biodiesel next time they head out to pick up some soybean meal!

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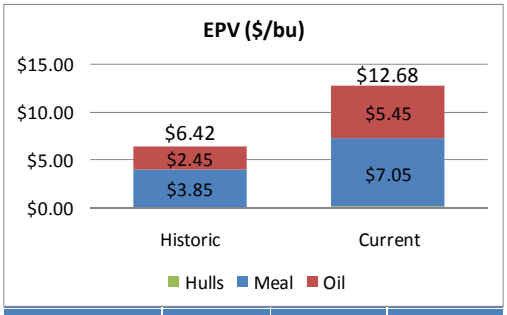
Appendix

The Estimated Processed Value (EPV) of soybeans

Oil and meal are the two major products of soybean crushing, and along with hulls and a processing margin, they formulate the total processed value of soybeans, often referred to as the Estimated Processing Value (EPV). The higher the oil and meal prices, the higher the EPV the processor realizes. Once the processing margin has been extracted from the EPV, the net EPV reflects the price processors are able to pay for soybeans. Assuming a constant margin, the higher the EPV, the higher the price paid to the soybean producer. For example, if prices representative of historic averages for oil and meal are used, the EPV is $6.42 (Figure A1). However, if current prices are used, the EPV is $12.68, almost double of the EPV using "historic" prices. This helps explain why soybean prices are at their current levels.



Product Prices	Historic	Current	% Change
Oil ($/lb)	$0.22	$0.49	123%
Meal ($/ST)	$178	$325	83%
Hulls ($/ST)	$75	$111	48%

Figure A1. EPV ($/bu)

Econ 101 – Soybean co-products

The way the oil and meal markets react to demand changes is often not easy to understand because of the relationship of oil and meal to soybeans. They are co-products from soybean crushing, meaning that they are joint products when soybeans are processed. Processors cannot trade more meal for oil or vice versa during crushing. Therefore, if soybean crush increases, more meal and oil are produced, and vice versa, if fewer soybeans are crushed, smaller amounts of meal and oil are produced. Because of this parallel change in output, the impact of changes in demand of one co-product (either meal or oil) on prices for both products and use of the other co-product is often tricky to understand.

To help describe the direction in which oil and meal prices move, a basic rule of thumb is often quoted. The rule of thumb is that, with all other things being equal, when demand for one co-product goes down, the price of the other co-product goes up. The following table, applying that rule of thumb, summarizes how changes in demand for a co-product (in this example, it is oil) impacts supply of soybeans and the other co-product (meal), and their respective prices.

Basic rule of thumb: When demand for one co-product decreases, the price of the other co-product increases, with everything else equal.

To illustrate, consider a decrease in domestic oil demand (Figure A2). With all other things held constant, a 5% demand reduction would cause domestic oil use to decrease by 2.2%, prompting oil prices to decline by 14.2%. Lower soybean oil demand decreases soybean use by 0.3% and prices by 2.6%. The decreased domestic use also produces less meal by 1.5%, but since demand for meal has not changed, the meal deficit causes meal prices to go up by 8.0%.

		Change from Baseline					
Change in Domestic Demand		**Oil**		**Soybeans**		**Soybean Meal**	
Oil	**Meal**	**Domestic Use**	**Price**	**Domestic Use**	**Price**	**Domestic Use**	**Price**
Decrease by 5%	No change	Decrease by 2.2%	Decrease by 14.2%	Decrease by 0.3%	Decrease by 2.6%	Decrease by 1.5%	Increase by 8.0%

Figure A2. Impact of a Decrease in Soybean Oil Demand

One might wonder what happens to exports when domestic demand for soybeans, oil or meal changes. The resulting price changes for all three also impact their respective export markets. Therefore, in the example above, the lower oil and soybean prices increase oil and soybean exports. However, since meal prices have increased, meal exports decline as a result.

This example describes the basic economic relationships between soybeans and its co-products when demand for only one of the co-products changes, along with the assumption that no other economic forces are impacting the markets. This lays the foundation for understanding the dynamics of the often confusing soybean complex, and provides some help in answering questions about demand changes to soybean products.

What would happen to meal prices if oil demand went down?

To begin exploring the scenario used in the aforementioned example, a level of biodiesel production has to be assumed. The starting point is the projected level or "Baseline" of soybean oil use for biodiesel production projected in FAPRI's *US Baseline Briefing Book* published in March 2008. Figure A3 shows the projected soybean oil use for biodiesel production from MY08 through MY17 where the long-run projection ranges from 7.2 to 7.7 billion pounds. Then, an alternate scenario in which not as much soybean oil is used for biodiesel production, is considered. One option is to specify that soybean oil use for biodiesel production might remain close to the level projected for MY08 indefinitely, which is close to 4 billion pounds. This reduction in soybean oil use for biodiesel production from the Baseline would decrease the overall domestic demand for soybean oil.

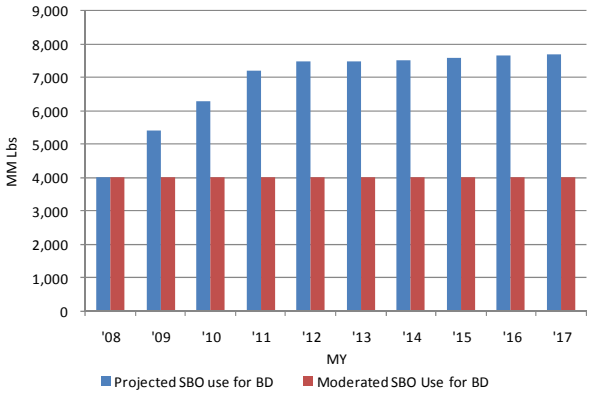


Figure A3. Projected and Moderated Soybean Oil Use for Biodiesel Production

The next step is to measure how the reduced domestic demand for soybean oil would impact oil prices, soybean prices and supply, meal supply and prices, and then ultimately, exports. To do this, USB's Value Chain Analysis (VCA) model is used to understand the impact of the reduced demand for soybean oil on the soybean complex. This model focuses on the US soybean complex, therefore not accounting for changes in other sectors such as other domestic oilseeds, corn, or non-US markets. In other words, this analysis only looks at the impacts of reduced domestic soybean oil demand, without any other forces impacting oil, meal and soybean demand, supply and prices.

The VCA model calculates results over a projection period of 20 years, and a summary of results over a ten year horizon (MY09 through MY18) is presented in the main body of this paper. The degree to which prices and supply are affected (shown as both relative and percentage changes) for MY12 is reported in this appendix to show results for a specific year. MY12 is chosen because it is four years into the projection period and markets have begun to stabilize. Figure A4 illustrates the impact of the cumulative reduced demand for soybean oil from MY09 through MY12 on oil use, prices, and soybean and meal production in MY12, assuming all other things are held constant. The decrease in demand in soybean oil each marketing year is calculated based on the difference in original projected use of oil for biodiesel production and the moderated use of oil in that specific time period. Within each marketing year, the reduced demand impacts use, prices and production for that specific year, and then the subsequent years of the projection period. In MY12, the cumulative decreased demand reduces the domestic use of soybean oil by 1.4B pounds or 6.6%, resulting in a 21 cent or 40.7% decline in oil price. The lower oil demand applies downward pressure on soybean prices by 46 cents or 4.4%, and domestic soybean use by 117M bushels or 5.3%. The lower soybean crush then decreases the supply of soybean meal by 2M short tons or 5.0%. Assuming that domestic meal demand stays at the same level, meal prices increase by $79 per short ton or 29.5%.

		Change from Baseline					
Cumulative Change in Domestic Demand		**Oil**		**Soybeans**		**Soybean Meal**	
Oil	**Meal**	**Domestic Use**	**Price**	**Domestic Use**	**Price**	**Domestic Use**	**Price**
Decrease	No change	Decrease by 1.4B lbs	Decrease by $0.21	Decrease by 117M bu	Decrease by $0.46	Decrease by 2M ST	Increase by $79/ST
		Decrease by 6.6%	Decrease by 40.7%	Decrease by 5.3%	Decrease by 4.4%	Decrease by 5.0%	Increase by 29.5%

Figure A4. Economic Impact of Moderated Soybean Oil Demand in MY12