Soybean Oil and Meal Economics:
How Livestock Producers Benefit from Biodiesel Production

Recent Developments in the Soybean Industry

While it is not necessarily intuitive, livestock producers benefit from biodiesel production. To explain, let's start with looking at what soybean oil and meal prices have done over the past few years. The soybean industry has seen unprecedented events during the last four marketing years. These changes have included shifting demand drivers (e.g., changing biodiesel production, declining livestock production, increased export demand), new competition (e.g., palm oil and dried distillers grains with soluble (DDGS)), and record high soybean oil and meal prices in the 2007 marketing year (MY07)[1] (Figure 1). The parallel price escalation of soybean oil and meal prices witnessed in MY07 prompted some people to conclude that the increased production of soy-based biodiesel led to the high meal prices. However, that is not the case.
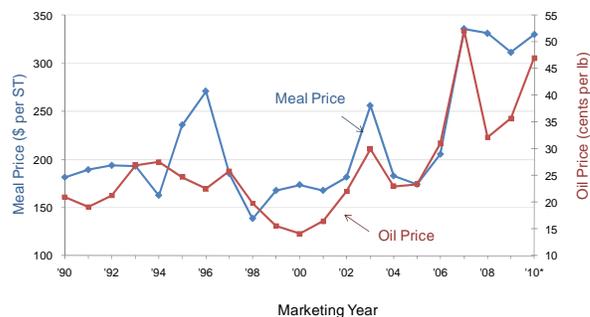

Figure 1. Soybean Oil and Meal Prices

This is where understanding demand, supply, and co-product relationships comes in (see the appendix for discussion about the economics of soybean co-products). Soybean oil demand increases cannot be blamed for soybean meal price increases because of the underlying economics of these two products of soybean crush. In fact, an increase in demand for soybean oil will actually cause soybean meal prices to decrease when meal demand is unchanged. The basic economic principle for these co-products is that when demand for one co-product increases, the price of the other co-product decreases. Thus, an increase in demand for soybean oil benefits livestock feeders through lower meal prices.

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

In turn, the recent price fluctuations can be explained by basic supply and demand factors, some impacting both meal and oil, while others being unique to each co-product. Overall soybean supply impacts soybean prices along with meal and oil prices. For example, the reduced soybean production in 2007 (Figure 2) contributed appreciably to the oil and meal price increases in MY07.
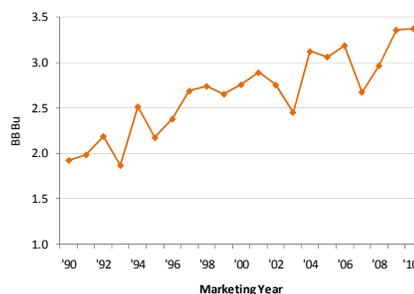

Figure 2. US Soybean Production

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[1] The marketing year for soybeans is from September through August of the following year. The marketing year for soybean oil and meal begins in October and ends in September of the following year.

Factors contributing to the recent variability in both oil and meal demand during the last four marketing years (Figure 3) include:

- Increased worldwide demand for protein
- The global economic recession
- The fluctuating value of the dollar
- Trans fat labeling requirements
- Increased edible oil competition from other fats and oils
- Fluctuating biodiesel production
- Declining livestock numbers
- Increased competition from protein sources including canola meal, synthetic amino acids and DDGS
- Increased soybean meal export demand

Understanding how these multifaceted supply and demand factors impact the soybean complex can be challenging at times. Nonetheless, we do know that strong oil demand for biodiesel production will benefit livestock producers by lowering meal prices and lessening the pressure on their already thin feeding margins.
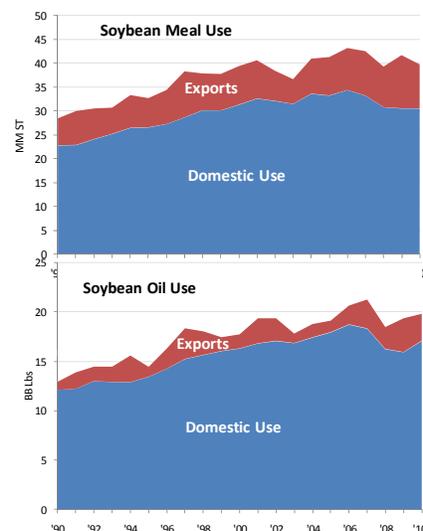

Figure 3. Soybean Meal and Oil Use

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 concurrently changing in the soybean complex. The United Soybean Board (USB) has developed a partial equilibrium model called the Value Chain Analysis (VCA) which is used for this analysis. The model evaluates the impact of a single supply or demand factor – for this study, the decrease in soybean oil demand for biodiesel – in isolation of other economic sectors. This helps us understand the impact of changes in soybean oil demand on oil prices, soybean prices and supply, meal prices and supply, and then ultimately, exports of soybeans, soybean oil and soybean meal.

To show why lowering soybean oil demand would be bad for meal users, let's suppose there is a significant reduction in biodiesel production, and thus soybean oil use for biodiesel production, from what is currently expected for MY11 through MY15. Baseline projections for future production of biomass-based diesel are developed as part of the VCA analysis. These baseline projections include the amount of feedstocks by category, including soybean oil, used for biodiesel production. These assumptions then impact the price and quantity produced and utilized of soybean oil, soybean meal, and soybeans in the baseline projections. Changing policy or other economic circumstances also affect the estimates of future prices and quantities. These baseline projections assume the RFS2 mandated

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[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)

amount of biomass-based diesel fuel is produced in MY11 and beyond. It subsequently assumes that 50% of the domestic biomass-based diesel or biodiesel produced from MY11 through MY15 will be from soybean oil (Figure 4)[3].

The biodiesel industry is currently facing numerous economic and policy uncertainties. These unknowns include potential revisions to the mandated volume of biomass-based diesel, the blenders' tax credit not being extended beyond 2011, and opposition leading to policy

Figure 4. Baseline Estimate of Biodiesel Production by Feedstock Type

changes that reduce the amount of biodiesel production from baseline levels. The extent to which these forces affect the U.S. biodiesel production industry is not known with certainty; therefore, a range of potential reduction in biodiesel production is considered for MY11 through MY15, and the economic impact from the reduced demand for soybean oil is evaluated for this study.

The lower and upper boundaries of the reduced biodiesel production are defined by the following two scenarios:

1. Moderate decrease of biodiesel production – this moderate scenario assumes a 25% reduction in biodiesel production from the projected baseline volume, beginning in MY11. It is further assumed that 80% of the reduced production would come from soybean oil-based biodiesel and the remaining reduction would impact the other feedstocks (Figure 5). This scenario forms the lower boundary of the range of results.

Figure 5. Moderate decrease of biodiesel production

2. Aggressive decrease of biodiesel production – this more aggressive scenario represents what might happen if current mandates and supporting policies were rescinded. This scenario makes the same assumptions for MY11 only - a 25% reduction in biodiesel production with 80% of the reduction coming from soybean oil. However, for MY12 through MY15, a 50% reduction in biodiesel production is assumed. The reduced biodiesel production would come from a 60% reduction of soybean oil-based

Figure 6. Aggressive decrease of biodiesel production

biodiesel and the remaining reduction would impact the other feedstocks (Figure 6). This scenario creates the upper boundary of the range of decreased biodiesel production.
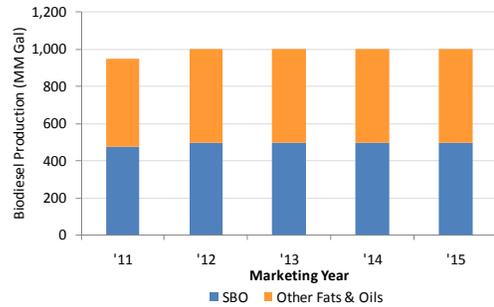
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[3] While current industry use of soybean oil use for biodiesel production is less than 50% of all feedstocks, industry expectations are that soybean oil use will be at least 50% at least in the ensuing five years. This is consistent with USDA's and FAPRI's annual baseline projections in which assumptions about biodiesel production are made. For their 2010 baselines, USDA assumed enough biodiesel would be produced to meet the 1 billion gallon mandated volume in 2012, while FAPRI projects that biodiesel in excess of the mandated volume would be produced. USDA and FAPRI estimate the share of soy-based biodiesel to be from 40% to 52%, respectively.

Table 1 summarizes the potential range of impact of the reduced soybean oil demand from both scenarios on each of the domestic sectors from MY11 through MY15[4].

Table 1. Summary of Potential Impact from Decreased Oil Demand from MY11 through MY15

Sector	Demand	Supply	Price	Net Sector Returns	Comments
Oil End-user	Decreases		Decreases in the range of 9 cents/lb in MY11 to 10 to 15 cents/lb by MY15		Oil end users, including remaining biodiesel producers, experience lower input costs
Soybean producers		Decreases	Decreases in the range of 21 cents in MY11 to 33 to 46 cents per bushel by MY15	Average annual sector returns are reduced by a range of $993M to $1,297M	Soybean producers are worse off due to lower soybean prices and reduced acres
Processor		Crush decreases due to lower oil demand		Average annual sector returns are reduced by $33M to $42M	Processors are worse off in general due to tightened margins
Meal End-user	Remains constant	Decreases	Increase in the range of $36 in MY11 to $34 to $50 per ST by MY15		Livestock producers are worse off because of the higher prices

In general, the oil-end user is the only sector that would benefit from reduced biodiesel production. The lower demand would decrease soybean oil prices, and as a result, the oil end-users would experience lower input costs. Soybean meal prices would increase; livestock producers could possibly pay anywhere from $34 to $50 per ton more for their soybean meal by MY15. However, soybean prices would decrease; the annual net returns for the production sector would be lower than if there was the greater soybean oil demand for biodiesel use. Processing margins would be tightened, and the processing sector's annual net returns would also decrease.

The export markets for soybeans, oil and meal would also adjust to the change in prices. The lower soybean and soybean oil prices would lead to an increase in soybean and soybean oil exports, respectively. On the other hand, higher soybean meal prices would prompt lower meal exports. For these examples, lower domestic soybean oil demand, holding all other factors constant, would shrink overall export sales by an average of $217M to $282M annually.

So what does reduced domestic oil demand mean overall?

There has been a lot of discussion about the drivers of the recent price increases for soybeans, soybean oil and soybean meal. 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 potential scenarios described above clearly indicate that if demand for soybean oil for biodiesel production is moderated from current projections with no other factors impacting the soybean complex:

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[4] Since the assumptions are the same for the first year in both scenarios, the VCA model generates the same results for MY11 for each scenario. However, the different assumptions for reduced soybean oil demand for biodiesel production from MY12 to MY15 produce different results. The ranges presented in Table 1 are the resulting changes with the more extreme numbers generated by the Aggressive Scenario.

- Soybean oil prices would decrease due to lower demand for oil; the lower input costs for oil end-users would temporarily increase margins until markets adjust and margins return to their long-run average.
- Soybean production and prices would decline because of the reduced oil demand, and 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!

Appendix

Econ 101 – Economics of 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 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.

The Estimated Processed Value (EPV) of soybeans

Oil and meal, the two major products of soybean crushing, along with hulls and a processing margin, 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. Figure 7 shows how soybean prices have risen and fallen with EPV over time, underscoring their economic relationship.
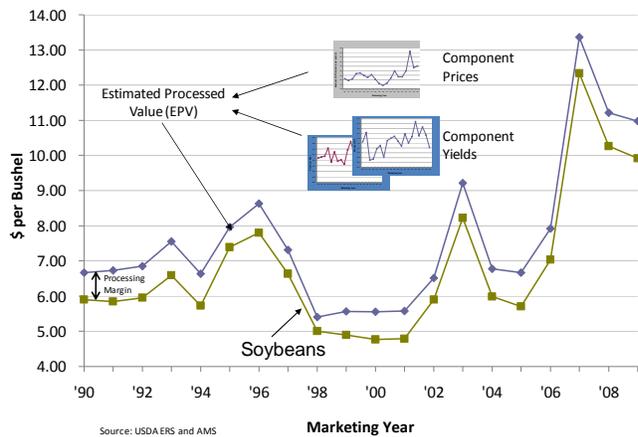

Figure 7. Estimated Processed Value (EPV) vs Soybean Prices

If the price of oil increases and the other prices and product yields stay the same, EPV will increase, implying that soybean prices will also increase. However, if the oil price increase is a result of new oil

demand (with no corresponding increase in meal demand), co-product economics will mitigate the impact of the EPV/soybean price increase. This is because an increase in demand for oil will increase domestic crush, putting more meal on the market. The increase in meal supply, with no new meal demand, will cause the meal price to decline. Thus, due to these co-product economics, EPV and ultimately soybean price increases might not be as high as one might expect. This is because only one factor that impacts soybean, oil and meal prices is being considered.