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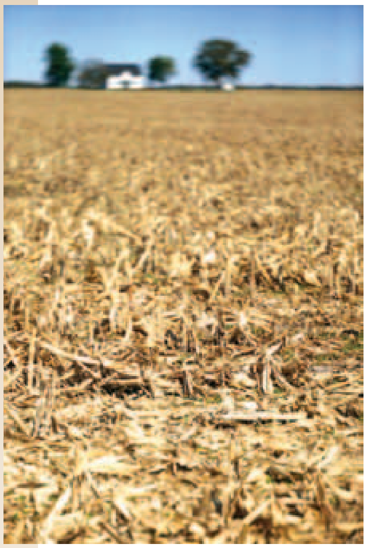
Incentives in Long-Term Biofuel Contracts



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Introduction

Biofuel production in the U.S. has seen tremendous growth in the past few years, spurred by government mandates and high oil prices. To this point, most of the growth in biofuel production has come from corn-based ethanol, contributing to the recent run-up in commodity prices (Abbott et al., 2009 and 2011). Future growth in biofuel production is likely to come from a variety of renewable, cellulosic fuel sources like wood wastes, crop residues, and dedicated energy crops such as switchgrass or miscanthus. The renewable fuel standard (RFS) alone requires 16 billion gallons from these types of advanced feed stocks by the year 2022.

Biofuel refineries that can process cellulosic feedstocks are particularly expensive to construct, costing three to four times more than corn ethanol refineries (Coyle, 2010). Typically, plants recoup the cost of these investments over 10 or more years, which requires them to have a secure, long-term supply of biomass for their operations. This is not a problem for corn ethanol refineries because corn starch and crop residues are readily available each year through existing markets. Dedicated energy crops, however, aren't traded commercially. Therefore refineries that use these crops will need to rely on long-term contracts to convince farmers to produce these crops on a large scale.

Even though commercial markets exist for corn starch and crop residues, corn ethanol refineries may also want to use long-term contracts to manage their feedstock input costs. A significant portion of a refinery's input costs comes from paying farmers to produce, harvest, store, and/or deliver feedstocks to the plant at a rate fast enough to keep the plant operating efficiently (Alexander et al., forthcoming). Long-term contracts can help manage the price volatility of these inputs costs, reducing the refinery's exposure to price variability while still satisfying farmers' need to achieve target profit or return on investment (ROI) levels.

This publication describes how incentives can be included in long-term biofuel contracts to induce farmers to participate in new markets, incentivize high-quality and high-quantity production, and prevent contract renegotiation. Correct incentives can reduce the total cost of biomass production, minimize the total effort spent on contracting by all parties, and help establish good-faith partnerships between farmers and refineries.

Getting Farmers to Participate in Long-Term Contracts

Convincing farmers to sign long-term contracts is all about making sure that their profit from the contract is at least as good as they would earn from their next best alternative. This might be measured as profit or ROI on a per-acre or per-bushel basis. Because profits depend on the price received per bushel of biomass output, farmers would like to get the highest price possible. Refineries, on the other hand, are buying large volumes of biomass to keep their plants running efficiently and would like to drive down the price. The key issue is the farmers' minimum profit or return, called the "reservation value." This is the absolute lowest payment farmers will accept to grow biomass feedstock under contract. As long as refineries are willing to pay at least as much as the reservation value, the farmers will be earning enough profit to have an incentive to continue growing biomass over the long term. The difference between a refinery's maximum price and a farmer's minimum price is their bargaining zone, where both parties can bargain and come to an agreement on a contract price (Figure 1).

What determines a farmer's reservation value? In a long-term contract, the reservation value may reflect the next best use of a farmer's land or crops. If a farmer is determining his or her reservation value as a return per acre, then the refinery can use local land rents and sales to ball-park the negotiations. If a farmer is determining his or her reservation value on a per-bushel basis, then it depends on whether there is an existing market for the biomass crop. For crops traded on a market, like corn or crop residues, the reservation value is based on the local market price. Farmers should be willing to contract with a refinery

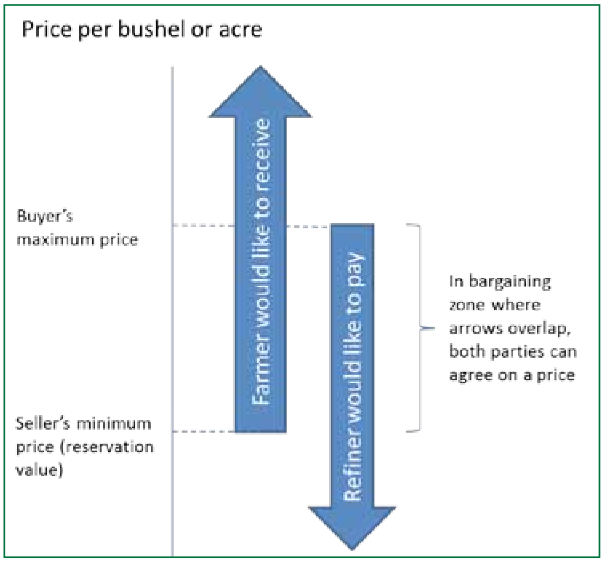

Figure 1. *Farmer's and Refinery's Reservation Prices and Bargaining Zone*

provided the refinery matches or betters the price offered by the local grain elevator or other buyers. For crops that are not currently traded in a market, like switchgrass and miscanthus, it may be more difficult for refineries to predict farmers' minimum prices.

Farmers' reservation prices for switchgrass or miscanthus are likely to be different than their reservation prices for corn for several reasons. First, farmers will be uncertain about how to manage cultural practices, logistics and storage, required equipment, initial investments, variable inputs, and timing conflicts with existing crops (Alexander et al., 2010). Uncertainty about these issues is likely to translate into a higher reservation price initially, but may be less of a factor over time as farmers become more comfortable with the new crop.

Second, perennial crops like switchgrass and miscanthus require a year or two of establishment time before the plants reach peak production levels. However, farmers will likely require some type of payment during the establishment time, even if no biomass is delivered to the refinery, to participate in a long-term contract. The type of payment depends on who assumes responsibility for the cost of planting. If planting is handled by a custom planter and paid for by the refinery, then a farmer will need to be compensated for land rental value only. If the farmer is responsible for planting costs, then the refinery will need to compensate the farmer for lost farm income as well as land rent value to meet the farmer's reservation value.

Third, refineries should expect to pay a risk premium to compensate farmers for the risks that come from working with a new crop. These include risks from yield variability and variability in crop quality, which are likely to be different then corn yield risks.[1] These risks are already well characterized for commercially grown crops like corn and soybeans and can be managed through a combination of insurance programs and marketing contracts. These risk management tools do not yet exist for dedicated energy crops. Fortunately for refineries, the amount they have to pay to cover farmers' risk premiums should decrease over time as these risk management tools become available and farmers learn more about crop variability from research, Extension, and peer and personal experience.

Additionally, farmers may require a premium to cover counterparty risk from producing a crop for a specialty buyer. Counterparty risk, or default risk, is the risk that either the refinery or farmer will go out of business and be unable to honor the terms of the contract. For example, the ethanol refinery VeraSun Energy declared bankruptcy in 2008 and refused to honor futures contracts with farmers for millions of bushels of corn (Steil, 2008). Without other potential buyers for switchgrass or miscanthus, farmers may be hesitant to sign a long-term contract and may demand a high premium to lock up their productive acres. One potential solution to mitigate the counterparty risk might be for the refinery to post a bond that would compensate farmers in the event of refinery bankruptcy (Alexander et al., 2010).

Fortunately for refineries, the advantage of perennial energy crops over annual crops like corn is that they produce higher biomass yields per acre and require few variable inputs (Lewandowski et al., 2003). Annual crops typically have high variable costs, and therefore farmers need high revenues to meet their target profit levels. Because farmers are likely to have lower variable costs for a dedicated energy crop, refineries should be able to meet perennial crop farmers' target profit levels with a lower per-bushel payment, compared to the price demanded by corn farmers. The reduction in variable costs should help offset the farmers' risk premiums for adopting a new crop.

Incentivizing High Quality and Volumes

Refineries generally prefer to contract farmers with high yields to reduce the total cost of delivering feedstocks to the plant. Refineries may also prefer to contract for high-quality feedstocks, such as those with low moisture content to reduce storage losses and transportation costs, low mineral concentrations to prevent boiler corrosion, and/or the right types of carbon compounds to optimize ethanol production (Adler et al., 2006). Both the yield and quality of the harvested biomass depend on multiple factors, only some of which are under farmers' control. Contracts that give farmers bonuses for higher-than-average yields or low moisture content, however, will incentivize farmers to do as much as possible to achieve those yield or quality goals.

Yield or quality bonuses create a large difference between what farmers earn for low yields (or poor quality) and high yields (or good quality). Increasing the bonus increases the strength of the incentives. Stronger incentives, however, mean more revenue risk for farmers because there is always potential for poor yields due to weather and other events outside of the farmers' control. Some farmers may be unwilling to take on this revenue risk or demand additional compensation for this type of contract. If there are two types of farmers, one willing to take on revenue risk and one not, a refinery should offer them a choice of contracts: one low risk, low reward and the other high risk, high reward. Each farmer could then pick the incentive scheme that suited his/her risk tolerance, and the refinery could contract for a larger volume of biomass.

Weather risk is a key issue for annual crop production, but less of a factor for perennial crops. Peak yields of perennial crops like miscanthus and switchgrass are not likely to vary as much with changes in the weather as peak yields for annual crops (Jain et al., 2010). If a miscanthus farmer and a corn farmer put in the same amount of time and money to growing their crops, the miscanthus farmer should see more consistent yields from year to year because weather is less of a factor. The miscanthus farmer can be more certain that a good yield was due to his or her own activities and not a particularly good weather year. This means that the miscanthus farmer's revenue risk with a yield bonus is lower than the corn farmer's risk, and in general, refineries should find it cheaper to incentivize farmers growing perennial crops.

In some situations, however, the cost of incentivizing farmers to produce high-quantity or high-quality feedstocks may outweigh the benefits to the refinery. Instead, a refinery may want to offer farmers production contracts. Production contracts specify what inputs and management procedures farmers must use because these are the choices most likely to produce the refinery's desired quantity or quality. The refinery then purchases the crop after harvest, regardless of the final quality or quantity. This shifts all the crop yield and/or quality risk from the farmers to the refinery. Refineries are willing to accept this risk because they are typically owned as part of a well-diversified business and better positioned to manage the yield risk in highly uncertain environments. In addition to taking on the cost of the production risk, the refinery also pays higher costs for monitoring and auditing the performance contracts to verify that the farmers' adhere to contract requirements.

There are three situations when refineries may prefer production contracts to incentive contracts. First, if the factors outside of farmers' control are very volatile (unusual weather patterns, short corn crops, oil price spikes, etc.), it may be very expensive for refineries to use performance incentives, even for perennial crops. The more uncertain the weather or macroeconomic climate, the more difficult it will be for farmers to achieve high yields no matter what type of crop grown.

Second, it may be prohibitively expensive for refineries to incentivize both high quality and high quantities. The key issue is which type of risk is more expensive from the farmer's point of view. If yield variability is more difficult to manage than biomass quality, then yield risk is the more expensive risk, and refineries should use production contracting to control for yields. If farmers find it more expensive to manage biomass quality, then refineries should use production contracts to specify procedures to produce high quality output and rely on performance incentives to get high yields. Because refineries spend much more time monitoring and auditing farmers under production contracts than incentive contracts, it is usually best to restrict production contracts to target either high yields or high quality, not both simultaneously.

Third, incentive contracts can break down when the goal of high yields conflicts with the need for high quality. For example, switchgrass harvested in the fall has higher yields but also higher moisture levels and ash concentrations than switchgrass harvested in the spring (Adler et al., 2006). Wetter switchgrass is more expensive to transport and more likely to degrade in storage. Likewise, switchgrass with high ash content is more likely to increase slag and corrosion in the processing equipment. If there is no way to balance the incentives to reward both goals equally, the refinery can use a trigger or threshold on the bonus payment. For example, a refinery might offer a bonus for high yields that is paid only if the moisture and ash contents are under specific thresholds. Alternatively, the refinery can use a production contract and jointly manage along with the farmer to make sure both goals are met. Regardless of the style of contract used, both parties should agree on a measure of quality that can be verified by a third party. Otherwise, bad will and legal disputes can arise between farmers and refineries over disagreements about quality.

Managing Renegotiation

Counterparty risk, the risk that the other party in the contract will default on the agreement, is a serious concern for long-term biofuel contracts. Refineries worry that farmers will want to opt out of contracts when corn or soybean prices spike. Farmers worry that refineries will be bankrupted before the contract ends, especially if they are committed to growing a dedicated energy crop with few alternate buyers. It's always possible to renegotiate a contract before the agreement completely breaks down. Renegotiation is risky, however. There is no guarantee that a new agreement will be reached. Moreover, if both parties expect the contract to be renegotiated in times of trouble, then the credibility of the original contract is eroded and renegotiation becomes a self-fulfilling prophecy.

Building flexibility into the contract, such as indexing the contract price to market prices, can reduce the likelihood of renegotiation but not eliminate it completely. If index prices increase too much, refineries will be bankrupted paying for feedstock inputs. If index prices drop too much, farmers may not be able to cover their costs and declare bankruptcy. Adding a maximum price (ceiling) and minimum price (floor) for the index can help avoid these problems, but the ceiling and floor prices may also be subject to renegotiation in times of high price volatility.

Refineries and farmers can structure contracts to manage the renegotiation process, adding limitations on who can initiate renegotiation or how frequently renegotiation can occur (Crocker and Masten, 1991). Specifying liquidated damages[2] and building up a long-term history of cooperation also add incentive for both parties to successfully renegotiate rather than exit the contract. However, courts do not always enforce liquidated damages (Edlin and Schwartz, 2003), and the recent history of the U.S. financial crisis shows that even long-term relationships can collapse during times of financial stress. When prices are volatile, shorter-term contracts may be the only choice that both parties can agree on (Gary, 1978).

Conclusion

Long-term contracts are an essential tool for expanding biofuel production to meet government growth targets. Careful design of incentives can help ensure that these contracts are acceptable to farmers while still providing incentives to meet refineries yield and quality targets.

Avoiding renegotiation is challenging, particularly in times of volatile prices. Indexing contract prices to market prices, specifying liquidated damages, and establishing a history of cooperation can all reduce the likelihood of renegotiation, but never completely eliminate that possibility. Contracts that are designed to address these potential problem areas from day one are much more likely to stand the test of time and build a foundation of cooperation and trust between farmers and refineries.

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Endnotes

[1] See McLaughlin et al. (2006) for a discussion of corn vs. switchgrass yields, and simulations of switchgrass yield variability in the U.S. See Price at al. (2004) for estimates of miscanthus yield variability based on field plots in the Uk. See Heaton et al. (2008) for a comparison of switchgrass and miscanthus yields at field plots in Illinois.

[2] Liquidated (or liquidation) damages are penalties written into the contract that the refinery promises to pay the farmer (or vice versa) in case of breach of contract.

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