Renewable Identification Numbers

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Renewable Fuel Standard

• Mandates imposed on fuel blenders based on market share
• Hierarchy
  – Cellulosic can be applied to any sub-mandate
  – Biodiesel can be applied to all but cellulosic
  – Sugar-based ethanol can be applied to advanced or conventional
• EPA waivers
• Borrowing/Rollover
  – previous year shortfall can be met in following year
RINs – Market and Trading

• Tracking/accounting/enforcement system chosen by EPA
  – RIN is produced for every gallon/batch of biofuel produced/imported
  – Blenders must provide at least their mandated level of RINs each year
  – RINs can be separated and sold to others by the blender/importer (not by biofuel producers)

• Primarily OTC trades
  – RINXchange, began trading Jan 2008
RINs – Market and Trading

• Speculation
  – Must register with EPA to purchase

• Timing
  – RINs have vintages (current and previous)
  – Prior year (previous RINs) can be applied to up to 20% of current year’s mandate

• RIN types and equivalence values
  – Cellulosic, conventional, and biodiesel RINs
  – Hierarchy of values
RIN can be applied to mandate for $t-1$, $t$, or $t+1$. 

\[ \text{RIN}_t \]
RINs Modeling

- **Factors**
  - Blending margins
  - Transactions costs
  - Transportation costs
  - Expectations
  - Vintage
  - Type

![Diagram](image)
• BP ethanol analyst
  – Companies view RINs as a cost/compliance issue
  – Thinly traded, small market
  – Exxons and BPs are trading, little to no speculation
  – Most flow out of the midwest to coastal areas
  – Companies do not believe mandates are credible threats
  – More focus on continuing to lobby for waivers (cellulosic, biodiesel) than worrying about RINs
• CBOE ethanol market rep
  – Ethanol futures and swap markets growing, but RINs not big enough to consider for futures
  – RINs viewed as a cost, not an opportunity

• Ethanol producers
  – RINs are a nightmare
RINs Data

- Collected from Oil Price Information Service (OPIS) weekly reports
- RIN prices reported daily since April 2008
- Based on national survey of blenders and brokers
Conventional RINs ($/gal)
Biodiesel RINs ($/gal)
Cellulosic RINs ($/gal)
RINs – Option Pricing Model

- Blending margins
- Production margins
- Uncertainty
  - Policy, corn production, oil prices
  - Assumed to be captured by gas and ethanol futures and options markets
RINs - Option Pricing Model

- Monte Carlo simulation
  - Futures settlement prices
    - CME ethanol and RBOB Gasoline
    - Implied volatilities from ATM options
    - Lognormality
    - Historical correlation structure
      - 0.8 to 0.9 for gas/ethanol

\[ RIN_t = E_t \left[ \max \left( 0, (Ethanol_t - TC_t) - Gasoline_t \right) \right] \]
• What future time period(s) are relevant?
  – 6 months out

• Ethanol implied volatilities
  (1) Assume equal to gasoline
  (2) Use RINs to estimate
Simulated RINs

RINs Price ($/gal)

RINs- Actual
RINs - Simulated


$0.00  $0.05  $0.10  $0.15  $0.20  $0.25
Transportation Cost Model

- 140+ blenders/refiners
- 200+ ethanol producers
- Heterogeneity among refiners w.r.t. blending costs
  - Captured by transportation costs, distance matrix for all blenders, producers
- RINs relaxes physical blending constraint, reduces gallon-miles driven to transport ethanol from producers to blenders
Choose quantity $q$ of ethanol to buy from producer $i$

$$\sum_{i,j} (td_{i,j} - B)q_{i,j}$$

Subject to:

1. Blender mandates
   $$\sum_i q_{i,j} \geq M_j$$

2. Blend limits
   $$\sum_i q_{i,j} \leq L_j$$

3. Producer capacities
   $$\sum_j q_{i,j} \leq C_i$$
Blenders/Refiners w/RINs

- Choose quantity $q$ of ethanol to buy from producer $i$

$$\sum_{i,j} \left( td_{i,j} - B \right) q_{i,j} + pRIN_j$$

Subject to:

(1) Blender mandates
$$\sum_i q_{i,j} + pRIN_j \geq M_j$$

(2) Blend limits
$$\sum_i q_{i,j} \leq L_j$$

(3) Producer capacities
$$\sum_j q_{i,j} \leq C_i$$
Conclusions

• When mandate is not binding, RINs prices are driven by transportation costs, allow for physical blending to adjust across refiners
• When mandate is binding, RINs prices driven by blending margins/core values
• Need to figure out best way to incorporate dynamics and uncertainty