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RINs Market Frictions and the RFS Point of Obligation

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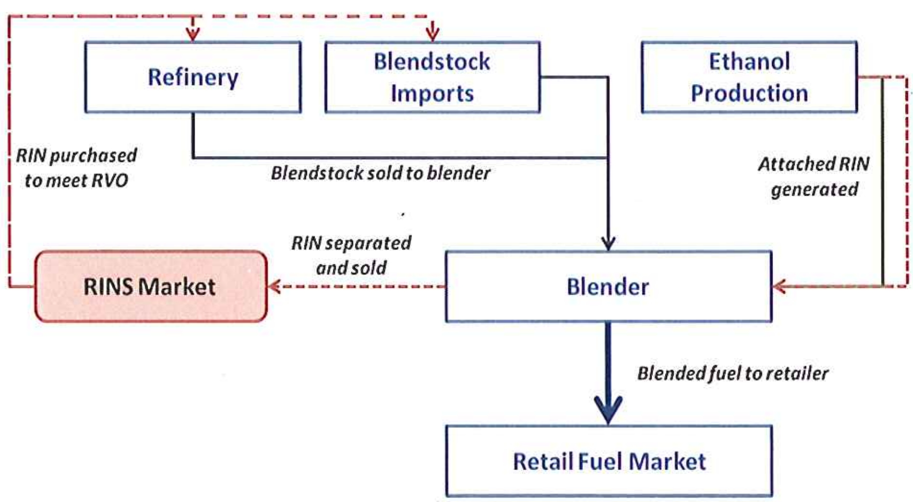
1. Introduction

The Renewable Fuel Standard ("RFS") program seeks to increase the use of renewable fuels in the United States. As currently constituted, the RFS program makes refiners and importers of gasoline and diesel fuels the "obligated parties" for meeting the Renewable Volume Obligation ("RVO"). The Environmental Protection Agency ("EPA"), which by statute operates the RFS, has recently created a public process to receive comments on EPA's proposed denial of petitions to open a rulemaking associated with a change in the RFS point of obligation.[1]

Figure 1 below provides a highly stylized representation of the current RFS structure, which operates through Renewable Identification Numbers ("RINs") which are generated with production of ethanol (and other covered program fuels, not shown on the diagram). These RINs are "attached" to the ethanol in this example, and the ethanol and RIN is sold together to a blender, who combines the ethanol with fuel blendstock purchased from refiners or importers.[2] The blended fuel can then be sold in the retail market. When the fuel is blended, the RIN can be "separated" and sold into the market for RINs. Refiners and importers, in turn, are forced to purchase these RINs to meet their RVO obligations under the RFS rules.

Figure 1: Stylized representation of the RINs market



1 United States Environmental Protection Agency, "Proposed Denial of Petitions for Rulemaking to Change the RFS Point of Obligation", EPA-420-D-16-004, November 2016. (hereafter the "EPA Proposed Denial")

2 In this paper we use the common term "blender" for the party who owns title to the hydrocarbon fuel immediately prior to its sale at the terminal (the "position holder"). This could be different than the party which physically blends ethanol to create finished fuel products for retail markets (e.g., the terminal operator).

The RIN mechanism is effectively a type of quantity-based tradable permit system which in effect subsidizes renewable fuel volumes in the fuel stream while penalizing the use of non-renewable fuel blendstocks. Peculiarly in this case, however, the permit obligation is not placed directly on the party selling the fuel at the rack (e.g. the blender), but rather on refiners and importers of gasoline and diesel blendstocks.

In this paper, we analyze the operation of the RINs markets from an economic perspective, focusing on the role of the over-the-counter ("OTC") RINs market in intermediating transactions between the sellers of RINs (blenders) and purchasers of RINs (refiners and importers). As we discuss in this paper, the characteristics of this RINs market is critical for assessing the efficiency of the RINs point of obligation and the RFS more broadly.

2. Why does the Point of Obligation matter?

In a highly competitive, frictionless market, the point of obligation would not matter. Blenders would strip the RIN and its value would be fully reflected in the price of blendstock fuels at the wholesale level, as the cost of the RIN is a marginal cost for all refiners and importers equally. Under these assumptions with perfect competition, there would also be no scope for RIN market prices to diverge from fundamental values, which would (at the margin) reflect the cost of substituting additional renewable fuels such as ethanol into the fuel supply at the level necessary to meet the mandated RVO.

With the assumption of a frictionless and perfectly competitive market, the theoretical result that the point of obligation does not matter is unsurprising. It is similar to the economic statement that tax incidence, or who bears a tax (in this case, the RIN obligation is similar to a tax), is independent of where the tax is levied by statute. A tax could be levied on producers or consumers, but absent market frictions the impact is the same.

With an imperfect intermediate market for RINs, this equivalence between having the point of obligation at the refiner/importer and the blender no longer holds. The efficiency of the broad RFS mechanism may be significantly impaired if the intermediate market for RINs is inefficient or not competitive. It is therefore important to consider the potential sources of frictions in the RINs markets and how they may impact the RFS program

3. Potential Sources of Frictions in the RINs markets

Broadly speaking, the sources of potential frictions in the RINs intermediate markets are similar to those that can exist in other commodity markets. These include:

- ***Transactional costs:*** RINs are generally not traded on exchanges but rather on an OTC basis, often through brokers and other intermediaries. There is little public information on the level and liquidity in RINs markets, but bid-ask spreads in such OTC markets are often high – a sign of significant transaction costs. As discussed in more detail below, the volatility in RINs prices is often very high – a potential sign of illiquid markets.

- ***Informational weaknesses:*** While the EPA, along with other private data providers such as OPIS, periodically publishes summary information on the RINs markets, it is noteworthy that the RINs markets and trader positions are often quite opaque. Unlike many commodities regulated by the Commodities and Futures Trading Commission ("CFTC"), there is no requirement to report and publish the commitments of traders. RINs trading is therefore subject to potentially significant asymmetric information which could be beneficial to a few large traders but could be damaging to market efficiency as a whole.

- ***Frictions in related physical markets:*** While the RINs market is a regulatory "paper" market, RINs prices are related to markets for physical products and transportation services where frictions may also exist. These could affect trading in RINs and speculative activities in RINs and related products (e.g. blendstocks). For example, access to geographic markets for final products through access to terminals in not assured, and could pose a barrier to entry in moving finished fuel products to retail markets, affecting the RINs market as well. Competition in retail markets for high ethanol fuels may also be limited, as EPA has concluded.[3]

- ***Scope for manipulation:*** The RINs market is not directly overseen by the CFTC. While CFTC and EPA have signed a Memorandum of Understanding to share information about the RINs market, the RINs market does not directly fall under the supervision of CFTC, despite its clear importance to consumers and the economy.[4] Since RINs are not exchange traded, the RINs market is also not subject to monitoring by exchange officials either. As we discuss below, the relatively inelastic supply of RINs due to the characteristics of the RFS program and supply conditions past the "blendwall" tends to make manipulation issues more serious.

While a source of market uncertainty rather than friction, strictly speaking, the nature of the RVO, which is always subject to regulatory change, adds to the problems in relying on RINs trading as the mechanism for implementing the RFS. As RINs are bankable over fairly long

3 See the discussion in Section 4.2 below.

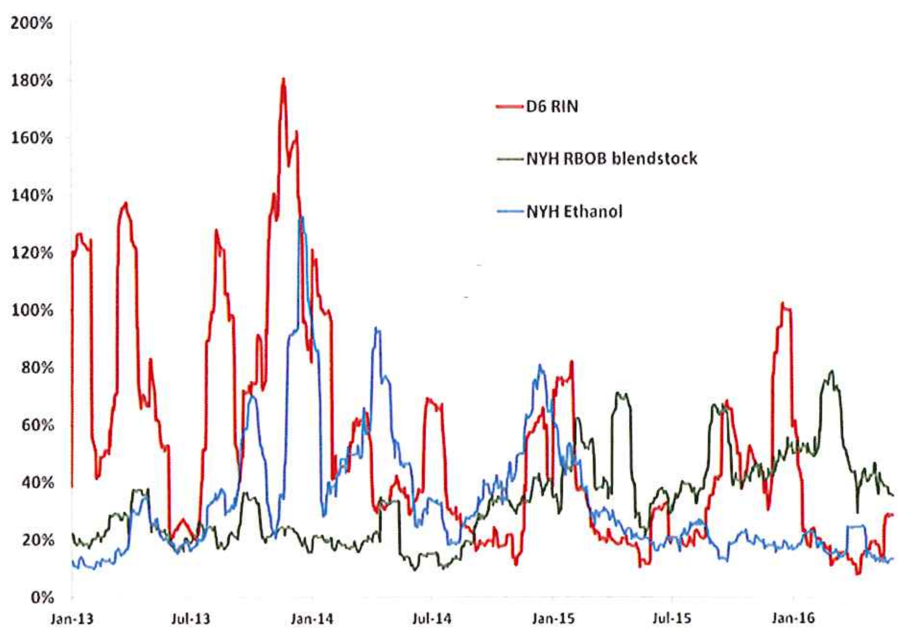
4 Memorandum of Understanding between the EPA and CFTC on Sharing of Information Available to EPA on the Related to the Functioning of Renewable Fuel and Related Markets, March 2016.

periods their future value depends critically on future regulatory policy, which is not easy to assess. Many of the recent swings in RINs values may be due to perceived future regulatory actions, for example.

3.1. RINs markets are highly volatile

It is not possible to evaluate RINs transactions costs and market depth directly, as even private data sources such as OPIS do not publish this data. However, an analysis of historical volatility of RINs prices, in comparison to other components of motor gasoline, demonstrates the relative thinness of these markets.

Figure 2: Historical volatility – D6 (ethanol) RINs and fuel feedstocks (annualized 20-day rolling average)



As shown in Figure 2, historical volatility in RINs prices in recent years has often been very high, well above RBOB and ethanol volatility in many periods. Given that RINs are a uniform national product and that EPA rules allow for some banking of RINs from year to year, this level of volatility does not appear consistent with a smoothly-functioning intermediate market for RINs.

3.2. Market structure and information asymmetries

Since RINs are a partially storable asset (through carryover and banking programs, for example), the levels of volatility shown in Figure 2 are extraordinary. These levels of volatility in a storable product market suggest price discovery in the RINs market is fairly weak, and that there may be significant informational asymmetries between market participants.

The RINs market is an OTC market, primarily intermediated by brokers. There is no direct exchange market for future or spot price discovery. A factor limiting liquidity is the fact that not all market participants are able to transact with each other, through lack of credit and other contractual agreements. A broker therefore might be able to match a potential offer to sell against only a subset of possible bids from possible buyers. We understand from interviews with RINs traders that liquidity is sometimes limited and that it is often not possible to obtain all needed RINs at a certain time. We also understand that that several RINs pricing fields are optional and that some parties provide no RINs price data. Price data integrity may also be an issue.

Another feature of the RINs market is the weak provision of public information on who owns RINs (e.g., who is long or short). This may make the market much more prone to volatility. The EPA maintains a database (called the EPA Moderated Transaction System ("EMTS")) which provides data on RIN generation, separation and annual sales and holdings.[5] While the EPA updates RIN generation and separation data monthly, the annual sales and holding reports only provide information through compliance year 2014. Adding to the opaqueness of the EPA provided data, the sales and holding report totals are aggregated into five categories, based on self-reported information by each individual company submitting a quarterly activity report. While individual parties may be registered and participate in several Business Activities categories under the RFS (including Refiner, Fuels Importer, Renewable Fuel Producer, RIN Owner Only, etc.), the report aggregation process may skew the category weighting of the sales and holding reports. The EPA report may thus reflect a relatively balanced level of sales activity or positions held, while masking the true position within a given aggregation.

RINs are also often traded forward using swap-type agreements and hence the historical data published on EMTS provides a limited view of actual RINs positioning. There is no obligation on parties that trade RINs to divulge their positions, which could be aggregated in a trader commitment report (as is common in many critical commodities subject to CFTC jurisdiction).

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5 https://www.epa.gov/renewable-fuel-standard-program/renewable-identification-number-rin-data-renewable-fuel-standard

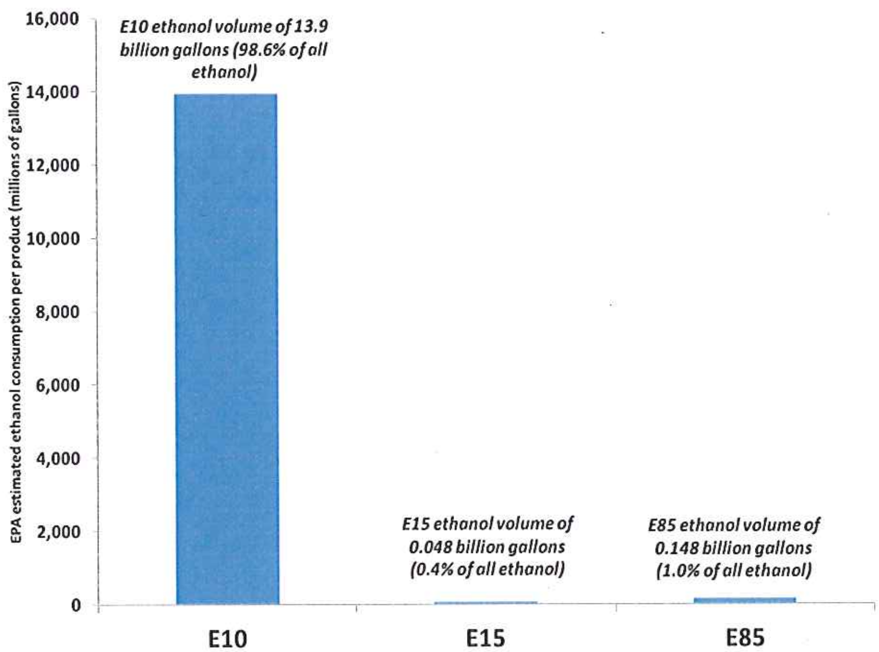
This lack of information and transparency is a key weakness of the current RINs market structure.

3.3. The differing scales of fuels markets impact the supply of RINs

The RINs mechanism was conceived as a means of increasing the penetration of renewable fuels, especially ethanol, into the national transportation fuel supply. A key assumption of the original program design is that the ethanol subsidy inherent in RINs prices (and the consequent relative downward shift in high ethanol motor fuel prices compared to low ethanol blends such as E10) would sharply increase the consumption of higher ethanol blends.[6]

These expectations have not been met. The vast majority of motor gasoline is E10. As the RVO has moved beyond the "blendwall" this has created the need for additional RINs beyond the level that can be created from blending E10.

Figure 3: EPA estimates for 2016 ethanol consumption by product



At present, however, total consumption of higher blends (e.g. E15 and E85) is minimal. Even if the costs of shifting to greater use of E15 and E85 were very low, these markets are so small that a huge shift from E10 to E85 consumption, for example, would be needed to make much of an impact on the supply of RINs, as the E10 market is approximately 100 times larger.

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6 E10 contains approximately 10% ethanol by volume, while E15 contains approximately 15% ethanol. E85 refers to a wide range of possible blends up to 85% ethanol, but generally lower in ethanol content.

This size mismatch between the E10 and E15/E85 markets has important implications for the elasticity of supply of RINs. The elasticity of supply in simple terms is the percentage change in supply of a product (RINs in this case) for a given percentage change in the price of the product. Even for a large change in the price of E85 (downward in this case, due to the design of the RINs subsidy) would make a very small change in the percentage change in the supply of RINs, as the E85 market is so small compared to the E10 market and the RVO.

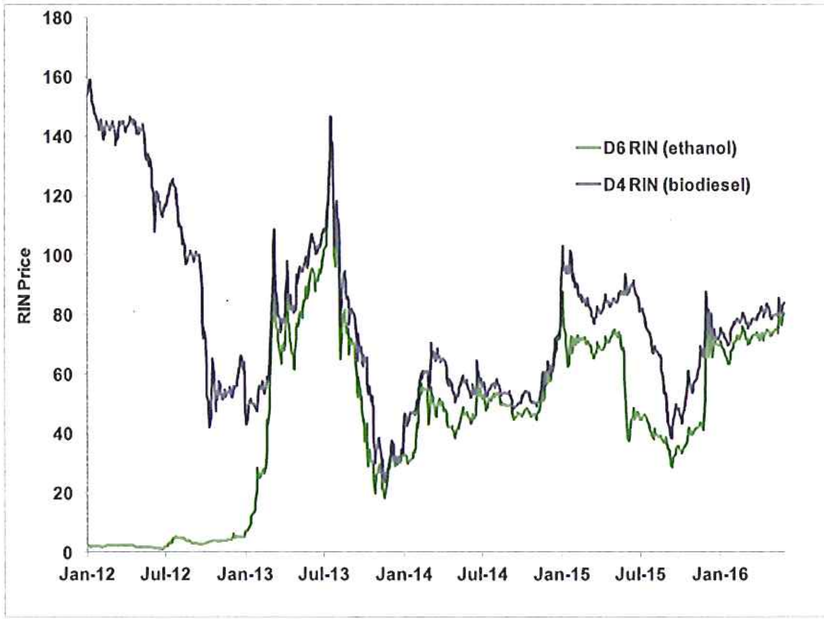
Some commentators on the RFS have suggested that at high enough RINs prices, economic pressures will force market participants to invest in infrastructure allowing for higher ethanol blends. Leaving aside the economic efficiency implications of such high RINs prices – and the impacts on consumers – the different scale of the E10 and E15/E85 markets outlined above shows that the supply of RINs from higher ethanol blending will likely remain highly inelastic for a long time, whatever the RINs price.

This analysis suggests that the elasticity of supply for RINs over the short- to medium-term is quite low. This in turn has implications for the importance of market frictions.

So ineffective has increasing ethanol penetration been that, beginning in 2013 when the E10 "blend wall" was reached, RINs from biodiesel production (D4 RINs) have been used at the margin to meet RVOs for ethanol (D6 RINs). This has led to D4 RINs and D6 RINs approaching price parity in some periods, as illustrated in Figure 4 below. This increases the supply elasticity of RINs, but at high cost compared with the pre-"blend wall" period. Burkholder reports that generation of D6 RINs for biodiesel and renewable diesel increased dramatically in 2013 over 2011-12 levels.[7]

7 D. Burkholder, "A Preliminary Assessment of RIN Market Dynamics, RIN Prices and Their Effects", Office of Transportation and Air Quality, U.S> EPA, May 14, 2015.

Figure 4: D4 (biodiesel) and D6 (ethanol) RINs prices



3.4. Low supply elasticity for RINs may increase market frictions

All markets in practice have some level of frictions. The significance of these frictions depends in part on the supply and demand conditions.

For example, consider the market for a product where consumers have a wide range of substitutes for meeting the same need. The product market may be quite inefficient, but the economic implications for consumers are relatively small. With many possible substitutes, the elasticity of demand is high, and so if prices are suddenly high then consumers can easily change their consumption. If demand is inelastic, consumers will face large price increases, which can occur for example when consumption is a necessity or required by law.

The same basic logic applies with the supply of a product. If the elasticity of supply is relatively high, a small increase in prices serves to bring large new supplies of the product to the market. This in turn tends to dampen price increases faced by consumers. If the elasticity of supply is low, then prices can rise substantially before significant new supply is available. This tends to increase price increases created by market frictions for example.

With respect to RINs, elasticity on the supply and demand side is low. On the supply side, markets for high ethanol fuels (e.g. E15 and E85) and biodiesel are quite small in relation to the E10 market and the RVO. So even under optimistic assumptions about the costs of bringing on new high ethanol fuel and biodiesel production, the supply of RINs will be quite inelastic. On the demand side, elasticity is low by design of the RFS program. Refiners and fuel importers have a legal obligation to meet the RVO in order to sell motor fuel blendstocks, so obtaining RINs is not optional.

3.5. Market frictions can raise the scope for RINs market manipulation

The RINs system, like other tradable permit systems, is potentially subject to manipulation.[8] With respect to a relatively thin and illiquid market like RINs, informational failures (e.g. many market participants may have trouble assessing the supply and demand of RINs at various points due to lack of complete information) could help increase volatility and market risks. Such weaknesses could also make withholding of RINs from the market, and other potentially manipulative strategies, more profitable.

The conditions of the RINs market, with relatively low overall supply and demand elasticity due to the structure of the renewable fuels markets and the RVO obligations, will tend to make manipulation more profitable and hence more likely. If supply and demand are sufficiently inelastic, a market participant holding even a relatively small share of available RINs may be able to profitably withhold some of them from the market to increase the price it receives for those it sells. It is possible that such strategies could also be combined with forwards positions in RINs, blendstocks or blended motor fuels markets. To our knowledge EPA has not historically engaged in active surveillance of the RINs market, and no commodity exchange has a full surveillance role either.

4. The RINs market structure and investment incentives

A primary policy objective of the RFS is to increase the penetration of renewable fuels in the U.S. fuel supply. As such, an important aspect of the RFS program is the need to stimulate investment in renewable fuel infrastructure (at the wholesale and retail levels) needed to bring these products to market.

The RFS as currently structured relies on price differences to stimulate investment in and consumption of renewable fuels. In theory, the value of the RINs separated in effect provides a discount on the final cost of higher renewable content fuels (e.g. biodiesel blends and high ethanol content blends such as E85 and E15) relative to lower renewable content fuels. This should in theory drive consumers to demand E85 and other renewable fuels, and drive the investment needed by blenders and retailers to make this possible.

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8 By market manipulation in this context we refer to the potential for manipulation of the intermediate market for RINs. There is a substantial literature on market power and manipulation issues in tradable permit markets. See for example W. Misiolek and H. Elder, "Exclusionary Manipulation of Markets for Pollution Rights", *Journal of Environmental Economics and Management*, p. 156-166 (1989). There have also been issues associated with sales of fraudulent RINs, which is a separate compliance matter.

In practice, this economic approach appears to be only partially successful. As discussed in Section 3.3 above, biodiesel consumption has increased, although we understand that that biodiesel blending infrastructure is still limited in some regions of the United States, and that high biodiesel blends such as B99 attract much larger margins that low biodiesel blends such as B5.

E85 availability and consumption remain limited. In the remainder of this section we examine the incentives for making the investments needed to increase E85 acceptance and availability across the country, consistent with the RFS policy objective.

4.1. E85 retail availability remains low

Only a relatively small number of stations sell E85 into the much larger gasoline market. EPA reports that at the end of 2015 approximately 3100 stations sold E85.[9] This represents only approximately 2% of all US retail gasoline outlets.[10] Given the scale of the gasoline market (currently dominated by E10) relative to other markets such as diesel, a key question related to the future success of the RFS is why retail availability of E85 is low, and that based on the limited information available, the full discount attributable to RIN value does not appear in E85 prices, which is necessary to affect customer fuel purchasing decisions.

4.1.1. Branded retailers sell E85 less frequently

As EPA has noted, branded retail fuel stations (stations affiliated with a refiner) are much less likely to sell E85 than independent stations. For example, of the 3100 stations selling E85, only 24% were branded, despite the fact that 50% of all retail fuel stations are branded.[11]

The EPA Proposed Denial recognizes these facts but EPA draws the cursory conclusion that moving the point of obligation would not increase E85 availability. EPA argues that the parties with the current point of obligation (e.g. refiners) offer less E85 through their affiliated stations than other, independent stations. Therefore under EPA's logic, moving the point of obligation towards the retail level (e.g. to blenders, and away from refiners) would not improve E85 availability.

A more complete analysis should consider the incentives and contractual relationships between vertically-integrated refiners and their brand-affiliated retailers. Several key aspects of these relationships are discussed below.

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9 EPA Proposed Denial at p. 35.

10 *Ibid*, p. 29.

11 EPA Proposed Denial at p. 35.

4.1.2. Branded stations are restricted by contractual terms

Branded stations are typically not free to determine what fuels they sell, but operate under contracts that may last for 10 years or more.[12] These contracts may contain numerous restrictions on retailers that could affect their ability to offer E85:

- ***Purchasing restrictions:*** Branded retailers generally must purchase fuel from a branded supplier or distributor. If the refiner's affiliated fuel distributor or supplier in the region does not offer E85 the retailer may have no way to offer such a product.
- ***Pricing and markup restrictions:*** Pricing of branded fuels is often tied to price indices plus a markup. NACS states that some retailer contracts also stipulate the retail markup to be charged by the retailer through consignment agreements. This could limit the ability of branded retailers to offer larger discounts on E85.
- ***Other contractual terms potentially affecting E85 sales:*** The Renewable Fuels Association ("RFA") has analyzed various contracts between the refiners and retailers and claims that various other common contractual provisions can limit E85 sales.[13] These provisions, RFA claims, include sales volume requirements for fuels (which could reduce the incentives for retailers to sell high ethanol blend fuels), and requirements to offer a variety of grades of gasoline (which could limit the scope for retailers to offer E85 or E15 if they only have two tanks on the premises).

4.1.3. Many large refiners may have weak incentives to expand E85 availability

Although refiners directly own a small proportion of retail stations, they may substantial control over fuel offerings and pricing through their retailer contracts. It is therefore critical to understand the incentives of refiners to understand why so few branded stations offer E85.

According to RFA, approximately 58% of branded stations are affiliated with the largest groups. The three largest brands account for over 40% of all branded retail stations.[14] Each of these refiners appears to be in a "Long RIN" position – that is they sell more branded gasoline than they refine.[15] Under the current RFS structure, they therefore have no incentive for RIN prices to go down, as they create more RINs than they need for their own refinery quantities. This may act as an economic disincentive for these large integrated refiners to sell

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12 NACS, "How Branded Stations Operate", Available from http://www.nacsonline.com/YourBusiness /FuelsReports/2015/RetailOperations/Pages/How-Branded-Stations-Operate.aspx

13 Renewable Fuels Association, "Protecting the Monopoly: How Big Oil Covertly Blocks the Sale of Renewable Fuels", July 2014.

14 RFA, 2014.

15 Lundberg Survey, Inc. *The Lundberg Letter*, "Refiners Branded Supply Liabilities 2015", August 18, 2015.

additional E85 or other higher ethanol blends, as doing so could put negative pressure on RIN prices.

Vertically-integrated refiners (who sell much of their refinery output through their own jobbers and distributors) may also have an incentive for higher RIN prices due to increased margins at the blender level. Analysis by CRA for three U.S. regional markets (New York, Chicago and Houston) where data was available suggests that in some cases blender margins increase with RINs prices.[16] While increasing E85 sales, as EPA suggests, could create profits from RIN sales, it also could affect the RIN price received across the whole of net RIN sales by the integrated refiner. Given the current small magnitude of E85 sales, the profits from larger E85 sales may be partially offset by lower RINs prices associated with larger volume E10 sales.

4.2. E85 retail pricing does not support efficient customer switching

The EPA has stated that while it believes that E85 pricing at the wholesale level is unproblematic, the lack of competition among E85 retail stations limited the ability of RIN prices to effectively impact retail E85 prices paid by consumers.[17] This could undermine the basic structure of the RFS, since the sole incentive to use more ethanol (and other renewable fuels) is the price discount on E85 (and other high ethanol blends) being present at the pump, where the final customer makes his or her purchasing decision.

4.2.1. Improved E85 consumption can shift RIN prices and reduce customer costs

EPA quotes analysis of retail E85 prices in Iowa to suggest that competition among E85 retailers is ineffective in ensuring that the full value of the RIN credit is passed to final consumers.[18]

This also appears broadly consistent with the results of Knittel, Meiselman and Stock ("KMS"), which concluded that the pass-through of RIN prices to the E85-E10 spread is zero, and hence that high RIN prices did not translate into discounted prices for E85.[19]

4.2.2. Improved E85 consumption can shift RIN prices and reduce customer costs

Over the long-term, customers will bear all costs from the RFS policy. In the short-run, currently obligated parties may suffer a loss if the RINs market does work well, but over time

16 Charles River Associates, "Evaluating the Response of Blender Margins to RIN Price Changes, February 2017.

17 EPA Proposed Denial at page 30.

18 *Ibid.*, page 32.

19 Christopher R. Knittel, Ben S. Meiselman and James H. Stock, "The Pass-Through of RIN Prices to Wholesale and Retail Fuels under the Renewable Fuel Standard", NBER Working paper No. 21343. July 2015.

customers will pay. It is therefore imperative that the RINs subsidy mechanism be as efficient as possible.

EPA argues that even if substantially more E85 can be sold, this will have a minimal impact on RINs prices.[20] For example, EPA argues that doubling sales of E85 to 300 million gallons would only increase supply by 110 million RINs per year. These, they argue would make no impact on the price of RINs as this represents a small portion of the RINs demand.

EPA is correct that doubling E85 use (which it should be remembered, is doubling from a very small number) will not push the market back under the "blendwall", and hence RIN prices are unlikely to collapse to the very low levels seen before the blendwall target was reached. However, pricing in a competitive market is at the margin, and if increased RINs supply allows the marginal RIN to be supplied at much lower cost (through E85 sales) then the impact on RINs prices could be substantial for a given RVO. Prices do not need to collapse for the consumer cost savings to be considerable, especially since gasoline makes up the majority of final fuel sales.

4.3. The current RFS does not adequately support investment

The current RFS appears to produce high RIN prices but does not seem to be successful in stimulating demand for high ethanol fuels such as E85 through the price differentials the RINs mechanism was designed to produce. To this extent, the current RFS structure is a failure.

Given the inability to stimulate sufficient E85 consumer demand at present, it is unsurprising that investment has not been forthcoming. As Magellan Midstream Partners ("Magellan") has indicated in its comments to EPA, owners and operators of renewable fuel infrastructure will make investments in these assets when their customers will make commitments that underwrite the capital investments.[21] Magellan, which is a service provider only in the fuels business, notes that a RIN-long party may have little inclination to make commitments for new renewable infrastructure. On the other hand, a RIN-short party might be incentivized to do so. This could include non-integrated refiners and importers.

From the perspective of the RIN-short parties such as refiners, however, the commitment may be practically impossible as the non-integrated refiner cannot ensure that increased volumes of high ethanol fuels are able to reach retail markets effectively. Nor do existing non-integrated refiners automatically have the ability to vertically-integrate into downstream rack and retail markets. This could require, for example, access to pipeline capacity that would

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20 EPA Proposed Denial at pages 33-34.

21 Magellan Midstream Partners, L.P. Letter from Bruce W. Heine to EPA with comments in Docket EPA_HQ-OAR-2016-004, July 11, 2016.

allow them to sell additional blendstock volumes into distant retail markets. Pipeline capacity is often constrained (especially on major pipelines such as Colonial which carry refined products from the Gulf Coast to markets in the Northeast) and existing shippers may not be able to access more capacity directly to move more blendstock.[22] Even if such capacity was available, this could at most improve the wholesale availability of E85 and other biofuel blends, and would not affect retail availability of these products.

5. Changing the Point of Obligation can reduce market frictions

As noted in Section 2 previously, the current RINs mechanism within the RFS program requires a well-functioning intermediate market for RINs. As RINs are separated by blenders but must be purchased, under the current structure, by refiners and importers who are often not vertically-integrated with the blending function, the entire RIN scheme depends critically on the efficient functioning of this intermediate market.

As we have discussed previously, however, the RINs market in practice appears to have shortcomings. It is highly volatile, showing substantially more volatility in many periods than the related RBOB and ethanol markets. Transaction costs are likely to be high, and the regulatory oversight appears very limited. Finally, we noted that the low effective elasticity of supply and demand of RINs (past the blendwall) increases the importance of market frictions and would tend the market more subject to manipulation. A fundamental re-think is needed.

5.1. An alternative RINs market structure

Figure 5 below illustrates an alternative, simpler RINs market structure, which places less stringent requirements on efficient intermediation. Under this structure, the RINs point of obligation is shifted to the blender/last holder of title, who blends feedstock and ethanol to make finished motor fuel. To the extent that the blender mixes ethanol and blendstock in the proportions needed to meet its RVO, it is in effect independent of the RINs market, as it has satisfied its regulatory requirement to use ethanol.

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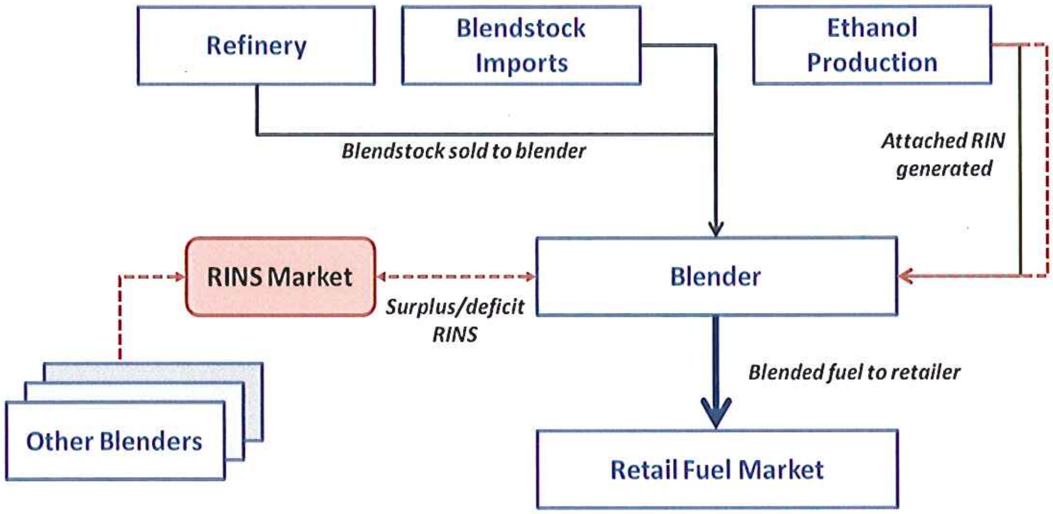
22 See for example the Colonial Pipeline Company tariffs and supporting shipper manual available at http://www.colpipe.com/home/customers/shipper-manual-tariffs.

Figure 5: RINs market structure with blender Point of Obligation



Of course, it is not efficient to require each and every blender to meet its RVO exactly. Some blenders may be closer to sources of lower-cost ethanol, for example, and they might naturally seek to blend ethanol in a higher proportion. In this case, such a blender could separate (and hence make tradable) surplus RINs, which could be sold in the market to blenders in net RINs deficit.

5.2. Advantages of this new RINs market structure

We believe that this simpler new market structure, which places less emphasis on market-based intermediation in the RINs market, has substantial advantages in terms of reducing existing and potential market frictions. These are discussed in the following subsections.

5.2.1. Less need for intermediate transactions

The existing RINs market structure, as was illustrated in Figure 1, depends critical on a well-functioning RINs intermediate market. As noted in this paper, certain features of the RINs market and the RFS more generally may lead to market frictions could prevent this intermediate RINs market from operating efficiently. Since it is unlikely that the RINs market can be perfectly competitive and efficient in all conditions, it is preferable that its impact is limited.

The alternative RINs market structure illustrated in Figure 5 helps address this issue. Most RIN-type transactions within this structure occur within the blender organization, and not through external market transactions. This approach will help shift the RFS towards its stated purpose, a mechanism to encourage increased penetration for renewable fuels, and away from a complex trading mechanism.

5.2.2. Less scope for market power and manipulation

As discussed in Section 3.5 above, the current RINs market structure may be vulnerable to market power abuse through withholding of RINs in the market by blenders, or through other forms of manipulation. Under the existing market structure, non-integrated refiners face substantial risks if RINs prices can be increased for some period – they are naturally short and are obligated to purchase RINs by law.

EPA has argued that the current obligation point gives incentives for the currently obligated parties (refiners and importers) to provide oversight of the RIN generation by renewable fuel producers, to ensure that the RINs purchased are valid. This is referred to as the "buyer beware" aspect of the RFS program.[23] RINs purchasers can try and check the validity of the RINs they individually purchase, but they cannot police the market as a whole.

Refiners and importers cannot adequately oversee the RINs market itself and the formation of prices in that intermediate market, there is simply not enough information and transparency to do so. This is the role of an agency or monitoring group with the ability to collect private information on the positions and behavior of individual RINs market participants. Refiners and importers clearly cannot fulfill that role.

The alternative structure illustrated in Figure 4 may help ameliorate this problem. Under this alternative structure, blenders have the obligation to use renewable fuels (e.g. ethanol) or purchase RINs from other blenders, but they also help control the supply of RINs through their production decisions. They therefore cannot be held hostage to the blending, separation and RINs marketing decisions of others, as blenders themselves control all of those functions.

5.2.3. Lower compliance and transactions costs

Along with the lower demand for intermediate RINs transactions discussed in Section 4.2.1, will come lower market transactions costs for both refiners and blenders. RINs transactions will be limited to blender-to-blender transactions at a much lower volume, from those with excess RINs (from blending more than the mandate to those that have blended less. Other industry participants (such as refiners) will not be relevant.

The EPA has argued that an advantage of the current structure (with the point of obligation on refiners and importers) is that are fewer of them, in comparison to blenders.[24] This they

23 EPA Proposed Denial at 23.

24 EPA Proposed Denial at 22-23.

argue lowers EPA's compliance burden (through requiring reporting to EPA from a smaller number of obligated parties).

This position would appear to misunderstand the nature of the compliance issues facing the EPA program. Under the current structure or the alternative structure proposed in Figure 3 the producers of renewable fuel (e.g. ethanol) must still be involved as they are creating the underlying RIN. There is also a compliance burden associated with ensuring that blenders have actually blended the amounts of renewable fuels into their final products in allowing the RIN to be separated and sold. This too is a constant across the two alternatives, and blenders must already register and interact with EPA processes in this regard.

The existing structure adds another layer of compliance issues on to EPA's compliance processes, by making involving the refiners and importers to perform the final reporting. While perhaps these entities may be used as aggregators of data provided to EPA, they cannot provide the actual compliance function of monitoring the production and blending of renewable fuels into the final fuel fix for the obvious reason that they are not involved unless they are vertically-integrated. EPA's argument that the current point of obligation minimizes the costs of compliance therefore ignores that most of the RINs market is outside of the refiners/importers direct knowledge or control. A reasonable compliance strategy for RFS volumes would focus on where renewable fuels are actually used – at the blender and terminal level. Such a change in focus will greatly simplify the administration of the program.

With fewer RIN transactions going through the RINs market in the proposed alternative structure, market costs such as broker fees and bid/ask spreads can also be greatly minimized. EPA does not appear to have considered these costs in its analysis.

5.2.4. Shifting the point of obligation could increase penetration of renewable fuels

The stated primary policy objective of the RFS program is to increase energy security and reduce emission by requiring increasing percentages of the nation's transportation fuels be made from renewable fuels.[25]

As illustrated in Figure 3, the share of higher ethanol fuels such as E15 and E85 in the US fuel supply is currently small. Many observers have agreed that a primary limitation of increasing the penetration of ethanol and other renewable fuels is the need for greater distribution and customer acceptance of high ethanol blends. To do so will require investments and promotional activities beyond the simple price signals in retail fuel costs created by RINs, which in effect raise the cost of lower ethanol fuels in relation to higher ethanol fuels.

25 EPA Proposed Denial, p. 6.

If raising the sale of high ethanol fuels is a key policy goal, and if investment (in physical distribution equipment such as tanks and pumps as well as consumer education campaigns) is needed, what parties are best placed to make this happen? Logically, it would appear that retailers and distributors of fuel would be closest to the problem, and could more directly help resolve through investment in their own stations and those of their customers. Refiners and importers, which can be far from the final retail customer for the most part, would appear to be especially poorly suited to this task. The current price incentives, although these have increased with RIN prices, do not appear to be sufficient. Shifting the point of obligation closer to the customer, where the decision is made, may help.

5.3. Conclusions

The design of the RFS was predicated on a highly efficient RINs market not subject to substantial frictions and inefficiencies. In this were true, the EPA's hypothesis could be correct that the point of obligation does not matter for the efficiency of the RFS program. If, however, the RINs market is subject to various substantial frictions, this hypothesis does not hold. In this case, the point of obligation does matter.

In this paper, we have shown that the RINs market appears to be subject to various sorts of frictions which could make intermediation between sellers of RINs (e.g., blenders) and buyers of RINs (refiners and importers) inefficient. Underlying these issues is the basic structure of the fuels markets. The market for E10 is so much larger than the market for E15 and E85 that supply of RINs through higher blending will not create substantial supply elasticity in RINs. These low supply elasticity conditions will tend to magnify and imperfections in the RINs markets.

While all intermediate markets, such as those for RINs, are subject to various frictions, these frictions in this context could be minimized through a simpler structure which moved the point of obligation to the blender or last holder of title to the fuel. In this case, many fewer RINs would need to be traded, and most RINs transactions could be within the same firm. Such a change might also limit the scope and impact of market power in RINs markets. This design change is consistent with the design of most regulatory tradable permit systems and is unlikely to create substantially higher compliance costs than the existing structure.

Disclaimer

The study was commissioned by Valero. The research, analysis, results and conclusions were all developed independently by the authors. The conclusions set forth herein are based on independent research and publicly available material.

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Evaluating the Response of Blender Margins to RIN Price Changes:

A More Direct Approach to Determining Pass-Through

February 2017

SUMMARY

INTRODUCTION

Discussion about the ideal point of obligation for compliance with the Renewable Fuels Standard ("RFS") has included debate over whether importers and refiners (currently the "obligated parties") are able to "pass through" their compliance costs in wholesale fuel prices. The EPA has claimed that if full pass-through exists, there is no burden on currently obligated parties beyond administrative costs and the expected demand reduction from displacement in the market by renewable fuels.

The limited existing literature on the pass-through of RIN costs has focused on the spread between obligated and non-obligated wholesale fuel prices. In this paper, we present a more direct way to evaluate pass-through. This approach analyses whether the margins of blenders – the parties that separate and sell RINS – increase as RIN prices increase. We statistically tested whether blender margins moved with changes in RIN prices from 2013 through mid-2016 in three key U.S. regional fuels markets.

BACKGROUND

In its proposed denial of a shift in the RFS point of obligation, the EPA relied on a limited set of studies to conclude that currently obligated parties are recouping their full RIN costs through increased wholesale fuel prices.[1] The EPA has frequently cited a study by Knittel, Meiselman, and Stock (referred to here as "KMS") which found evidence of full pass-through of RIN prices to

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1 EPA, "Proposed Denial of Petitions for Rulemaking to Change the RFS Point of Obligation," November 2016.

the wholesale prices of RFS-obligated fuels.[2] CRA has reviewed these findings in a recent study that replicated and extended the KMS analysis, finding signs of incomplete pass-through, especially in later periods.

According to the EPA, the billions of dollars in RIN costs paid by refiners and other current obligated parties do not create added profit to blenders because the RIN values are immediately charged back to blenders in the prices of wholesale fuels. Therefore, if the RFS system is working as intended, blenders would not see their margins change as RIN prices change, because all changes would be reflected in the prices they pay the refiners for wholesale fuels.[3] In formal terms, there would be no statistical relationship between RIN prices and blender margins.

This is an empirically testable hypothesis with available data. A finding of positive relationship between the RINS price and blender margin would indicate that blenders are capturing a portion of the increasing RIN value. Such RIN value capture could lead to windfall profits, which the EPA has noted would be a concern, but which it has not directly studied to date.[4] Substantial RIN value capture by blenders could also lead to competitive advantages for integrated refiners over merchant refiners, causing distortions in the refining industry and overall fuels markets.

Model Formulation and Data

We define blender margins as simply the difference between blenders' direct revenues and costs, as illustrated in Figure 1 below. Blenders' revenues are driven by the sale of the finished blended fuel products, such as E10 gasoline, and by the payments they receive for RINs. Blenders costs include the petroleum feedstock cost, the cost of ethanol, and any blending and terminal fees.

Figure 1: Blender Margin Calculation

Blender Margin					
E10			RBOB price *.9		
	E10 price at rack		+ ethanol price * .1		
	+ RIN value * .1		+ fees		
	Total Revenues	*less*	**Total Costs**	=	**E10 blender margin**

2 Knittel, Meiselman, and Stock, "The Pass-Through of RIN Prices to Wholesale and Retail Fuels under the Renewable Fuels Standard," Working Paper, July 2015.

3 It is also possible that blenders "pass-through" RIN values elsewhere on the supply chain, such as in reducing E10 prices. This would also be captured in this analysis, but not distinguished from pass-through to refiners.

4 The EPA simply cited anecdotal evidence from blender company executives as evidence that windfall profits have not occurred.

Blender revenues on a per E10 gallon basis include the E10 sales price and the value of the 1/10th of a RIN that the blender separates for each E10 gallon. Blender costs include the blending components (0.9 gallons of petroleum blendstock and 0.1 gallons of ethanol) and fees. The RIN value is the ethanol RIN (D6) value, which matches the E10 final product.

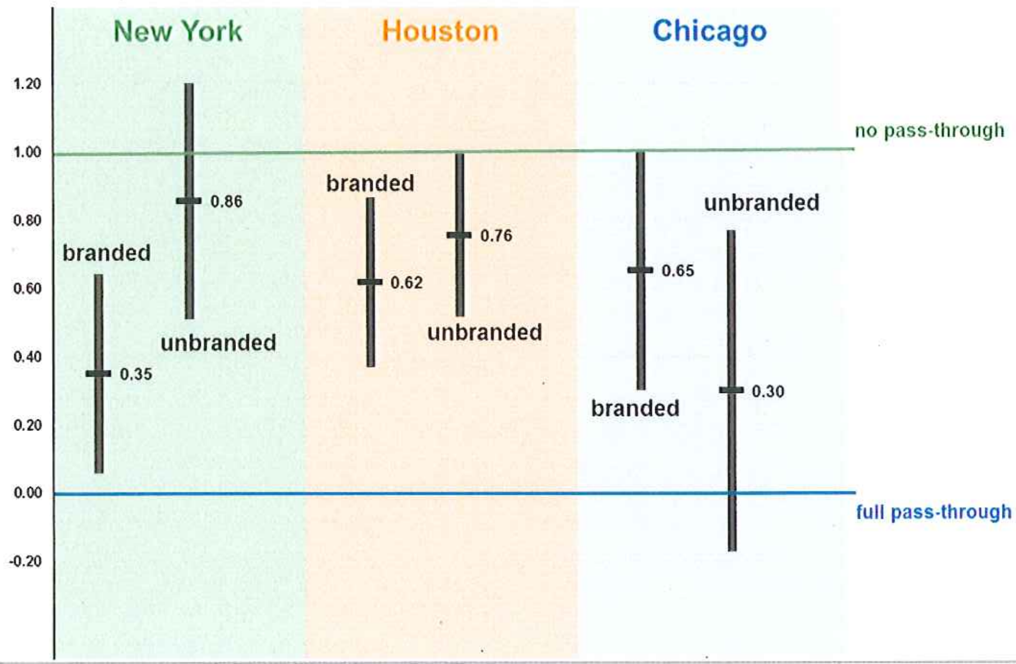
We analyzed data from January 2013 through the end of May 2016. We focused our research on three key geographic markets where blendstock prices and blended product prices were available in the same location. These markets were New York, Gulf Coast (Houston), and Chicago. All three of these terminal regions sell gasoline products in areas requiring reformulated gasoline, and thus we assumed RBOB as the petroleum fuel blendstock. We also evaluated both branded and unbranded blended products. Data was obtained from OPIS.

The analysis involved regressions with RIN prices as the independent variable and blender margins as the dependent variable. Seasonal adjustments to prices were made using the two methods in the original KMS paper. Full pass-through would be represented by a regression coefficient of 0, indicating blenders did not capture higher RIN prices in margins. Conversely, no pass-through of RINs values would be indicated by a correlation of 1.

Key Findings

Our analysis shows blender margins do change with RIN prices. In only one of the six geographic market/branding pairs (Chicago, unbranded) was there sign of possible full pass-through of RIN values (and hence blender capture is at or near zero). In all other market/branding pairs, the blenders held a portion of RIN value significantly greater than 0. The following chart shows the amount that the blender margin moved on average per change in RIN price. A value of 0 would represent full pass-through. This analysis suggests that, on average, blenders over this period in these three markets captured about 50% of RIN price increases.

Figure 2: Change in Blender Margin per Change in RIN price



Bars show blender margin response coefficient, +/- one standard error

DETAILED FINDINGS AND DISCUSSION

For the purposes of this brief paper, we assume familiarity with the terminology and concepts used in the KMS working papers.

COMPONENTS OF BLENDER MARGINS

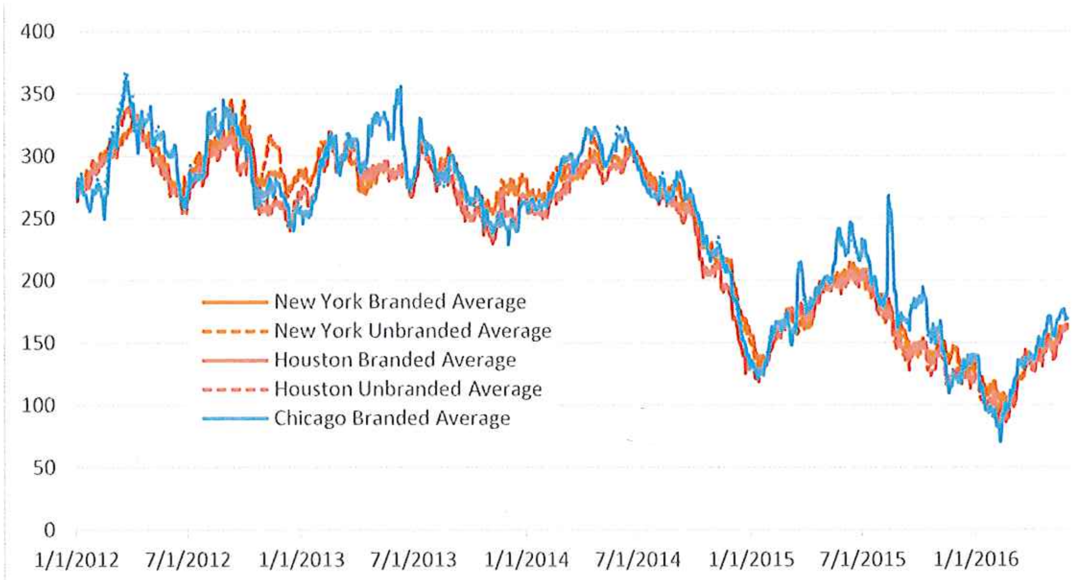
In this study, we evaluate the changes of blender margins in response to changes in RIN value. In this section of the paper, we describe the components of calculated blender margins, following the equation in Figure 1. We also provide a review of historical prices for each of the components of the blender margin equation.

Blender Revenues

The blender earns two sources of revenues: selling finished fuel and selling the separated RINs. In this study, we focused on the sale of E10, which is by far by the most common ethanol blend. We calculated margins for blenders of both branded and unbranded E10 fuels at the rack, for each of the three geographic markets. Because blenders of E10 generate D6 RINs, we used prices for these RINs to represent the RIN revenues.

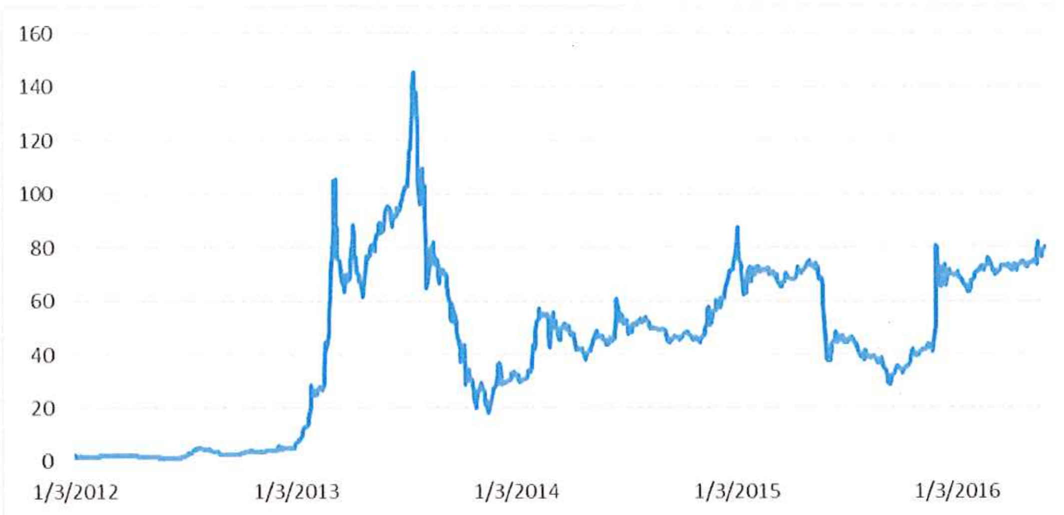
There are multiple E10 prices listed for each day at each terminal. They are listed by octane rating (unleaded regular, mid and premium), by branding (branded and unbranded), and by company. We calculated daily unweighted average prices for branded and unbranded unleaded regular E10, as shown in the chart below. While the prices in each of the markets tend to move together, there are short departures at times. This is most clear for Chicago, which moved independently during specific refinery issues and during movements from winter-blend to summer-blend fuels.

Figure 3: E10 prices (cents per gallon)



The other revenue component is the RIN value. As mentioned previously, the RIN value used in this study is the D6 price multiplied by the share of E10 represented by ethanol. It represents the revenue a blender can receive when it separates and then sells RINs in the market. The following chart shows RIN prices through the study period.

Figure 4: D6 RIN prices (cents per gallon)

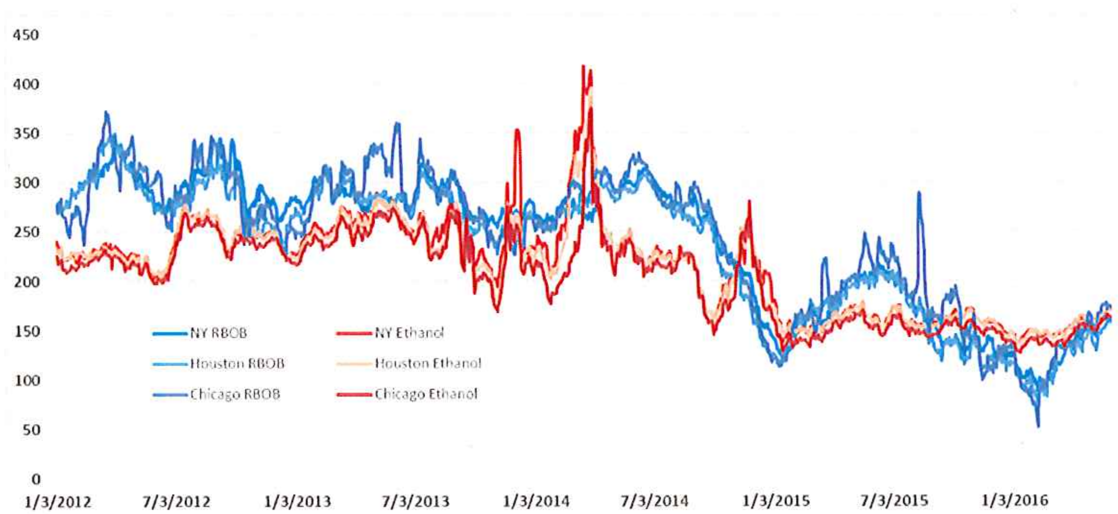


Blender Costs

Blender costs also differed by geographic market. The three components of blender costs were the RBOB price, the ethanol price and terminal and other fees. Each of the selected geographic markets require reformulated gasoline so RBOB is the appropriate local blendstock.

The following chart shows RBOB and ethanol prices for the study period. There is a long-term downward trend of both components. In addition, each product shows significant volatility for short periods of time.

Figure 5: Blendstock and Ethanol prices, Jan 2012 to May 2016 (cents per gallon)



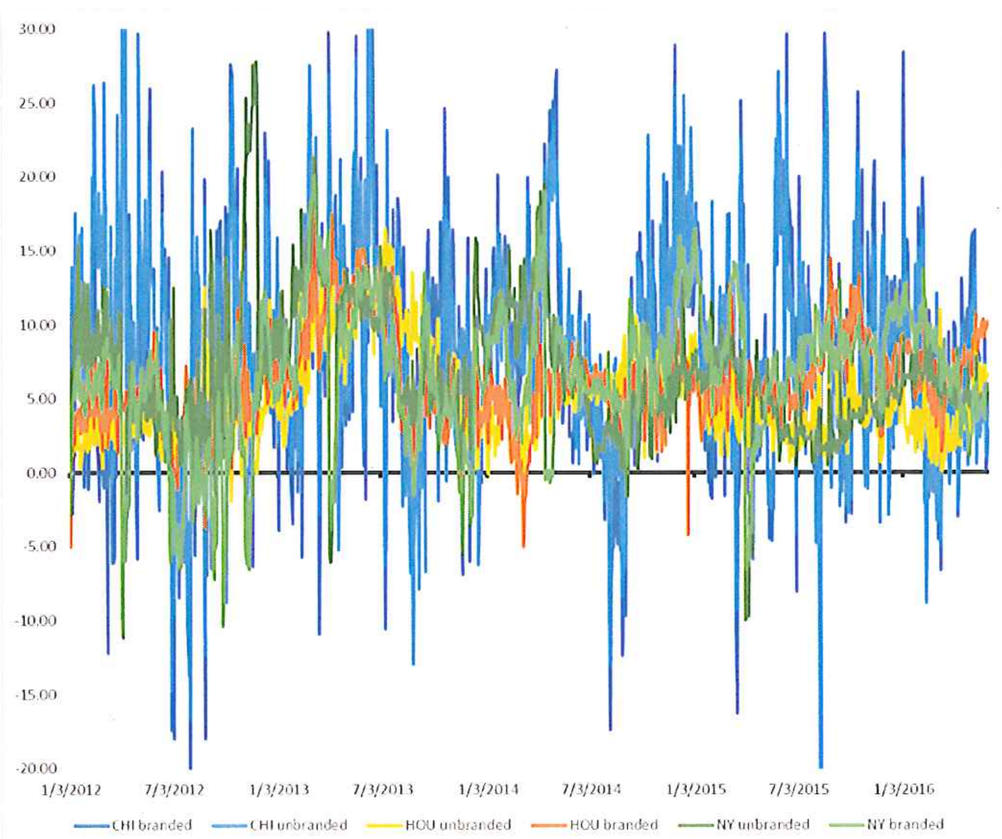
Terminal fees were obtained from OPIS. While they differ by market, they do not constitute a large share of the final product price and they do not fluctuate signfiicantly over time.

Review of Historical Blender Margins

In a perfectly competitive market, any exceptionally high blender margins would be reduced over the long-term (assuming competitive entry) to a level just adequate to compensate blenders for their costs of operations and a return commensurate with the cost of obtaining capital in the industry. We do not form an opinion on what that appropriate level of blender margin should be, but only examine the relationship between blender margins and RIN values.

The following chart shows daily historical blender margins (unweighted by volumes) in the three examined markets during the study period. These margins include the RIN value. Chicago blender margins are more volatile than the other two markets, which is driven by the structure of the market for E10 using reformulated blendstock in that region.

Figure 6: Blender margins (cents per gallon)



The following table shows the average blender margins by year in each of the examined markets.

Table 1: Average annual blender margins (cents per gallon)

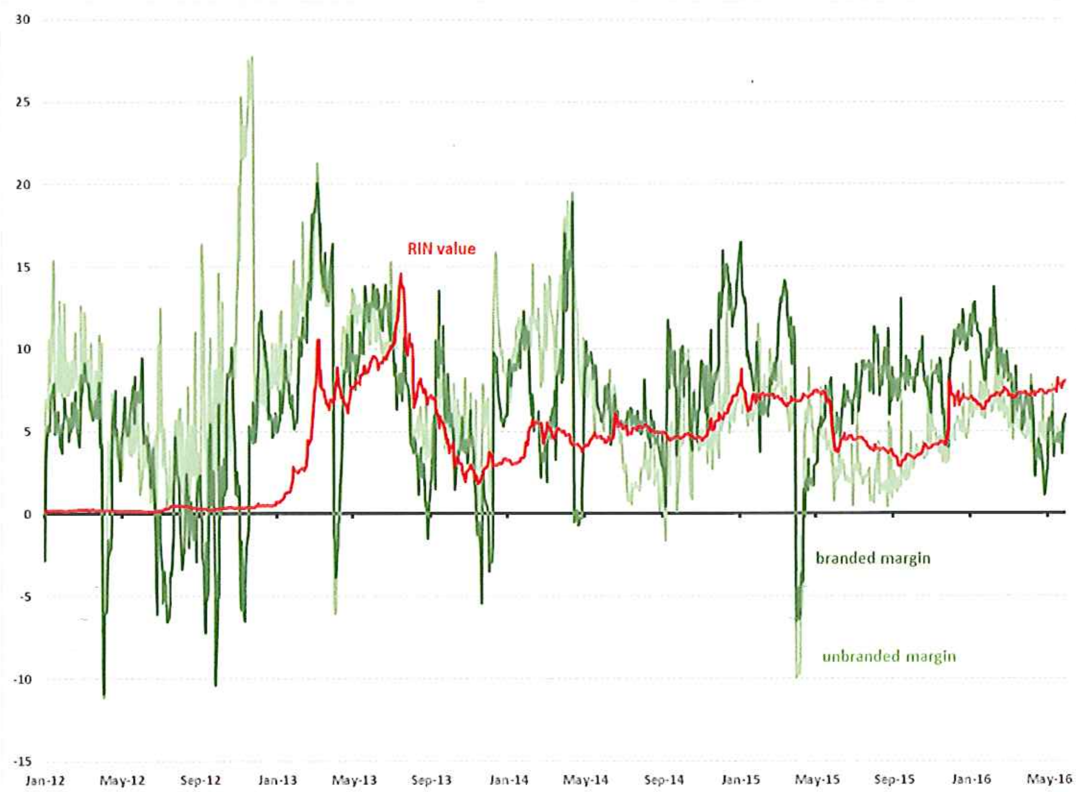
	New York		Houston		Chicago	
	branded	unbranded	Branded	unbranded	branded	unbranded
2012	2.9	6.8	4.4	3.5	6.7	8.9
2013	7.5	8.9	8.2	8.6	9.2	8.7
2014	7.5	7.1	5.1	5.1	8.9	9.0
2015	7.8	4.2	6.9	4.4	7.6	7.3
2016	7.2	5.8	7.1	3.7	6.8	5.4
all years	6.5	5.8	7.1	3.7	6.8	5.4

RIN Values vs. Blender Margins

The charts in this section illustrate how blender margins changed over time, in relation to changes in RIN prices. The hypothesis of full pass-through would suggest that the blender margins are independent of RIN prices (the dark red line).

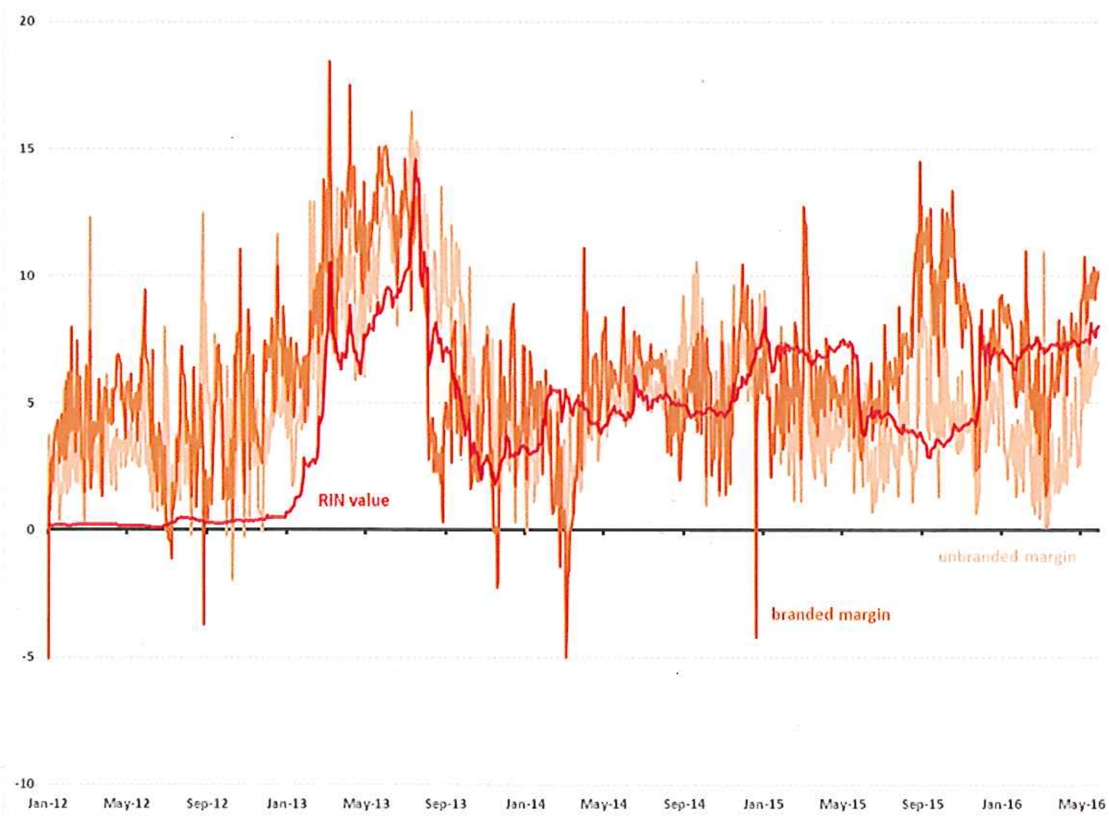
For New York, the branded and unbranded margins appear to move together, with a few periods of separation. The only period of frequent negative blender margins were in 2012, the period with lowest RIN values.

Figure 7: Blender Margins vs. RIN value, New York (cents per gallon)



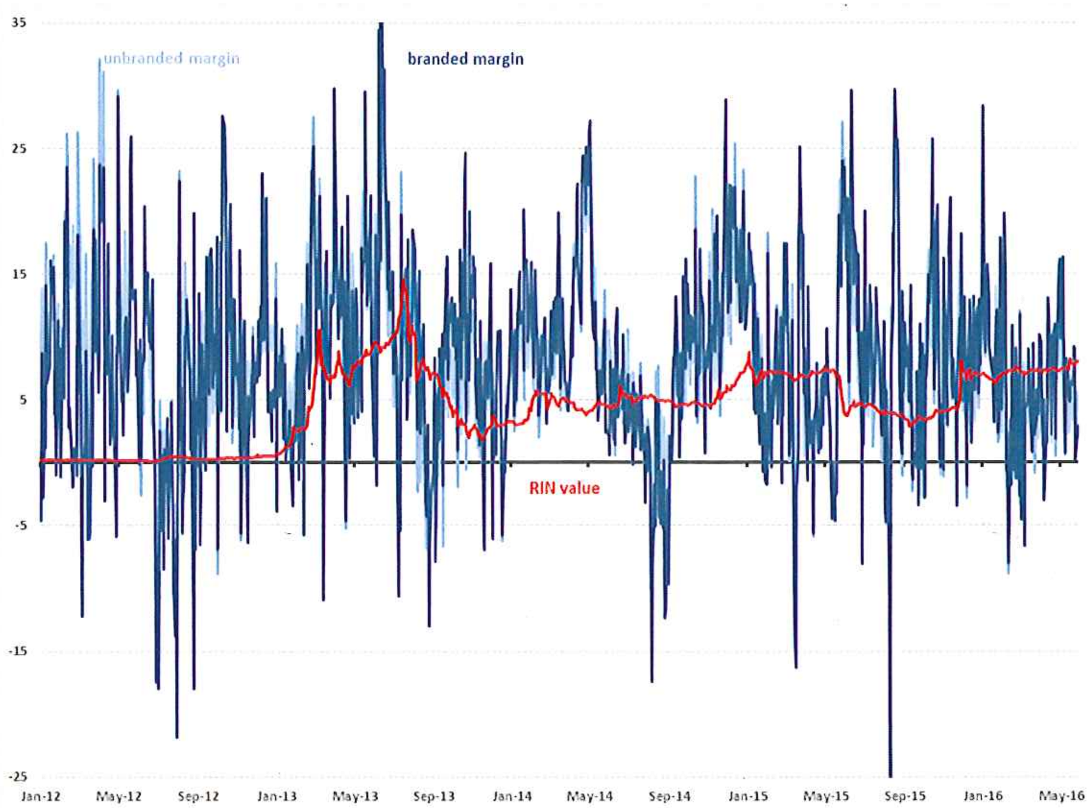
The Houston market displays more consistent blender margins than in New York and Chicago. Note that the axis is on a tighter scale than the charts for the other two markets. There also appears to be less volatility and fewer periods of negative margins, particularly in the first year of the study period when RIN prices were much lower. The branded and unbranded margins appear to have diverged more since mid-2015.

Figure 8: Blender Margins vs. RIN value, Houston (cents per gallon)



The Chicago market displays signficantly greater volatility in blender margins than New York and Houston. The scale on the chart is wider than the other charts, and in two cases the margins extend well beyond the scale. The majority of the large swings in margins match large movements in refined product prices, which have been attributed to supply constraints such as refinery outages. There is not a large difference between branded and unbranded margins.

Figure 9: Blender Margins vs. RIN value, Chicago (cents per gallon)



Statistical Review of Blender Margin Response to RIN Price Changes

To analyze the impact of RIN values on blender margins, we performed a series of levels regressions and structural vector autoregressions (SVARs) for each market. To adjust for seasonality, we performed the same two seasonal adjustment methods in accordance with the most recent KMS study.

Levels Regressions Results

For the first set of regressions, we used the RIN value as the independent variable and the blender margin, including RIN, as the dependent variable, subject to different seasonal adjustments. The test is to see whether the estimated coefficient is equal to zero, which would be the expected result if full pass-through is occuring. The results of this analysis are presented in the table below. The most relevant data to consider are the coefficients for model specification (5), as they are post-seasonal adjustment. For those unfamiliar, the asterisks indicate significance from a coefficient of zero, which suggests significance. For example, the model specification (5) value for Houston Unbranded fuels of 0.76 is different from 0.0 (full pass-through) with 99% certainty.

Table 2: Regression Results for RIN price vs. Blender Margins (including RIN value)

	New York		Houston		Chicago	
Regression coefficients (SEs):	**Branded**	**Unbranded**	**Branded**	**Unbranded**	**Branded**	**Unbranded**
(1) OLS, full sample, seasonals	0.47 ** (0.196)	0.26 (0.307)	0.60 *** (0.183)	0.81 *** (0.196)	0.38 (0.313)	0.22 (0.289)
(2) Dynamic OLS, full sample, seasonals	0.50 ** (0.206)	0.24 (0.323)	0.59 *** (0.176)	0.83 *** (0.206)	0.39 (0.333)	0.21 (0.297)
(3) OLS, full sample, augmented seasonals	0.44 ** (0.202)	0.22 (0.305)	0.60 *** (0.191)	0.82 *** (0.198)	0.40 (0.312)	0.22 (0.293)
(4) OLS, full sample, no seasonals	0.36 * (0.215)	0.33 (0.252)	0.60 *** (0.208)	0.71 *** (0.216)	0.27 (0.285)	0.24 (0.261)
(5) OLS, full sample, seasonally-adjusted data	0.35 (0.292)	0.86 ** (0.346)	0.62 ** (0.248)	0.76 *** (0.239)	0.65 * (0.353)	0.30 (0.470)
Test statistics (no seasonals)	2.65	3.01	1.55	3.49	1.65	2.02
F on seasonals (p-value)	(0.007)	(0.002)	(0.137)	(0.001)	(0.106)	(0.042)
DF-GLS, dependent variable	(5.295) ***	(3.426) ***	(3.427) ***	(2.555) **	(5.781) ***	(4.014) ***
ADF, dependent variable	(5.741) ***	(4.739) ***	(3.619) ***	(2.985) **	(7.288) ***	(7.015) ***
Engle-Granger cointegration	(5.884) ***	(4.846) ***	(3.761) **	(3.407) **	(7.281) ***	(6.888) ***

*Note: In specification (5), we adjusted seasonality for blender margins but not RIN prices using data from January 1, 2012 to January 1, 2013, then ran the OLS regression. This serves as a secondary approach to adjust for seasonality. Tests/coefficients are significant at the *10% **5% ***1% significance level.*

Structural VAR Results

The structural vector autoregression ("SVAR") analysis estimates the dynamic short-term response of blender margins to changes in RIN obligation prices. It shows the lagged response, which was used by KMS to show the pass-through up to the first 15 days after the RIN price change. We use it in the same way here.

The tables on the following pages show the results of the SVAR analyses for each of the three pricing locations. The tables show the coefficients for the first 15 business days after a RIN price change, reflecting the cumulative impulse response functions (IRFs) for both branded and unbranded fuels. The charts display the IRFs as green lines, with the surrounding grey areas denoting +/- one standard error in each direction.

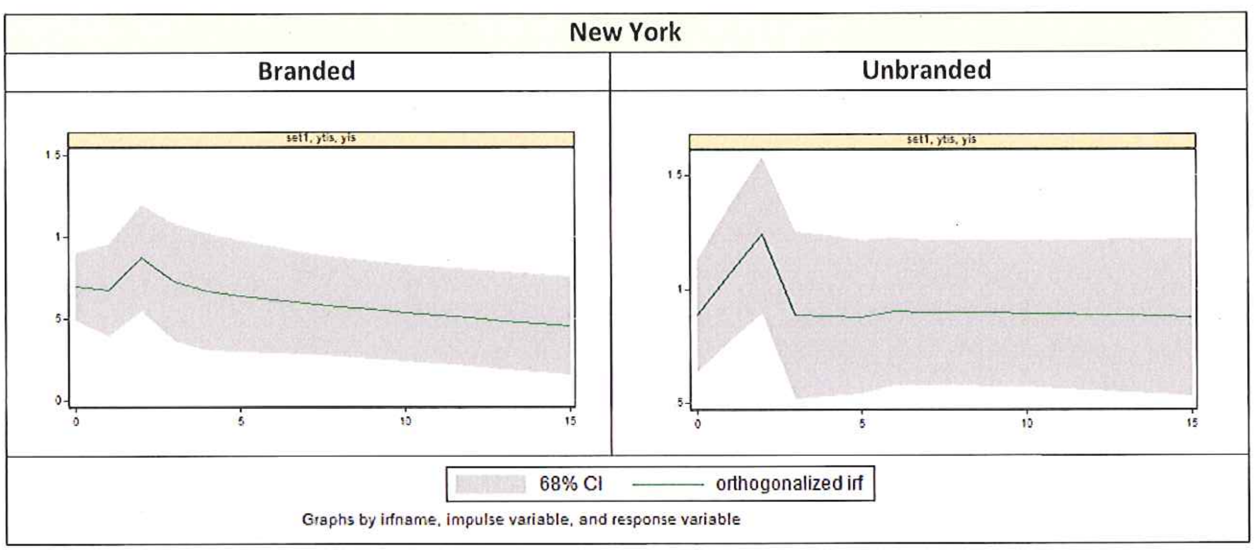
In general, these results confirm the findings of the levels regressions. Unbranded blenders have a similar degree of dynamic pass-through in the first 15 business days to branded blenders, but the former shows slightly more volatility. Only the Chicago blender margins appear to exhibit any indication of possibly having full pass-through at any point during the 15 days.

New York SVAR Results

Table 3: New York SVAR Results Table

	New York					
Lag	Branded			Unbranded		
0	0.700	***	*(0.209)*	0.886	***	*(0.246)*
1	0.676	**	*(0.278)*	1.075	***	*(0.300)*
2	0.874	***	*(0.324)*	1.241	***	*(0.342)*
3	0.728	**	*(0.357)*	0.890	**	*(0.367)*
4	0.670	*	*(0.358)*	0.885	**	*(0.352)*
5	0.639	*	*(0.341)*	0.879	***	*(0.337)*
6	0.616	*	*(0.323)*	0.904	***	*(0.323)*
7	0.596	*	*(0.311)*	0.899	***	*(0.320)*
8	0.576	*	*(0.302)*	0.899	***	*(0.319)*
9	0.557	*	*(0.297)*	0.896	***	*(0.320)*
10	0.539	*	*(0.294)*	0.895	***	*(0.322)*
11	0.522	*	*(0.294)*	0.892	***	*(0.326)*
12	0.506	*	*(0.294)*	0.889	***	*(0.330)*
13	0.490	*	*(0.296)*	0.886	***	*(0.336)*
14	0.475		*(0.298)*	0.882	***	*(0.341)*
15	**0.461**		***(0.301)***	**0.877**	**	***(0.347)***

Figure 10: New York SVAR Charts

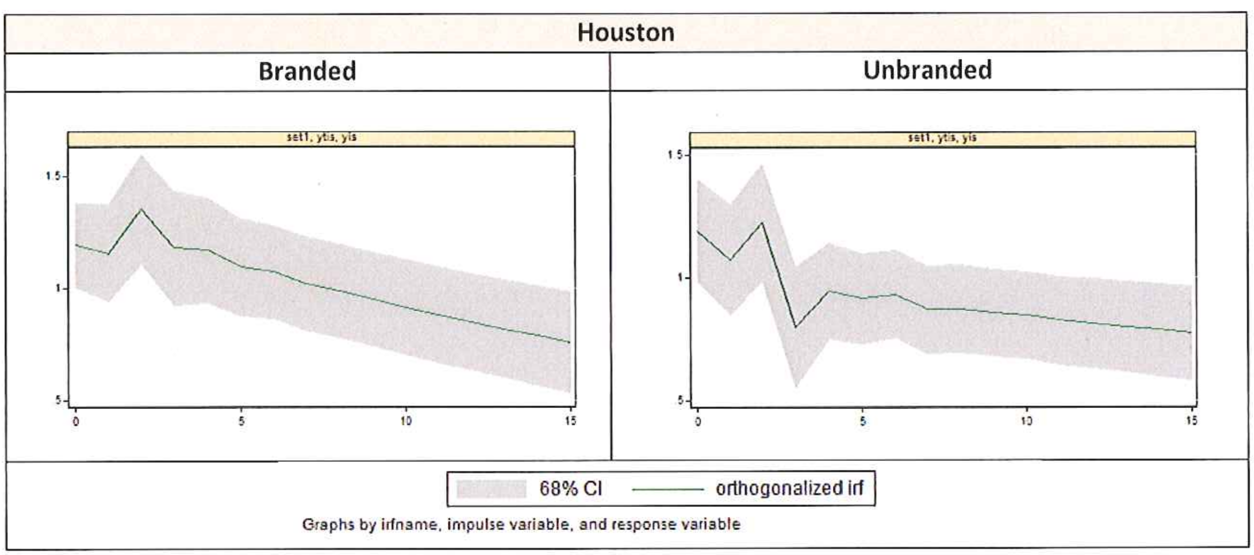


Houston SVAR Results

Table 4: Houston SVAR Results Table

	Houston					
	Branded			Unbranded		
Lag	w/ RIN			w/ RIN		
0	1.193	***	*(0.190)*	1.193	***	*(0.210)*
1	1.158	***	*(0.221)*	1.074	***	*(0.225)*
2	1.352	***	*(0.245)*	1.225	***	*(0.239)*
3	1.180	***	*(0.257)*	0.799	***	*(0.244)*
4	1.169	***	*(0.233)*	0.948	***	*(0.196)*
5	1.095	***	*(0.220)*	0.916	***	*(0.183)*
6	1.073	***	*(0.209)*	0.934	***	*(0.177)*
7	1.024	***	*(0.210)*	0.871	***	*(0.181)*
8	0.990	***	*(0.209)*	0.876	***	*(0.177)*
9	0.950	***	*(0.210)*	0.859	***	*(0.177)*
10	0.917	***	*(0.211)*	0.849	***	*(0.178)*
11	0.882	***	*(0.213)*	0.828	***	*(0.180)*
12	0.851	***	*(0.216)*	0.816	***	*(0.182)*
13	0.819	***	*(0.219)*	0.802	***	*(0.185)*
14	0.790	***	*(0.223)*	0.789	***	*(0.188)*
15	0.761	***	*(0.226)*	0.775	***	*(0.191)*

Figure 11: Houston SVAR Charts

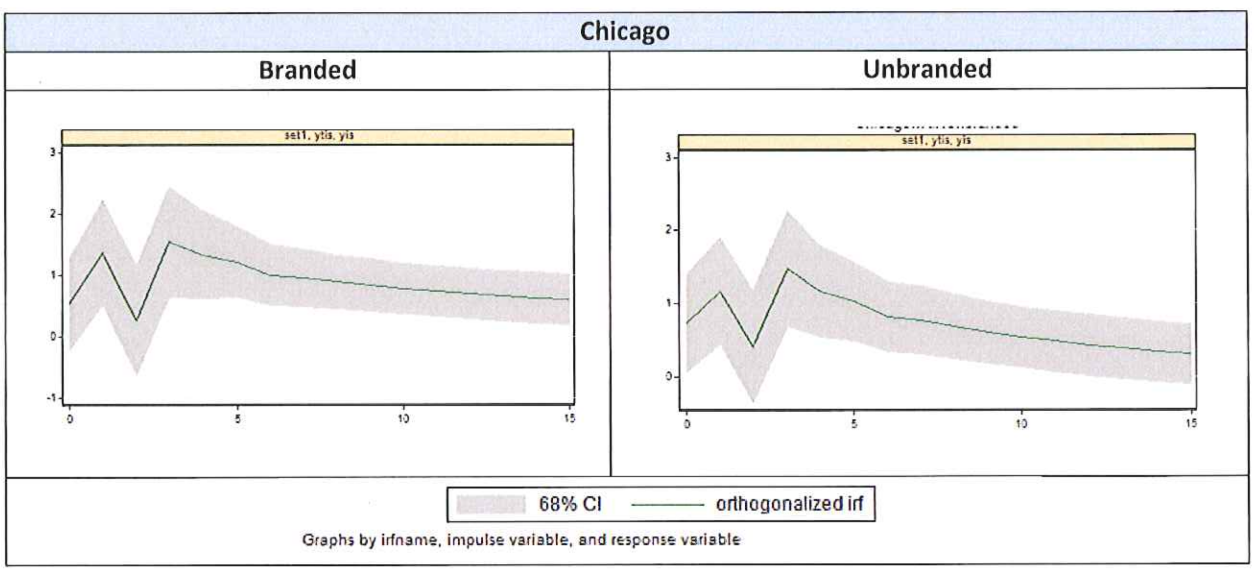


Chicago SVAR Results

Table 5: Chicago SVAR Results Table

	Chicago					
	Branded			Unbranded		
Lag	w/ RIN			w/ RIN		
0	0.547		(0.761)	0.738		(0.674)
1	1.377		(0.851)	1.168		(0.739)
2	0.273		(0.900)	0.404		(0.785)
3	1.544	*	(0.906)	1.481	*	(0.794)
4	1.338	*	(0.721)	1.169	*	(0.630)
5	1.224	**	(0.586)	1.032	*	(0.543)
6	1.011	**	(0.503)	0.820	*	(0.487)
7	0.965	**	(0.470)	0.776	*	(0.468)
8	0.901	**	(0.444)	0.685		(0.445)
9	0.842	**	(0.427)	0.610		(0.430)
10	0.786	*	(0.419)	0.537		(0.421)
11	0.742	*	(0.415)	0.481		(0.418)
12	0.703	*	(0.414)	0.429		(0.417)
13	0.669		(0.415)	0.383		(0.417)
14	0.639		(0.415)	0.343		(0.418)
15	0.612		(0.415)	0.307		(0.419)

Figure 12: Chicago SVAR Charts



Discussion of Statistical Results

Four of the evaluated market and branding pairs indicate that increasing RIN values are retained at the blender level with some level of significance. For example, blenders in the Houston unbranded market appear to collect 76% of the RIN value (greater than 0 at the 1% significance level, as indicated by the three asterisks to the right of the estimated coefficient). The New York branded and Chicago unbranded coefficients are also greater than 0, although at a lower level of significance due to high standard errors. These results were further confirmed by the SVAR test results that also indicate incomplete pass-through.

These statistical results, which are based on direct price changes rather than indirect price spreads, are in stark constrast to the KMS study, indicating a potentially much weaker pass-through of RIN prices into whoelsale fuel (e.g. RBOB) prices. These results therefore do not support EPA's policy conclusions with respect to the operations of the RINs market, the lack of harm to existing obligated parties, and the effectiveness of the RFS.

Disclaimer

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Review of Updated Pass-Through Analysis of Knittel, Meiselman and Stock

February 2017

Summary

In a July 2015 working paper, Knittel, Meiselman and Stock (2015) (hereafter "KMS1") analyzed the extent to which RIN prices were passed through to the wholesale prices of RFS-obligated fuels from January 1, 2013 through March 10, 2015.[1] In that paper, the authors claimed to have found evidence of full pass-through of RIN prices. Charles River Associates ("CRA") reviewed these findings in a recent study that replicated and extended the KMS1 analysis through May 31, 2016, finding signs of incomplete pass-through.[2] Among our findings were that the more recent period (after the KMS1 sample) showed a breakdown in the relationships found by KMS1 and that some of the assumptions for the authors' empirical methods, such as pooling fuel spreads data to estimate a unified pass-through, were not clearly justified for their data set.

The KMS authors recently released a follow-on study (referred to here as "KMS2") that modifies their original analysis in KMS1 and extends it through November 14, 2016. In addition to expanding the study period, the new paper also departs from the original one in several significant ways. First, the authors removed two of the six KMS1 fuel spreads due to a period of confounding results, as well as a reconsideration of including spreads between dissimilar fuels. Second, they added an additional fuel spread, New York Harbor CBOB – Rotterdam EBOB. Third, they introduced a new way to seasonally adjust the data, in response to the concern of the out-of-sample period being significantly shorter.

In KMS2, the authors again claim evidence of full pass-through of RIN obligation value to wholesale prices of RFS-obligated fuels.[3] Specifically, they found that the pass-through indicated

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1 Knittel, Meiselman, and Stock, "The Pass-Through of RIN Prices to Wholesale and Retail Fuels under the Renewable Fuels Standard," Working Paper, July 2015.

2 Charles River Associates, "Re-examining the Pass-through of RIN Prices to the Prices of Obligated Fuels," October 2016.

3 Knittel, Meiselman, and Stock, "The Pass-Through of RIN Prices to Wholesale and Retail Fuels under the Renewable Fuels Standard: Analysis of Post-March 2015 Data," Working Paper, November 2016.

in KMS1 held across the full KMS2 sample period for the four original refined product spreads and the newly added refined product spread. Through the new seasonal adjustments and pooling, they estimate a pass-through of 1.12 (standard error of 0.09).

CRA has reviewed the KMS2 methodology, results, and discussion. We find that multiple methodological decisions made by the authors contributed non-trivially to the finding of full pass-through.

- Dropping the two Brent crude-based spreads appears ad hoc and causes for greater concern about omitted variable bias.
- Adding the NYH CBOB – Rotterdam EBOB price spread has the effect of placing inordinate weight on a single fuel price location and pair.
- The pooling approach does not pass a statistical test of appropriateness in some specifications.

In addition to these concerns about the KMS2 methodology, we also find that the results provided in the paper could be interpreted as casting doubt on a consistent full pass-through of RIN value over time. They clearly show that pass-through can change over time, which is a significant finding for obligated parties exposed to fluctuating impacts on their margins.

Given these concerns and the indirect nature of this approach in general, we do not recommend sole reliance on the KMS findings of complete pass-through of RIN value to wholesale prices of RFS-obligated fuels. Rather, we also look to other approaches, such as evaluating blender margins in response to changes in RIN obligation prices.

Detailed Discussion

The findings are not indicative of consistent pass-through over time.

A simple visual review of the RIN price and fuel spreads charts in KMS2 shows that the worst performing time period in terms of co-movements appears to be approximately March 2015 through February 2016. It is during this time period that the refined product to Brent crude prices spread showed negative correlation with RIN obligation prices. It is also a period in which nearly every fuel spread shows difficult-to-explain pass-through rates, even when combined with the seemingly more moderated period from March 2016 through November 2016.

For example, despite using historical seasonality in adjusting the KMS out-of-sample period variables, they showed pass-throughs ranging from 0.49 (Gulf diesel – Gulf jet fuel) up to 1.73 (NYH RBOB - Rotterdam EBOB). We have not seen any economic argument supporting findings of pass-through greater than 1.0, particularly in light of new research showing that blenders are holding at least a portion of the RIN value. Additionally, three of the five refined product spreads had standard errors greater than 0.4, which is a high percentage of the total pass-through estimates.

Of course, these wide variations in pass-through are muted by expanding the sample period to a nearly four year period and then pooling the results for the various spreads. While this paper is not focused on policy implications, it should be noted that a variance in pass-through rates among refined product types does matter to market participants and that significant periods with uncertain pass-through can also be disruptive to obligated parties under the RFS.

Dropping the two Brent crude-based spreads is cause for greater concern about omitted variable bias.

While there appears to be justification for a refocus on refined product spreads, the dropping of the spreads involving Brent crude prices should not be taken lightly. These spreads contributed to the KMS1 finding of full pass-through, which was relied on heavily by EPA, including citations in a recently proposed rulemaking.[4] The decision to drop the spreads is based on a period in which non-RIN factors appeared to move the spreads in the opposite direction of the RIN value movements, causing negative correlation.

The omitted variables that drove this negative correlation contribute to a period of nonsensical pass-through estimates and a finding of insignificance over the full sample period for the refined product to Brent crude spreads. KMS therefore drop the spreads, but do not consider implications for the other spreads or their approach in general.

The omitted variable bias was only detected during times of extreme fuel price fluctuations caused by events considered exogenous to the RIN markets. These were not only events driving Brent crude price movements. In fact, in their explanation, the authors are more focused on events impacting the refined product prices. The movements happened to be in the opposite direction of the RIN price impacts on the spreads. This calls into question the existence of other omitted variables that could be moving the spreads in the same direction as the RIN value changes. The potential existence of such variables could give a distorted view of pass-through.

A remedy for such omitted variable bias raised by the KMS2 authors is to include more control variables that provide at least partial explanation to the events. However, instead of providing detailed discussion about relevant control variables, the authors completely abandoned the Brent crude spreads, which appears rather *ad hoc*.

4 EPA, "Proposed Denial of Petitions for Rulemaking to Change the RFS Point of Obligation," EPA-420-D-16-004, November 2016.

Adding the NYH CBOB – Rotterdam EBOB spread creates added weight to a single pricing location and pair.

KMS2 adds a new price spread to the four remaining price spreads and re-estimated the RIN pass-through based on the five spreads. They justify this by assuming that the RIN pass-through should be similar across price spreads, so the selection of spreads should not matter to the final result and additional spreads would add confidence. However, we do not find that the pass-through is statistically similar across spreads. Specifically, we find that, particularly in the more recent period, gasoline and diesel spreads show dissimilar pass-through when formally tested. (discussed more in the next section). Therefore, adding new spreads that are highly correlated with an exisiting spread can add undue weight to a single price spread.

We performed a simple regression test to confirm that the NYH RBOB and NYH CBOB spot prices are nearly identical (coefficient = 1.0) and move together at a highly significant level (p-value = 0). Therefore, the difference seen in the KMS2 summary tables is mostly driven by using spot vs. futures prices for nearly identically priced products. This places added weight on the spread that, out of the four KMS1 refined product spreads, exhibits a pass-through closest to 1.

The difference in pass-through rates between gasoline and diesel spreads across the full sample period leads to concerns about the KMS pooling method.

We find that diesel and gasoline spreads have statistically different pass-through rates for a significant time period. This leads to an open question about the KMS assumption of equal-pass-through across spreads, and thus the economic validity of the pooled regression approach.[5]

In the both KMS1 and KMS2, the authors argued that according to theory, there should not be any difference in the pass-through rate from RIN obligation price to different wholesale fuel spreads. Therefore, they assume the pass-through rates to be equal across all six fuel spreads and ran a "pooled regression" to estimate a "one-for-all" pass-through rate for all fuel spreads that they investigate. However, they failed to empirically test the validity of the equal-pass-through assumption, which is essential to draw their main conclusion.

Here, we formally test whether the assumption of the equal pass-through rate is supported for January 1, 2013, through May 31, 2016. As all fuel spreads are not only autocorrelated over time, but also correlated cross-sectionally, we use a refined method to estimate the variance of the coefficients, taking into account both dimensions of correlation. We find that, during the second period (March 11, 2015, through May 31, 2016, which is a large majority of the KMS2 "out-of-sample" period), we can reject the hypothesis of an equal pass-through for all six original fuel spreads under all specifications of the regression model. That means we have reason to doubt

5 We do not investigate the possible reasons for this result in this brief paper.

the pooled regression because its assumption is highly probable to fail during that period. For the first period and the full period scenarios, we can only reject the null hypothesis under the no-seasonality specification, but not the other three specifications.

Table 1: Testing Equal Pass-Through Across Fuel Spreads

	Wald test: all six spreads have the same pass-through rate; (p-value in parentheses)		
	1st period: 01/01/2013-03/10/2015	2nd period: 03/11/2015-05/31/2016	Full period: 01/01/2013-05/31/2016
(1) OLS, full sample, seasonals	8.259	50.120***	2.863
	(0.143)	(0.000)	(0.721)
(2) DOLS, full sample, seasonals	8.140	48.948***	3.157
	(0.149)	(0.000)	(0.676)
(3) OLS, full sample, augmented seasonals	8.422	28.175***	4.453
	(0.135)	(0.000)	(0.486)
(4) OLS, full sample, no seasonals	42.550***	17.619***	50.074***
	(0.000)	(0.004)	(0.000)
(5) OLS, full sample, seasonally adjusted data	19.245***	3.664	5.456
	(0.002)	(0.599)	(0.363)

Notes: The data are daily and the full sample is Jan. 1, 2013 – May 31, 2016. The Wald test is against the null hypothesis: all six spreads have the same RIN pass-through rate. Significant statistics mean the null is rejected with high confidence. * 10% significance level; ** 5% significance level; *** 1% significance level.

Disclaimer

The study was commissioned by Valero. The research, analysis, results and conclusions were all developed independently by the authors. The conclusions set forth herein are based on independent research and publicly available material.

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Review of CARD Policy Brief 16-PB 20:

"Impact on Merchant Refiners and Blenders from Changing the RFS Point of Obligation"

by Bruce A. Babcock, Gabriel E. Lade, and Sébastien Pouliot

December 2016

Summary

Charles River Associates ("CRA") has reviewed the recent ISU-CARD policy brief from December 2016 by Babcock, Lade, and Pouliot ("BLP"). In their high-level policy brief, the authors attempt to dismiss the case for shifting the Renewable Fuel Standard ("RFS") point of obligation by showing how refiners should be indifferent to the point of obligation in a theoretical RFS market construct (with the exception of avoiding administrative costs). While the theory of the incidence of the RFS in perfectly competitive markets is not in doubt, the practical aspect of this market and their implications are. The BLP paper appears to assume these away, which has the effect of assuming the answer of indifference of the point of obligation. In addition, they rely on a set of primary assumptions that they do not substantiate and on which other research casts doubts. Without citations, the authors assume away the most contentious points of debate amongst economists, such as complete RIN value pass-through at the wholesale and retail levels.

Review of Assumptions

The BLP policy brief provides stylized examples of the RFS and the fuels market for two scenarios: 1) an RFS mandate level that can be met with E10, and 2) an RFS mandate level that also requires blending of E85. For each, they try to show how profit margins are identical for refiners regardless of the point of obligation. To get to this conclusion, they rely on the following key assumptions:

1. **Competitive markets** – BLP assume competitive markets that drive pass-through of all costs from one level of the supply chain to the next. The following is their only justification for such an assumption:

   > *"By most accounts, the market for gasoline, particularly at the wholesale level, is competitive."* – p. 3

   While wholesale fuels markets are indeed generally viewed as competitive on the national level, there are regional markets that may contain non-competitive elements that would allow for profits beyond cost recovery. There is also ongoing debate on the competitiveness of the much smaller RINs market, as CRA is addressing in currently active research. While assuming competitive markets makes analysis easier, each subsequent assumption driven by the competitive markets assumption should be viewed critically and tested against reality through empirical study.

2. **Blender margins independent of RIN price** – BLP assume that blenders' profits remain constant regardless of RIN prices, without empirical evidence. It is central to the BLP findings:

> *"Given sufficient competitive pressures, the market price for E10 will reflect blenders' cost of producing E10 plus enough profit to keep them in business. We assume that the profit level needed to keep them in business is the same whether RIN prices are high or low. Thus, we can safely set this profit level equal to zero without impacting our analysis."* – p.4

The authors do not cite their evidence for assuming that blenders' profit margins are independent of RINS prices. CRA's analysis of blender margins in three key metropolitan regions contradicts this assumption. We have found that blender margins have historically been affected by RIN price movements. This negates the BLP assumption of zero blender profit, which is a key driver of their ultimate conclusion because any RIN value held by blenders is clearly not being recovered by merchant refiners.

3. **RIN price pass-through to gasoline price** – The authors acknowledge that a key assumption to their conclusion is that RIN prices are fully reflected in wholesale fuel prices:

> *"Our conclusion that refiners are unaffected by high RIN prices depends on the assumption that the market price of gasoline increases by exactly the per-gallon RIN tax."* – p.6

The authors do not cite a source for this assumption, but we imagine it is from the Knittel et. al. paper cited by EPA in its proposed denial document. CRA has reviewed and expanded the KMS analysis and found less conclusive results, suggesting that pass-through may not be complete in several markets and obligated fuel products.

4. **Fuel market supply and demand elasticities** – The following excerpt from BLP introduces an unsubstantiated supply elasticity, which then leads to an example where they actually show incomplete RIN price pass-through (from what appears to be an incidence calculation).

> *"A drop in consumption of 0.4% with a supply elasticity of 0.5 implies a drop in the price of gasoline of -0.8% (-0.4%/0.5). The RIN tax is not entirely passed to the wholesale price of gasoline, such that from a $1.6557 wholesale gasoline,*

> *the price paid to refiner declines by 1.3 cents to $1.6425. This means that the refiners pay 1.3 cents of the 11.68-cent RIN tax. Blenders pay 10.35 cents."* – p. 8

> The first thing to note is the assumption of a supply elasticity of 0.5 without any citation. One might also guess that from their assumptions the incidence on blenders would actually be zero (as price increases would actually be passed to consumers of fuel – see point 2 above).

We agree with BLP that the RFS effectively acts as a tax and that the objective of this incentive mechanism is to encourage renewable fuel consumption (at the expense of conventional fuels). This implies that for some period there can be an impact on refiners due to a lower quantity demanded for gasoline blendstocks. However, at least to our knowledge, this demand impact is not the basis for many of the criticisms that have been levied against the current RFS point of obligation. The criticisms focus on the effectiveness of the RINS mechanism and not the core RFS policy objective of lowering conventional fuel demand and increasing ethanol consumption. The BLP critique appears to mix the two issues.

Conclusion

The brief BLP paper illustrates through examples how the RINS mechanism works in an idealized theoretical sense, without acknowledging any of the empirical and practical issues that may be affecting it in practice. The BLP paper therefore offers no new real evidence to support the current RFS point of obligation, as the paper implicitly assumes that the current mechanism is working correctly and as it was (ideally) conceived.

Disclaimer

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