

Does Blended Gas Price Reflect Ethanol's Low Energy Content?

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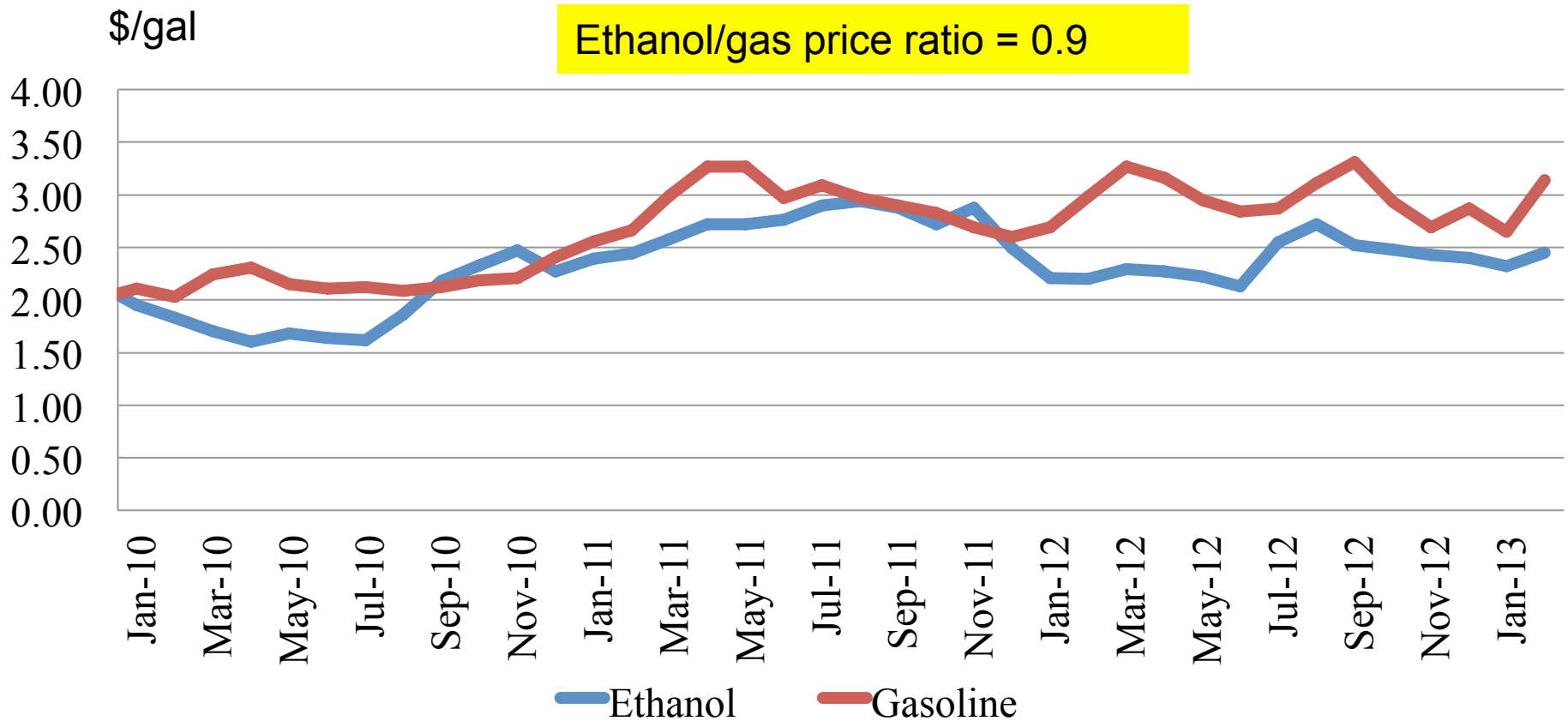
Motivation

- We set out with the belief that refiners/blenders would buy less ethanol if it wasn't required.
- In 2012 EPA denied “temporary” waiver request, concluding it would have limited impact on the demand for ethanol & corn prices.
- EPA decision implies ethanol demand curve is v inelastic & refiners/blenders will bid for ethanol, even if it's priced above its energy content.
- Why are refiners/blenders willing to bid more than $0.7 \times \text{BOB}$ for corn ethanol?

Economists argued waiver would have little impact

- Too costly for refiners to switch back to higher octane BOB;
- Pipeline logistics limit delivery of heterogeneous BOBs;
- Ethanol is required as an oxygenate in gasoline;
- Ethanol is a cheap source of octane;
- It's profitable to “cut” gasoline with ethanol;
- RINs are inexpensive;
- (e.g., see [Irwin & Good](#); [Babcock](#); [Tyner et al.](#); [Carter, Smith, & Abu-Sneneh](#))

Price of Ethanol V. Gasoline (Rack Prices)



Source: Nebraska Energy Office

Motivation

Our paper has 2 objectives:

1. Use a LP model to estimate ethanol demand.

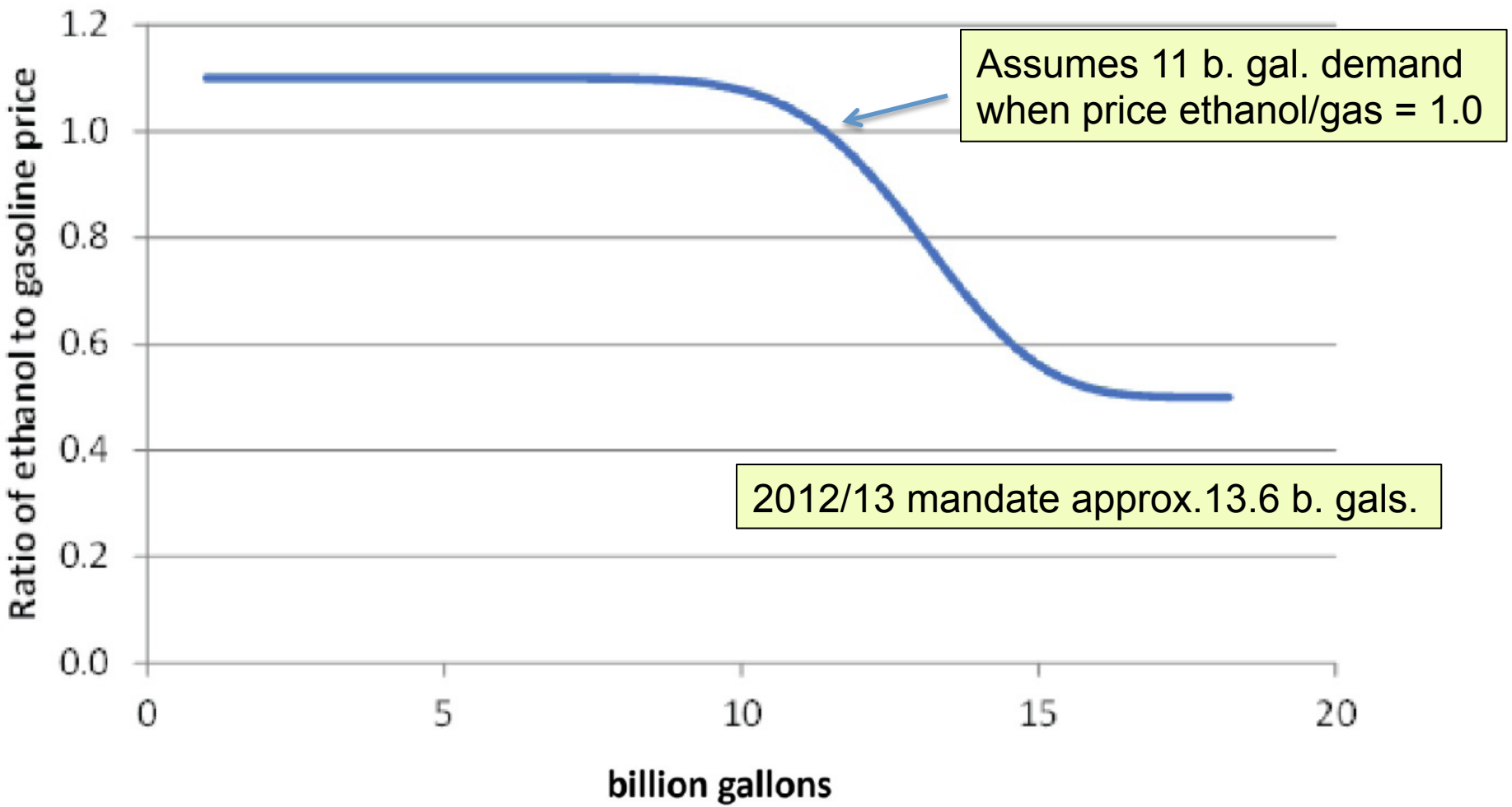
- Accounting for ethanol's octane benefits & low energy content.
- We estimate willingness to pay for ethanol w/o mandate.

2. Regression analysis: Impact of increased blending on gasoline prices.

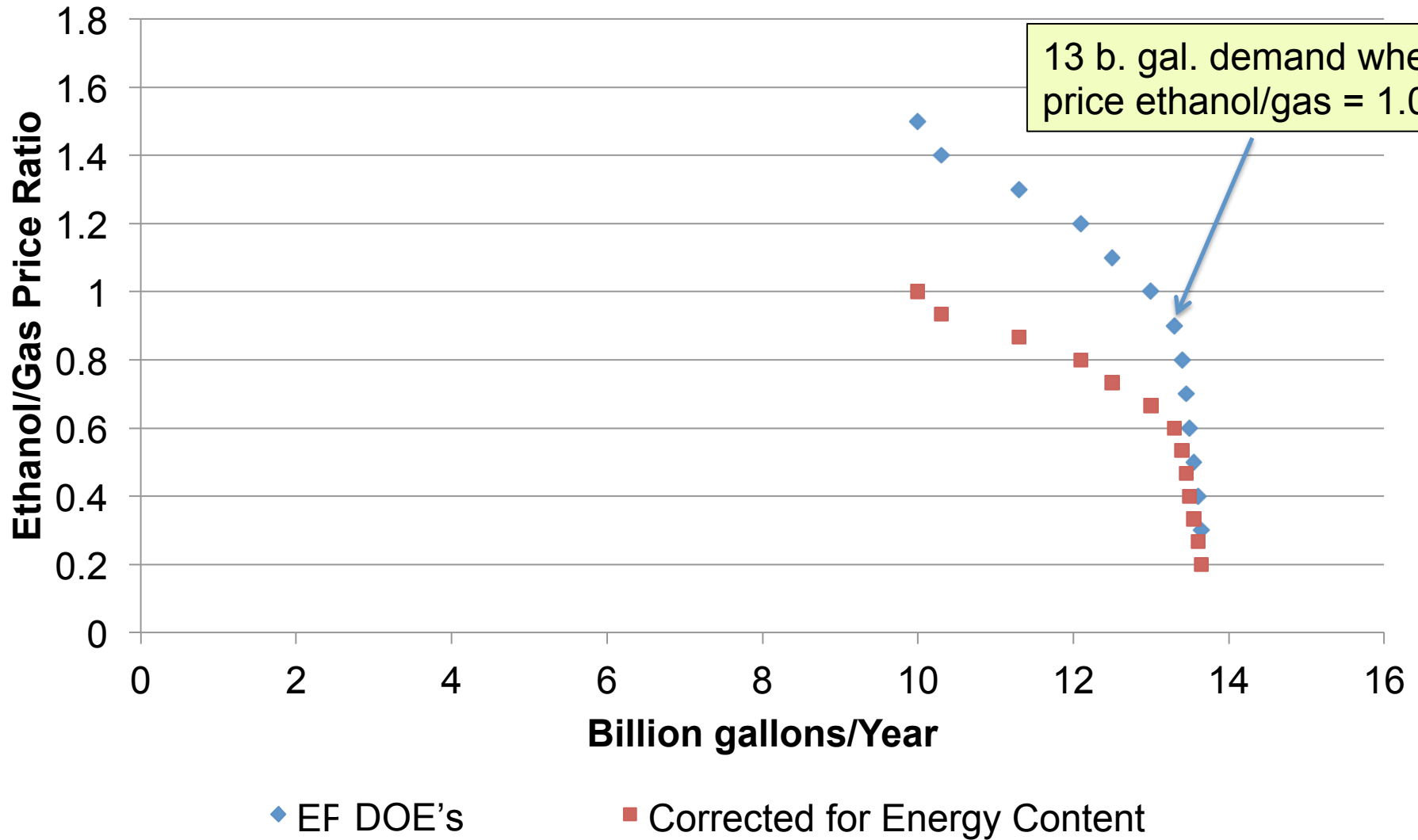
Waiver Debate

- Our submission to EPA argued that a waiver would have an impact if finished gasoline blend is priced according to energy content.
- EPA's response to our submission “we did not see evidence presented in this study to change our reasoning with respect to how ethanol is priced.” (Fed. Register, Nov 27, 2012).

Bruce Babcock's Ethanol Demand Curve



DOE's Ethanol Demand Curve 2012/13



Our Linear Program

- A representative refiner minimizes total cost of finished gasoline subject to the following constraints
 - **Volatility**: must be below 8.64 RVP in summer, 14.7 RVP in winter.
 - **Octane** rating: The finished fuel must have at least 87.6 rating.
 - **Ethanol** content no more than 10%

Linear Program - Inputs

Input	Ethanol	BOB	Octane Enhanced BOB	Butane
Octane Rating	Highest	Lowest	High	High
RVP (Volatility)	High	Low	Lowest	Highest
Energy Content	Lowest	Highest	Highest	Medium
Price	-	-	High	Low

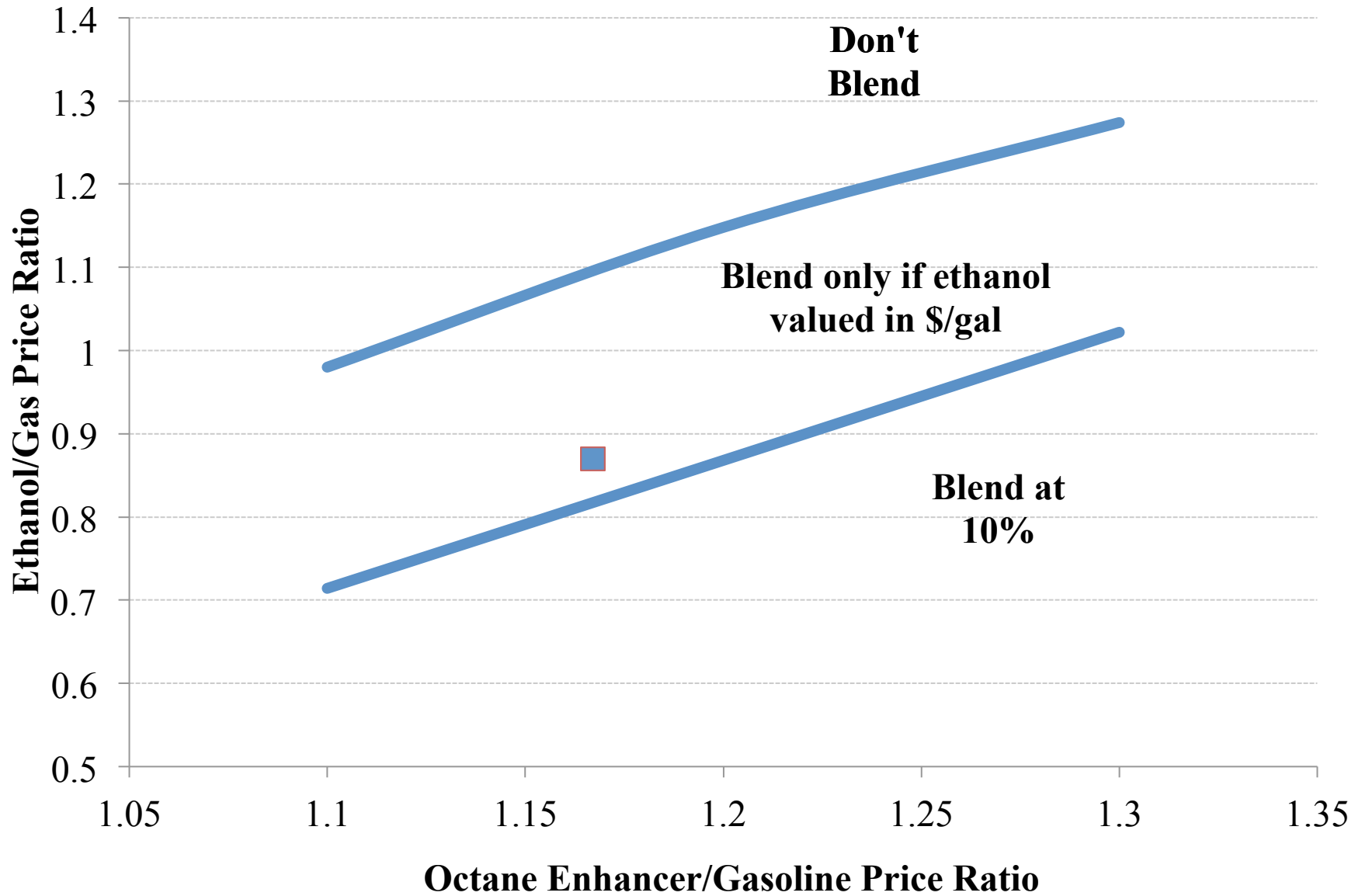
Results for Summer Blend

- In summer blends, the use of butane is limited, due its high RVP.
- Thus ethanol & octane-enhanced BOBs are mainly used to increase octane.
- In the absence of a mandate, demand for ethanol is largely determined by the relative price of ethanol to octane enhanced BOB.

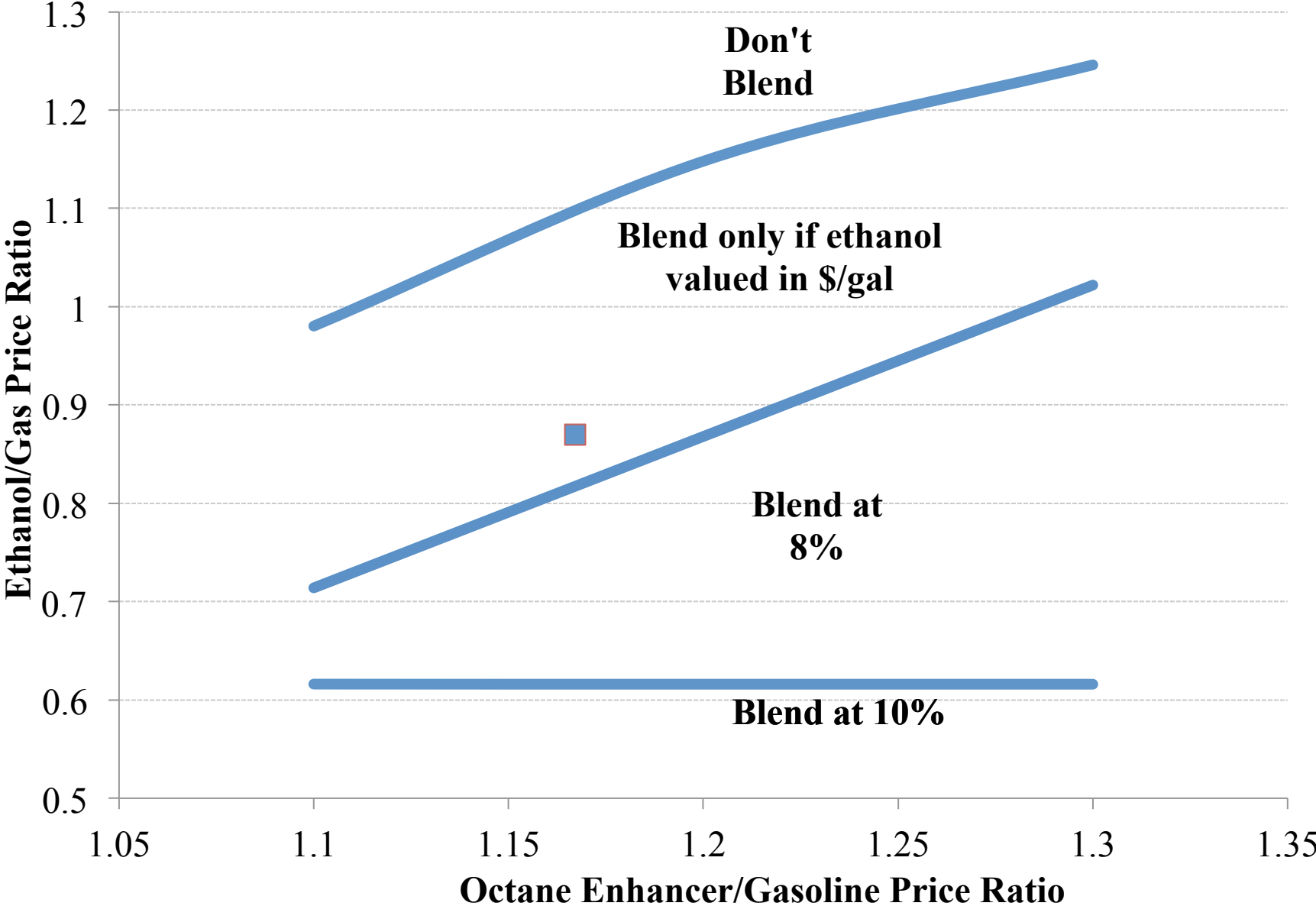
Results for Winter Blend

- In winter blends, volatility requirements are lower & more butane is used.
- Hence a lower willingness to pay for ethanol, given butane's relatively low price.
- However, the results change dramatically if energy content is not priced into finished product, since ethanol's big disadvantage is its high price/energy ratio.

Ethanol profit thresholds in Summer



Ethanol profit thresholds in Winter



Does ethanol in the mix reduce the price of gasoline?

- Natural experiment 1: ethanol was introduced at different times in different markets. When the proportion of ethanol changed, did it alter the price of the blended product?
- Regress gasoline on crude price & switch dummy.
- Natural experiment 2: ethanol in mix allowed refiners to switch from 87 to 84 octane BOB.
- Regress BOB on crude price & switch dummy.
- For both regressions, Null hypothesis: No effect. In both cases we fail to reject.

Conclusion

- Mandate costs U.S. motorists min. \$3.1 Bil/yr due to gasoline being “cut” with lower-valued ethanol.
- No competitive discipline to lower finished gasoline price if consumers have no choice @ pump.
- Therefore pricing ethanol on “volumetric” basis endogenous to RFS mandate.
- Recent RIN price increase suggests waiver may have worked.
- “Cutting” gasoline “works” for E10 but will not for E85, which should be at 25% price discount.