Journal of Environmental Economics and Management 67 (2014) 258–273

Contents lists available at ScienceDirect

Journal of Environmental Economics and Management

journal homepage: www.elsevier.com/locate/jeem

A ban on one is a boon for the other: Strict gasoline content rules and implicit ethanol blending mandates

Soren T. Anderson [a,*], Andrew Elzinga [b]

[a] Michigan State University, NBER, United States
[b] Brown University, United States

ARTICLE INFO

Article history:
Received 16 January 2013
Available online 18 January 2014

Keywords:
Ethanol
Gasoline
MTBE
Gasoline content regulations

ABSTRACT

Ethanol and methyl-tertiary butyl ether (MTBE) were close substitutes in the gasoline additives market until MTBE was banned due to the concerns about groundwater contamination, leading to a sudden and dramatic substitution toward ethanol as an alternative oxygenate and octane-booster. We use variation in the timing of MTBE bans across states to identify their effects on gasoline prices. We find that state bans increased reformulated gasoline prices by 3–6 cents in non-Midwestern states for which the bans were binding, with larger impacts during times of high ethanol prices relative to MTBE and crude oil. We find qualitatively similar, yet smaller effects for conventional gasoline. We argue on the basis of a simple conceptual model and supporting empirical evidence that these bans functioned as implicit ethanol blending mandates in areas that were previously using MTBE to comply with strict environmental constraints. Overall, our results are consistent with the theoretical prediction that mandating a minimum market share for a more costly alternative fuel—either directly, or implicitly through a ban on the preferred conventional fuel—will inevitably increase fuel prices in a competitive market.

Introduction

Gasoline refiners have faced increasingly stringent environmental constraints in recent decades, significantly narrowing their options for maintaining high levels of fuel octane.[1] By the late 1990s, suppliers in many cities came to rely heavily on a fuel additive known as MTBE (methyl-tertiary butyl ether) to boost octane, while suppliers in other cities used ethanol instead. Like ethanol, MTBE was valued for its energy, oxygen content, and high octane—but was found to leak from underground storage tanks and contaminate groundwater. Thus, a total of 19 states banned MTBE from 2000 to 2006 before it was phased out nationwide in mid-2006, leading to a dramatic substitution toward ethanol. We present theory, empirical evidence, and institutional background to shed light on this era of gasoline content regulation, which came after the reformulated gasoline (RFG) regulations of the 1990s, and which served as prelude to the federal Renewable Fuel Standard in the 2000s.

We show theoretically that MTBE bans function as implicit ethanol blending mandates in the presence of existing environmental constraints. We confirm this interpretation empirically, finding that MTBE bans had large, discrete, and immediate effects on ethanol blend shares. We then use variation in the timing of MTBE bans across states to identify their effects on gasoline prices. We distinguish the effects of these bans by (1) conventional gasoline versus reformulated

* Corresponding author.
E-mail addresses: sta@msu.edu (S.T. Anderson), andrew_elzinga@brown.edu (A. Elzinga).
URL: http://www.msu.edu/~sta (S.T. Anderson).

[1] High-octane fuels are more resistant to "knocking," which occurs when the pressurized fuel–air mixture in the engine ignites prior to the spark plug firing, reducing engine efficiency.

0095-0696/$ - see front matter © 2014 Elsevier Inc. All rights reserved.
http://dx.doi.org/10.1016/j.jeem.2013.11.009

gasoline, which faced more stringent environmental constraints, (2) geography, to account for whether the bans were binding or not, and (3) time, based on prices for ethanol, MTBE, and crude oil—the key commodity inputs into oxygenate-blended gasoline.

We find that MTBE bans increased reformulated gasoline prices by 3–6 cents in non-Midwestern states—where MTBE was preferred to ethanol. As expected, price impacts were larger when ethanol prices were high relative to MTBE and crude oil. Consistent with this evidence, we find that MTBE bans increased the monthly pass-through rate of wholesale ethanol prices into retail gasoline prices, while decreasing the pass-through rates of MTBE and crude oil prices. We find little effect of MTBE bans in the Midwest—where ethanol was preferred over MTBE. We also find minimal effects for conventional gasoline, which faced less stringent environmental constraints. Overall, our results are consistent with the prediction that a ban on a less costly conventional fuel—in extreme cases, a de-facto mandate for the more costly alternative fuel—will inevitably increase fuel prices in a competitive market.

This paper contributes to a recent empirical literature that exploits variation in gasoline content regulations across locations and over time to identify their effects on gasoline prices. In general, this literature finds that gasoline content regulations increase average prices by raising production costs (Muehlegger, 2006; Chouinard and Perloff, 2007; Brown et al., 2008; Chakravorty et al., 2008). Seasonally and geographically differentiated regulations also segment markets, exacerbating price spikes following refinery outages (Muehlegger, 2006; Brown et al., 2008) and increasing the exercise of local market power (Brown et al., 2008; Chakravorty et al., 2008). Overall, however, content regulations account for a relatively small share of total costs (Chouinard and Perloff, 2007).[2]

Our paper contributes to this literature in three ways. First, while previous papers focus on the gasoline content regulations following the Clean Air Act Amendments of the early 1990s, we focus on state MTBE bans, which occurred later, which apply to gasoline sold everywhere in a state, and which likely had different impacts on prices. Thus, our paper helps document an important era in gasoline content regulation that led to a significant increase in ethanol consumption. In particular, the MTBE bans are important pre-existing regulations that must be considered when assessing the impacts of the federal Renewable Fuel Standard (RFS).

Second, like previous studies, we study heterogeneous effects by location and regulatory stringency. In particular, we allow the effects of MTBE bans to differ for Midwestern states, which were closer to ethanol supply, as well as for conventional gasoline, which faced weaker environmental constraints. Unlike previous studies, however, we allow the effects of content regulations to vary over time with the prices of key gasoline inputs. Thus, our estimates may have greater external validity in the face of changing market conditions. Controlling for input prices also mitigates potential bias related to spillovers from one state's policy to another state's prices via national fuel markets—something that is ignored in previous studies.

Third, we show that state MTBE bans approximated direct state-level ethanol mandates in areas that were previously using MTBE to comply with existing environmental regulations. Thus, our results also help to inform a current policy and research debate about whether ethanol blending mandates increase or decrease gasoline prices (see Knittel and Smith, 2012). In this case, our results suggest that direct, state-level ethanol blending mandates would have increased fuel prices. Our approach may prove to be useful in other contexts, when the impact of a new or future policy cannot be estimated, but can be inferred from a surrogate policy sharing a similar economic structure.[3]

In addition, our paper contributes to the literatures on overlapping environmental policies and rent-seeking behavior. We show that a ban on an input (MTBE) can—in the presence of other policy constraints—lead to dramatic substitution toward one particular close substitute (ethanol). In the extreme, when all other options have been eliminated, a ban on one input is a de-facto mandate for its alternative. Excessive regulation also comes with a hidden political cost: eliminating substitutes via regulation inflates incentives for rent-seeking behavior among the industries that remain viable. Indeed, ethanol producers were among the most ardent supporters of MTBE bans, with virtually all corn-growing Midwestern states banning MTBE.

The rest of this paper proceeds as follows. The section "Industry background and conceptual model" discusses important background on the economics of ethanol and MTBE blending before presenting our conceptual model. The section "State MTBE bans and their effects on blending" presents evidence on MTBE bans and their effects on ethanol usage. The section "Econometric models and estimation results" describes our estimation strategy and presents our regression results for the effects of MTBE bans on retail gasoline prices. The section "Conclusion" summarizes and concludes.

[2] Brown et al. (2008) find that the mean and variance of wholesale prices increased following the implementation of federal Reid Vapor Pressure (RVP) and reformulated gasoline (RFG) regulations in affected cities, while the number of wholesalers decreased. Chakravorty et al. (2008) find that state prices increased following the implementation of RFG and winter oxygenated fuel regulations, attributing the increase both to higher refining and distribution costs, as well as to market power. Muehlegger (2006) also attributes price increases to higher refining and distribution costs and argues that uniform regulations could substantially mitigate the severity of local price spikes. Finally, Chouinard and Perloff (2007) estimate the effects of oil prices, taxes, market power, vertical integration, and environmental regulations on gasoline prices, finding that environmental regulations account for a relatively small share of the retail price.

[3] Other policies that share a similar economic structure include the U.S. federal Renewable Fuel Standard (RFS) and California's Low-Carbon Fuel Standard (LCFS). While the federal RFS is legislated as a minimum quantity, it is implemented by EPA as a minimum market share requirement. Likewise, in the case of a conventional high-carbon fuel (gasoline) and a single low-carbon fuel (say ethanol), the LCFS is equivalent to a minimum market share for the low-carbon fuel.