Transport Policy 37 (2015) 121–133

Contents lists available at ScienceDirect

Transport Policy

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

Analysis of impacts of alternative policies aimed at increasing US energy independence and reducing GHG emissions

Eric G. O'Rear*, Kemal Sarica, Wallace E. Tyner

Department of Agricultural Economics, Purdue University, 403W. State Street, West Lafayette, IN 47907-2056, USA

ARTICLE INFO

Article history:
Received 15 April 2013
Received in revised form
1 June 2014
Accepted 23 October 2014
Available online 20 November 2014

Keywords:
Energy security
CAFE
Fuel tax
Emissions
Light-duty vehicles
Climate change

ABSTRACT

The primary objectives of recent energy initiatives have been: (1) lowering greenhouse gas (GHG) emissions; and (2) increasing US energy security by reducing oil imports for the purposes of making the US less vulnerable to the actions of other countries. The concern is that relying on sometimes adversarial, sometimes unstable countries for a quarter of our oil carries certain risks. For that reason, reducing the external oil dependence has been of interest to policy makers. This paper examines the impacts and costs of transportation-based policies on light-duty vehicle fleet energy usage and emissions. Using the 2010 elastic version of the US Environmental Protection Agency's Market Allocation (MARKAL) model, recent increases in US Corporate Average Fuel Economy (CAFE) Standards are compared to what some economists suggest would be a much more "efficient" alternative-asystem-wide oil tax internalizing a number of environmental externalities. We discover that our series of oil taxes produce larger and more cost-effective reductions in economy-wide emissions than CAFE. The same cannot be said in regards to net oil imports. Stricter fuel economy regulations result in much larger cutbacks in imports than the oil tax. In fact, we found that in 2040 import demands are roughly 250 million BOE (barrels of oil equivalent) higher with our oil tax regime than they are with CAFE. The additional import reductions achieved with stricter CAFE Standards do come, however, at a much larger cost to society. A great deal of these additional economic costs stems from greater usage of more energy-efficient automobiles and the higher initial capital costs associated with their adoption. In our supplementary analysis, we find that even if the costs of these types of vehicles are lowered by as much as 75%, oil taxes would still be able to maintain their competitive edge over CAFE standards in regards to cost-effectiveness.

1. Introduction

The primary objectives of recent US energy initiatives have been: (1) lowering greenhouse gas (GHG) emissions; and (2) increasing US energy security by reducing oil imports (Tyner and Taheripour, 2007). The question is what is the relative effectiveness of different policies in achieving these objectives? Energy security is often measured by the additional military costs of protecting Middle Eastern oil supplies (Knittel, 2011). This study refers to improvements in energy security as continued reductions in demands for foreign oil for the purposes of making the US less vulnerable to the actions of other countries. The majority of the world's oil reserves are controlled by members of the Organization of the Exporting Petroleum Countries (OPEC), many of whom are found in the Middle East (e.g. Saudi Arabia). In total, about 40% of US oil is imported with about 15% coming from Canada and Mexico, which leaves 25% from the rest of the world (Energy Efficiency & Renewable Energy (EERE), 2014). The concern is that relying on sometimes adversarial, sometimes unstable countries for a quarter of our oil carries certain risks. For that reason, reducing the external oil dependence has been of interest to policy makers.

Close to 70% of the total US petroleum use is in the transportation sector, with cars and light-trucks responsible for roughly 60% of sector petroleum use (Davis et al., 2012). Because light-duty vehicles, followed by medium- and heavy-duty vehicles, are the largest consumers of fuel by the sector, it is no surprise that gasoline and diesel are the most heavily used fuels by the sector (Center for Climate Change and Energy Solutions, 2011). Measures like Corporate Average Fuel Economy (CAFE) standards and fuel taxes, which target these vehicles, could have a rather large influence on petroleum demands.

Reducing oil demands generally coincides with emission reductions. Approximately 27% of US emissions come from

* Corresponding author.
E-mail addresses: eorear@purdue.edu (E.G. O'Rear), ksarica@purdue.edu (K. Sarica), wtyner@purdue.edu (W.E. Tyner).

http://dx.doi.org/10.1016/j.tranpol.2014.10.016
0967-070X/

transportation. It is the second largest contributor to the nations' overall emission levels behind the electric power sector. Again, with LDVs being the largest fuel consumer of any other mode in the sector, they end up being the greatest contributor to sector emissions (responsible for almost 60% of transportation emissions in 2011). Policies like CAFE help lower motor gasoline and diesel use by forcing a strict fleet average efficiency for the LDV fleet that tightens over time. CAFE standards were initially launched under the Energy Policy and Conservation Act of 1975 (EPAct) as a direct result of the 1973 Arab oil embargo. Fuel taxes are another tool targeting fuel demands. The US currently charges a per-gallon tax for all gasoline and diesel used. Relative to the rest of the world US tax rates are rather modest. Rates in a number of European countries (e.g. Turkey and Germany) are five to six times higher than current US rates (Energy Efficiency & Renewable Energy (EERE), 2013). They have witnessed the benefits of higher taxes through substantial reductions in GHG emissions. If the US were to raise rates close to those seen in many European nations, they too could expect to experience similar benefits (Sterner, 2007).

This study looks to build on previous studies which have already examined the impacts of different transportation-based policies on both GHG emissions and oil imports. Our own contributions to the existing literature involve a comparison between more recent increases in CAFE regulations with taxes applied to all crude oil products. Other studies have made similar comparisons. None of them, however, have evaluated fuel economy standards as stringent as those authorized by the current administration. We go on to examine the implications of introducing a set of oil taxes capable of achieving similar cutbacks in oil use by the transportation sector as our CAFE increases. Doing this should reveal a degree of the "hidden" or implicit costs of higher efficiency requirements. We have not evaluated oil import taxes as those would be illegal under the current WTO agreement.

We also analyze reductions in the capital costs for higher efficiency vehicles and determine how such reductions potentially influence the competitiveness of recent CAFE adjustments. The 2010 version of the US EPA MARKAL model is used to observe and gauge policy impacts. MARKAL is a bottom-up, dynamic, partial equilibrium model that provides a rather detailed layout of the US energy system. The model spans all five major economic sectors, but our focus will be on the largest contributor to the nation's energy security matter, the transportation sector.

2. US transportation policies to lower fuel demands

Many economists agree that market-based tools be a more efficient approach to meeting the above policy goals. They have suggested that fuel tax rates be raised or begin pricing emissions. However, these suggestions have often been rebuffed given the political distaste for taxes any kind, and the beliefs of some environmental groups that taxes may not truly achieve the reduction targets governments have in mind. Background is provided on a couple of the more popular mechanisms in the next section, followed by a discussion of how exactly they affect the aforementioned policy initiatives.

2.1. Fuel economy regulations

CAFE standards have been a way for the US to ensure that vehicle fuel economy improves over time. The initial CAFE program required each manufacturer to meet a sales-weighted average of 18 miles per gallon (mpg) for all new passenger cars by the 1978 model year. Standards continued to rise until finally reaching 27.5 mpg in 1985. Mandates for light-duty trucks later came with the 1979 model year. Mandates for light-duty trucks later came with the 1979 model year. CAFE adjustments lately have been set using complex mathematical formulas which base standards according to an individual vehicles' carbon footprint. Another aspect of the automobile efficiency improvements are the required per-mile reductions in CO_2 emissions (g CO_2/mile). California was the first state to authorize restrictions on tailpipe emissions. The Environmental Protection Agency (EPA) later adopted similar requirements. Recent changes to fuel economy regulations are based on a combination of the National Highway Traffic Safety Administration (NHTSA) fuel efficiency requirements and the EPA restrictions on vehicle CO_2 emissions intensity (Environmental Protection Agency (EPA), 2011). Failure by manufacturers to comply with the regulations would face harsh penalties based on the fee structure already in place. Those that exceed standard requirements earn credits based on how much they over comply; they then have the options to bank these credits or sell them to firms are not in compliance (McConnell, 2013).

In 2011, the President of the United States, President Barack Obama, mandated that existing CAFE standards be tightened such that average fuel economy levels would be doubled by 2025. It called for annual increases of 5% from 2017–2025 for cars. Light trucks face annual increases of 3.5% from 2017–2021, before switching to annual 5% increases through 2025 (Environmental Protection Agency (EPA), 2011). These improvements follow the ones introduced under the Energy Independence and Security Act of 2007 (EISA). Before this, there had been no changes in fuel efficiency standards since 1990.

Many politicians favor CAFE standards over fuel taxes given the general aversion to taxing environmental goods. The predictability of fuel demand changes CAFE standards offer is rather appealing to them. Fuel economy improvements lower per-mile driving costs (fuel costs) and make driving less expensive. Consumers see these fuel cost savings and are inclined to drive a little more. This consumer response is referred to as the *rebound effect* (Binswanger, 2001, Sorrell and Dimitropoulos, 2008). Studies measuring rebound effects in the US (Greene et al., 1999, Small and Van Dender, 2005, Su, 2011, Small and Van Dender, 2007, O'Rear, 2014) have approximated long-run rebound levels ranging anywhere between 10–30%, with short-run estimates topping off at around 10%. O'Rear finds that even under the assumptions of a rebound effect as large as 10%, the erosion of anticipated benefits related to fuel economy improvements are likely minimal.

2.2. Fuel taxes

Fuel taxes are a form of consumption tax, a charge on spending on different goods and services. Their appeal lies in their ability to incentivize reductions in fuel use and jumpstarting innovation in energy efficiency (Fitzroy and Papyrakis, 2010). In regards to transportation, fuel taxes lower petroleum demands. They act as "price-signals" and encourage drivers to be more conservative in the use of their vehicle. For example, a gasoline tax charges a fee for each gallon of gasoline purchased. It discourages heavy use of the fuel while indirectly inciting changes in driving behavior. Changes in driving behavior are crucial for reducing external costs linked to driving (Forkenbrock, 2004).

The US federal excise tax on gasoline today is \$0.18/gallon, and \$0.24/gallon for diesel. State and local taxes average \$0.31 and \$0.29 per gallon of gasoline and diesel, respectively. Combined, the average national fuel taxes are \$0.49/gallon of gasoline and \$0.54/gallon of diesel (API, 2012). Because national fuel taxes have failed to keep up with inflation, we have witnessed the purchasing power of existing rates continue to fall over time (Wachs, 2003). US fuel taxes largely serve as an indirect charge on highway users for their use of highways. It is similar to a fee for entrance to a national park. Taxes, however, fail to charge individual drivers for