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King Abdullah Petroleum Studies and Research Center

Commentary

An Alternative Framework for Measuring New Vehicle Buyers' Responsiveness to Changes in Fuel Prices[1]

December 2019

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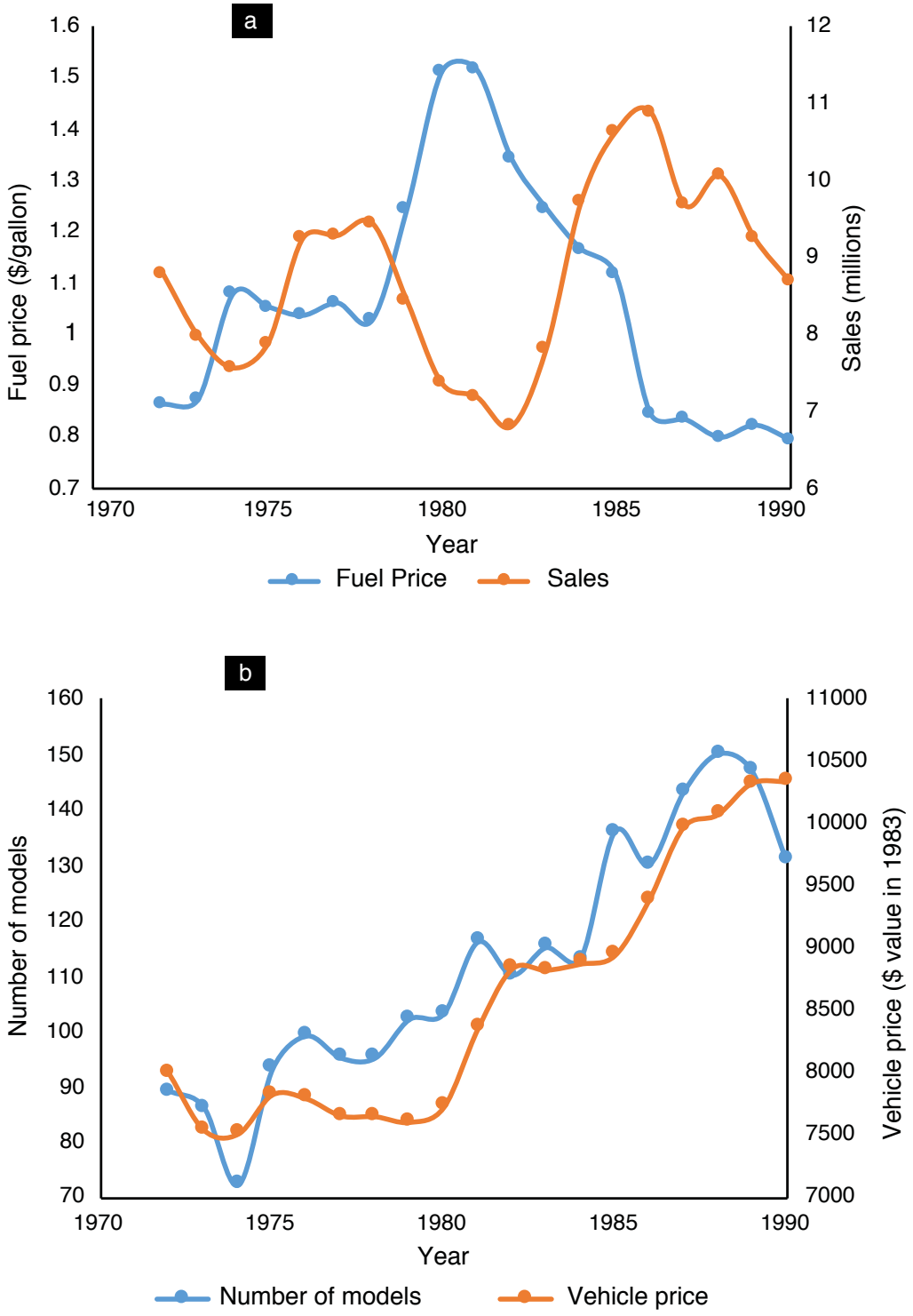
The estimated results are found to be in line with the values reported in the literature.

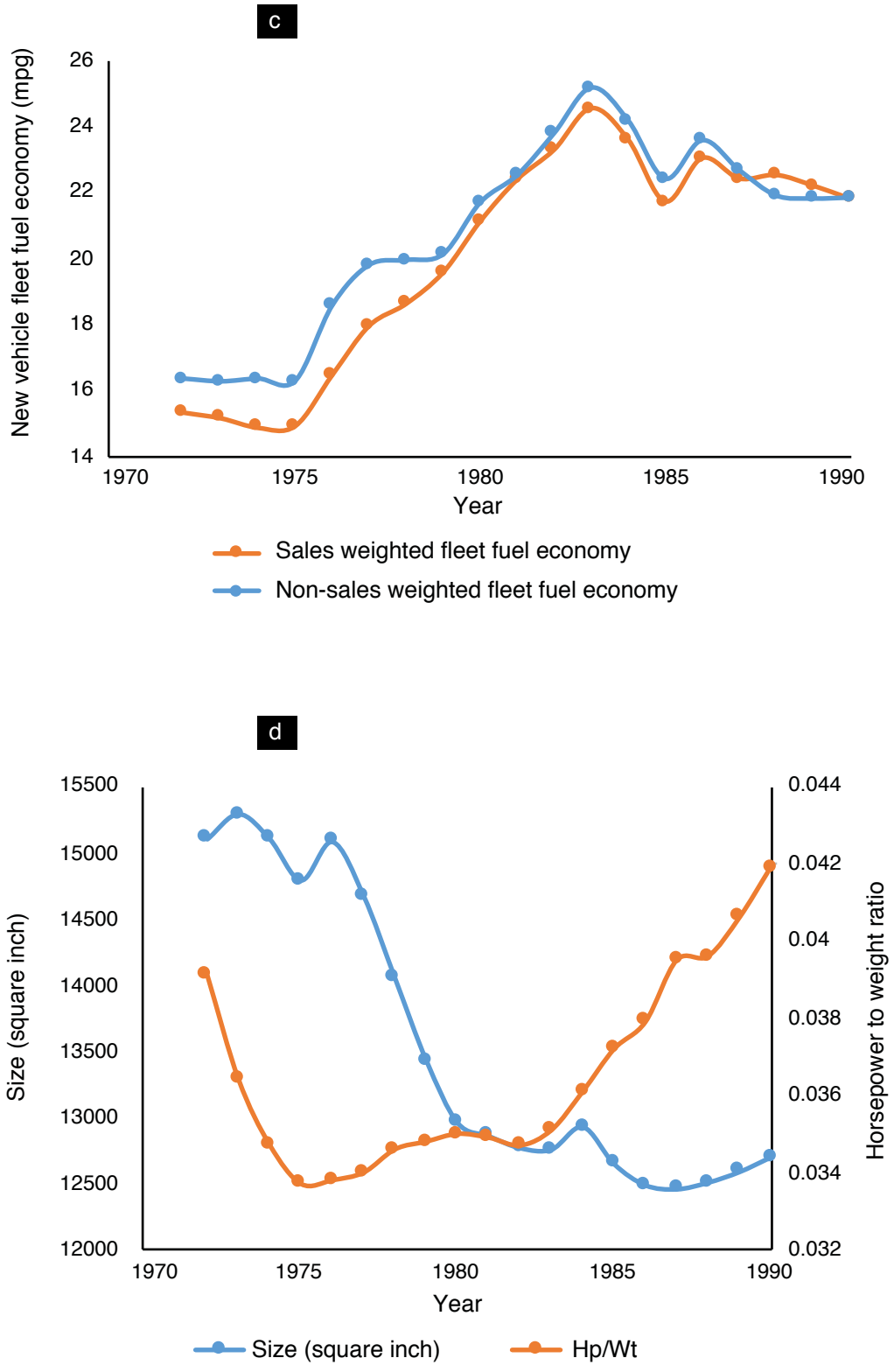
This commentary uses a cost per perceived value (CPPV) based utility maximization framework to measure new vehicle buyers' responsiveness to changes in fuel prices. We recently used the CPPV framework to estimate the responsiveness of new light-duty vehicle (LDV) buyers to changes in fuel prices in the Kingdom of Saudi Arabia (Sheldon and Dua 2019). We could not validate the results obtained using the CPPV framework because of the lack of prior literature on the fuel price elasticity of new vehicle fleet fuel economy for the Kingdom. To support the validity of the CPPV framework, we applied it to the historical aggregate United States (U.S.) sales data from 1972 to 1990, for which prior elasticity estimates are available. The estimated results are found to be in line with the values reported in the literature. The 1972 oil crisis, which led to higher retail gasoline prices in the U.S., resulted in the enactment of the U.S. Corporate Average Fuel Economy (CAFE) standards by Congress in 1975. The increase in fuel prices in the Kingdom between 2013-2016, as a result of the country's fuel price reform, and the implementation of Saudi fuel economy standards in 2016, has echoes of the U.S. experience in the 1970s. The analysis of the U.S. LDV market in 1972-1990 provides a comparable template to contrast the findings for the Saudi market reported in Sheldon and Dua (2019).

Aggregate U.S. market share data for 1972-1990 was obtained from Knittel and Metaxoglou (2014). This data was utilized in the seminal Berry, Levinsohn, and Pakes (1995) 'BLP' paper. The data set includes information on both new vehicle sales and vehicle characteristics compiled at the make-model level. Figure 1 shows the summary statistics of the U.S. new vehicle fleet from 1972 to 1990. The 1972-1990 period was characterized by two major oil crises in 1973 and 1979, resulting in sharp increases in retail gasoline prices. The LDV sales trend during this period was almost inversely proportional to the trend in retail gasoline prices. The number of LDV models for sale increased from a low of 72 in 1974 to a high of 150 in 1988. In real terms, the sales-weighted average price increased by almost 50% during the 1980s after having been almost constant during the 1970s. Fleet fuel economy increased from 1975 as a result of the introduction of the U.S. CAFE standards enacted by Congress in 1975, while the vehicle size followed an inverse trend to that of fleet fuel economy. In other words, consumers started shifting from larger, lower fuel economy vehicles to smaller, higher fuel economy vehicles. The ratio of horsepower to weight fell in the early 1970s but has since trended upward. The increase in the ratio from 1980 is mainly attributed to an increase in horsepower value, with the weight remaining constant (Davis and Boundy 2019).

[1] This commentary is linked to the KAPSARC discussion paper "Drivers of New Light-Duty Vehicle Fleet Fuel Economy in Saudi Arabia" (Sheldon and Dua 2019).

Figure 1. Temporal variation of U.S. new vehicle fleet: (a) vehicle sales and the number of models offered; (b) fuel price and vehicle price; (c) average new vehicle fleet fuel economy; (d) size and horsepower to weight ratio.





Source: KAPSARC analysis of BLP (1995) data.
Note: mpg = miles per gallon; Hp = horsepower; Wt = weight.

Total new vehicle sales in the Kingdom also declined by about 20% in 2016, perhaps partly driven by the increase in domestic gasoline prices.

The higher consumer sensitivity during the second oil crisis is because, unlike the first oil crisis, consumers had better fuel economy vehicle options to choose from.

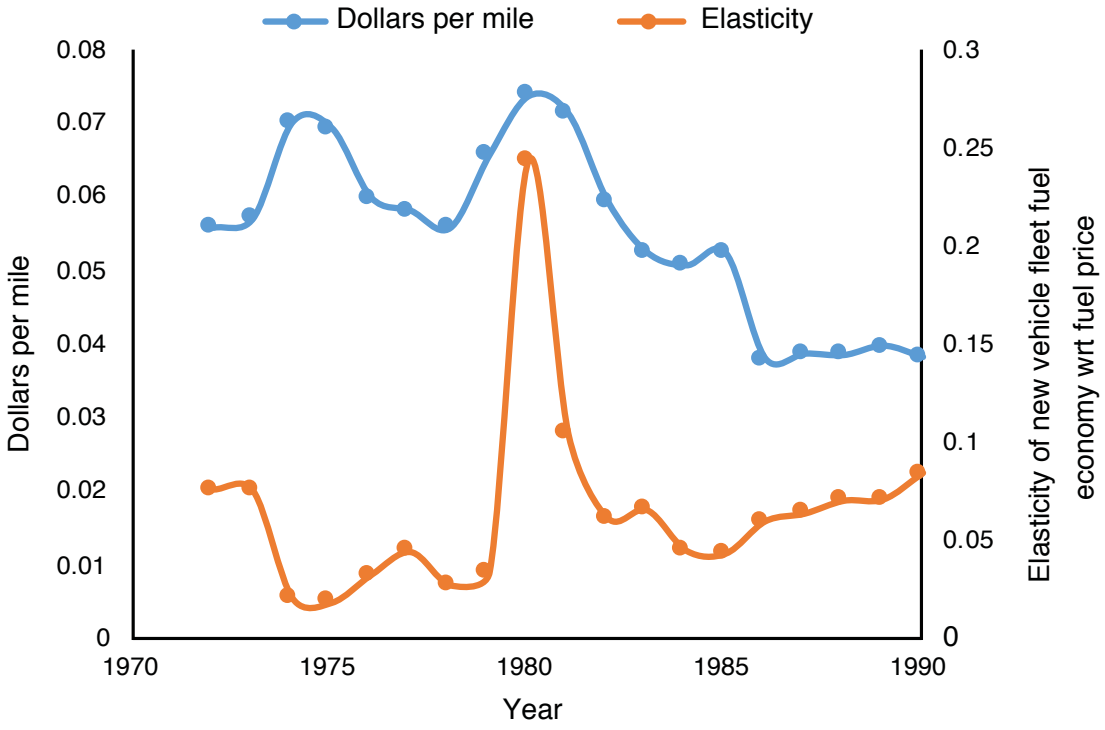
Using the historical data from 1972 to 1990, we obtain a short-run elasticity value of -0.041 for the new vehicle fleet fuel intensity (the inverse of fuel economy) with respect to changes in the fuel price measured at the average fuel price of $1.05 per gallon for 1972-1990. Our finding is close to the short-run elasticity estimate of -0.044 with an average fuel price of $1.09 per gallon found by Small and Van Dender (2007). They use a three-stage least squares technique applied to pooled cross-sectional time-series data at the U.S. state level for 1966-2001.

Figure 2 shows the yearly elasticity estimates for new vehicle fleet fuel economy with respect to fuel price, estimated by fitting separate choice models for each year. The results are in line with findings reported in Pakes et. al (1993). As pointed out by Pakes et al., the new vehicle fleet fuel economy decreased following the fuel price increases from 1973-1975. They argue that lower-income consumers might have responded to the 1973-1975 rise in fuel prices by not purchasing new cars, evidenced by the declining sales of new cars. They hypothesize that, in the absence of the fuel price increases, these consumers might have purchased inexpensive, high fuel economy cars, thereby explaining the observed decrease in the average fuel economy of the new vehicle fleet. Similar to their findings, we also find that the elasticity of the new vehicle fleet fuel economy decreased in 1974 following the fuel price increases. The remaining new vehicle buyers in 1974 were less responsive to fuel price changes, in terms of buying higher fuel economy vehicles, than the new vehicle buyers in 1973.

Similar findings were reported in Sheldon and Dua (2019) for the Saudi new LDV market. The Kingdom's new vehicle buyers' estimated elasticity remained almost constant from 2013 to 2015, at just over 0.08, before decreasing to 0.067 in 2016. Total new vehicle sales in the Kingdom also declined by about 20% in 2016 (focus2move 2017), perhaps partly driven by the increase in domestic gasoline prices in 2016 and cautionary consumer spending, among other factors. Similar to the hypothesis of Pakes et al. (1993) for the U.S. LDV market in 1972-1990, we hypothesized that it is likely that the most price-sensitive Saudi consumers left the Saudi new car market in 2016. It is likely that these consumers either entered the used car market or decided to hold on to their current cars for longer, thereby resulting in a decrease in the elasticity of the remaining new vehicle buyers.

From 1975, fleet fuel economy started rising again, as did elasticity values. The second oil crisis started in 1979, the year after the implementation of the U.S. CAFE standards, resulting in an increase in fuel prices. This time, however, new vehicle fleet fuel economy continued to rise until 1983, with both the estimated elasticity and dollars per mile peaking in 1981. The higher consumer sensitivity during the second oil crisis is because, unlike the first oil crisis, consumers had better fuel economy vehicle options to choose from, as shown in Figure 1(c), due to the U.S. CAFE standards enacted in 1975.

Figure 2. Temporal variation of estimated elasticity of new vehicle fleet fuel economy with respect to changes in fuel price (measured at the average fuel price of $1.05 per gallon from 1972 to 1990).



Source: KAPSARC analysis.
Note: wrt = with respect to.

In summary, it is important for policymakers to understand the responsiveness of new vehicle buyers to changes in the price of fuel. Using the historical aggregate U.S. sales data from 1972 to 1990, the recently proposed CPPV framework[2] estimated that a 1% increase in the average price of fuel would have resulted in only a ~0.041% increase in new vehicle fleet fuel economy. The low responsiveness implies that in a counterfactual case involving no other countervailing measures, a change in the fuel price of about 21% (equivalent to the average change observed between 1972-1990) would have contributed to only around a 1% improvement in fleet fuel economy. The observed long-term improvement in fleet fuel economy, including supply-side countervailing measures inspired by fuel economy standards and higher oil prices, was about 28%. These results highlight the importance of coupling a fuel price demand-side policy with additional policy instruments, such as the supply-side fuel economy standards, as adopted by Saudi policymakers, in achieving greater fleet fuel efficiency improvements.

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[2] The vehicle choice model (using the software package Stata) is also included to assist with policy evaluations.

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