RE-IDENTIFYING THE REBOUND: WHAT ABOUT ASYMMETRY?

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Overview

An important issue that has been ignored in the debate on the rebound effect is the potential asymmetry in fuel demand, by which motorists display differential responses to fuel price increases and decreases. In particular, several studies have emerged suggesting that the response to price increases is stronger than the response to price decreases. As Gately (1992) and others have argued, asset fixity provides one explanation for this so-called hysteresis: improved auto design features that emerge in response to higher fuel prices are unlikely to be abandoned after prices fall, giving rise to a muted demand response. Numerous empirical studies by Dargay (1992), Gately (1992), Dargay and Gately (1994, 1997), Gately and Huntington (2002), Huntington (2006), Adeyemi and Hunt (2007), and Adeyemi et al. (2010) lend support to the view that asymmetric price responses deserve consideration.

Using data from a German household panel spanning 1997 through 2009, the present study advances the understanding of fuel price asymmetries and the rebound effect in several respects. First, and contrary to previous studies, we suggest a novel definition of the direct rebound effect that lends itself to an asymmetric modeling of fuel price responses. Presuming that the asymmetry assumption is found to be correct, we argue that the rebound effect is consequently identified by an elasticity estimate that reflects changes in travel demand due to decreases in fuel prices, as the rebound effect represents the response to a decrease in the unit cost for car travel due to improved fuel efficiency. Second, contrasting with the typical reliance on time series data or panel data aggregated at the country level, the data used here is drawn from individual households, specifically those that have not changed their cars over the three consecutive years they are surveyed, thereby reducing the possibility that mainly technical change is driving the result. This focus effectively allows isolation of the short-run behavioral response to changes in fuel prices and circumvents many of the identification challenges that confront studies using more aggregate data. Finally, expanding on the single-car focus of Frondel, Peters, and Vance (2008), the data set analyzed here includes multiple-vehicle households, thereby allowing us to explore the sensitivity of the estimates to their inclusion. In addition, the robustness of the results of the former study is checked by employing four additional waves of data for the years 2006 to 2009, so that the number of households in the database employed here almost doubles.

Methods

While abstaining from the application of the classical approaches that capture long-run asymmetric demand relationships and potential shifts of the corresponding demand curve in the long term (Dargay, 1992:169), we follow Tweeten and Quance (1969a, b) and choose a model specification that allows for identifying possible asymmetric fuel price responses in the short term, as we deliberately confine our investigation to households that have not changed their cars over the three years they are surveyed. In line with Tweeten and Quance, to distinguish between the response to rising and falling fuel prices, we employ two price variables, p^+ and p^-, with the price variable p^+ being defined as $p^+_{it} := p_{it}$ if $p_{it} > p_{i(t-1)}$ and $p^+_{it} := 0$ otherwise, while p^- is generated from falling prices in a similar way.

Given this price decomposition and our focus on the rebound definition preferred by Frondel, Ritter, and Vance (2012), we regress the logged monthly vehicle-kilometers traveled, ln (s), on those logged fuel prices D^+ ln (p) that are observed after a price increase from year t-1 to t, where $D^+_{it} := 1$ if $p_{it} > p_{i(t-1)}$, and zero otherwise, and on those logged fuel prices D^- ln (p) that are observed after a price decrease or stagnation from year t-1 to t, as well as a vector of control variables **x**:

$$\ln(s_{it}) = \alpha_0 + \alpha_{p^+} D^+_{it} \ln(p_{it}) + \alpha_{p^-} D^-_{it} \ln(p_{it}) + \alpha_X^T x_{it} + \xi_i + \nu_{it}$$

with $D^{+}_{it} = 1 - D^{-}_{it}$ for all i and t. The superscript T designates the transposition of a vector, ξ_i denotes an unknown individual-specific term, and ν_{it} is a random component that varies over individuals and time. Since travel demand shrinks with increasing fuel prices, the coefficients α_{p+} and α_{p-} of both price level terms should be negative in this model specification, as is confirmed by our estimation results.

Results

By using panel data comprised of households who did not change their automobile during the survey period, our econometric analysis was structured to allow for asymmetric price responses while at the same time minimizing the possibility that these arise from technical change. If asymmetric responses were to arise, they would rather be the result of changes in driving behavior. Failure to control for asymmetry would result in an upwardly biased estimate of the rebound, presuming that the response to price increases was indeed greater than to decreases.

Our empirical estimates suggest that, at least with respect to our isolation of potential behavioral changes in driving, concerns about such a bias are unsubstantiated, as the response to fuel price fluctuations is symmetric. In fact, we have failed to reject the null hypothesis that the magnitude of the response to a price increase is equal to that of a price decrease. Our symmetry finding also maintains when we expand the sample to include households owning multiple cars.

Conclusions

One implication emerging from this finding may be that the price asymmetry observed in many other studies is largely the result of the sunk-cost nature of energy-saving capital equipment, rather than behavioural inertia on the part of consumers. From a policy perspective, the fact that the estimated rebound is relatively high calls into question the effectiveness of the European Commission's current emphasis on efficiency standards as a pollution control instrument. The random-effects estimates of the rebound resulting from both the asymmetric and the reversible specification range between 58% to 70% for single-car households, which is virtually the same range as that obtained by Frondel, Peters, and Vance (2008), who used an abridged version of the current data set that merely extended to the year 2005.

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