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Asymmetric Reactions of Retail Gasoline Prices on the Changes in Crude Oil Prices in Chosen U.S. Cities

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Motivation

- Several studies dealing with the transmission of crude oil prices to retail gasoline prices indicate that retail gasoline prices respond more quickly when crude oil price rises rather than when it decreases; e.g. Radchenko (2005), Liu et al. (2010), Bacon (1991) called this adjustment as ”rockets and feathers” effect, Borenstein et al. (1997).
- Although U.S. Energy Information Administration website provide data retail gasoline prices on the aggregate U.S. level as well as on the lower levels, according to our best knowledge, the asymmetric reactions of retail prices on lower geographical levels has been not studied yet.

Focus and objective

- Focus
  - The commonly used methods in given empirical studies are error correction models (ECM) and vector autoregressive models (VAR); e.g. Radchenko (2005), Honarvar (2009), Liu et al. (2010) and Szomolányi et al. (2020a).
  - We provide an alternative empirical approach based on the adjustment cost function in linear-exponential (linex) form (Szomolányi et al., 2020b).
- Objective; we verify the asymmetric reactions of retail gasoline prices on the changes in crude oil prices in chosen U.S. cities using the linex approach.

Methods

- The LINEX adjustment costs form:

$$F\left[p_t, E_{t-1}(c_t)\right] = \frac{-\gamma\left[p_t - kE_{t-1}(c_t)\right] + e^{\gamma\left[p_t - kE_{t-1}(c_t)\right]} - 1}{\gamma^2}$$

- The input and output prices are denoted as *c* and *p*; technological coefficient is *k*; asymmetry coefficient is *γ*; the rockets and feathers hypothesis assumes a negative value of *γ*.
- The firm choses *c* to minimize the adjustment cost function. Using the rational expectation hypotheses, the result of the problem describes the reaction function in the form:

$$\Delta p_t = k\Delta c_t - \frac{1}{2}\gamma\Delta\left[\left(p_t - kc_t\right)^2\right] + u_t$$

Methods

- The orthogonality condition implied by the rational expectation hypothesis makes the general method of moments (GMM) a natural candidate to estimate equation. A Newey and West (1987) estimator is used to provide the estimates of standard errors.
- Assuming that oil shocks Δc_t is a normally distributed process with zero mean and variance σ^2, taking the first differences, expected values and logarithms of the first-order condition, we gain the price bias in the form:

$$E\left(\Delta p_t\right) = -\frac{k^2\gamma}{2}\sigma^2$$

Data

- Data are obtained from U.S. Energy Information Administration website:
- daily, Cushing, OK WTI Spot Price FOB in dollars per barrel (84522 observations).
- Weekly, MA Regular All Formulations Retail Gasoline Prices in dollars per gallon) in U.S. cities: Boston, Chicago, Cleveland, Denver, Houston, Los Angeles, Miami, New York, San Francisco, and Seattle (842—998 observations).
- According to the U.S. Energy Information Administration website, the retail fuel prices are collected every Monday, therefore the daily spot prices are aggregated to weekly to match their Monday spot values.

Results

- The value of Breusch-Pagan LM test statistics with 45 degrees of freedom is 11651.61. This is the reason why all equations are estimated with the system GMM method.
- We can confirm asymmetric reactions of retail gasoline prices on the changes in crude oil prices in each given city.
- The average weekly one-gallon gasoline price biases from the rockets and feathers effect differ from city to city; their values are between 0.02 cents in Los Angeles and 0.44 cents in Cleveland.

City	k	gamma	Bias
Boston	0.018039***	–0.685504***	**0.078918**
(std.err.)	(0.003822)	(0.130043)	
Chicago	0.026207***	–0.947743***	**0.230284**
(std.err.)	(0.005145)	(0.320860)	
Cleveland	0.028726***	–1.496240***	**0.436779**
(std.err.)	(0.002919)	(0.516326)	
Denver	0.019953***	–0.815281**	**0.114831**
(std.err.)	(0.007524)	(0.333588)	
Houston	0.023043***	–1.062391***	**0.199566**
(std.err.)	(0.004432)	(0.342203)	
Los Angeles	0.010804**	–0.423459***	**0.017485**
(std.err.)	(0.005313)	(0.067794)	
Miami	0.023451***	–0.822312***	**0.159988**
(std.err.)	(0.002830)	(0.137389)	
New York City	0.019534***	–0.654715***	**0.088383**
(std.err.)	(0.003227)	(0.097481)	
San Francisco	0.014321***	–0.509070***	**0.036937**
(std.err.)	(0.004256)	(0.080092)	
Seattle	0.015732***	–0.494553***	**0.043300**
(std.err.)	(0.003573)	(0.064116)	

Discussion and conclusion

- We verified and confirmed the hypothesis if the retail gasoline prices in chosen U.S. cities react asymmetrically on the changes in crude oil prices.
- We prefer the linex approach, because the character of fuel price making is rather discretionary and it better corresponds to the process of minimizing price adjustment costs.
- The study may be useful for explanation of price rigidities. Douglas and Herrera (2010): asymmetric retail gasoline price reactions to crude oil price changes can be addressed by the theory of strategic interactions between a firm and its consumers; e.g. Okun (1981).
- The average weekly one-gallon gasoline price biases from the rockets and feathers effect differ from city to city. Their values are between 0.02 cents in Los Angeles and 0.44 cents in Cleveland.

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