Online Appendix: Linking the Short-Run Price Elasticities of Gasoline and Oil Demand

In this appendix, we derive an explicit relationship between consumers' demand for gasoline and refiners' demand for crude oil in a model in which refiners are allowed to, but not required to have market power in the gasoline market. Refiners are treated as price-takers in the crude oil market. Our analysis is strictly short-term, as is appropriate in constructing impact price elasticities. In the interest of tractability, we abstract from the fact that gasoline is only one of several refined products jointly produced from crude oil. We postulate that gasoline is produced according to a Leontief production function over capital, labor, and oil, $G = \min\left(K, L, \alpha O\right).$ If capital is fixed in the short run and refiners' labor input can be varied on the intensive margin, which seems plausible in practice, refiners produce gasoline in fixed proportion to the quantity of oil consumed, $G = \alpha O,$ and pay a marginal cost equal to the price of oil, $P_O,$ plus the marginal cost of labor, $MC = P_O + c.$ P_G denotes the price of gasoline.

Consumers demand $G(P_G) = XP_G^{-\sigma} \big/ P^{1-\sigma},$ where X is the expenditure on gasoline, P is the consumer price index, and the price elasticity of demand for gasoline, η^G, equals $-\sigma.$ The inverse demand function is $P_G(G) = \omega G^{-1/\sigma}$ where $\omega \equiv X \big/ P^{1-\sigma}$. In the Cournot-Nash equilibrium, each of J identical refinery firms will choose its own quantity of gasoline output, $g_j,$ $j = 1, ..., J,$ given the outputs of other firms, to maximize profits $\pi_j = P_G(G) g_j - \left(c + P_O\right) g_j$ with respect to $g_j,$ where $G = \sum_j g_j$. The first-order condition is $\omega G^{-1/\sigma} - \omega g_j G^{(-\sigma-1)/\sigma} / \sigma - \left(c + P_O\right) = 0,$ $j = 1, ..., J.$ Summing over j and solving for the market price and gasoline production yields

$$P_G = \frac{J\sigma\left(P_O + c\right)}{J\sigma - 1} \qquad G = \left(\frac{\omega(J\sigma - 1)}{J\sigma\left(P_O + c\right)}\right)^{\sigma}.$$

Given $G = \alpha O,$ we obtain

$$\alpha O = \left(\frac{\omega\left(J\sigma - 1\right)}{J\sigma\left(P_O + c\right)}\right)^{\sigma}.$$

Log-linearization yields $\eta^{O,Use} \approx \eta^G P_O \big/ (P_O + c),$ where $\eta^{O,Use}$ denotes the price elasticity of demand for crude oil in use. The marginal cost estimates in Considine (1997) suggest that $c \approx 0,$ which implies $\eta^{O,Use} \approx \eta^G$.