PRICE PASS-THROUGH DEPENDENCE ON THE SOURCE OF COST INCREASES: EVIDENCE FROM THE EUROPEAN GASOLINE MARKET

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EXTENTED ABSTRACT

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1. Overview

This study uses European data to assess the pass-through from both exchange rate changes and world gasoline prices to retail prices. Specifically, we investigate if the degree of pass-through varies depending on whether the change in the domestic cost of foreign inputs is driven by exchange rate versus international price shocks. In the context of the European gasoline market, the main finding is that retail gasoline prices respond more mildly to changes in the dollar exchange rate than to changes in the dollar price of wholesale gasoline. Several supply and demand-side explanations are discussed including the magnitude of fluctuations, potential idiosyncrasies of the Euro, the degree of persistence in shocks, differences in contractual arrangements, the effect of currency depreciations on domestic demand and differences in consumer search behaviour. While the degree of cost pass-through has been widely discussed, especially within the international finance literature, little or no attention has been devoted to the specifics of cost shifter types. This study attempts to fill this gap highlighting that the source of cost changes matters in determining the adjustment path. In addition, it explores, albeit timidly, alternative theoretical explanations to this empirical pattern.

We argue that the most plausible explanation is related to changes in exchange rates which tend to reflect domestic conditions (i.e., the demand curve that they face) and hence sellers are quicker to pass on the implied price change to consumers, whereas world gasoline price changes are more likely global supply shocks, so they absorb more of this in their margins. In other words, consumers draw a direct link between the crude oil and retail gasoline prices, affecting their price expectations and their search intensity, and thus the optimal pass-through. We provide also fresh evidence that consumers are more exposed to news about oil prices than to news about exchange rates.

2. Methods

We employ the two most prevalent specifications in the retail gasoline price adjustment literature. The simplest and oldest of these is the Distributed Lag model (DL), which when estimated using a panel of countries, takes the form:

$$\Delta\log\left(R_{j,t}\right) = a_j + a_s + \sum_{l=0}^{L} b_l \Delta\log(C_{t-l}) + \varepsilon_{j,t} \qquad (1)$$

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where $R_{j,t}$ is the retail price (in the *domestic* currency) of gasoline in country j and period t, C_t is the upstream input price (in the domestic currency), $\Delta X_{j,t}$ is the change in $X_{j,t}$ from period t-1 to period t in country j, L is the number of lags in the upstream and downstream prices, a_j is a set of country dummy variables, and a_s is a set of seasonal dummy variables. This regression can also be estimated for a subset of countries or periods, or a subset of the parameters can be allowed to vary across countries or periods (e.g., they may take different values when the domestic currency is the Euro.

The changes in upstream prices in domestic currency can be decomposed into changes in the international price of gasoline and changes in the country's exchange rate. Let Γ_t be the international price of the upstream fuel in U.S. dollars (common for every country) and $E_{j,t}$ the exchange rate of country j to the dollar (units of domestic currency to one dollar). Then, the domestic currency price of the upstream fuel is $C_{t-l} = E_{j,t}\Gamma_t$. Substituting into equation (1), and allowing for the response to the exchange rate to differ from that of the international price of the input, we obtain the equation

$$\Delta\log\left(R_{j,t}\right) = a_j + a_s + \sum_{l=0}^{L} b_l \Delta\log\left(E_{j,t-l}\right) + \sum_{l=0}^{L} \beta_l \Delta\log(\Gamma_{t-l}) + \varepsilon_{j,t} \quad (2)$$

When the retail price response to the international price of the upstream input is the same as its response to the exchange rate, $b_l = \beta_l$ at all lag lengths. The DL model is sometimes augmented by the use of lags of the dependent variable. This yields the Autoregressive Distributed Lag (ARDL) model that is also common in the literature, and given by

$$\Delta\log\left(R_{j,t}\right) = a_j + a_s + \sum_{l=0}^{L} b_l \Delta\log(C_{t-l}) + \sum_{l=1}^{L} c_l \Delta\log\left(R_{j,t-l}\right) + \varepsilon_{j,t} \quad (3)$$

After decomposing upstream prices into prices in dollars and the exchange rate, this model yields

$$\Delta\log\left(R_{j,t}\right) = a_j + a_s + \sum_{l=0}^{L} b_l \Delta\log\left(E_{j,t-l}\right) + \sum_{l=0}^{L} \beta_l \Delta\log(\Gamma_{t-l}) + \sum_{l=1}^{L} c_l \Delta\log\left(R_{j,t-l}\right) + \varepsilon_{j,t}$$
(4)

The ARDL model does not account for the possibility that the upstream and downstream prices are cointegrated. If that is that case, incorporating the long-run relationship between these prices in the short-term dynamics through an error correction term provides for more efficient estimation and a more accurate representation of the price adjustment process. Let this long run relationship be given by the equation

$$\log\left(R_{j,t}\right) = k_j + m\log(C_t) + u_t \quad (5)$$

Then, the Error Correction Model (ECM) estimated from the entire panel of countries is given by:

$$\Delta\log\left(R_{j,t}\right) = a_j + a_s + \sum_{l=0}^{L} b_l \Delta\log(C_{t-l}) + \sum_{l=1}^{L} c_l \Delta\log\left(R_{j,t-l}\right) + d\left(\log\left(R_{j,t-1}\right) - k_j - m\log(C_{t-1})\right) + \varepsilon_{j,t} \quad (6)$$

where the parameter d is the speed at which the retail price returns to its long run equilibrium value. Substituting in for the international price of the upstream input and the country's exchange rate in the short-run dynamics yields the equation

$$\Delta\log(R_{j,t}) = a_j + a_s + \sum_{l=0}^{L} b_l \Delta\log(E_{j,t-l}) + \sum_{l=0}^{L} \beta_l \Delta\log(\Gamma_{t-l}) + \sum_{l=1}^{L} c_l \Delta\log(R_{j,t-l}) + d\left(\log(R_{j,t-1}) - k_j - m\log(C_{t-1})\right) + \varepsilon_{j,t} \quad (7)$$

This specification allows for the retail price in domestic currency to differ with respect to exchange rate fluctuations and fluctuations in the world price in US dollars, but imposes no differences in the long run relationship. We believe this to be reasonable, but in principle one could decompose the domestic price into an exchange rate component and a dollar price component in the cointegrating vector as well, yielding the specification

$$\Delta\log(R_{j,t}) = a_j + a_s + \sum_{l=0}^{L} b_l \Delta\log(E_{j,t-l}) + \sum_{l=0}^{L} \beta_l \Delta\log(\Gamma_{t-l}) + \sum_{l=1}^{L} c_l \Delta\log(R_{j,t-l}) + d\left(\log(R_{j,t-1}) - k_j - m\log(E_{j,t-l}) - \mu\log(\Gamma_{t-l})\right) + \varepsilon_{j,t} \quad (8)$$

It turns out there is minimal difference in the impulse response functions between using (7) and (8). Moreover, the ARDL model is "bracketed" by the DL and ECM models. Therefore, in what follows, we estimate regressions (2) and (7) for the entire panel of European Union countries, and also for subsets of those countries that use the Euro and those that do not.

When expressing changes in levels, the Distributed Lag model becomes

$$\Delta R_{j,t} = a_j + a_s + \sum_{l=0}^{L} b_l \Delta C_{t-l} + \varepsilon_{j,t} \quad (9)$$

To decompose the change of the input price into a foreign exchange and a world price component, we use the product rule, i.e., we write $\Delta C_t \approx \Delta E_{j,t}\Gamma_{t-1} + \Delta\Gamma_{j,t}E_{t-1}$. This expression is exact for infinitesimal changes (that is, using differential notation). For finite changes, the decomposition will be approximate. Using Γ_t and E_t instead of Γ_{t-1} and E_{t-1} yields an alternative approximation. In practice, there is minimal difference between the two expressions, and we report our main results based on the former decomposition. After substituting into equation (9) we obtain

$$\Delta R_{j,t} = a_j + a_s + \sum_{l=0}^{L} b_l \Delta E_{j,t}\Gamma_{t-1} + \sum_{l=0}^{L} \beta_l \Delta\Gamma_{j,t}E_{t-1} + \varepsilon_{j,t} \quad (10)$$

The corresponding error correction model in levels with a common long run response is given by

$$\Delta R_{j,t} = a_j + a_s + \sum_{l=0}^{L} b_l \Delta E_{j,t}\Gamma_{t-1} + \sum_{l=0}^{L} \beta_l \Delta\Gamma_{j,t}E_{t-1} + \sum_{l=1}^{L} c_l \Delta R_{j,t-l} + d(R_{j,t-1} - k_j - mC_{t-1}) + \varepsilon_{j,t} \quad (11)$$

We estimate specifications (10) and (11). As a robustness exercise, we also estimate threshold models in which the response of the retail price to small changes in the exchange rate or small changes in the upstream price is zero. To perform each of these regressions, we need to specify the lag length. We report results based on a lag length of 9 weeks, but shorter lags (e.g., 2 or 4 weeks) yield results that are substantially the same. The alternative approach, of using a different lag length for each specification (or subset of countries) based on some goodness of fit criterion, seems less appealing, because any differences across the estimation results might possibly in part be accounted for by differences in the lag length.

3. Data

Our empirical analysis is based on an unbalanced panel dataset of pre-tax retail gasoline prices comprising of weekly observations spanning the period from 1994 to 2015. The sample includes all 28 European Union countries, but no data are available for a country prior to its accession to the EU.[1] Our measure of upstream price is the New York spot price of wholesale gasoline, obtained from the U.S. Energy Information Administration.[2] The downstream price series contain occasional gaps reflecting weeks when there is no data collection (typically over the Christmas/New Year's holidays). When data is missing for a week, we impute the average value of the adjacent weeks.

4. Preliminary results

The empirical findings reveal a noticeable difference between the responses to exchange rate fluctuations and to changes in the world price of gasoline, especially in the first few weeks. Changes in the world price (in dollars) are passed through faster than changes in the exchange rate. For some, but not all lags, these differences are large when compared with the standard errors, which are clustered at the week level to account for cross-sectional dependence. In part because of somewhat large standard errors for the exchange rate pass-through, the joint test of the differences $b_l \neq \beta_l$ for all nine lags and the contemporaneous term is not statistically significant for either specification.[3] However, the object of primary interest is the cumulative pass-through of a cost change, not the incremental pass-through from one week to the next. Even though the differences in the incremental effects may not be statistically significant, the sum of these differences (which yields the cumulative effect) could be. This is particularly likely since almost all differences are of the same sign. Indeed, the null hypothesis of $\sum_{l=0}^{L} b_l = \sum_{l=0}^{L} \beta_l$ is rejected at the 5% level for the DL model and at the 1% level for the ECM model. Thus, the differences in the cumulative effects are statistically significant. The monthly effects are also statistically significant, but country effects only for the error correction model, suggesting differences in the price level across countries but not in the responses to upstream cost shocks.

The results indicate that a change in the wholesale cost of gasoline due to a change in the world dollar price of gasoline is passed through faster to the retail price than an equivalent change in the cost of wholesale gasoline due to a change in the exchange rate. The pattern of differences is somewhat distinct, with a large difference shortly after impact that is partially made up in later weeks. This results in rejecting the null of equal coefficients, but not rejecting the null that

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[1] The source of the retail data is the Weekly Oil Bulletin (http://ec.europa.eu/energy/en/data-analysis/weekly-oil-bulletin). Typically, a downstream price quote for a week corresponds to a Monday, and it is based either on an average of quotes obtained over the preceding week, or of reports obtained for that same day. Details of the sampling scheme for each country are contained in the Bulletin.

[2] https://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm. The data frequency for these series is weekly, but a daily series is also available and allows us to ascertain how the aggregation to the weekly series is implemented. Using a crude oil price, e.g., that of Brent, is less appropriate because it is further up the supply chain and has a smaller explanatory power in terms of explaining retail gasoline price movements as measured by the R-squared of the price adjustment equations. Moreover, crude is not a homogeneous product, and not all grades move in lock step in terms of price.

[3] The differences between the parameter estimates are statistically significant when cross-sectional dependence is ignored, but we believe the more conservative standard errors reported here are appropriate.

cumulative effects are the same: under this specification, foreign exchange shocks pass through slower to downstream prices, but cumulative effects are not different.

There are a number of possible explanations. Though we cannot investigate all of them, we examine (and to a large extent reject) some of them. These explanations can be divided to those that originate from the supply side (i.e., Non-linear Response with Respect to the Size of the Shock., Euro Specific Factors, Differential Persistence of Shocks, Contractual Factors) and to those that originate from the demand side such as correlation Between Currency Fluctuations and Growth, Consumer Search, Local Market Competition). However, these explanations are likely to hold more generally beyond EU countries. The question is to what extent they might be operative for other products. The demand channel that operates through consumer search is only applicable for consumer products for which the foreign input price is salient in the minds of consumers. This is unlikely to be the case for most imported goods. However, the demand channel that operates through the correlation of exchange rate changes and aggregate domestic demand should be relevant for most products. Therefore, the possibility exists that this divergence in pass-through rates holds more broadly beyond the market for liquid fuels, albeit to a smaller extent.