ASYMMETRIC TRANSMISSION OF GASOLINE PRICES IN BRAZIL: IMPACTS OF THE NEW PETROBRAS STRATEGY AND INFLUENCE OF ETHANOL MANDATE

Francisco Teixeira Raeder, Niágara Rodrigues and Luciano Losekann
Universidade Federal Fluminense (UFF) – Niterói/Brazil
Group of Energy and Regulation (GENER/UFF)
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Introduction: The Brazilian Gasoline Market

E&P Petroleum → Production of Ethanol → Addition mandate: 73% gasoline A + 27% anhydrous ethanol

Refinery → Distribution → Resale → Final Consumers

- Petrobras: more than 98% of refining capacity
- 131 firms in the sector, but 3 companies have 60% of market-share
- More than 40,000 gas stations and 43.5% are independent
- Gasoline C and hydrated ethanol are substitutes at the pump

Source: Authors’ elaboration
The Problem: Pricing Strategy and Price Transmission

- Petrobras is the main agent in the industry → relevance of its pricing strategy
  - Two periods: stability (until 2015) and short-term international alignment (since 2016)
- After price formation in the refining sector, how is it transmitted through all activities until final consumers?

Source: Authors’ elaboration using data from ANP (2020) and CEPEA (2020)
What is Asymmetry in Price Transmission?

- Symmetrical transmissions are Pareto-efficient

- Differences between negative and positive price adjustments in retail (R), in a specific market, when price changes in wholesale (W)

- “Feather” and “Rocket” Effects

- Asymmetrical transmissions cause distributive distortions in welfare

- This phenomenon is usually verified in commodities

Source: Adapted from Meyer and von Cramon-Taubadel (2004)
What Causes Asymmetry in Price Transmission?

a) Imperfect Competition:
   - Market power (collusion, profitability)
   - Search Costs
   - Edgeworth Cycles

Source: Maskin e Tirole (1988)

b) Brazilian Particularities:
   - Ethanol Addition Mandate
   - Taxation (ICMS)

Source: NovaCana (2020)
Objective and Methods

**Objective:** to verify the presence of asymmetries in price transmission between: (i) refinery, ethanol and distribution; and (ii) distribution and resale (gas stations)
- Does Petrobras’ pricing strategy change the dynamic of price transmission?
- Does the ethanol mandate influence asymmetries?
- How much do consumers lose because of asymmetries?

**Methods:** Long-term relationships:

\[
\text{Dist}_t = \beta_0 + \beta_1 \text{Ref}_t + \beta_2 \text{Eth}_t + \epsilon_t \quad (1)
\]

\[
\text{Res}_t = \beta_0 + \beta_1 \text{Dist}_t + \epsilon_t \quad (2)
\]

**Dynamic Ordinary Least Squares (DOLS) Estimator for (1) and (2)**
- Five Brazilian regions: Midwest, Northeast, North, Southeast and South
Methods: Testing for Asymmetries

• Lagged residuals from (1) and (2) used in Error Correction Models:

\[
\Delta Dist_t = \alpha + \sum_{i=1}^{I} \theta_i \Delta Dist_{t-1} + \sum_{j=0}^{J^+} \beta_j^+ \Delta Ref_{t-j}^+ + \sum_{j=0}^{J^-} \beta_j^- \Delta Ref_{t-j}^- + \sum_{k=0}^{K^+} \beta_k^+ \Delta Eth_{t-k}^+ + \sum_{k=0}^{K^-} \beta_k^- \Delta Eth_{t-k}^- + \lambda^+ ECM_{t-1}^+ + \lambda^- ECM_{t-1}^- + \epsilon_t
\]

(3)

\[
\Delta Res_t = \alpha + \sum_{i=1}^{I} \theta_i \Delta DRes_{t-1} + \sum_{j=0}^{J^+} \beta_j^+ \Delta Dist_{t-j}^+ + \sum_{j=0}^{J^-} \beta_j^- \Delta Dist_{t-j}^- + \lambda^+ ECM_{t-1}^+ + \lambda^- ECM_{t-1}^- + \epsilon_t
\]

(4)

• Hypothesis tests in (3) and (4)
  • Instantaneous Asymmetry of Magnitude: \( H_0: \beta_0^+ = \beta_0^- \)  
  
(5)

  • Short-term Asymmetry of Magnitude: \( H_0: \sum \beta^+ = \sum \beta^- \)  
  
(6)

  • Asymmetry of Speed: \( H_0: \lambda^+ = \lambda^- \)  
  
(7)
**Methods: Consumer Cost**

- Two Cumulative Response Functions (CRF) for resale, after a 1% shock in distribution
- Average prices in Brazil (not in regions)

\[
\text{Consumer Cost} = \sum_{j=0}^{J} CRF_{t+j}^+ - CRF_{t+j}^-
\]  

(8)

Where:

\[
CRF_{t+j}^+ = CRF_{t+j-1}^+ + \hat{\beta}_{t+j}^+ + \sum_{i=1}^{I} \hat{\theta}_i^+ \Delta Res_{t+j-i}^+ + \lambda^+(CRF_{t+j-1}^+ - \bar{\beta}_{1LT})
\]

\[
CRF_{t+j}^- = CRF_{t+j-1}^- + \hat{\beta}_{t+j}^- + \sum_{i=1}^{I} \hat{\theta}_i^- \Delta Res_{t+j-i}^- + \lambda^-(CRF_{t+j-1}^- - \bar{\beta}_{1LT})
\]
Results: Asymmetries Between Refinery, Ethanol and Distribution

- Decrease in the number of magnitude asymmetries in refinery: instantaneous ($5 \rightarrow 2$) and short-term ($4 \rightarrow 3$)

- New magnitude asymmetries in ethanol: instantaneous ($0 \rightarrow 3$) and short-term ($2 \rightarrow 4$)

- Decrease in the number of asymmetries of speed ($3 \rightarrow 2$)

- “Rocket” in magnitude; “Feather” in speed

<table>
<thead>
<tr>
<th>Period</th>
<th>Region</th>
<th>Magnitude (Refinery)</th>
<th>Magnitude (Ethanol)</th>
<th>Speed</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Instantaneous</td>
<td>Short-Term</td>
<td>Instantaneous</td>
</tr>
<tr>
<td>2004-2015</td>
<td>Midwest</td>
<td>Yes</td>
<td>Yes</td>
<td>No</td>
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<tr>
<td></td>
<td>Northeast</td>
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<td>South</td>
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<td>Yes</td>
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</tr>
</tbody>
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Source: Authors’ Elaboration
Results: Asymmetries Between Distribution and Resale

- The number of instantaneous asymmetries of magnitude remains the same ($4 \rightarrow 4$)
- Increase in the number of short-term magnitude asymmetries ($2 \rightarrow 4$)
- Decrease in the number of asymmetries of speed ($4 \rightarrow 3$)
- “Rocket” in magnitude; “Feather” in speed

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<tr>
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<th>Region</th>
<th>Magnitude Instantaneous</th>
<th>Magnitude Short-Term</th>
<th>Speed</th>
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<td>Yes</td>
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<td>No</td>
<td>Yes</td>
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<tr>
<td>2016-2019</td>
<td>Midwest</td>
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Source: Authors’ Elaboration
Results: Consumer Cost and Loss of Welfare

- There is no difference between Petrobras’ pricing strategy in $t=0$ and $t=1$

- After $t=2$, the consumer cost decreased

<table>
<thead>
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<th>Period</th>
<th>Monetary Loss</th>
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<td>2004-2015</td>
<td>R$ 2,57</td>
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<tr>
<td>2016-2019</td>
<td>R$ 2,07</td>
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Assumptions:
- 15,000 km in a year
- Fuel consumption: 1 liter per 10 km
- Gasoline price: R$ 4,80
- Thus, weekly expenditure: R$ 138,24

Source: Authors’ Elaboration
Conclusions

• Price transmission process, in all Brazilian regions, is asymmetric

• Petrobras’ pricing strategy and ethanol addition mandate influence the price transmission dynamics between refinery and distribution, but not in resale

• Short-term international alignment: higher volatility in prices, but better for consumers in terms of welfare

• Discussion: how to mitigate the asymmetries?
  • Transparency
Thank You!

Francisco Teixeira Raeder
francisco.raeder@yahoo.com.br