In Hot Water:
Clarifying British Prices in the Wake of Brexit

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Non-trade policy barriers remain poorly understood

- International goods markets seem on a **path of fragmentation**.
  - **Shallow integration**: goods markets disrupted by trade policy barriers
    - e.g. import tariffs and quotas in 2018, 2025, ...
  - **Deep integration**: trade-facilitating markets disrupted by non-trade-policy barriers
    - e.g. regulation of transport markets, use of financial sanctions.
- Assessing the **importance of non-trade policy barriers** is **empirically hard**:
  - **Relevant measure** when barriers relate to efficacy of trade-facilitating markets?
  - **Seperate change in barriers** from endogenous response of agents?
  - **Mechanism** behind the change in the barriers?
- Consider the EU-UK **Trade and Cooperation Agreement (TCA)**:
  - ensures tariff-free trade between the EU and UK...
  - ... but EU → UK trade was 25% lower in 2022 (Freeman et al., 2024).

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This paper aims to:

1. estimate increase in **EU → UK non-trade policy barriers** following the introduction of the TCA
2. quantify the **contribution** of one mechanism, i.e., an increase in freight rates for road transport.

How do we answer **abovementioned concerns**?

- **Relevant measure** when barriers relate to efficacy of trade-facilitating markets?
  - Compare change in marginal cost of imported products in UK to the marginal cost in IE and FR
- **Seperate change in barriers** from endogenous response of agents?
  - We focus on the bottled water industry
  - (1) Production relocation is restricted, (2) Short value chain
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What do we do and find?

I will discuss **three results**:

1. Response of **UK consumer prices** after the introduction of the TCA:
   - Prices of imported products ↑ ≈ 17%,
2. Response of **freight rates** for road transportation:
   - International routes ↑ ≈ €850
3. What is the overall increase in **non-trade-policy barriers** and what is the contribution of changes in freight rates?
   - We estimate a model of demand and supply of the bottled water industry

   ⟶ Non-trade policy barriers increased by 17% following the TCA (preliminary!)

   ⟶ Transport costs account for ≈ 25% of this increase (preliminary!)

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Data sources

We combine **three data sources**:

1. **Household-level scanner data** on non-alcoholic beverages from GfK and Kantar
   - **Spatial**: BEL, FRA, and UK
   - **Time**: Daily from 2010 until 2022, aggregated to monthly level
   - **Water variety**: A combination of brand-flavored-package-bottle size
2. Based on Directive 2009/54/EC, we hand-collect **production locations** of bottled water
3. Route-level **freight rates** from Upply
   - **Spatial**: From ≈ 20 water sources to ≈ 40 major population centers
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Finding 1: Consumer prices of **imported** products

Consider the following **specification**:

$$\ln\left(p_{j,dt}^{\text{LCU}}\right) = \sum_{k \neq 2019M12} \beta_k \left(\mathbb{1}\,(d = UK) \times \mathbb{1}\,(k = t)\right) + \theta_{j,d} + \lambda_{j,t} + \varepsilon_{j,dt}$$

where

- $\theta_{j,d}$ are product-destination fixed effects.
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- Sample: (j, d) = {Evian-BEL, Evian-FRA, Evian-UK, ~~Buxton-UK~~}

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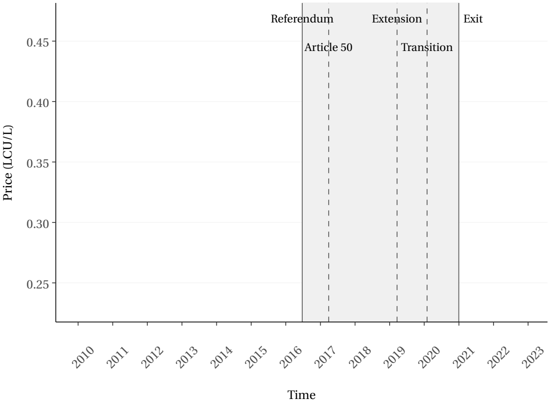
Finding 1: UK consumer prices of **imported water** $\uparrow \approx 17\%$



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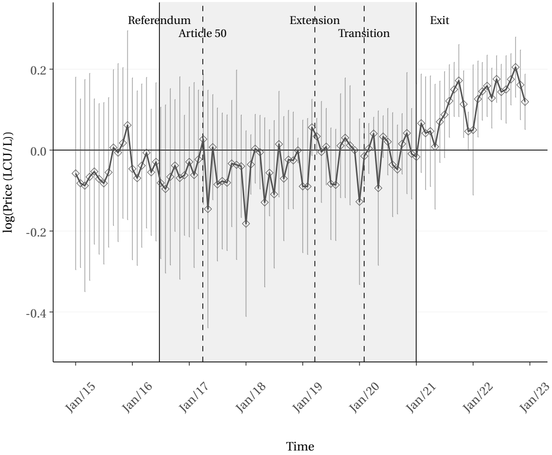
GBP/EUR Covid infections

Finding 1: UK consumer prices of imported water $\uparrow \approx 17\%$

Figure 1: Treatment effect



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Finding 1: Consumer prices in BEL ≈ Consumer prices in FRA

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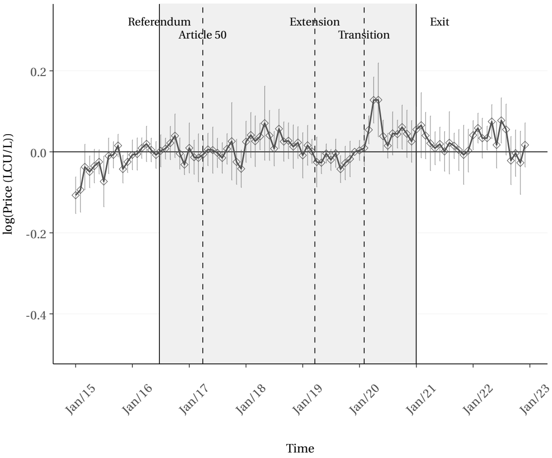
Finding 1: Consumer prices in BEL ≈ Consumer prices in FRA

Figure 2: Placebo effect



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Finding 2: Freight rates on **international** UK-bound routes

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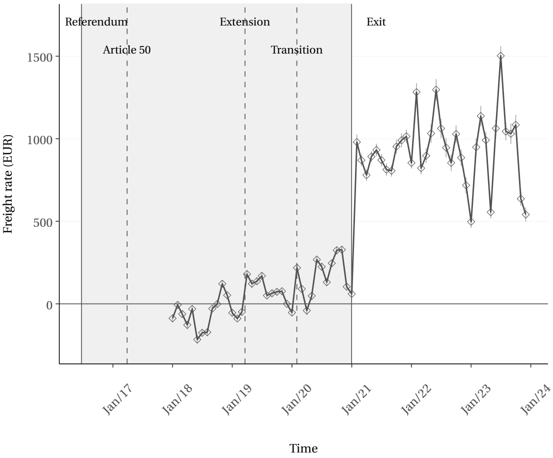
- **Sample**: {Evian-Brussels, Evian-Paris, Evian-Cambridge, ~~Buxton-Cambridge~~}
- **Findings**:
  - **Prior to the TCA**, rates on international UK-bound rates are on a mild upward trend.
  - Two years **after the TCA**, rates on international UK-bound rates are €850 more expensive.

Finding 2: **international** UK-bound freight rates $\uparrow \approx 850EUR$

Figure 3: Treatment effect



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- **Sample**: {Evian-Brussels, Evian-Paris, Evian-Cambridge, ~~Buxton-Cambridge~~}
- **Findings**:
  - **Prior to the TCA**, rates on international UK-bound rates are on a mild upward trend.
  - Two years **after the TCA**, rates on international UK-bound rates are €850 more expensive.

Finding 2: Freight rates on BEL-bound ≈ freight rates on FRA-bound routes

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- **Findings**:
  - **Prior to the TCA**, rates on BE- and FR-bound routes closely track each other
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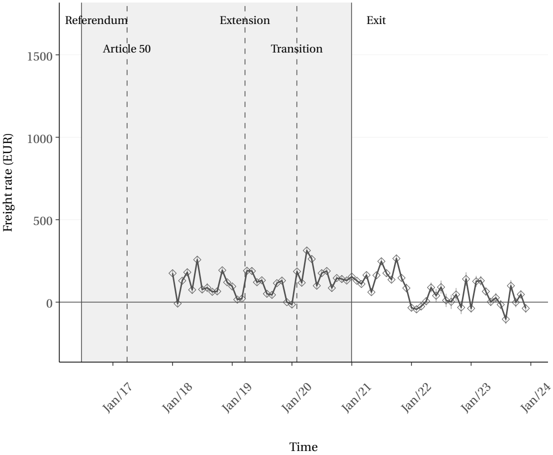
Figure 4: Placebo effect



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Result 3: Contribution of Δ freight rates → Δ consumer prices

Work-in-progress structural model

We leverage a **structural model** for two reasons:

1. to map changes in consumer prices into **changes in non-trade policy barriers**
   - separating changes in **destination-specific markups** from changes in destination-specific marginal costs
   - controlling for changes in **other destination-specific non-traded costs**, e.g. distribution costs.
2. to quantify **the contribution of changes in freight rates** to changes in non-trade policy barriers
   - by calculating a **counterfactual scenario** where UK-bound freight rates track BEL- and FRA-bound rates.
   - by estimating the **cost-function** of supplying bottled water

▸ Demand model ▸ Demand Estimation ▸ Supply model ▸ Supply Estimation ▸ Specification of the counterfactual

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First results

- **"Actual"**: Marginal cost of imported water ↑ 17%.
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  - **Construction**: Use post-TCA evolution for BE- and FR-bound routes to predict counterfactual freights rates on UK-bound routes
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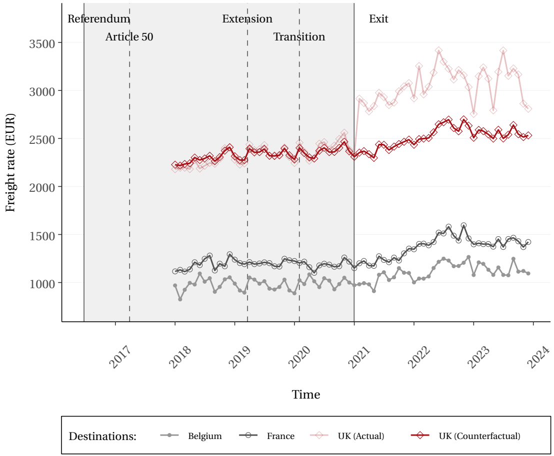

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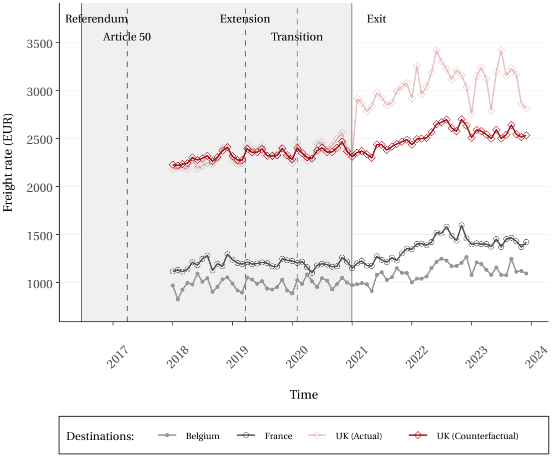

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Concluding remarks

- Renewed **fragmentation** of international goods markets
  - ↪ non-trade policy barriers remain poorly understood (Goldberg and Pavcnik, 2016).

- **This paper** leverages the bottled water industry
  1. to estimate the Brexit-induced increase in non-trade policy barriers
  2. quantify the contribution of one non-trade policy barrier, i.e. increased freight rates

- We have **three main findings**:
  - UK **consumer prices of imported water** increased by 17% relative to BEL and FRA prices.
  - **Freight rates on UK-bound routes** increased by 30% relative to BEL- and FRA-bound routes.
  - Increase in **freight rates explains** 25 – 30% of the increase in marginal costs of foreign products.

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Appendix

Contribution to the literature - Back

- **Deep trade agreements and non-trade policy barriers**: Kee, Nicita, and Olarreaga (2009), Chen and Novy (2011), Baier, Bergstrand, and Feng (2014), Fontagné et al. (2015), and Dhingra, Freeman, and Huang (2023)
  - uses trade flows as the measure $\Longrightarrow$ little guidance on which barriers matter most.
  - This paper uses prices as measure and quantifies contribution of changes in freight rates
- **Endogenous transport costs**: Hummels, Lugovskyy, and Skiba (2009), Behrens and Picard (2011), Pascali (2017), Ishikawa and Tarui (2018), Brancaccio, Kalouptsidi, and Papageorgiou (2020) and Wong (2022)
  - considers the joint determination of trade flows and freight rates in equilibrium
  - *This paper* shows that freight rates endogenously responded following the TCA.
- **Effects of Brexit**: (Steinberg, 2019; Graziano, Handley, and Limão, 2021; Fernandes and Winters, 2021; Breinlich et al., 2022; Bakker et al., 2022; Corsetti, Crowley, and Han, 2022; Ahmad et al., 2023; Freeman et al., 2024)
  - focuses on uncertainty and news effects before the TCA
  - *This paper* focuses on the effects after the TCA and quantifies the contribution of one channel.

Data - Consumption data - ▸ Back

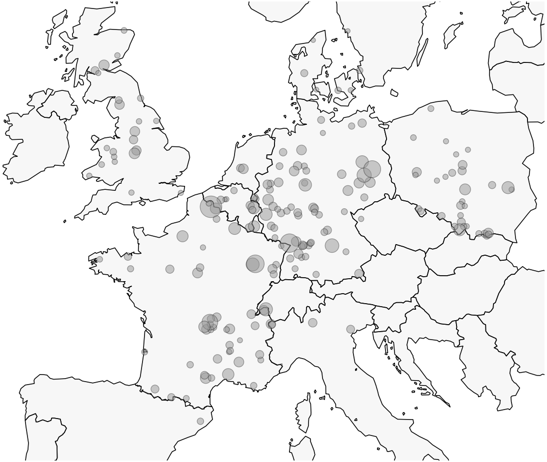
Table 1: Sample overview

Variable	Overall	BEL	FRA	UK
Nr. Households				
· NARTD	53,122	5,303	17,915	29,904
· Water	40,219	4,662	16,326	19,231
Transactions ('1,000)	7,319	1,014	3,293	3,012
Nr. Products	660	297	265	214
Average consumer price				
· (LCU)	-	0.37	0.28	0.33
· (EUR)	-	0.37	0.28	0.40
Inside good share (rel. NARTD)				
· Expenditure	-	0.22	0.30	0.13
Nr. Production locations				
· All	122	71	67	48
· Local	-	10	56	35
Origin (volume share)				
· Belgium	-	0.211	0.001	0.000
· France	-	0.473	0.902	0.075
· UK	-	0.000	0.000	0.743
· Other	-	0.103	0.066	0.021
· Unknown	0.091	0.213	0.031	0.161

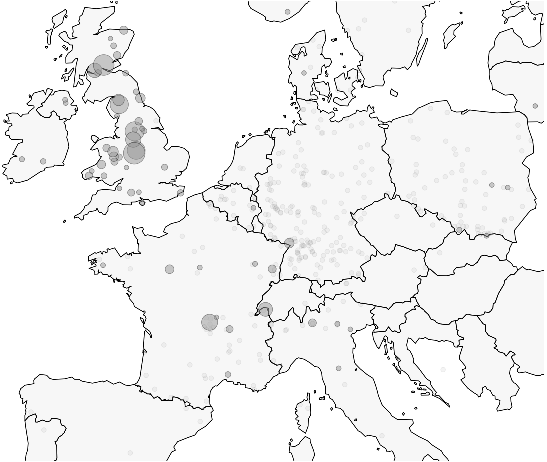
Data - Production locations - ▸ Back

Figure 5: Production locations

(a) All sources



(b) Sources selling to UK



The timeline of Brexit - ▸ Back

Brexit was a **lengthy process**:

1. The UK decides to leave the EU through the **referendum of June** 23^{rd}**, 2016** ...

2. ... which was followed by a **painfully slow process**:
   - Article 50 was triggered in 2017
   - A bunch of missed deadlines and extensions in 2019
   - Transition period towards offical exit in January 2020

3. The **Trade and Cooperation Agreement** governs EU-UK trading relations from January, 2021 onwards:
   - *Free trade agreement* subject to rules-of-origin rules

   ↪ But: *Regulatory changes* about cross-border safety provision and customs checks.

GBP/EUR Exchange Rate

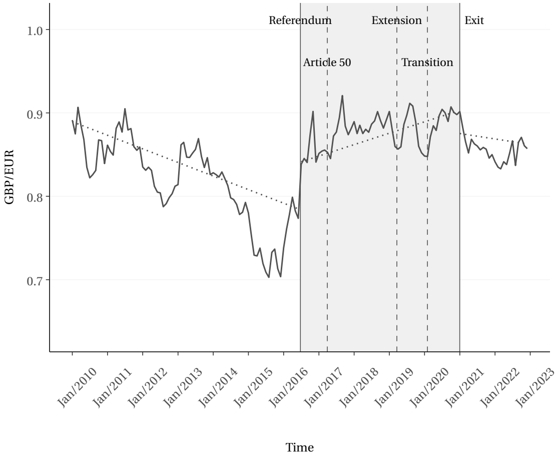


Figure 6: Source: European Central Bank

Daily Covid-19 infections per 1mln people

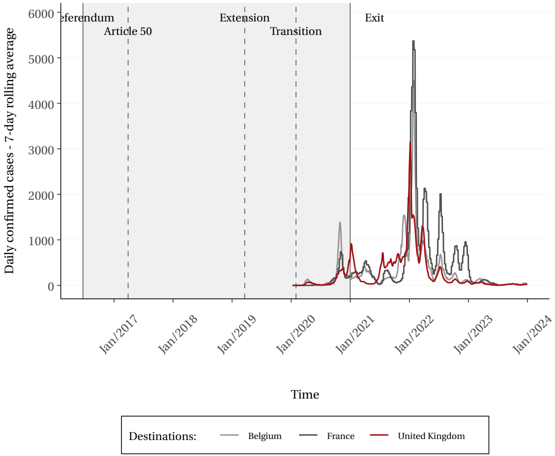


Figure 7: Source: Our world in Data - Oxford Martin School

Average evolution of LCU price per liter

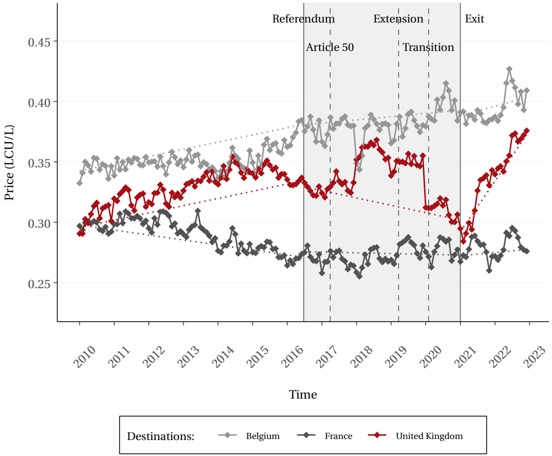


Figure 8: Source: Authors' own calculations

Evolution of wage cost in retail

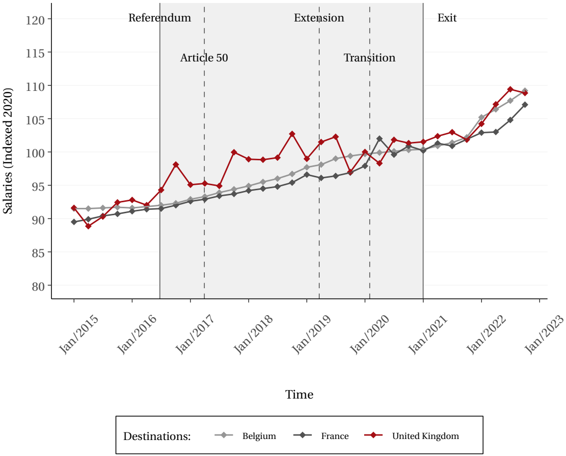


Figure 9: Source: Eurostat and Office for National Statistics (ONS)

Preferences - Assumptions and specification - ▸ Back

Consumers $i = 1, \ldots, N_{dt}$ chooses among $j = 1, \ldots, \mathcal{J}_{dt} + 1$ products by solving:

$$\max_{j \in \mathcal{J}_{dt}+1} U_{ij,dt} = \alpha \ln\left(P_{j,dt}\right) + \boldsymbol{\beta}^{'} \boldsymbol{X}_{j,dt} + \xi_{j,dt} + \zeta_{g(j)} + \tilde{\varepsilon}_{ij,dt}$$

where

- $\alpha \ln\left(P_{j,dt}\right)$ captures price sensivity
- $\boldsymbol{\beta}^{'} \boldsymbol{X}_{j,dt} = \{\theta_{j,d}, \theta_{dt}\}$ are absorb product characteristics.
- $\xi_{j,dt}$ is a product-level demand shifter.
- $\zeta_{g(j)}$ is a random effect with $\mathcal{G} = \{\text{branded, private label}\}$.
- $\tilde{\varepsilon}_{ij,dt}$ captures taste for products by consumers. We assume:

$$\zeta_{g(j)} + \tilde{\varepsilon}_{ij,dt} \sim F(\varepsilon) = \exp\left\{ -\sum_{g \in \mathcal{G}} \left(\sum_{j \in \mathcal{J}_{g,dt}} \exp\left[-\varepsilon / (1-\sigma)\right] \right) \right\}^{1-\sigma}$$

Preferences - Results - Back

Table 2: Demand estimates

	OLS	IV
$\ln\left(s_{j,dt}/s_{0,dt}\right)$	(1)	(2)
$\log\left(p_{j,dt}\right)$	-0.0287^{*}	-1.69^{**}
	(0.016)	(0.772)
$\log\left(s_{j\|g,dt}\right)$	1^{***}	0.86^{***}
	(0.003)	(0.143)
N	28,275	28,275
1^{st}Stage F-stat : $\log\left(p_{j,dt}\right)$	-	41.20
1^{st}Stage F-stat : $\log\left(s_{j\|g,dt}\right)$	-	25.95
$\theta_{j,d}$	✓	✓
λ_{dt}	✓	✓
Median Own Price Elasticity	-	-12.03
Median Market Price Elasticity	-	-0.35

Notes: Standard errors clustered at the product-destination level. Significance at the 0.1^{*}, 0.05^{**}, 0.01^{***} levels.

- With assumption on $\zeta_{g(j)} + \tilde{\varepsilon}_{ij,dt}$, **estimable equation** is:

$$\ln\left(\frac{s_{j,dt}}{s_{0,dt}}\right) = \alpha \ln\left(P_{j,dt}\right) + \boldsymbol{\beta}' \boldsymbol{X}_{j,dt} + \sigma \log\left(s_{j|g,dt}\right) + \xi_{j,dt}$$

- The **results** are:
  - **OLS** yields inelastic demand
  - We employ the following **instruments**:
    - $P_{j,dt}$: international hausman instrument (F-stat: 41.20)
    - $s_{j|g,dt}$: number of products per nest (F-stat: 25.95)
  - **IV** yields very elastic own-price elasticities at ≈ -12.

Backing-out marginal costs - Assumptions and specification - Back

With **upstream Bertrand-Nash** and **perfect pass-through downstream retailers**, we have that:

- Using the FOCs, we **separate markups from marginal costs**:

$$\underbrace{\boldsymbol{c}^r_{dt} + \boldsymbol{c}^m_{dt}}_{\text{Marginal cost}} = \underbrace{\boldsymbol{p}^r_{dt}}_{\text{Retail price}} + \underbrace{\left(\boldsymbol{\Delta}_{dt} \odot \boldsymbol{\Omega}^w_{dt}\right)^{-1} \cdot \boldsymbol{s}_{dt}(\boldsymbol{p}^r; \boldsymbol{\Theta}^d)}_{\text{Manufacturer markup}}$$

- By parameterizing backed out marginal costs, we **decompose changes in marginal costs**:

$$\underbrace{c^r_{j,dt} + c^m_{j,dt}}_{\text{Marginal costs}} = \underbrace{\omega_{j,t}}_{\text{production costs}} + \underbrace{\beta\left(\frac{1}{k}\sum_k \mathrm{t}_{s(j),dt-k}\right)}_{\text{Transport costs}} + \underbrace{\gamma w^r_{dt}}_{\text{Distribution cost}} + \eta_{j,dt}$$

- By feeding in **counterfactual** $t^{\text{counter}}_{s(j),dt-k}$, we can recompute $c^r_{j,dt} + c^m_{j,dt}$ and $p_{j,dt}$.

Backing-out marginal costs - Results - ▸ Back

Table 3: Cost function estimates

$\hat{mc}_{j,dt}$	k = 0	k = 1
$\frac{1}{k}\sum_k \mathrm{t}_{j,dt-k}$ (1'000 EUR)	-0.0122	0.124^{**}
	(0.034)	(0.060)
N	28,853	28,853
Adj. R^2	0.71	0.72
$\omega_{j,t}$	✓	✓

Notes: Standard errors clustered at the product-destination level. Significance at the 0.1^{*}, 0.05^{**}, 0.01^{***} levels.

- Estimate the following **equation**:

$$\widehat{c^r_{j,dt} + c^m_{j,dt}} = \omega_{j,t} + \beta \left(\frac{1}{k} \sum_k \mathrm{t}_{s(j),dt-k} \right) + \eta_{j,dt}$$

- We obtain the following **results**:
  - **Contemporaneously** uncorrelated
  - When accounting for **lags**:

$$\mathrm{t}_{s(j),dt-k} \uparrow €1000 \implies \widehat{c^r_{j,dt} + c^m_{j,dt}} \uparrow €0.12$$

Clarifying British Prices in the Wake of Brexit - Back

Table 4: Foreign products: $\ln\left(y_{j,dt}\right) = \sum_t \beta_t \left(\mathbb{1}\left(d = UK\right) \times \mathbb{1}\left(t \neq 2019M12\right)\right) + \theta_{j,d} + \lambda_{j,t} + \varepsilon_{j,dt}$

y	$\ln\left(p_{jt}\right)$	$\ln\left(\hat{mc}_{jt}\right)$	$\ln\left(\hat{\mu}_{jt}\right)$	$\ln\left(mc_{jt}^{\text{Counter}}\right)$	$\ln\left(p_{jt}^{\text{Counter}}\right)$
	(1)	(2)	(3)	(4)	(5)
$T_{i,d} \times \mathbb{1}\left(t = 2018\right)$	-0.0337^{**}	-0.0339^{**}	-0.0323^{**}	-0.0191	-0.0189
	(0.0154)	(0.0154)	(0.0154)	(0.0132)	(0.0165)
$T_{i,d} \times \mathbb{1}\left(t = 2019\right)$	-	-	-	-	-
$T_{i,d} \times \mathbb{1}\left(t = 2020\right)$	0.00812	0.00645	0.0213^{*}	0.00449	0.00567
	(0.0114)	(0.0114)	(0.0118)	(0.0118)	(0.0121)
$T_{i,d} \times \mathbb{1}\left(t = 2021\right)$	0.109^{***}	0.108^{***}	0.117^{***}	0.0672^{***}	0.0871^{***}
	(0.0203)	(0.0192)	(0.0329)	(0.0193)	(0.0194)
$T_{i,d} \times \mathbb{1}\left(t = 2022\right)$	0.171^{***}	0.17^{***}	0.182^{***}	0.116^{***}	0.123^{***}
	(0.0358)	(0.0336)	(0.0528)	(0.0271)	(0.0282)
Median of LHS	0.91	0.80	0.10	0.79	0.88
$\theta_{i,d}$	✓	✓	✓	✓	✓
$\lambda_{i,t}$	✓	✓	✓	✓	✓
R^2	0.377	0.378	0.361	0.193	0.236
No. obs	378	378	378	378	378

Notes: Standard errors clustered at the product-destination level. Significance at the 0.1^{*}, 0.05^{**}, 0.01^{***} levels.

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