Price Passthrough without Intertemporal Substitution: Evidence from Germany's Temporary VAT Cut

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Motivation

- Recent crises have led to renewed interest in temporary VAT changes as unconventional fiscal policy with interest rates at the zero lower bound (e.g., Feldstein 2002, Hall 2011, Correia et al. 2013, Seidl and Syrich 2023, Andreolli et al. 2025)

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- Temporary VAT changes can stimulate the economy if
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  - The elasticity of intertemporal substitution (EIS) is sufficiently high

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- Temporary VAT changes can stimulate the economy if
  - Price passthrough is sufficiently high
  - The elasticity of intertemporal substitution (EIS) is sufficiently high
- Sizable literature characterizing passthrough, but effectiveness of temporary VAT remains debated...
  - Debate on quantity responses to VAT changes
    (e.g., Cashin and Unayama 2016, 2021; Koeniger and Kress 2024; Bachman et al. 2026)
  - Longstanding debate on the value of the EIS in other contexts
    (e.g., Havranek 2015, Best et al., 2020)

This Paper

- We assess an unconventional fiscal policy reform implemented during the COVID crisis in Germany
- From July to December 2020, Germany reduced the regular VAT rate from 19% to 16%
- We use unique and comprehensive scanner data on durable (SMCG) and non-durable (FMCG) goods
- We estimate the policy effect on prices and quantities using other European countries as control groups (as well as a within-Germany design for prices)
- We use a simple model to recover the implied EIS from our price and quantity estimates

Preview of Results

1. High passthrough rates: 65% for durables and 91% for non-durables

2. No evidence of significant quantity effects

3. Low implied values of elasticity of intertemporal substitution (accounting for noise)
   - upper bound EIS of 0.09 in presence of strong adjustment frictions
   - intuition: short-run quantity response is small even for durable goods, for which price incentives to adjust are strong (b/c VAT change is high relative to per-period user cost)

Literature

1. Price effects of value-added or sales taxes

   Besley and Rosen (1999), Carbonnier (2007), Crossley et al. (2014), Kosonen (2015), Benzarti and Carloni (2019), Benzarti et al. (2020), Benedek et al. (2020), Buettner and Madzharova (2021), Montag et al. (2023), and Fuest et al. (2025)

   We add:

   → Focus on a broad set of durable and non-durable goods for a temporary VAT change

   → Comprehensive microdata across several countries

2. Estimating quantity responses and the EIS

   Blundell (2009), Crossley et al. (2009), Crossley et al. (2014), Havránek (2015), Cashin and Unayama (2016), Cashin and Unayama (2021), D'Acunto et al. (2018), Best et al. (2020), Buettner and Madzharova (2021), D'Acunto et al. (2022), Koeniger and Kress (2024), and Bachmann et al. (2026)

   We add:

   → Direct evidence on simultaneous price and quantity responses for both durables and non-durables

   → Quasi-experimental, high-frequency research design combined with simple model delivers tight bound on EIS

Roadmap

1. Data
2. Empirics
3. Model-implied Bound for the EIS

Data source

- Data from NielsenIQ (formerly GfK), provided by AiMark
- Transaction data based on scanners for durables (SMCG) and non-durables (FMCG) in Germany, the Netherlands, Italy and Austria
- In all four countries, SMCG and FMCG account for approximately 50% of household expenditures on goods and 25% of total household expenditures
  - Main missing items: shelter, transportation, services

Durable goods

- Durables = slow-moving consumer goods, SMCG
- Scanned at point-of-sale, i.e. cash desk of the store
- Examples: consumer electronics, furniture, gardening, major domestic appliances (e.g., washer), small domestic appliances (e.g., microwave)
- Dataset covers both online and offline purchases
- Sample covers more than 100 million transactions in 2020-2021 in Germany, the Netherlands, Italy and Austria

Non-durable goods

- Non-durables = "fast-moving consumer goods", FMCG
- Barcodes are scanned by households participating in the survey
- Typically goods purchased at the supermarket
- Examples: food, beverages, personal care, etc.
- Dataset covers both online and offline purchases
- Sample includes around 30,000 households in Germany, around 10,000 in NL, 8,500 in ITA, and 4,500 in AUT

Outline

Treatment: Stimulus program

- On June 03, 2020, the German government announced a 130 billion Euro economic stimulus program, consisting of four main measures
  1. Temporary VAT rate cut
  2. Bonus payments for families
  3. Temporary support for small and medium-sized firms
  4. Financial support for municipalities

Treatment: Temporary VAT rate cut

- Two VAT rates were changed
  - Standard rate from 19% to 16%
  - Reduced rate (for necessities): from 7% to 5%
- Timing
  - Announced: June 3, 2020
  - Rate cut: July 1, 2020
  - Rate re-raised: January 1, 2021

Research Design

- We use different research designs from the family of differences-in-differences (DID) models
  - Treatment group: Germany
  - Two Treatments: Temporary VAT rate cut from July 2020 until December 2020; increase to old levels in January 2021
  - Control groups: The Netherlands, Italy, Austria

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  - Treatment group: Germany
  - Two Treatments: Temporary VAT rate cut from July 2020 until December 2020; increase to old levels in January 2021
  - Control groups: The Netherlands, Italy, Austria
- Identifying assumption: Price/quantity changes in counterfactual Germany without a VAT reduction are identical to the ones in control group countries, NL, AUT, ITA
  - Main concern: time-varying, Germany-specific shocks
  - Assess in several ways:
    - consider precise timing of both treatment (July & January)
    - prices: graphical approach
    - quantities: leverage heterogeneity across categories
      (model predicts stronger quantity response for more durable goods)

Empirics Roadmap

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    - Turn to statistical diff-in-diff designs in following steps to estimate the average effect for both prices and quantities

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  - Step 2: Diff-in-diff results for price passthrough

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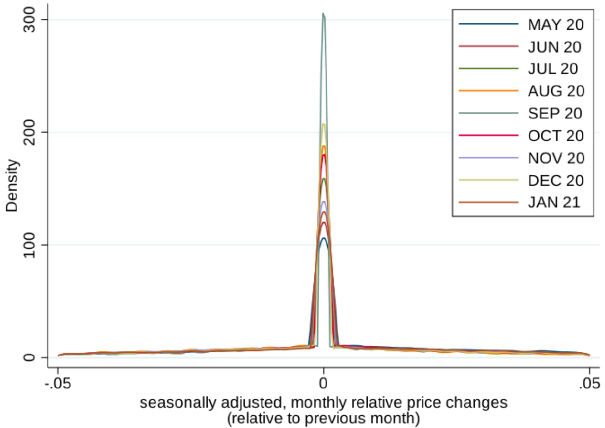
  - Step 2: Diff-in-diff results for price passthrough
  - Step 3: Diff-in-diff results for quantities

Outline

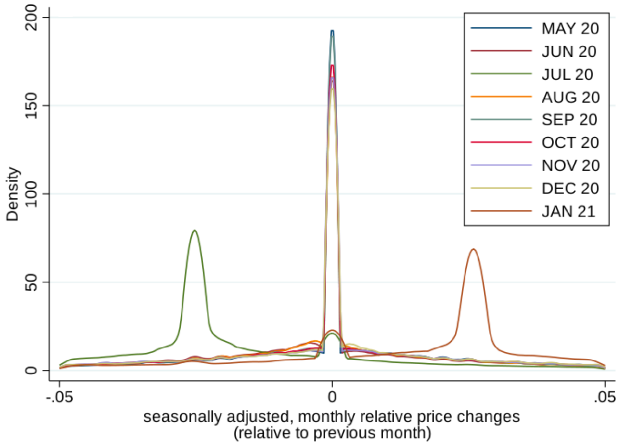
Graphical Approach

- Perfect pass-through would imply a price change of -2.52% ($= 1.16/1.19 - 1$) from June to July 2020
- Price changes of this or larger magnitudes are routinely observed in price change distribution at monthly or weekly levels
- However, price change distribution tends to be concentrated around zero in all periods/countries – test whether this is still the case when VAT changes

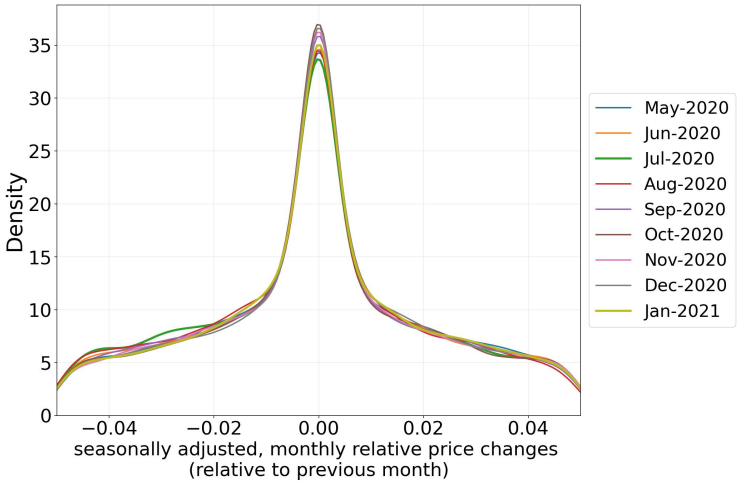
Monthly Price Changes over the Pandemic: Durables, Netherlands



Monthly Price Changes over the Pandemic: Durables, Germany



Monthly Price Changes over the Pandemic: Non-Durables, Netherlands



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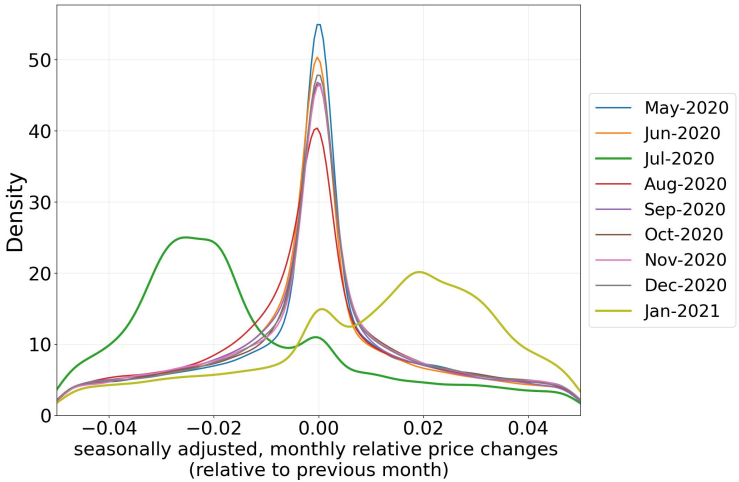


Step 1: Summary

- Peaks of the density centered around -2.5% in July 2020 and +2.5% in January 2021
- Suggests high pass-through rates for many product categories, but mostly informative above the modal price change
- Methodology not feasible for quantities as there is no stable part of the distribution of quantities changes (vs. stable modal null price change)

Outline

Outcomes: Granular Price and Quantity Indices

- We calculate monthly Tornqvist price and quantity index for a granular country-specific product category c, sold in country j and month t
- The price index is defined as (quantity index $Q_{c,t}$ analogously):

$$P_{c,t} = \prod_{i \in \Omega_{c,t,t-1}} \left(\frac{p_{ic,t}}{p_{ic,t-1}}\right)^{\frac{s_{ic,t-1}+s_{ic,t}}{2}}$$

  - $p_{ic,t}$: average price of product i of category c sold in month t with products i defined at the retailer-barcode level
  - $\Omega_{c,t,t-1} = \Omega_{c,t} \cap \Omega_{c,t-1}$: basket of all goods that are available across *adjacent* periods $t-1$ and t in category c
  - $s_{ic,t}, s_{ic,t-1}$: Tornqvist weight, i.e. average expenditure share of the product in the two periods:

$$s_{ic,t} = \frac{p_{ic,t} q_{ic,t}}{\sum_{i \in \Omega_{c,t,t-1}} p_{ic,t} q_{ic,t}} \quad \text{and} \quad s_{ic,t-1} = \frac{p_{ic,t-1} q_{ic,t-1}}{\sum_{i \in \Omega_{c,t,t-1}} p_{ic,t-1} q_{ic,t-1}}$$

Empirical Model: Triple Differences

- Given outcome $Y_{c,t} \in [P_{c,t}, Q_{c,t}]$, we estimate the following triple-difference-model at the category-month level

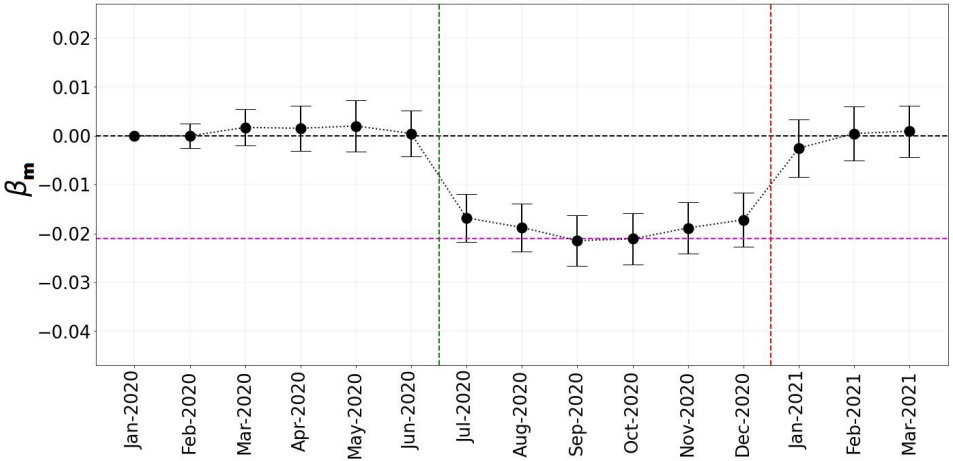
$$\ln \Delta Y_{c,t} = \sum_m \beta_m \left(\mathbb{1}\{j = \text{Germany}\} \cdot \mathbb{1}\{t = m\} \right) + \gamma X_{j(c),t} + \mu_{j(c)} + \rho_t + \varepsilon_{c,t}$$

  - 1st Diff: $\mathbb{1}\{j = \text{Germany}\}$ is a dummy variable equal to one if product category c is sold on the German market
  - 2nd Diff: The set of months dummies $\mathbb{1}\{t = m\}$ before and after the reform
  - 3rd Diff: Δ represents the difference of the current monthly value to the value in the previous year: takes out seasonality and difference out country-specific category c fixed effects

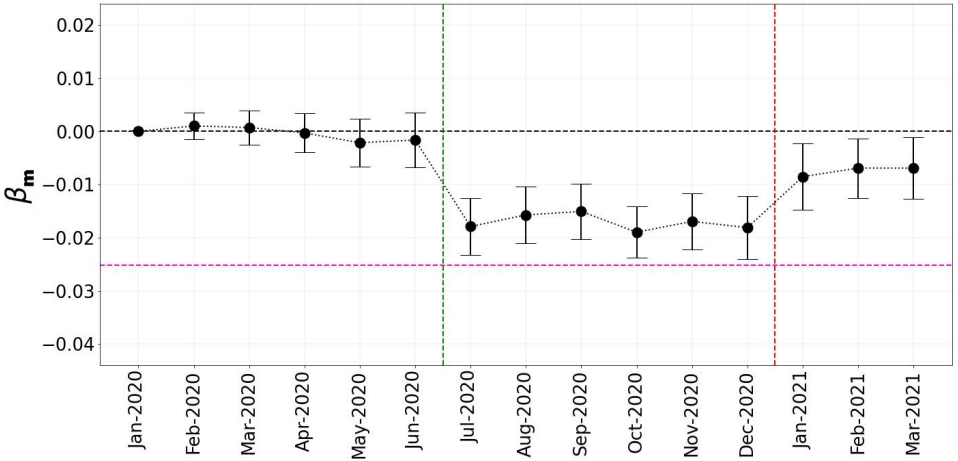
  - ρ_t are month fixed effects
  - $\mu_{j(c)}$ are country-specific linear time-trends

- Estimated using a weighted least squares where the weights are defined to be inversely proportional to the volatility of the category level index.

Prices of Non-Durables



Prices of Durables

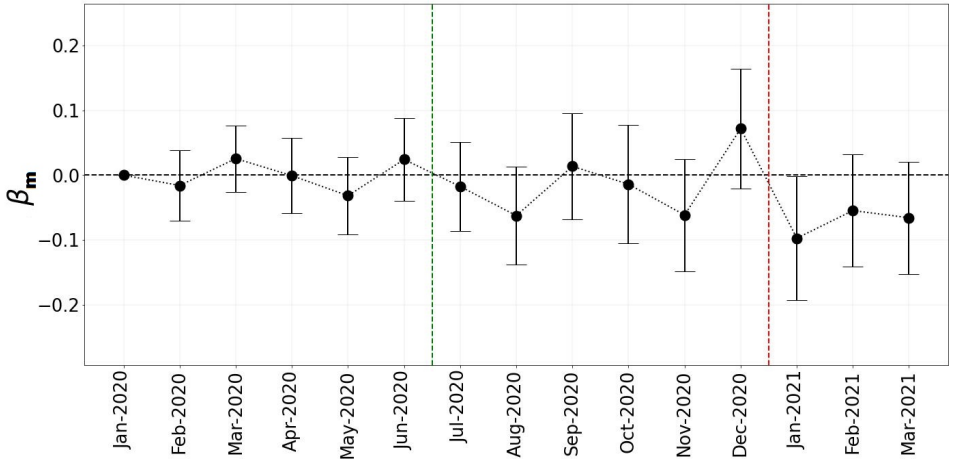


Step 2: Price Effects Summary

- Durables:
  - Point estimate of -0.0163 (0.0024)
  - Passthrough of $\frac{d \ln p}{d \ln(1+\tau)} = 0.65$
  - Slightly asymmetric response
- Non-Durables:
  - Point estimate of -0.0190 (0.0025)
  - Passthrough of $\frac{d \ln p}{d \ln(1+\tau)} = 0.91$
  - Symmetric response
- Overall passthrough (expenditure weighted average): 76%

Outline

Quantities of Non-Durables



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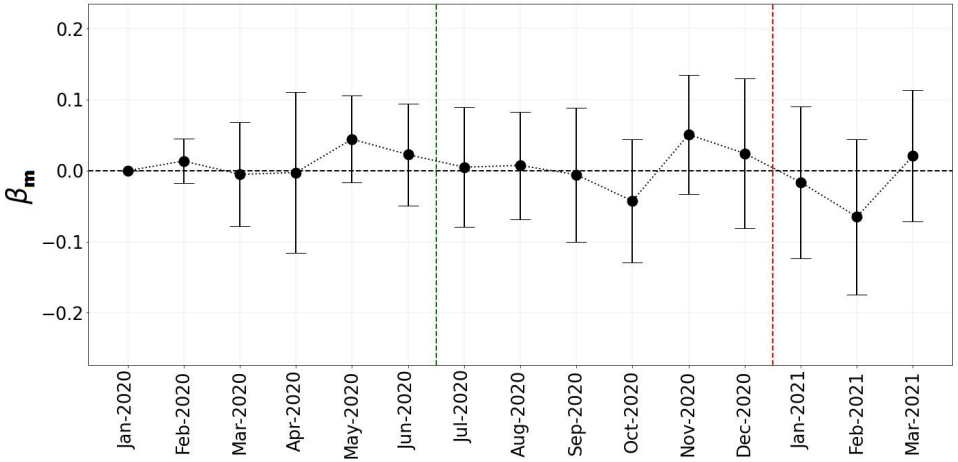

Step 3: Quantity Effects Summary

- We do not find evidence of significant quantity effects
  - Quantity response of durables: 0.0065 (0.0410)
  - Quantity response of non-durables: -0.0116 (0.0387)
- Semi-elasticities (% quantity change for a 1pp increase in the VAT):
  - Durables: -0.22 (1.367)
  - Non-durables: 0.50 (1.683)

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Robustness and Heterogeneity (1/2)

- Subsample analyses
  - Within durables, find higher (perfect) passthrough for lower-priced product categories (e.g., ink cartridge, paint, hook, ...), but no quantity response

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  - Similar results in quantile regressions (p25, p50, p75)
  - Similar for continued products (barcodes available in all months)
  - Similar when dropping any of the control countries (leave-out)

Robustness and Heterogeneity (2/2)

- Alternative specifications
  - Similar with country-specific measures of COVID dynamics (total COVID deaths and/or national containment policies)
  - Similar with different price indices (Paasche, Laspeyres, Fisher, etc.)
- Alternative data sources
  - Similar price passthrough with official CPI data (rather than scanner data)
  - Similar (lack of) quantity response in national accounts data (similar recovery cycle in Germany and control countries)

Effect Size

- Are the quantity responses large or small?
- One key benchmark is to back out the implied EIS (elasticity of intertemporal substitution)
- Follow Orchard et al. (2025) (also used in Bachman et al., 2026), where quantity response for durables is the product of
  1. the EIS
  2. terms capturing the user cost and stock-to-flow adjustments
  3. potential adjustment frictions

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  1. the EIS
  2. terms capturing the user cost and stock-to-flow adjustments
  3. potential adjustment frictions
- Not today: interpreting empirical estimates through alternative models would be instructive
  - model of durables with adjustment costs and financial frictions (e.g., Beraja and Zorzi, 2026)
  - behavioral model to account for low quantity response, e.g. rational inattention

Simple Model following Orchard et al. (2025)

- A household derives utility from non-durable consumption c_t and service utility from owning a durable stock d_t
- Calvo-type friction: only fraction $1-\theta$ adjusts stock of durables each period
- CRRA utility for optimizing households:

$$U = \sum_{t=0}^{\infty} \beta^t \left[\frac{c_t^{1-\frac{1}{\sigma}}}{1-\frac{1}{\sigma}} + \psi \frac{\int_0^1 d_t(i)^{1-\frac{1}{\sigma}} di}{1-\frac{1}{\sigma}} \right]$$

- Period budget constraint: $c_t + p_t x_t + a_t = y_t + (1 + r_{t-1}) \left(\frac{1+\tau_{t-1}}{1+\tau_t} \right) a_{t-1}$.
  - x_t: net purchases of durable goods, $x_t = \int_0^1 \left(d_t(i) - (1-\delta) d_{t-1}(i) \right) di$
  - p_t: prices of durable goods
  - τ_t: VAT rate
  - r_{t-1}: interest rate
  - y_t exogenous income; a_t: bonds
  - σ: EIS
  - δ: depreciation of durable goods

Empirical Counterparts

- Log-linearize optimal durable consumption around a temporary (one-period) change in VAT
- Net-purchases of durables:

$$\Delta \ln x_t \approx \text{const.} + \sigma\Phi \ln(1 + r_{t-1}) - \sigma\kappa\Phi\Delta \ln(1 + \tau_t),$$

$$\text{where } \Phi \equiv \left[\frac{1 - \theta(1-\delta)}{\delta}\right]\left[\frac{(1-\delta)\left[1 - \frac{1}{1+\bar{r}}\theta(1-\delta)\right]}{[\bar{r}+\delta]}\right]$$

$$\text{and } \kappa = \frac{\Delta \ln p}{\Delta \ln(1+\tau)}$$

- Interpretation:
  - Change in VAT works like a change in the interest rate (unconventional fiscal policy)
  - Response depends on
    - the elasticity of intertemporal substitution σ
    - price pass-through κ
    - user cost $\bar{r} + \delta$
    - frictions θ

Quantification

- Assume plausible parameter values at monthly frequency,
  - expenditure-weighted average lifetime of the durable goods in our sample as 6.38 years, $\Rightarrow \delta = 0.025$
  - estimated price passthrough $\kappa = 0.65$
  - set $\bar{r} = 0.001$ and $\beta = 0.997$
- Quantity response: take the average of the quantity changes for durables estimated for June to July 2020 and December 2020 to January 2021

$$\frac{d \ln x}{d \ln(1+\tau)} = -0.46$$

Quantification: Frictionless Benchmark

- Frictionless benchmark ($\theta = 0$):

$$\frac{d \ln x}{d \ln(1+\tau)} = -0.46 \approx -\sigma \cdot \underbrace{\kappa}_{\text{Passthrough}} \cdot \underbrace{\frac{1}{\delta}}_{\text{Stock-to-flow.}} \cdot \underbrace{\frac{(1-\delta)}{[\bar{r}+\delta]}}_{\text{User-cost normalization}}$$

$$\Rightarrow \sigma \approx 0.00047$$

- Intuition:
  - Monthly *user cost* ($\bar{r} + \delta$) is about same magnitude as VAT change (2.5% of purchase price), so the policy creates a large price incentive to adjust the stock of durables
  - Adjusting the *stock* implies a proportionally larger change in *purchases* ($1/\delta$)
  - After adjusting for passthrough, σ is about 1,000 times smaller than the estimated quantity response, $\frac{d \ln x}{d \ln(1+\tau)}$

Quantification: Strong Frictions

- Strong frictions ($\theta = 0.85$ as in Orchard et al. (2025)):

$$\frac{d \ln x}{d \ln(1+\tau)} = -0.46 \approx -\sigma \cdot \underbrace{\kappa}_{\text{Passthrough}} \cdot \underbrace{\frac{1-\theta(1-\delta)}{\delta}}_{\text{Stock-to-flow}} \cdot \underbrace{\frac{(1-\delta)\left[1-\frac{1}{1+\bar{r}}\theta(1-\delta)\right]}{[\bar{r}+\delta]}}_{\text{User-cost normalization}}$$

$$\Rightarrow \sigma \approx 0.016$$

- Intuition:
  - Only a fraction θ of households can adjust their purchases, which dampens the response

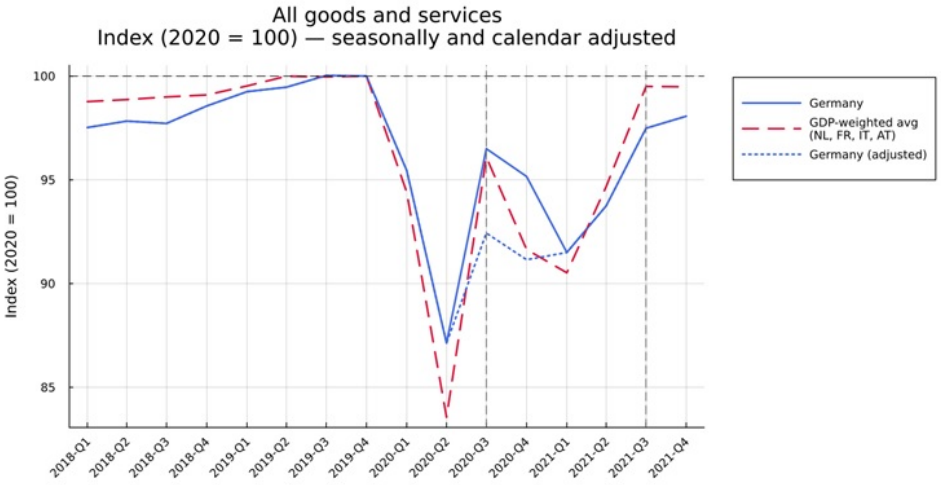
Quantification: Summary

Frictions θ	σ using point estimate for $\frac{d \ln x}{d \ln(1+\tau)}$	Upper bound for σ, using 95% confidence interval for $\frac{d \ln x}{d \ln(1+\tau)}$
0	0.00047	0.0023
0.7	0.0048	0.027
0.85	0.016	0.088

Conclusion

- We evaluate the unconventional fiscal policy implemented in Germany after the first wave of the COVID Pandemic
- Temporary VAT cut triggered a sizable reduction in prices with an average pass-through rate of 0.76
- No evidence of significant quantity responses
- With strong frictions as in Orchard et al. (2025), upper bound on EIS is 0.09
  - Consistent with low EIS estimates in other contexts (e.g., Havranek 2015, Best et al., 2020)

Appendix


All goods and services
Index (2020 = 100) — seasonally and calendar adjusted
Index (2020 = 100)
100
95
90
85
2018-Q1
2018-Q2
2018-Q3
2018-Q4
2019-Q1
2019-Q2
2019-Q3
2019-Q4
2020-Q1
2020-Q2
2020-Q3
2020-Q4
2021-Q1
2021-Q2
2021-Q3
2021-Q4
Germany
GDP-weighted avg (NL, FR, IT, AT)
Germany (adjusted)

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