The Transmission of Covid-19 Related Trade Shocks Across Countries: Comparative Firm-level Evidence

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Motivation

- Global trade flows dropped considerably during the first wave of Covid-19 pandemics

- Workplace closing and other anti-Covid measures disrupted the global value chains (GVCs) causing decline in trade and economic activity even in countries not (yet) affected by Covid-19

- The propagation of shocks via GVCs could have a complicated mechanism, coming both from the upstream and the downstream

- Baltic States are potentially very vulnerable to such shocks:
  - Rely heavily on GVCs (including high share of re-exports) and have very high sensitivity to foreign shocks
  - Small scale would complicate or even disable substitution to local suppliers or customers

- Covid-19 pandemics is not a unique example of GVCs-related shocks, war in Ukraine and related economic sanctions produced similar disruptions in GVCs

Trade Flows in the World and the Baltics, 2019–2020

Imports of goods (value), annual growth
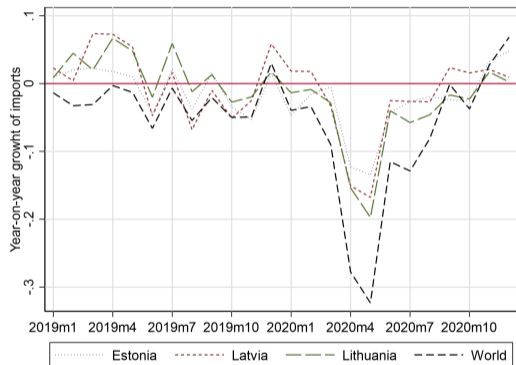
Exports of goods (value), annual growth
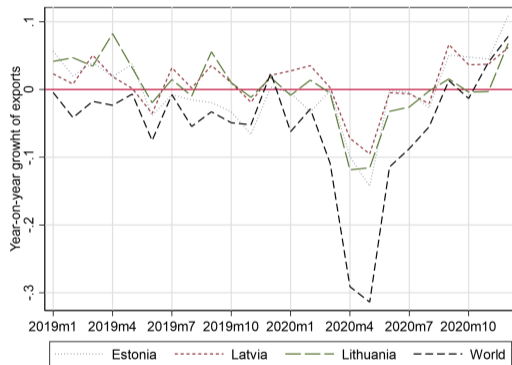
▶ We observe a pronounced decline both in the values of imports and exports for Baltic States, which is still smaller comparing with the world average

Overview of the Literature, I

▶ More general literature on propagation of shocks via input-output linkages:

  ▶ Acemoglu et al. (2016) shows that at the industry-level, supply or demand shocks affecting particular industry amplify via input-output linkages

▶ Literature on the impact of Covid-19 shock on international trade:

  ▶ Gravity models with aggregate country-level trade data: Khorana et al. (2022), Kejžar et al. (2022) – impact and type of covid shock (S-D), importance of forward linkages, development level of a country

  ▶ Gravity models with sector-level trade data: Espitia et al. (2022), Sforza and Steininger (2020), Aiyar et al. (2022), Ando and Hayakawa (2022) – sector-level assessment of shock effects; larger effects for services, smaller effects for remote work sectors and sectors with the fiscal response; magnified for sectors with global production linkages and domestic lockdowns, even if short-lived

  ▶ Product-level models (diff-in-diffs approach): Bas et al. (2022), Berthou and Stumpner (2022) – most effects in exports of products of lower complexity, higher reliance on unskilled labour, and products for which China is a dominant supplier of inputs or suppliers are not diversified

  ▶ Product-level (gravity-like): Liu et al. (2022) – negative demand effects prevailed over the negative supply effects of the pandemic; trade-postponement rather than trade-destruction

Overview of the Literature, II

- Literature on the impact of Covid-19 shock on international trade (contd.):
  - Firm-level papers (diff-in-diffs approach):
    - Amador et al. (2021) – imports and exports of Portuguese firms to Covid-19-related lockdowns; the impact is stronger for **larger firms** and those more integrated in **global value chains**
    - Lafrogne-Joussier et al. (2022) – French firms importing **intermediates from China** before the pandemics suffered in lower domestic sales and exports; ex-ante geographic diversification of inputs does not mitigate the impact of the shock, but higher **inventories help**
    - de Lucio et al. (2022) – analysis of Spanish firms; exports decreased more in destinations with **strict containment measures**, low share of **remote jobs at destination**, for goods consumed **outside the household**, for **traders**, and for manufacturers **not** participating in **global value chains**
    - Constantinescu et al. (2022) – **globally engaged** firms are recovering faster after Covid-19 shock due to their higher capabilities; the result **varies** widely by firm traits, sectoral attributes, and country characteristics
    - Bricongne et al. (2022) – French data; top exporters **(largest firms)** react disproportionately stronger to demand shocks; **GVC exposure** is found to have a **weak** explanatory power
    - Lebastard et al. (2023) – analysis of French exporters; firms participating in **GVCs** had worse outcomes in export performance and probability of survival in the export market in response to COVID-19 shock; relatively more **downstream firms** were affected even more negatively; **diversification of core inputs'** sourcing countries helped fighting the shock.

Broad Overview of Our Approach

▶ We ask **whether** and **how** the Covid-19 related shocks in international trade are transmitted across countries

▶ Use firm-level international trade in goods data from three Baltic countries in 2019–2020

▶ We proceed with difference-in-differences style approach to estimate the effect of lockdowns in partner countries on imports and exports

    ▶ The supply shock is identified following earlier studies on shock propagation at the level of firm like in Boehm et al. (2019) and on the identification of Covid-19 shocks like in Bonadio et al. (2021)

    ▶ We follow the literature on transmision of shocks after natural disasters (Barrot and Sauvagnat 2016; Boehm et al. 2019; Carvalho et al. 2021) and take the trade shock in partner country as exogenous shock

    ▶ Focus on the first wave of Covid-19 pandemics, which was unexpected at the time and provides more similarities to a natural experiment

    ▶ We distinguish between upstream shocks (in import origin countries) and downstream shocks (in export destination countries) to study the mechanism of shock propagation

    ▶ We analyse the shock effects on the intensive and extensive margins, price and quantity margins, as well as some heterogenous reactions of firms

Preview of Results

- We document **negative effects** of Covid-19 restrictions in trading partner countries – suppliers and buyers – on firm **imports and exports**, respectively, in all three Baltic States:
  - Both for internationally trading firms in **manufacturing and trade**, no qualitative differences between effects in the two sectors
  - Mostly comes through the **intensive margin** and adjustments in **quantity** traded
  - Upstream effects on importing firms quantitatively very similar to downstream effects for exporting firms
- There is some evidence that firms participating in **GVCs** suffered **less**
- There is some evidence that firms with **more differentiated** products suffered **more**

Trade Data Description

- Detailed trade in goods data available for all three Baltic countries:
    - firm-level
    - monthly frequency
    - by partner/destination countries
    - eight-digit HS products (aggregated to six-digits to avoid problems with re-classification)
    - Information on values and volumes are available for Latvia and Estonia, which allows disentangling values into unit values (proxy for prices) and volumes. Information for Lithuania is imputed using aggregated data from EUROSTAT
- We use monthly data for 2019–2020, to focus on the pre-Covid year and the first wave of Covid-19
- We look at firms in Manufacturing and Trade sectors together, since no major qualitative differences between sectors were detected

Descriptive Statistics

Descriptive statistics, exporters and importers in manufacturing and trade, 2019–2020

	Lithuania		Latvia		Estonia	
	Mean	St.dev.	Mean	St.dev.	Mean	St.dev.
Imports	no. of flows: 45 204		no. of flows: 23 390		no. of flows: 28 581	
Value of trade flow, th. EUR	51.4	955.2	46.9	340.7	40.0	287.9
No. of products per destination	3.8	13.4	3.9	14.4	4.0	15.3
Mean value per product	23.0	480.3	19.6	96.9	16.2	84.1
Exports	no. of flows: 33 312		no. of flows: 21 419		no. of flows: 17 366	
Value of trade flow, th. EUR	74.0	632.6	60.3	340.8	67.8	337.9
No. of products per destination	3.1	11.6	3.1	12.1	3.0	9.3
Mean value per product	45.4	456.9	39.0	263.6	41.8	253.8
Firm characteristics, two-way traders	no. of firms: 4 861		no. of firms: 3 008		no. of firms: 2 450	
Value added, th. EUR	1583.2	8332.1	1217.5	4916.0	1499.2	4093.6
Employment, FTE	48.7	223.0	39.4	185.2	42.5	127.2
Labour productivity, th. EUR / FTE	39.7	80.4	38.9	74.8	47.7	253.5

Types of Covid-19 Related Shocks in GVCs

- Covid-19 related shocks can come from three directions:
    - <u>Upstream shock</u>: restrictions in import partner countries, disrupting the supply of intermediate inputs
    - <u>Downstream shock</u>: restrictions in export destination countries, reducing the demand for the output
    - <u>Domestic shock</u>: restrictions for the activity of the firm, as well as its domestic suppliers and buyers

Data on Covid-19 Related Restrictions

▶ Domestic restrictions to the economic activity are approximated by the number of Covid-19 cases per 1000 inhabitants at the regional level

▶ Upstream and downstream restrictions are approximated by **workplace closing index**

  ▶ From Oxford Stringency Index

  ▶ One of nine indicators, focused specifically on workplace closures, which are related to GVCs the most

  ▶ Ensures better comparability between countries, good coverage

  ▶ Index between 0 (no measures) and 3 (require closing or work from home in all but essential workplaces)

  ▶ Despite the global nature of the shock, the index provides some heterogeneity across the countries, mostly in the second half of 2020

Data on Covid-19 Related Restrictions

Workplace closing in selected countries, Oxford Stringency Index
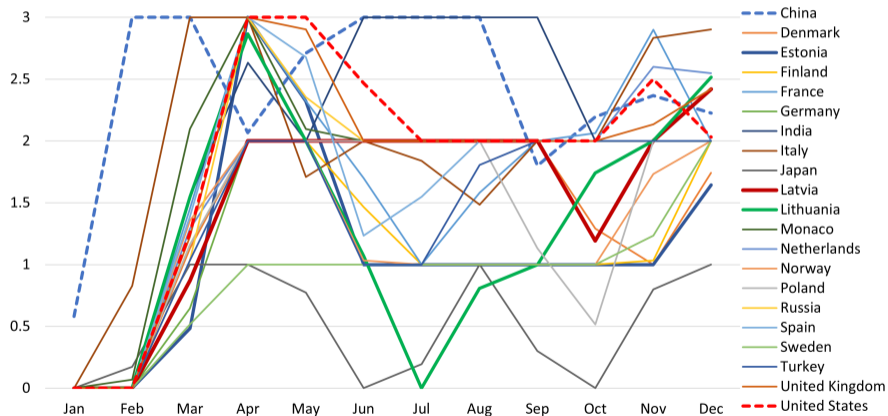
Regression for Imports (levels)

▶ Importing firms include both exporters and non-exporters

▶ Focus on the effect of **upstream workplace closing**, controlling for domestic restrictions and other factors:

$$IM_{i,c,t}^{s} = \beta_1 Upstream_{c,t} + \beta_2 Local_{r,t} + \beta_3 \ln(Turnover_{s,t}) + \alpha_{i,c} + \epsilon_{i,c,t}, \qquad (1)$$

where

  ▶ i – refers to a firm, c – partner country, t – month, s – sector at NACE 2-digit level, r – region
  ▶ $IM_{i,c,t}^{s}$ – various import margins: probability to import, logarithm of value of imports, log of number of products per country, log of mean value per product, log of unit values, and log of quantity imported
  ▶ $Upstream_{c,t}$ – workplace closing in partner country level
  ▶ $Local_{r,t}$ – Covid-19 cases per 1000 inhabitants at regional level in home country
  ▶ $\ln(Turnover_{s,t})$ – logarithm of turnover of the sector where firm operates, to account for domestic industry-specific shocks
  ▶ $\alpha_{i,c}$ – firm-partner fixed effects, and $\epsilon_{i,t}$ – error term

▶ Estimated by WLS, using 2019 import value weights to avoid endogeneity

Effect of Upstream Closing on Probability to Import and Value of Imports

The effect of workplace closing in supplier countries on probability to import and the value of imports, 2019–2020

| | Probability to import | | | Value of imports (conditional on importing) | | |
	Lithuania (1)	Latvia (2)	Estonia (3)	Lithuania (1)	Latvia (2)	Estonia (3)
$Upstream_{c,t}$	-0.002*	-0.011***	-0.014***	-0.098***	-0.070***	-0.091***
	(0.001)	(0.001)	(0.002)	(0.015)	(0.013)	(0.014)
$Local_{r,t}$	-0.002	-0.001***	-0.001	-0.020*	0.001	-0.012
	(0.002)	(0.000)	(0.001)	(0.011)	(0.004)	(0.008)
$\ln(Turnover_{s,t})$	-0.001	0.058***	0.062***	1.078***	0.859***	0.895***
	(0.002)	(0.011)	(0.014)	(0.191)	(0.113)	(0.107)
Firm × Country FE	✓	✓	✓	✓	✓	✓
No. of observations	1 085 045	557 352	679 266	497 055	259 559	305 017
R^2	0.001	0.005	0.006	0.082	0.022	0.029

- Covid-19 restrictions in import partners reduces the probability to import in Latvia and Estonia more than in Lithuania
- The negative effect on the extensive margin is small quantitatively
- The negative effect on value of imports is large and negative in all three countries

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# Effect of Upstream Closing on Probability to Import and Value of Imports

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	(0.001)	(0.001)	(0.002)	(0.015)	(0.013)	(0.014)
$Local_{r,t}$	-0.002	-0.001***	-0.001	-0.020*	0.001	-0.012
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▶ The negative effect on the extensive margin is small quantitatively

▶ The negative effect on value of imports is large and negative in all three countries

Effect of Upstream Closing on Intensive and Extensive Import Margins

Effect of upstream closing, number of products and average value per product
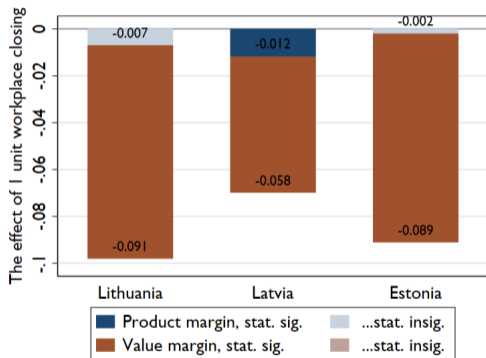
Effect of upstream closing, average price and quantity of products
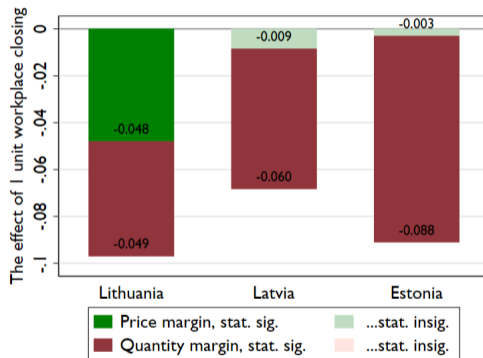
▶ Upstream closing reduces the average value of imports. Adjustments in intensive margin dominate the effect

▶ Upstream closing mostly affects the quantities (except for Lithuania)

Regression for Exports (levels)

▶ We estimate the effect on exports using similar regression with **downstream workplace closing index**:

$$EX_{i,c,t}^s = \beta_1 Downstream_{c,t} + \beta_2 Local_{r,t} + \beta_3 \ln(Turnover_{s,t})$$
$$+ \beta_4 \ln(Imports_{i,c,t}) + \alpha_{i,c} + \epsilon_{i,c,t}, \tag{2}$$

where

- ▶ i – refers to a firm, c – partner country, t – month, s – sector at NACE 2-digit level, r – region
- ▶ $EX_{i,c,t}^s$ – export margins: probability to export, logarithm of value of exports, log of number of products per country, log of mean value per product, log of unit values, and log of quantity exported
- ▶ $Downstream_{c,t}$ – workplace closing in destination country c
- ▶ $Imports_{i,c,t}$ – world (top 50 importers) annual nominal imports for the respective six-digit HS product category, aggregated using the product weights in 2019 for the respective destination; world demand proxy
- ▶ $\alpha_{i,c}$ – firm-partner fixed effects, and $\epsilon_{i,t}$ – error term

▶ Estimated by WLS, using 2019 export value weights to avoid endogeneity

# Effect of Downstream Closing on Probability to Export and Value of Exports

The effect of workplace closing in supplier and destination countries on probability to export and the value of exports, 2019–2020

	Probability to export			Value of exports (conditional on exporting)		
	Lithuania (1)	Latvia (2)	Estonia (3)	Lithuania (1)	Latvia (2)	Estonia (3)
$Downstream_{c,t}$	-0.000	-0.019***	-0.018***	-0.088***	-0.044***	-0.107***
	(0.000)	(0.002)	(0.003)	(0.018)	(0.008)	(0.029)
$Local_{r,t}$	-0.001	-0.001*	0.001	-0.010	0.0002	-0.009
	(0.001)	(0.001)	(0.002)	(0.019)	(0.002)	(0.013)
$\ln(Turnover_{s,t})$	0.019	0.064***	0.041***	0.818***	0.838***	0.708***
	(0.018)	(0.011)	(0.011)	(0.129)	(0.067)	(0.076)
$\ln(Imports_{i,c,t})$	-0.019	0.052	0.013	0.873***	0.425***	0.873*
	(0.018)	(0.035)	(0.037)	(0.274)	(0.120)	(0.469)
Firm × Country FE	✓	✓	✓	✓	✓	✓
No. of observations	916 334	508 104	412 536	389 152	216 661	184 257
R^2	0.000	0.009	0.006	0.078	0.022	0.033

▶ Downstream closing has more pronounced negative effect for Latvia and Estonia. Insignificant effect on exports in Lithuania

▶ Intensive margin (the value of exports) is large, negative and significant in all countries

Effect of Downstream Closing on Export Margins

Effect on average value and number of products of downstream closing
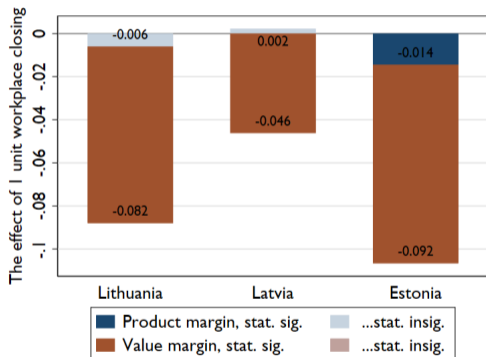
Effect on average prices and quantities of downstream closing
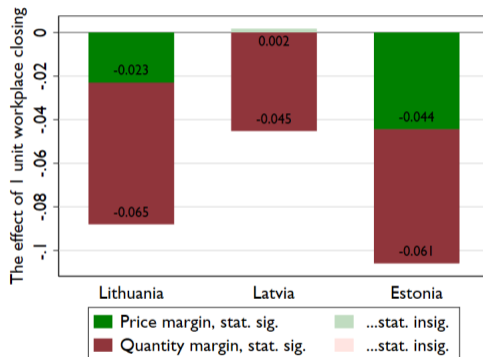
- ▶ Intensive margin dominates the change in exports in all countries
- ▶ Quantity adjustments dominate price adjustment channels

Economic Size of the Effect

The economic size of the effect of upstream and downstream closing (mln EUR)

	Imports			Exports		
	Lithuania (1)	Latvia (2)	Estonia (3)	Lithuania (4)	Latvia (5)	Estonia (6)
Partner country margin (probability of trading)						
Workplace closures ↑	-3.2	-24.1	-32.0	-5.4	-49.1	-42.4
Local infections ↑	-0.4	-0.5	-0.6	0.0	-0.6	0.6
Industry demand (turnover) ↓	-5.1	-12.7	-14.2	1.8	-11.6	-6.8
World demand (global imports) ↓	-	-	-	-0.2	-2.7	-0.6
Total country margin in mln EUR	-8.7	-37.4	-46.8	-3.7	-64.0	-49.2
Total country margin in %	-0.3	-3.4	-4.1	-0.2	-5.0	-4.2
Value per partner margin (value of trade)						
Workplace closures ↑	-446.9	-153.6	-208.1	-438.4	-113.7	-252.0
Local infections ↑	0.0	0.5	-6.9	-3.0	0.1	-5.3
Industry demand (turnover)	-523.0	-188.5	-204.6	-294.6	-151.5	-116.7
World demand (global imports)	-	-	-	-74.8	-22.0	-41.1
Total value margin in mln EUR	-969.9	-341.5	-419.6	-810.8	-287.0	-415.1
Total value margin in %	-41.7	-31.1	-36.7	-32.9	-22.2	-35.3

Heterogeneous Reactions to Closures

We added various interaction terms to check the heterogeneity of the impact of Covid-19 related closures on firms:

- ▶ Firms in Manufacturing vs. Trade industries

- ▶ Firm size: micro, small, medium, large firms

- ▶ First half of 2020 (first wave) versus second half of 2020 (second wave)

- ▶ Exposure of different imported products to workplace closures

- ▶ Diversification of imports by partner countries

- ▶ The share of imports in total turnover

- ▶ Broad category of exported products (consumer / intermediate / capital good)

- ▶ Productivity level (VA/worker) of the firm

- ▶ Products by differentiation (complexity)

	Imports			Exports		
	Lithuania (1)	Latvia (2)	Estonia (3)	Lithuania (4)	Latvia (5)	Estonia (6)
Partner country margin (probability to trade)						
Firm size by employment in 2019	↓	↓	↓	↓	↓	↓
Firm productivity quartiles in 2019 ↓	↓	↓	↓	↓	~	
Finished products to turnover in 2019	↓	↓	~	↓	↓	↓
Supplies to turnover in 2019	↓	~	~	↓	~	↓
Value per partner margin (value of trade)						
Firm size by employment in 2019	↑	↓	~	↑	↓	~
Firm productivity quartiles in 2019	↑	~	↓	~	~	~
Finished products to turnover in 2019	~	~	~	~	↓	↓
Supplies to turnover in 2019	↑	~	~	↑	~	~

▶ No systematic effect was uncovered in many cases

▶ **Smaller** firms are more likely to cease trading due to lockdowns compared to larger firms; the evidence is more mixed when considering the value traded or the intensive margin

▶ **Low productivity** firms are much more likely to stop trading the market after lockdowns than high productivity firms are, while the relationship between lockdowns and value traded is ambiguous

▶ Firms that had accumulated more **finished products** or **supplies** were less sensitive to lockdowns

Relationship Stickiness and Product Differentiation

- ▶ Global value chains are sticky, since international trade involves large sunk costs for firms. ''Sticky relationships'' played a dominant role during the Great Recession (Antràs (2020))

- ▶ Sectors with more sticky products display a higher share of intrafirm trade as predicted (Antràs and Chor (2013))

- ▶ Product characteristics (differentiation vs. homogeneity) imply different search costs and relationship stickiness (Rauch (1999)):

    - ▶ Organized exchange - trade in homogeneous commodities that are traded in organized exchange (non-differentiated products)

    - ▶ Referenced priced - goods that are not traded on organized exchanges but nevertheless possessing "reference prices"

    - ▶ Differentiated products - trade in goods that are "branded"

Product Differentiation

	Imports			Exports		
	Lithuania	Latvia	Estonia	Lithuania	Latvia	Estonia
	Partner country margin (probability to trade)					
Organised exchange	0.002	-0.006	-0.0003	-0.001	-0.004***	-0.003
	(0.003)	(0.006)	(0.002)	(0.001)	(0.001)	(0.003)
Reference priced	-0.006***	-0.009**	-0.001	-0.002	-0.008***	-0.004
	(0.002)	(0.004)	(0.006)	(0.005)	(0.002)	(0.004)
Differentiated products	-0.018***	0.000	-0.004	-0.007*	-0.011***	-0.010***
	(0.006)	(0.007)	(0.007)	(0.004)	(0.002)	(0.002)
	Value per partner margin (value of trade)					
Organised exchange	-0.047	0.004	0.009	-0.046*	-0.065	-0.038
	(0.031)	(0.037)	(0.060)	(0.027)	(0.045)	(0.055)
Reference priced	-0.040***	-0.082**	-0.004	-0.023	-0.063***	-0.086***
	(0.013)	(0.022)	(0.026)	(0.036)	(0.018)	(0.033)
Differentiated products	-0.138	-0.087***	-0.098***	-0.060***	-0.047***	-0.103***
	(0.097)	(0.028)	(0.016)	(0.017)	(0.013)	(0.034)

▶ Differentiated products - exhibited the largest drop in the value of imports and–especially–exports in all three countries

▶ Yet, some evidence of breaking relationships in differentiated products as well

Conclusions

▶ We observe the **negative effect** of Covid-19 restrictions in a particular trading partner country of imports or exports on the trade flows in three Baltic States; the effect mostly comes through the **intensive margin** and adjustments in **quantity** traded

▶ The **upstream and downstream** restrictions were found to be equally important for the decline in trade

▶ For downstream effects on the exporters, the **global demand** conditions had a substantial effect

▶ Heterogeneity of effects:

  ▶ No qualitative differences between reactions of firms in Manufacturing and Trade sectors

  ▶ **Small and low productivity firms** were most likely to loose a partner due covid shock restrictions

  ▶ **Larger inventories** reduced the negative reaction of firm trade to the restrictions in a partner country

▶ We add some evidence to the mechanism for **sticky trade relationships**:

  ▶ **Differentiated products** reacted most strongly to trade shocks **upstream**, less heterogeneous reactions to shocks downstream

▶ There is some evidence that firms **participating in GVCs** suffered less (similar to de Lucio et al. (2022), contrary to Amador et al. (2021))

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THANK YOU!

Reserve Slides

Regression for Imports (differences)

- It is possible that the initially negative effect of upstream restrictions is compensated in later months, that's why the effect is not observed in level regression

- We can analyse a **short-term effect** by running regression in differences: changes in import variable responding to the changes in upstream restrictions in the previous month

$$\Delta IM_{i,c,t}^{s} = \beta_1 \Delta Upstream_{c,t-1} + \beta_2 Local_{r,t} + \beta_3 \Delta \ln(Turnover_{s,t}) + \alpha_{i,c} + \epsilon_{i,c,t} \tag{3}$$

- One month lag should be enough given that majority of trade in the Baltics is concentrated in the region

Short-run Effect of Upstream Closing on Imports

▶ In the absence of time fixed effects, the short run effect is consistent with the long run effect:

  ▶ Negative changes in import value next month after increasing upstream restrictions
  ▶ The effect mostly comes through intensive margin and quantity channel

The effect of changes in workplace closing in supplier countries on changes in import margins, 2019–2020

Import variable	Lithuania Manufacturing	Trade	Latvia Manufacturing	Trade	Estonia Manufacturing	Trade
$\Delta \Pr(Value_{i,c,t} > 0)$	-0.000	0.001	-0.009***	-0.001	-0.011***	-0.007***
No. of observations	299 882	693 869	161 032	349 784	174 891	333 342
$\Delta \ln(Value_{i,c,t})$	-0.063***	-0.056***	-0.097***	-0.069***	-0.054***	-0.074***
$\Delta \ln(N_{i,c,t})$	-0.170*	-0.017***	-0.022**	-0.005	-0.020	-0.018**
$\Delta \ln(\bar{x}_{i,c,t})$	0.107	-0.039***	-0.075**	-0.064**	-0.034*	-0.056***
No. of observations	96 869	236 793	51 082	129 174	69 523	140 409
$\Delta \ln(UV_{i,c,t})$	0.044	-0.008	0.019	-0.023	-0.001	-0.067**
$\Delta \ln(Quantity_{i,c,t})$	-0.106*	-0.048***	-0.116***	-0.047***	-0.053**	-0.007
No. of observations	96 126	235 328	50 368	126 825	69 506	140 381
Firm x Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	No	No	No	No

Short Run Effects of Downstream Closing on Exports

The effect of changes in workplace closing in supplier and destination countries on changes in export margins, 2019–2020

Export variable	Lithuania Manufacturing	Trade	Latvia Manufacturing	Trade	Estonia Manufacturing	Trade
	Changes in downstream (at destination countries) workplace closing in the previous month					
$\Delta \Pr(Exi, c, t > 0)$	0.001	0.002	-0.006	0.006	-0.005	-0.007
$\Delta \ln(Value_{i,c,t})$	-0.101***	-0.065***	-0.037***	-0.085***	-0.086***	-0.072**
$\Delta \ln(N_{i,c,t})$	0.040***	-0.027***	-0.011	-0.015*	-0.019*	-0.041**
$\Delta \ln(\bar{x}_{i,c,t})$	-0.061**	-0.037**	-0.027**	-0.070***	-0.067***	-0.031
$\Delta \ln(UV_{i,c,t})$	-0.034***	-0.013***	0.012*	0.005	-0.005	0.009
$\Delta \ln(Quantity_{i,c,t})$	-0.056***	0.031**	-0.049***	-0.089***	-0.064***	-0.064**
Firm x Origin FE	Yes	Yes	Yes	Yes	Yes	Yes
Time FE	No	No	No	No	No	No

▶ Short-run effects coincide with findings in levels: intensive margin dominates the change in exports; quantity adjustments dominate price adjustments

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