Trade Disruptions Along the Global Supply Chain

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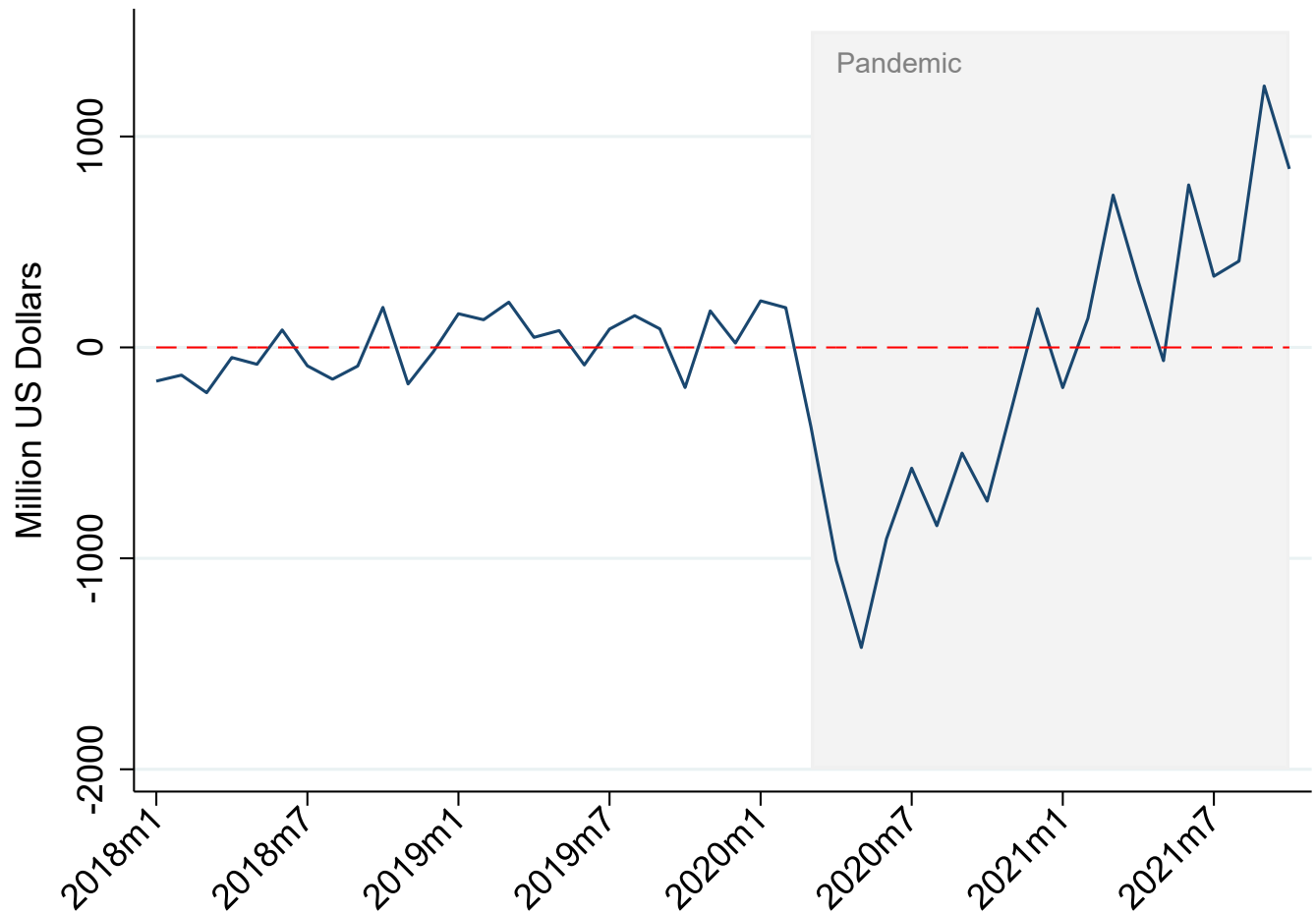
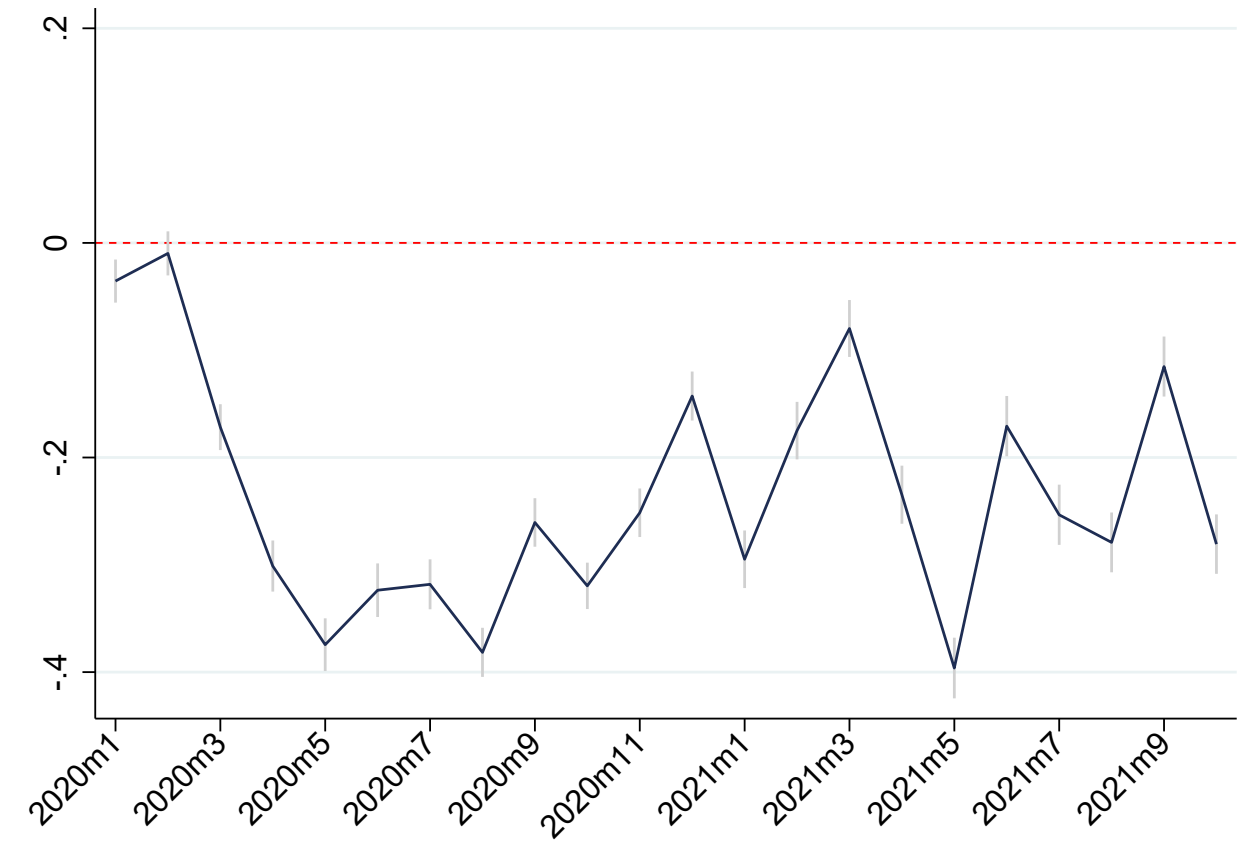
Trade, Value Chains, and Financial Linkages in the Global Economy
Rome, June 2023

Monthly Imports in Colombia, Around Pandemic (relative to by-month averages in 2018 and 2019)



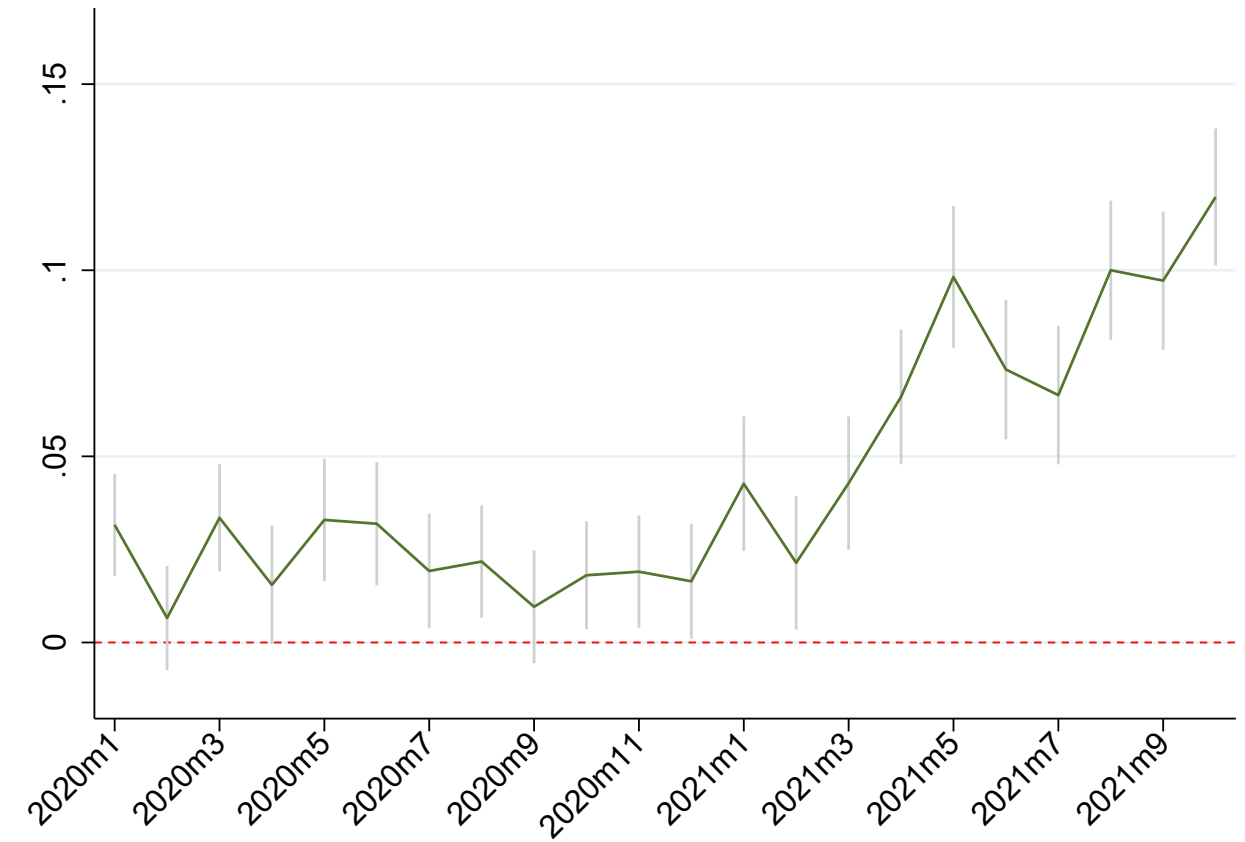
Import by Colombia During the Pandemic

- Average exporter-importer-product level deviation from pre-pandemic trends of import quantities



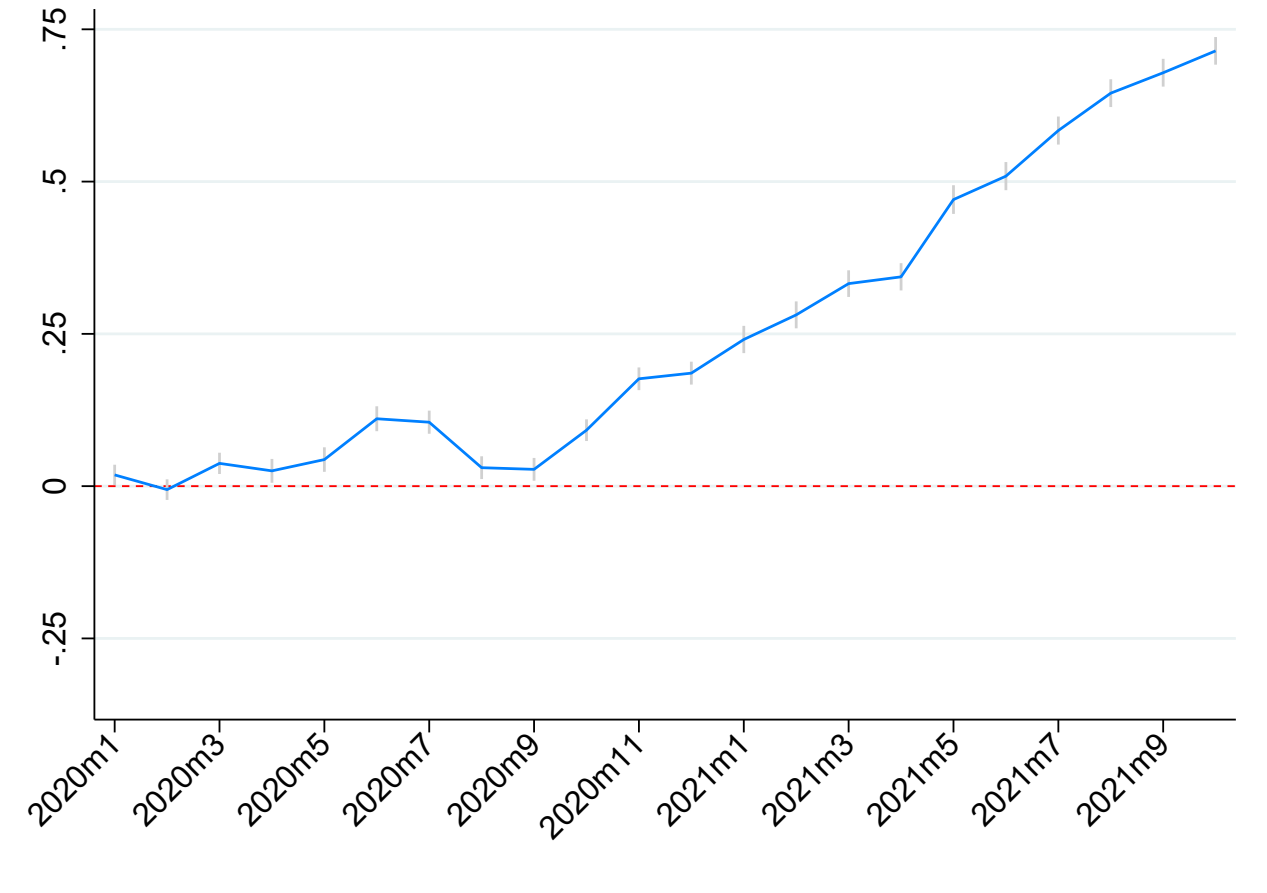
Import by Colombia During the Pandemic

- Average exporter-importer-product level deviation from pre-pandemic trends of FOB prices

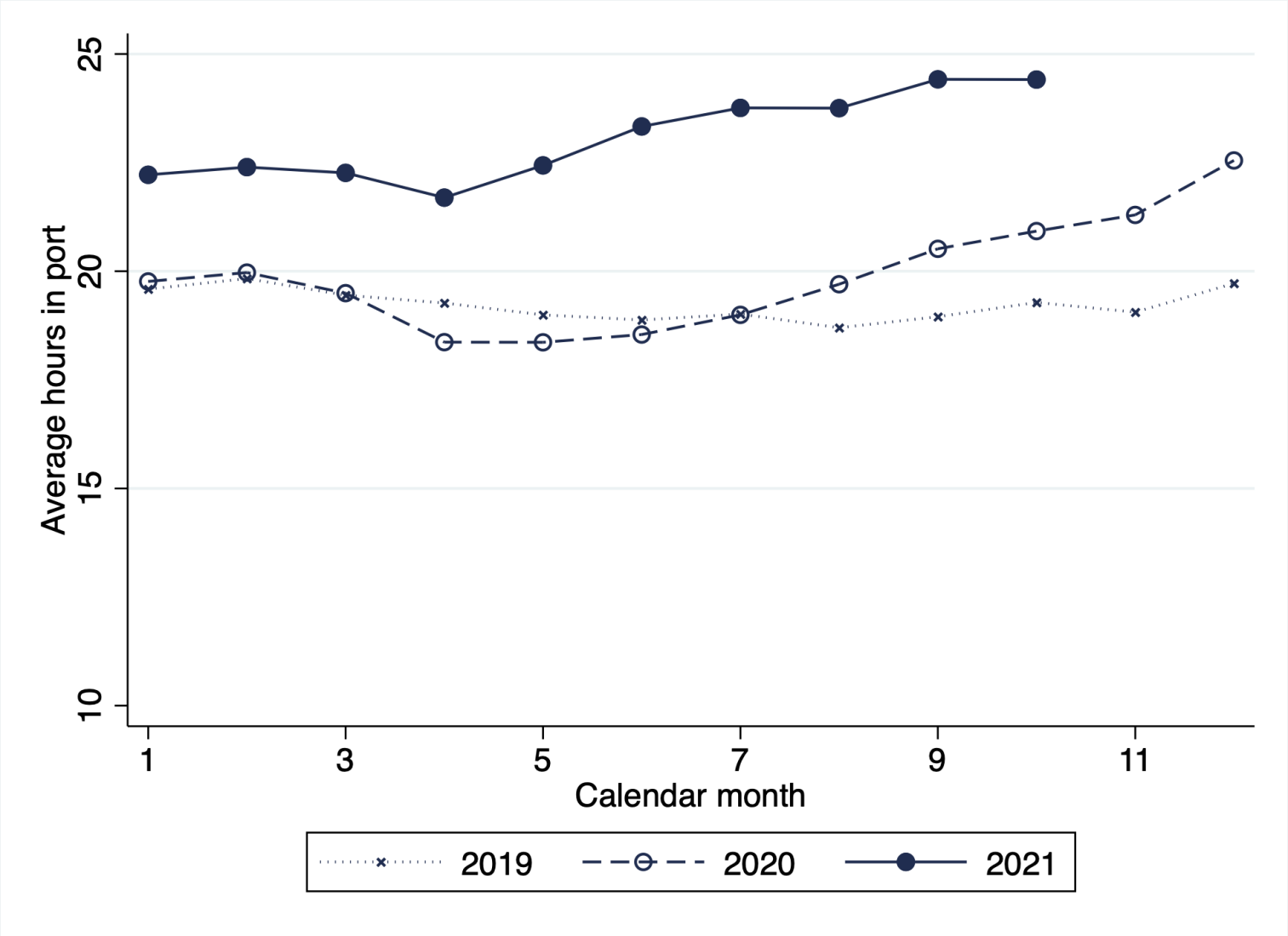


Import by Colombia During the Pandemic

- Average exporter-importer-product level deviation from pre-pandemic trends of freight unit costs



Port Processing Time Started Experiencing a Steady Increase Since July 2020



Understanding the Impact of the Pandemic on International Trade

- Was the change in the trade flows (value, quantity, price) caused by demand shocks, supply shocks, or shocks in the transportation network?

This Paper: Demand, Supply, and Transportation Network

- Combine highly **granular** data on human mobility, trade, and container ship port calls
- Use a simple *theoretical framework + cross-sectional variation in importer and exporter mobility changes*
  - Estimate the impact of changes in mobility on import **quantities**, **prices**, **port efficiency**, and **freight costs**
  - Recover structural **elasticity of substitution** across location-specific varieties
  - **Decompose** average effect of local disruptions into an exporter, importer, and transportation terms over time
  - Estimate the import price passthrough to domestic **inflation**

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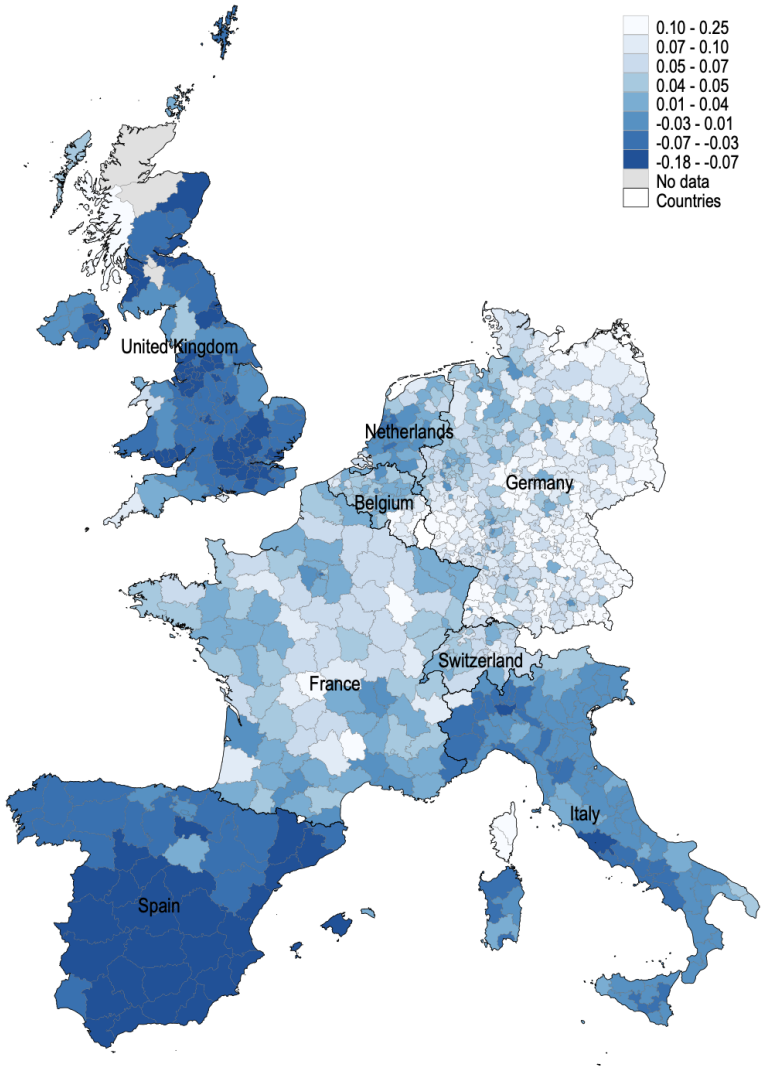
Exporter City Mobility Changes, September 2020, Facebook Data



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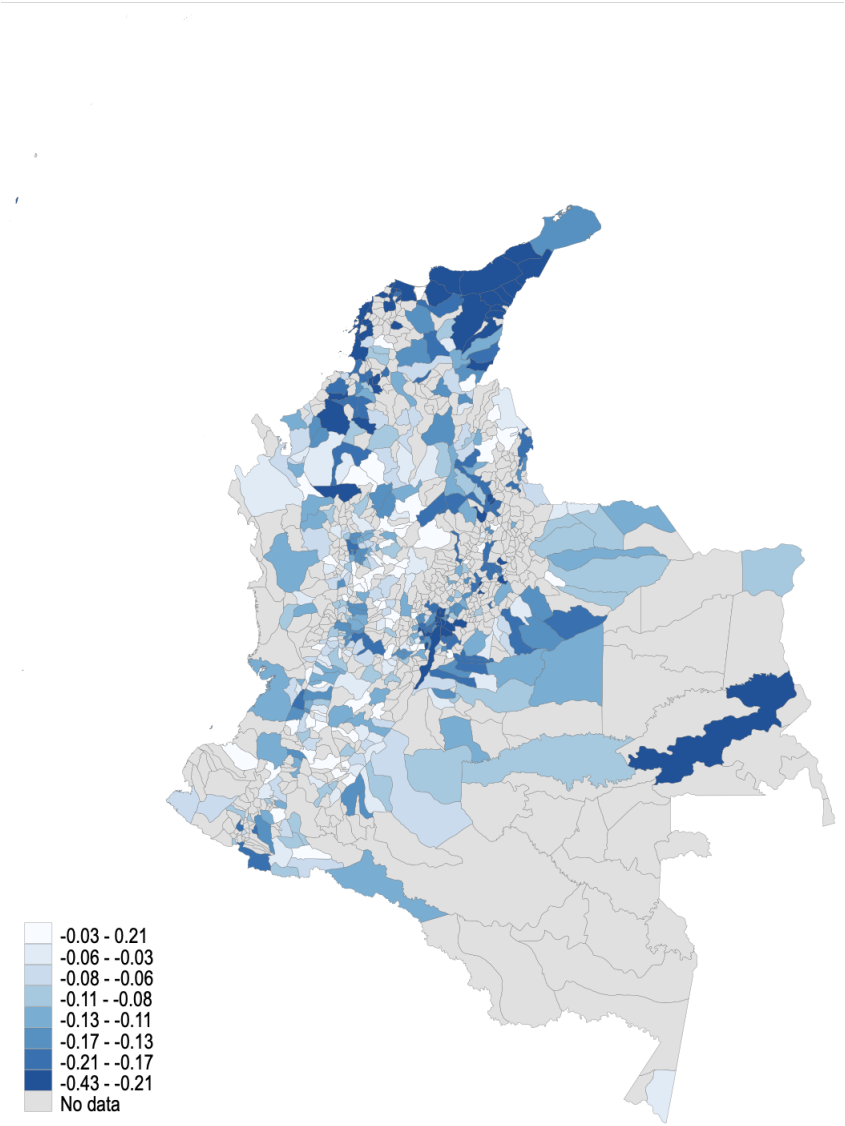

Measurement of Trade Shocks

- Declines in within-city human mobility during the pandemic due to
  - Government restrictions, sickness, voluntary containment efforts, business closures
- Captures **negative labor supply shocks** at the foreign exporter location and the foreign seaports
- Captures **net** demand shocks at the Colombian importer location
  - Negative **income effect** due to loss in income for households
  - Positive **domestic substitution effect** due to increase in prices of domestic goods
  - **Change in preferences** for households (e.g., increase in demand for furniture and decrease in demand for restaurants and trips)

Data details

Theoretical Framework

- Model at product level (k, omitted): varieties produced by exporter (i) demanded by importer (j)
- Demand side:
  - Importers imperfectly substitute varieties (CES over varieties)
  - Elasticity of substitution η and demand shifter Z_j
- Supply side:
  - Exporters cost function is $A_i Q_i^{\alpha}$
  - A_i is supply shifter and Q_i is total production
  - Decreasing returns of scale in the short-run implies $\alpha > 1$
- Exporter profit maximization:
  - T_{ij} is the per-unit transport cost
  - Optimal CIF price: $p_{ij}^M = \frac{\eta}{\eta-1}[\alpha A_i Q_i^{\frac{\alpha-1}{\alpha}} + T_{ij}]$

Structural Equations in Log Changes

- **Import price equation**:

$$\hat{p}_{ij}^{M} = \iota_{ij}\hat{A}_{ij} + \iota_{ij}\frac{\alpha - 1}{\alpha}\hat{Q}_{ij} + (1 - \iota_{ij})\hat{T}_{ij}$$

  where ι_{ij} is the domestic to import price ratio charged by i

- **Quantity equation**:

$$\hat{q}_{ij}^{M} = -\eta\hat{p}_{ij}^{M} - (\eta - 1)\hat{P}_{j} + \hat{Z}_{j}$$

  where P is the product-specific price index at j

- We use these equations as a guideline for estimation

Matching Structural Equations to Empirics

- We interpret structural equations as first-order changes around an equilibrium $\iota_{ij} = \bar{\iota}$
  - February 2020 as the pre-pandemic equilibrium

- Mapping data to cost shifters (A) and demand shifter (Z):

$$\hat{A}_i = \gamma_{\mathrm{A}} \hat{x}_i^I + \epsilon_{\mathrm{A},i}$$
$$\hat{Z}_j = \gamma_{\mathrm{Z}} \hat{x}_j^J + \epsilon_{\mathrm{Z},j}$$

  - $\hat{x}_i^I$ and $\hat{x}_j^J$ are log changes in mobility at exporter and importer locations
  - $\epsilon_{\mathrm{A},i}$ and $\epsilon_{\mathrm{Z},j}$ are idiosyncratic shocks

- γ_{A} and γ_{Z} are the empirical elasticities of supply and demand shifters with respect to exporter and importer mobility
  - γ_{A}: negative
  - γ_{Z}: positive ("income" effect) or negative ("substitution" effect)

Trade Outcomes and Exporter/Importer Mobility Shocks

- Estimation equation (importer j, exporter i, product k, time t):

$$\hat{m}_{ijkt} = \beta_I \hat{x}^I_{it} + \beta_J \hat{x}^J_{jt} + \delta^P_{kt} + \delta^{Tr}_{cut} + \varepsilon_{ijkt}$$

  - $\hat{m}_{ijkt}$: import values, quantities, or prices
  - Product-time fixed effect δ^P_{kt}: control for import price indices
  - Exporting country (c)-entry port (u)-time fixed effect δ^{Tr}_{cut}: control for transport costs
  - Standard errors: clustered at importer-time and exporter-time level

- Identifying assumptions: product-specific j demand and i supply "small" relative to i and j overall mobility changes

- Identifying variation: within product-time, within import-route-time variation, and between exporter-importer pairs

Higher Mobility at Importer and Exporter Locations, Larger Total Import

	(1) Value	(2) Quantity	(3) Price
Importer Mobility	0.433***	0.410***	0.023
	(0.068)	(0.073)	(0.053)
Exporter Mobility	0.249***	0.352***	-0.103**
	(0.094)	(0.124)	(0.044)
N	537,100	537,100	537,100
R^2	0.100	0.101	0.076
Mean (s.d.) of Y:	-0.16 (1.53)	-0.18 (1.78)	0.03 (1.17)
Mean (s.d.) of importer mobility:		-0.27 (0.28)	
Mean (s.d.) of exporter mobility:		-0.15 (0.18)	

Higher Mobility at Importer and Exporter Locations, Larger Total Quantity

	(1) Value	(2) Quantity	(3) Price
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Higher Mobility Exporter Locations, Lower Prices

	(1) Value	(2) Quantity	(3) Price
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Summary of Results on Quantity and Price

- Pooled results on intensive margin:
  - Both exporter and importer mobility negative shocks lowered import quantities
  - Only exporter shocks affected prices
  - Short-term elasticity of substitution between sub-national varieties $\eta = \beta_I^q / \beta_I^p = 3.4$
- Heterogeneous results by consumer goods and intermediates details
  - Importer mobility decline had similar impacts
  - Elasticity of substitution higher for intermediates
- Demand for Covid-related medical goods increased when importer mobility declined details

Summary of Port and Transportation Cost Results

- A 10% decline mobility at port locations generated:
  - a 1.3% increase in the number of hours at ports
  - a 1.1% decrease in the number of port calls
  - a 2.5% increase in freight costs
- There were also accumulated effects of the transportation sector disruptions: one additional month into the Pandemic
  - a 1.4% increase in the number of hours at ports
  - a 4% increase in freight costs

details

Decomposition and Passthrough

- Decomposition over time: details
  - Initial declines explained mostly by exporter shocks
  - Importance of freight costs rose over time
- Pass-through from import to consumer prices was about 60% details

Thank you!

This Paper: Impact of Local Trade Disruptions on Trade Flows (importer, exporter, seaports)

- Challenges in identifying the role of demand, supply, and transportation networks at the country level:
  - Correlated Covid outbreaks affected all three simultaneously
  - Measurement errors due to differential exporting/importing intensities within a country

- This paper studies the impact of sub-national level shocks on trade by combining highly granular data on
  - Human mobility at the sub-national (city) level to measure Covid shocks
  - Detailed trade flow (prices, quantities, transportation costs) information that identifies importer and exporter location
  - Port call information to measure port performance

Colombian Context and Identification

- Colombia as a laboratory: a relatively small economy that is integrated into international supply chains
  - Changes in local mobility in foreign countries are unlikely to be impacted by the demand and supply of goods in Colombia
  - Changes in Colombian demand are unlikely to generate shipping congestion in foreign ports
- Identifying variation
  - Different regions across the world experiencing Covid outbreaks and mobility declines differentially over time
- Key identification assumption: local human mobility changes are uncorrelated with counterfactual trade outcomes
  - Evidence on pre-trends

Contribution: Local Impacts of a Global Shock Along the Supply Chain

- Impact of local shocks on firms and trade (Volpe, Martincus, and Blyde 2013, Barrot and Sauvagnat 2016, Boehm et al. 2019, Carvalho et al. 2020)
  impact of economy-wide shocks (Jorda et al 2022, Benguria and Taylor 2020, Novy and Taylor 2020)
  - Local shocks during an economy-wide crisis
  - **Directly identify** demand-side shocks, supply-side shocks, and shocks in the transportation network
- Maritime shipping and trade costs (Hummels and Skiba 2004, Heiland et al. 2019, Brancaccio et al. 2020, Ignatenko 2020, Coşar and Thomas 2021, Ganapati et al. 2021)
  - Construct **novel** measures of **port productivity**
  - Directly measure impact of **labor shock** on port productivity and freight cost
- Short run effects of trade shocks, including Covid (Anderson and Yotov 2020, Fajgelbaum et al. 2020, Guan et al. 2020, Bonadio et al. 2021, Fajgelbaum et al. 2021, Liu et al. 2021, Martin et al. 2021)
  - First to **causally** estimate the impact of local pandemic shocks on trade using actual trade outcomes

Trade Data, 2018 to 2021

- Import data from Colombia's customs official agency (DIAN) at monthly frequency at 6-digit HS product level
  - Importer municipality and exporter addresses
  - Import value, quantity, and price
  - Freight and insurance costs
- 27 main partners in terms of 2018–2019 import
  - Cover about 90% of total imports
  - US (30%), China (9%), Mexico, Switzerland, Panama, Brazil, Korea, Germany, Japan, Spain, UK, France, Chile, HK, Uruguay, Ecuador, Netherlands, India, Peru, Argentina, Canada, Italy, Belgium, Taiwan, Bolivia, Vietnam, Australia
  - Exporter location mostly at the second-highest sub-national level (i.e., cities) – 3,748 locations with export and mobility data

Maritime Shipping Data

- Container ship port call data (AIS)
  - Source: IHS Markit's Maritime & Trade Platform
  - Coverage: 150 ports in 25 main partners and Colombia (at least 10 port calls per month in 2019) — Bolivia and Switzerland landlocked
  - Variable: ship characteristics, port of call, time of arrival, departure, previous port of call
  - Time: January 2018 to October 2021
- Measures of port productivity
  - Number of port calls
  - Number of hours spent in ports
- Additional information
  - Tonnage of ships arriving at each port (TEU, i.e., twenty-foot equivalent units)

Data on Changes in Within-City Human Mobility

- Colombia and its 26 main partners
  - Facebook, relative to February 2020
  - Uses the location information of users who enable location services on their mobile Facebook app to measure the change in the log average number of 0.6×0.6 km squares visited during a day
  - 20 periods: March 2020 to October 2021
- China
  - Baidu, relative to January 2020
  - Uses the indexation of the share of people who leave home for at least 500 meters for more than 30 minutes
  - 12 periods: March to May 2020, September 2020 to May 2021

Aggregate Trends

Pandemic Affected Human Mobility

- Monthly average of daily new cases at NUTS3 level in eight European countries, March 2020–August 2021
- Country-level stringency index from Hale et al. (2021)

Dependent Variable:	Changes in log human mobility				
	(1)	(2)	(3)	(4)	(5)
New cases, per capita	-0.111***		-0.018***		-0.040***
	(0.007)		(0.005)		(0.004)
Stringency Index		-0.008***		-0.007***	-0.007***
		(0.000)		(0.000)	(0.000)
Observations	16,443	16,445	16,443	16,445	16,443
R-squared	0.012	0.279	0.742	0.810	0.811
Country FE	-	-	Yes	Yes	Yes
Time FE	-	-	Yes	Yes	Yes

- Larger number of local cases and more stringent containment policies $\Longrightarrow$ larger declines in mobility

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Heterogeneity by Type of Good (Consumer, Intermediate, Capital by BEC): Similar for Importer Mobility

	(1) Value	(2) Quantity	(3) Price
Importer mobility × Consumer	0.469***	0.387***	0.082
	(0.139)	(0.149)	(0.081)
Importer mobility × Intermediates	0.420***	0.393***	0.027
	(0.075)	(0.085)	(0.062)
Importer mobility × Capital	0.393***	0.417***	-0.024
	(0.107)	(0.110)	(0.061)
Exporter mobility × Consumer	-0.023	0.074	-0.096**
	(0.126)	(0.148)	(0.048)
Exporter mobility × Intermediates	0.280***	0.398***	-0.118***
	(0.094)	(0.121)	(0.045)
Exporter mobility × Capital	0.330***	0.322**	0.008
	(0.103)	(0.141)	(0.069)
Observations	533,312	533,312	533,312
R^2	0.100	0.101	0.077

Substantial Effects of Exporter Mobility on Intermediate Goods

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Observations	533,312	533,312	533,312
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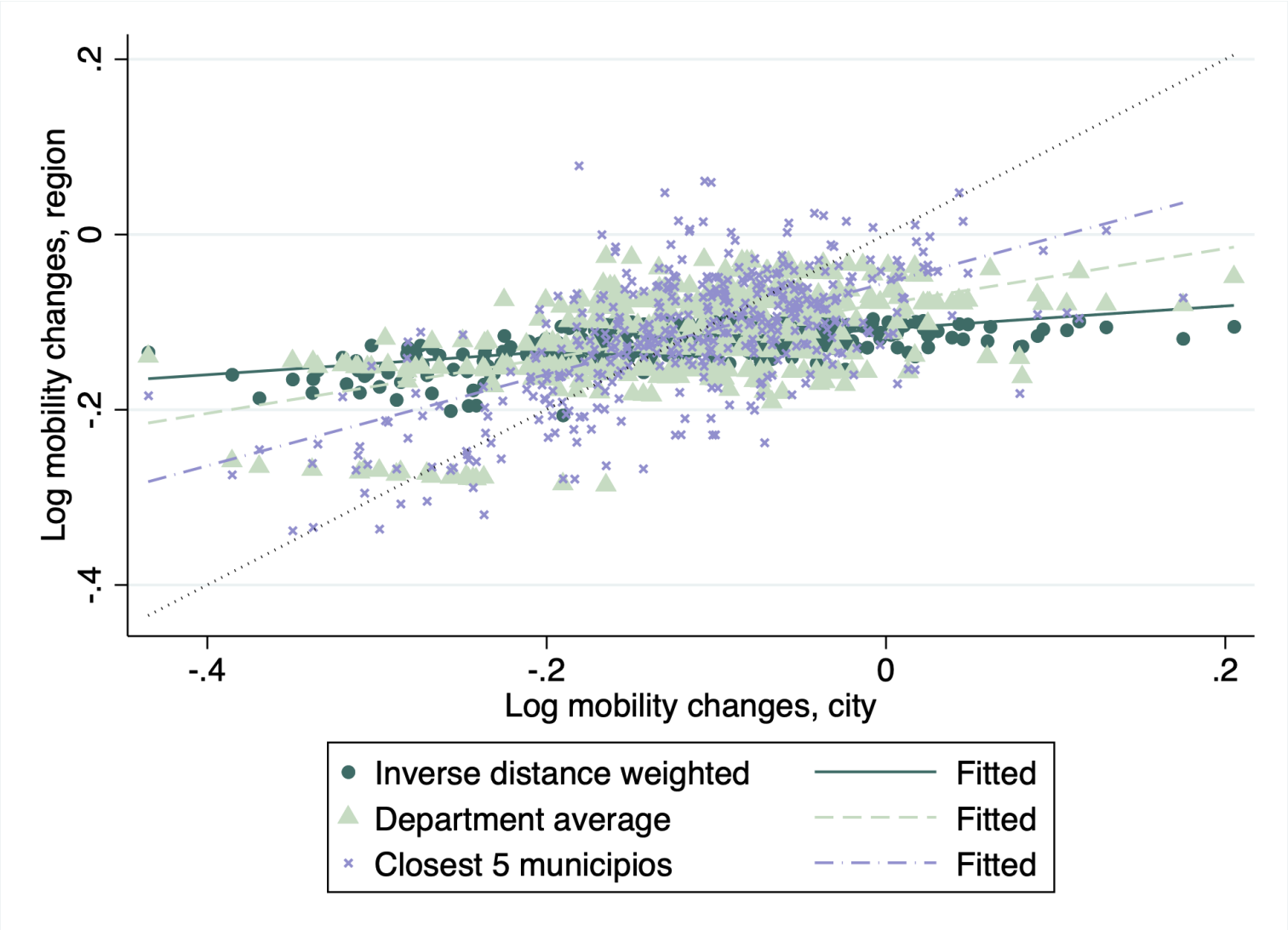
Elasticity of Substitution

- Short-term elasticity of substitution between sub-national varieties
- Estimation $\eta = \beta_I^q / \beta_I^p$:
  - Pooled regression: $\eta^{cons} = 3.4$
  - Consumer goods: $\eta^{cons} = 0.8$
  - Intermediate goods: $\eta^{inter} = 3.4$
- Using a balanced sample (flows that happened in all 20 months)
  - Similar effects of importer mobility change
  - Larger effects of exporter mobility change on quantity and price
  - A larger elasticity of substitution $\eta^{balanced} = 6.3$

Back

Understanding the Importer Effect



Covid-Related Medical Supplies

- A list by World Customs Organization and World Health Organization at HS6 level
  - COVID-19 Test kits/instruments and apparatus used in diagnostic testing
  - Protective garments and the like
  - Disinfectants and sterilisation products
  - Oxygen therapy equipment and pulse oximeters
  - Other medical devices and equipment
  - Other medical consumables
  - Vehicles
- About 7.7% of the total trade value

Covid-Related Medical Supplies, Examples

- Examples for consumption good
  - Men's protective garments made of rubberised textile fabrics
  - Tents for setting up field hospitals, including temporary canopies
  - Alcohol solution, undenatured, 75% ethyl alcohol
- Examples for intermediate good
  - Laboratory, hygienic or pharmaceutical glassware
  - Medical oxygen
  - Hydrogen peroxide in bulk
- Examples for capital good
  - Intubation kits
  - Medical ventilators (artificial respiration apparatus)

Covid-Related Medical Supplies: Lower Importer Mobility, Higher Demand

	(1) Value	(2) Quantity	(3) Price
Importer mobility	0.491***	0.457***	0.034
	(0.070)	(0.074)	(0.052)
Importer mobility $\times D(Medical = 1)$	-0.383***	-0.254	-0.128
	(0.135)	(0.156)	(0.125)
Exporter mobility	0.243***	0.349***	-0.106**
	(0.094)	(0.125)	(0.046)
Exporter mobility $\times D(Medical = 1)$	0.302**	0.374***	-0.072
	(0.123)	(0.136)	(0.083)
Observations	537,102	537,100	537,100
R-squared	0.100	0.101	0.076

Back

Robustness and Additional Results

- Balanced Sample
- Alternative Fixed Effects
- Alternative Clustering
- Pre-trends controls
- Other heterogeneous effects
- Controlling for congestion variables
- Exporter and importer mobility interaction
- Extensive margin results

Mobility Shocks at Ports, Port Efficiency, and Freight Costs

- **Exporter country port performance and port mobility shocks** (country c, year y, calendar month m):

$$\hat{Y}_{cym} = \alpha_0 \hat{x}^{\text{Ports}}_{cym} + \delta_m + \delta_y + \delta_c + \epsilon_{cym}$$

  - $\hat{Y}_{cym}$: number of hours in port, number of port calls
  - $\hat{x}^{\text{Ports}}_{cym} \equiv \sum_{p(c)} \frac{\text{TEU}_{p(c)2020}}{\sum_{p'(i)} \text{TEU}_{p'(c)2020}} \hat{x}_{p(c)ym}$
  - $\text{TEU}_{p(c)2020}$: TEU in port p of country c in February 2020
  - Alternative fixed effect with time trend: captures cumulative effects

- **Freight cost and port mobility shocks** (product k):

$$\hat{T}_{kcym} = \beta_0 \hat{x}^{\text{Ports}}_{cym} + \delta_m + \delta_y + \delta_c + \delta_k + \epsilon_{kcym}$$

  - T: freight cost in unit, or in weight

Lower Port Mobility, Longer Hours at Ports, Fewer Calls Processed

Panel A.	(1)	(2)	(3)	(4)	(5)	(6)
Outcome: 2020 and 2021	Δ log hours		Δ log number of calls		Δ log hours	
Δ log mobility	-0.129**	-0.129**	0.108**	0.108**		
	(0.053)	(0.053)	(0.049)	(0.049)		
Δ log number of calls					-0.268***	-0.268***
					(0.090)	(0.090)
I (Year=2021)	0.169***		-0.021		0.149***	
	(0.021)		(0.020)		(0.018)	
Time trend		0.014***		-0.002		0.012***
		(0.002)		(0.002)		(0.002)
Constant	-0.042**	-0.106***	0.084***	0.092***	0.003	-0.052***
	(0.016)	(0.023)	(0.011)	(0.017)	(0.010)	(0.016)
Observations	492	492	492	492	492	492
R-squared	0.654	0.654	0.727	0.727	0.661	0.661

Pre-trends

Lower Mobility, Higher Freight Costs

Outcome: 2020 and 2021	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ log freight cost, unit				Δ log freight cost, weight			
Δ log mobility change	-0.25**	-0.25**	-0.29**	-0.53**	-0.30***	-0.30***	-0.34***	-0.57***
	(0.11)	(0.11)	(0.12)	(0.20)	(0.10)	(0.10)	(0.11)	(0.18)
I (year=2021)	0.51***		0.51***	0.54***	0.55***		0.55***	0.58***
	(0.08)		(0.08)	(0.08)	(0.07)		(0.07)	(0.07)
Time trend		0.04***				0.05***		
		(0.01)				(0.01)		
Constant	0.02	-0.17**	0.01	-0.04	-0.04	-0.25***	-0.05	-0.09*
	(0.05)	(0.07)	(0.05)	(0.06)	(0.04)	(0.07)	(0.04)	(0.05)
Observations	245,995	245,995	239,425	245,991	245,995	245,995	239,425	245,991
R-squared	0.11	0.11	0.16	0.11	0.15	0.15	0.20	0.16
Month FE	Yes	Yes			Yes	Yes		
Product FE	Yes	Yes		Yes	Yes	Yes		Yes
Exporter country FE	Yes	Yes	Yes		Yes	Yes	Yes	
Product-month FE			Yes				Yes	
Country-month FE				Yes				Yes

Back Pre-trends

Robustness and Additional Results

- Variation in country-level port performance ▷
- Variation in product-level freight cost ▷
- Drop one country at a time ▷
- Drop one period at a time ▷
- Residual plots ▷
- Intermediate country ports ▷

Decomposition: Methodology

- We decompose the total direct impact of disruptions into import, exporter, and port location shocks
- Expected quantity and prices effects *conditional on fixed effects*:

$$\begin{aligned} \hat{q}^{est} &\equiv b_I^q \hat{x}_I + b_J^q \hat{x}_J + Transportation \\ \hat{p}^{est} &\equiv b_I^p \hat{x}_I + b_J^p \hat{x}_J + Transportation \end{aligned}$$

- Transportation fixed effect δ^{Tr} in price and quantity equations:

$$\hat{\delta}^{Tr,p} = (1 - \bar{\iota}) t^{Tr,est} + \epsilon^{Tr,p},$$

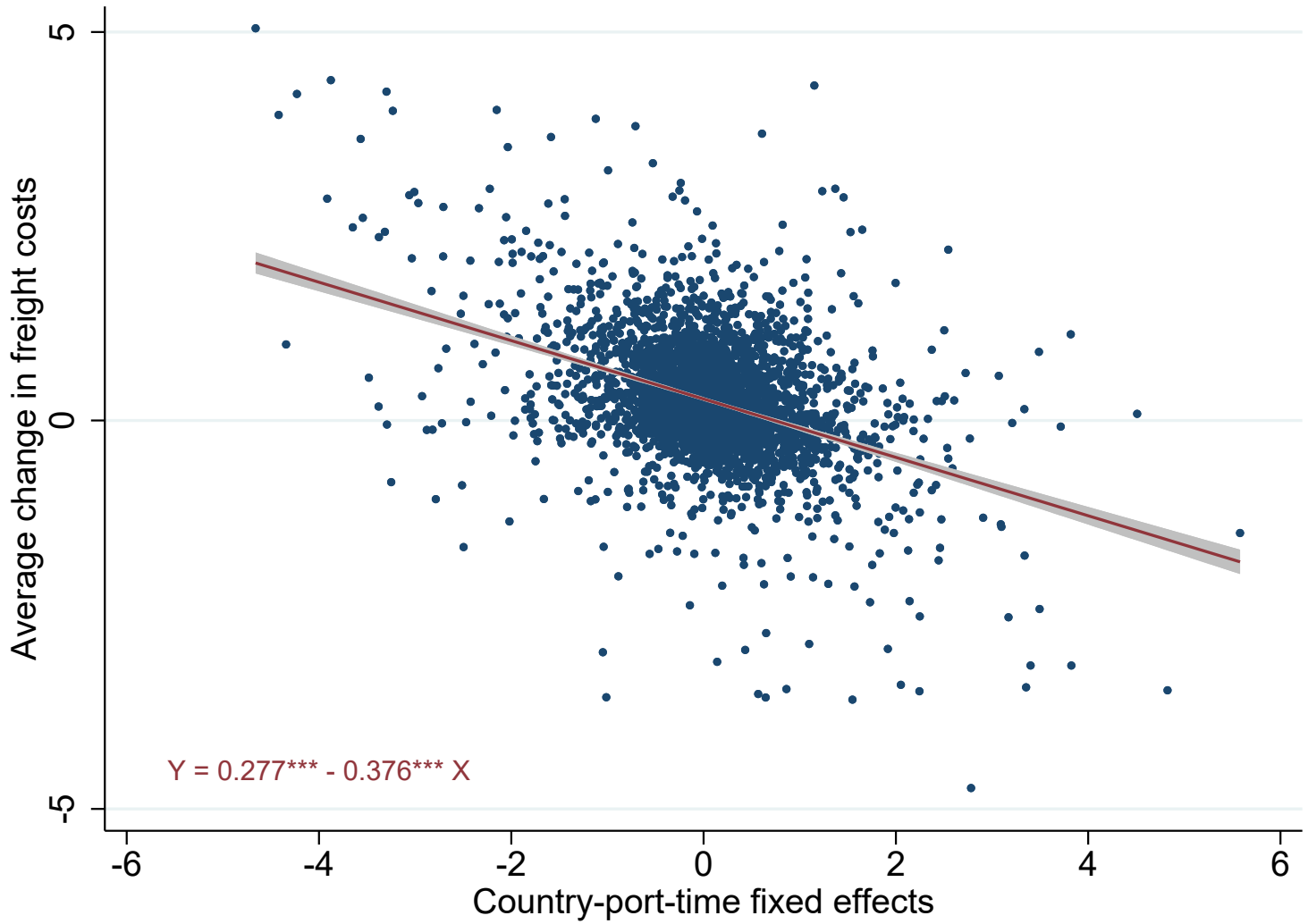
$$\hat{\delta}^{Tr,q} = -\hat{\eta}(1 - \bar{\iota}) t^{Tr,est} + \epsilon^{Tr,q}.$$

- The estimated freight cost:

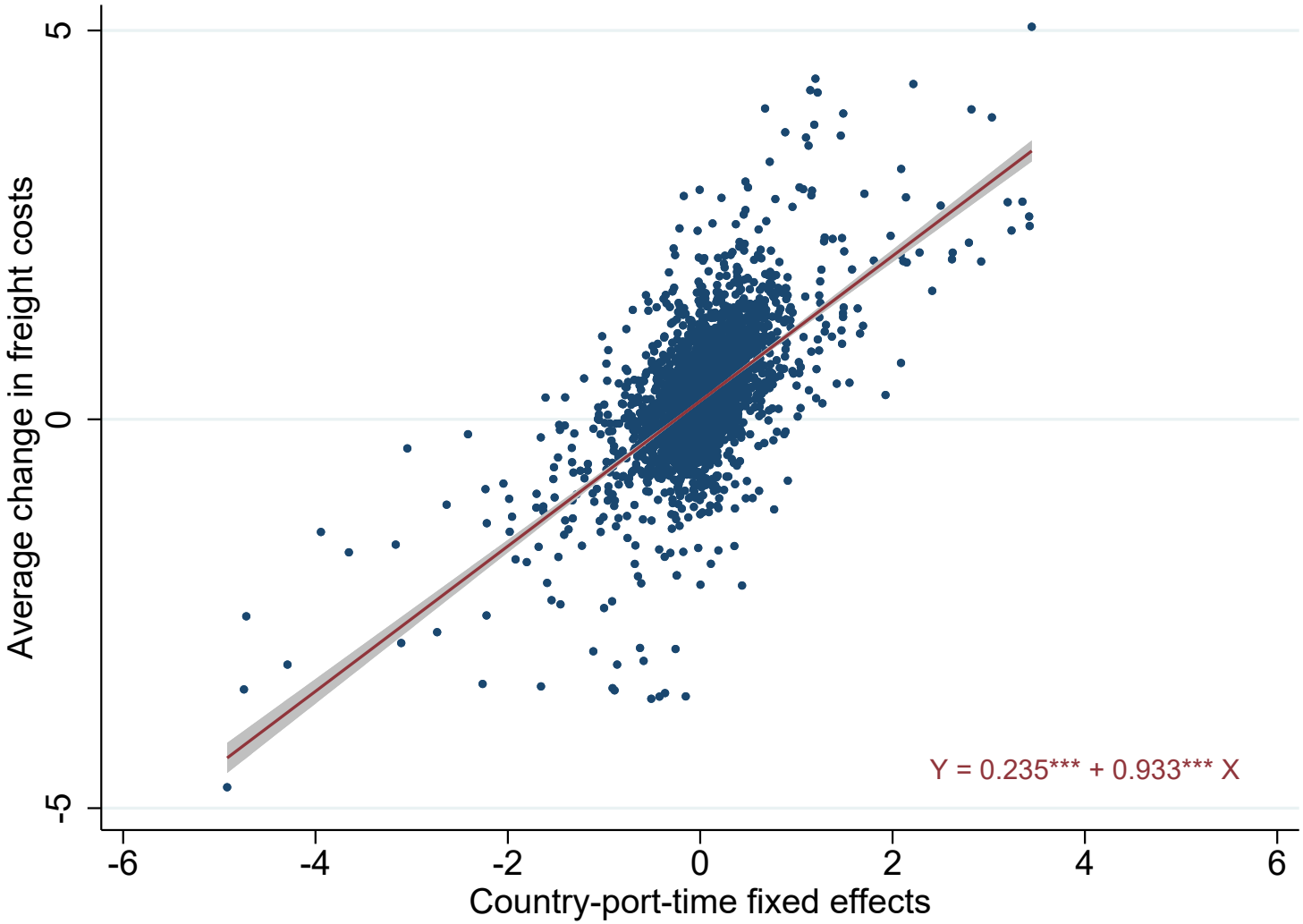
$$t^{Tr,est} \equiv b_0 \hat{x}^{Ports} + b^{trend} \times \text{time}$$

$\bar{\iota} = 0.07$ (average pre-pandemic share of transportation in import price)

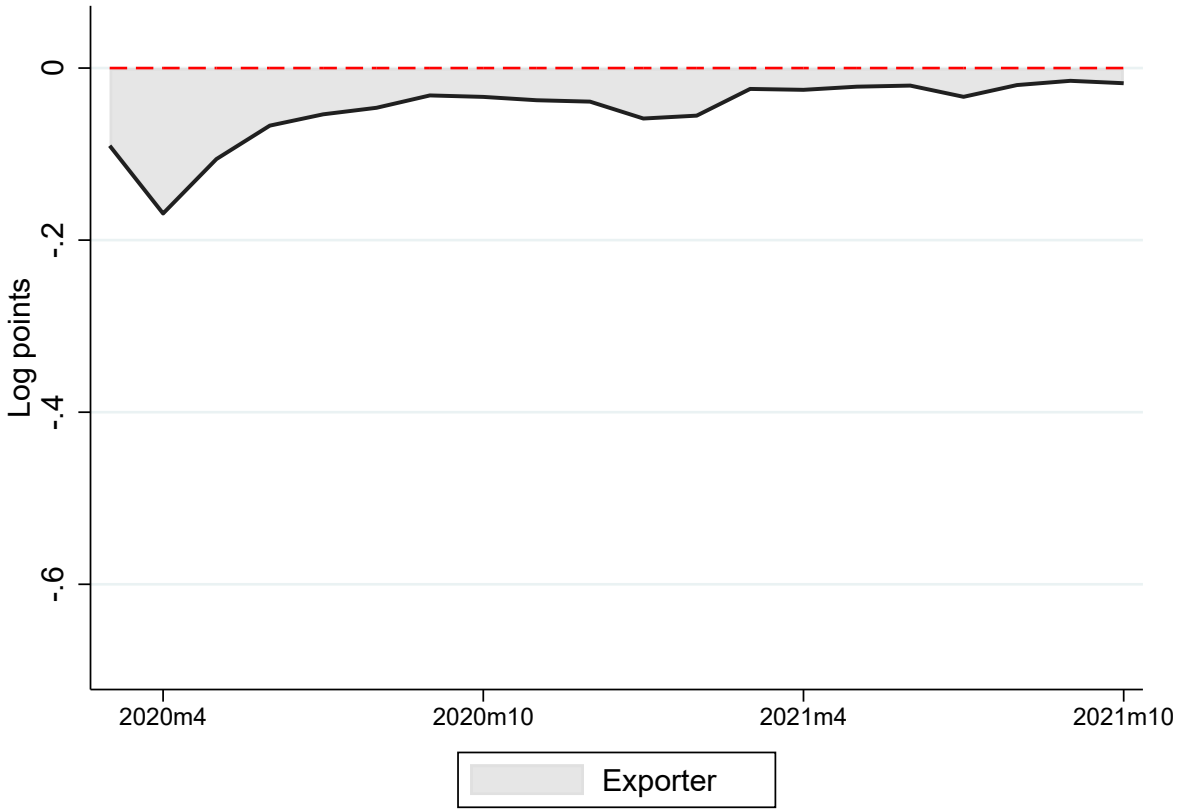
Validation: Correlation Between Country-Port-Time Fixed Effect (δ^{Tr}) and Country-Port-Time Observed Freight Unit Values Averages, Quantity



Price


Average change in freight costs
5
0
-5
-6
-4
-2
0
2
4
6
Country-port-time fixed effects
Y = 0.235*** + 0.933*** X

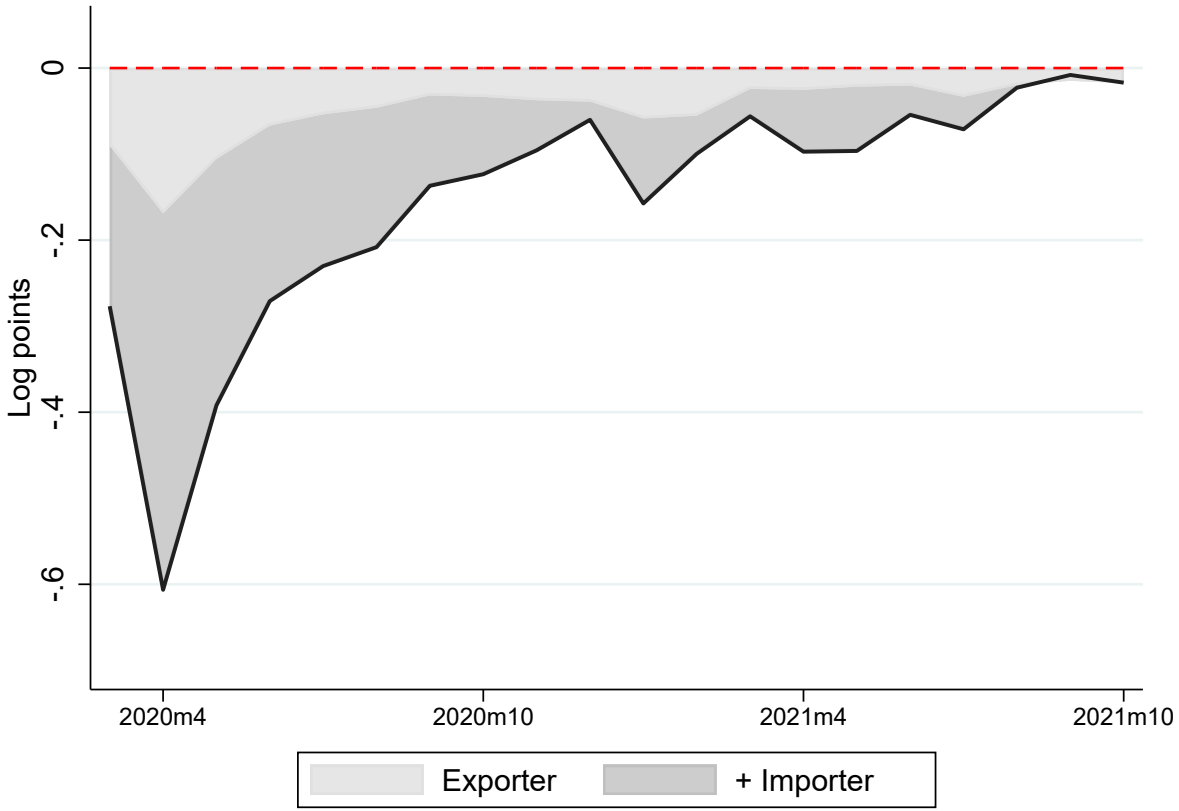
Decomposition: Import Quantities of Intermediate Goods



- Importer mobility shocks explained 67%, exporter shocks 26% and port shocks 7% at the onset of the pandemic (April 2020)

Consumer Goods

Decomposition: Import Quantities of Intermediate Goods



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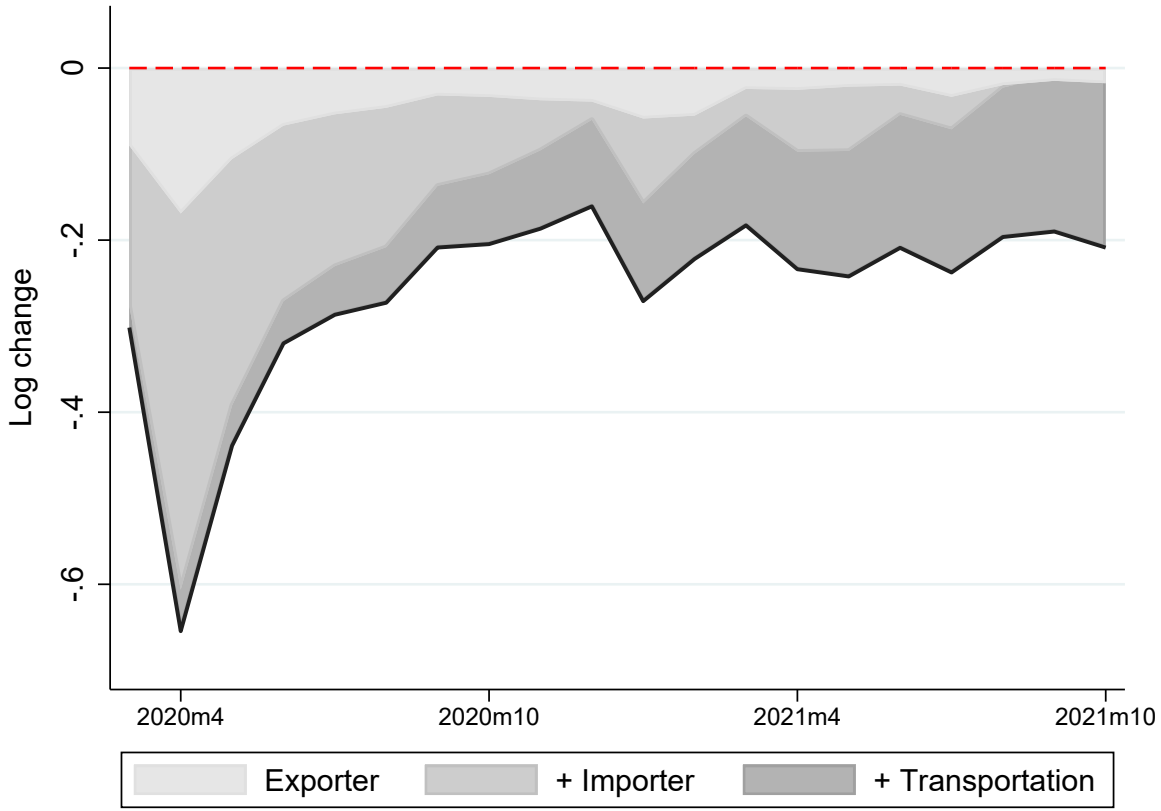
Consumer Goods

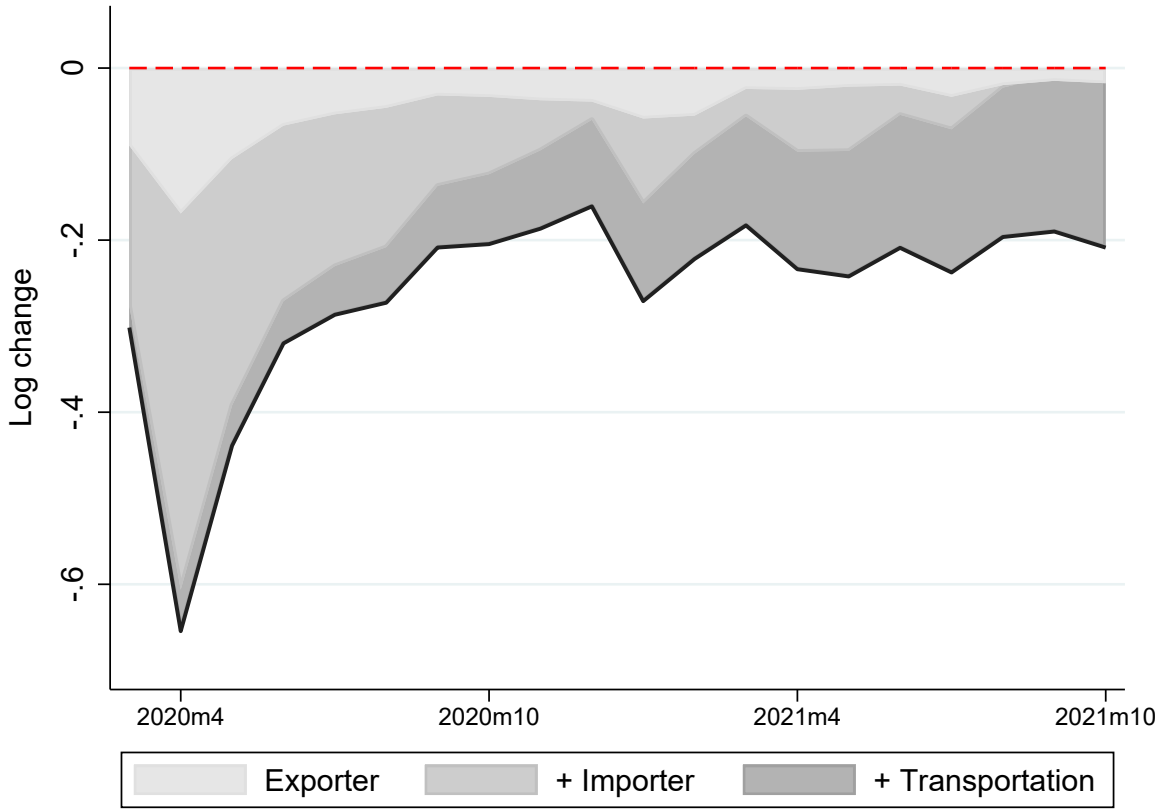
Decomposition: Import Quantities of Intermediate Goods



- Importer mobility shocks explained 67%, exporter shocks 26% and port shocks 7% at the onset of the pandemic (April 2020)

Consumer Goods

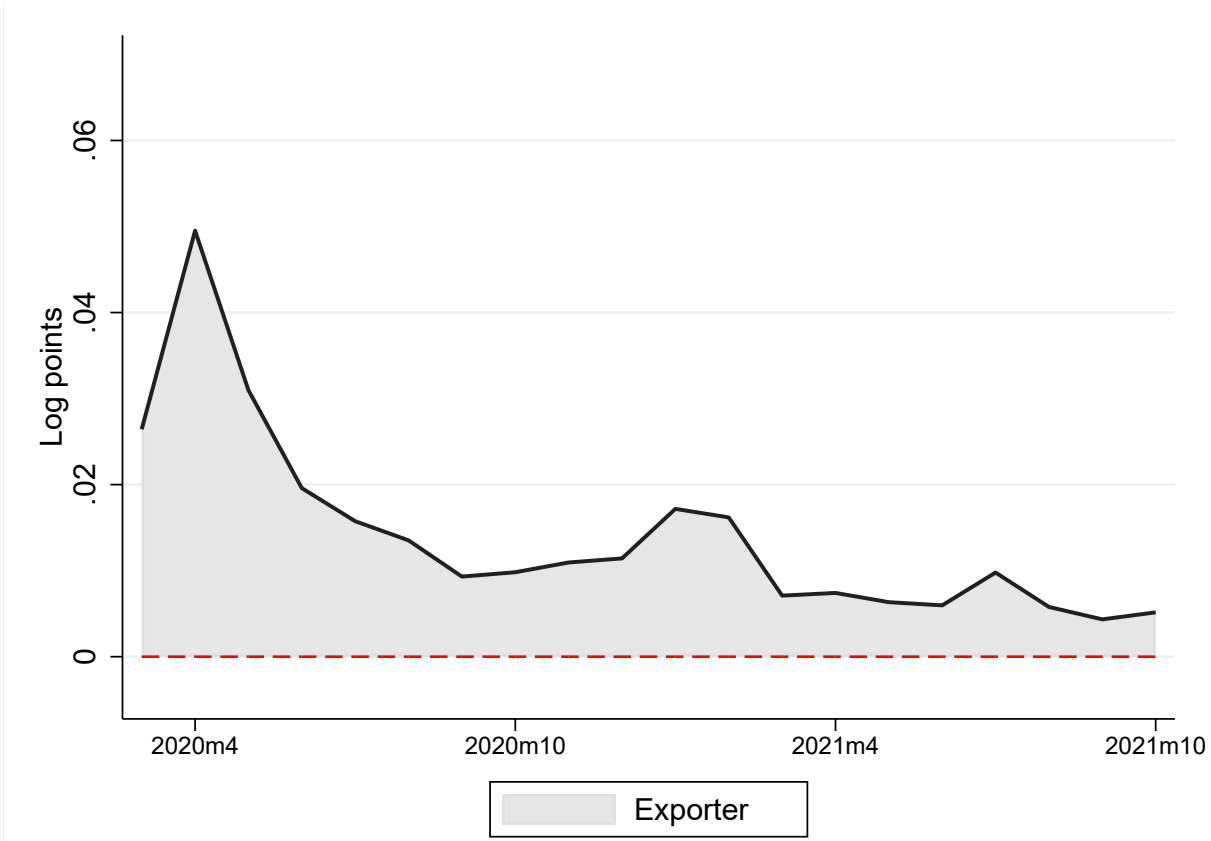
Decomposition: Import Quantities of Intermediate Goods



- Importer mobility shocks explained 67%, exporter shocks 26% and port shocks 7% at the onset of the pandemic (April 2020)

Consumer Goods

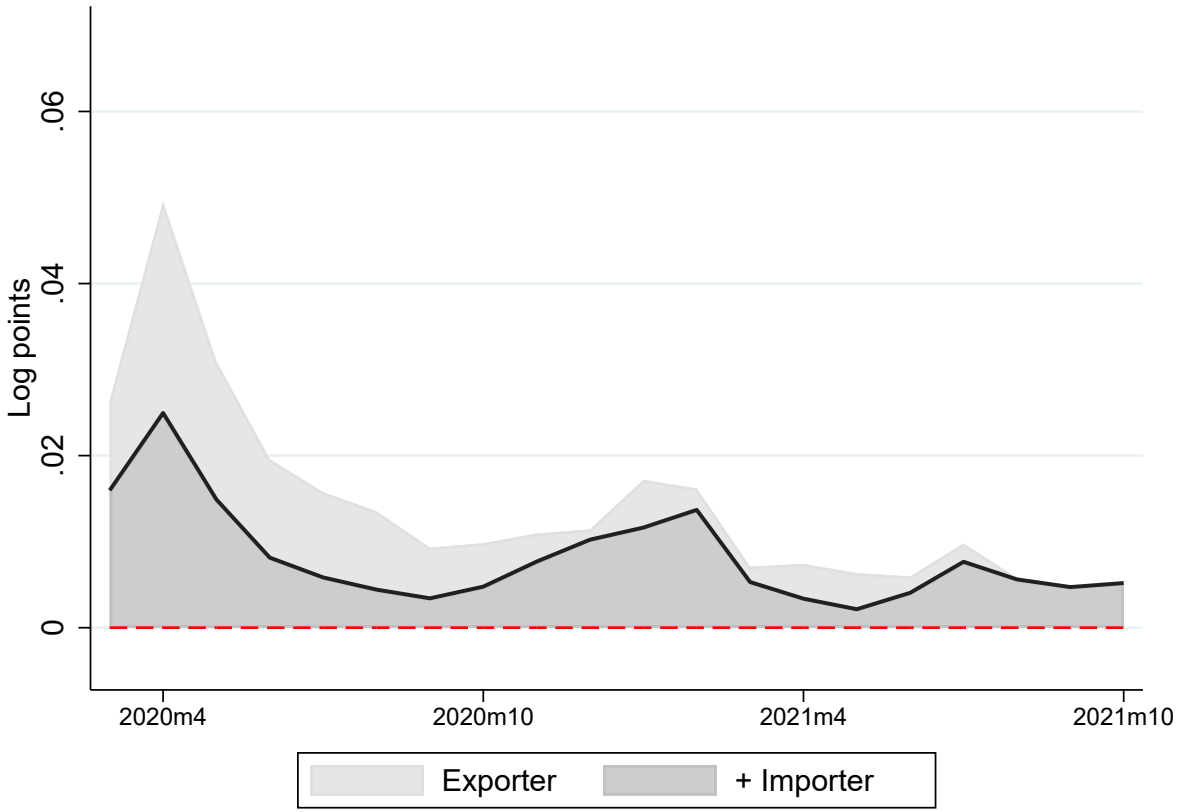
Decomposition: Import Prices of Intermediate Goods



- The price effect in April 2020 is explained fully by exporter mobility.
- Transportation effects explained 90% in October 2021

Back Consumer Goods

Decomposition: Import Prices of Intermediate Goods



- The price effect in April 2020 is explained fully by exporter mobility.
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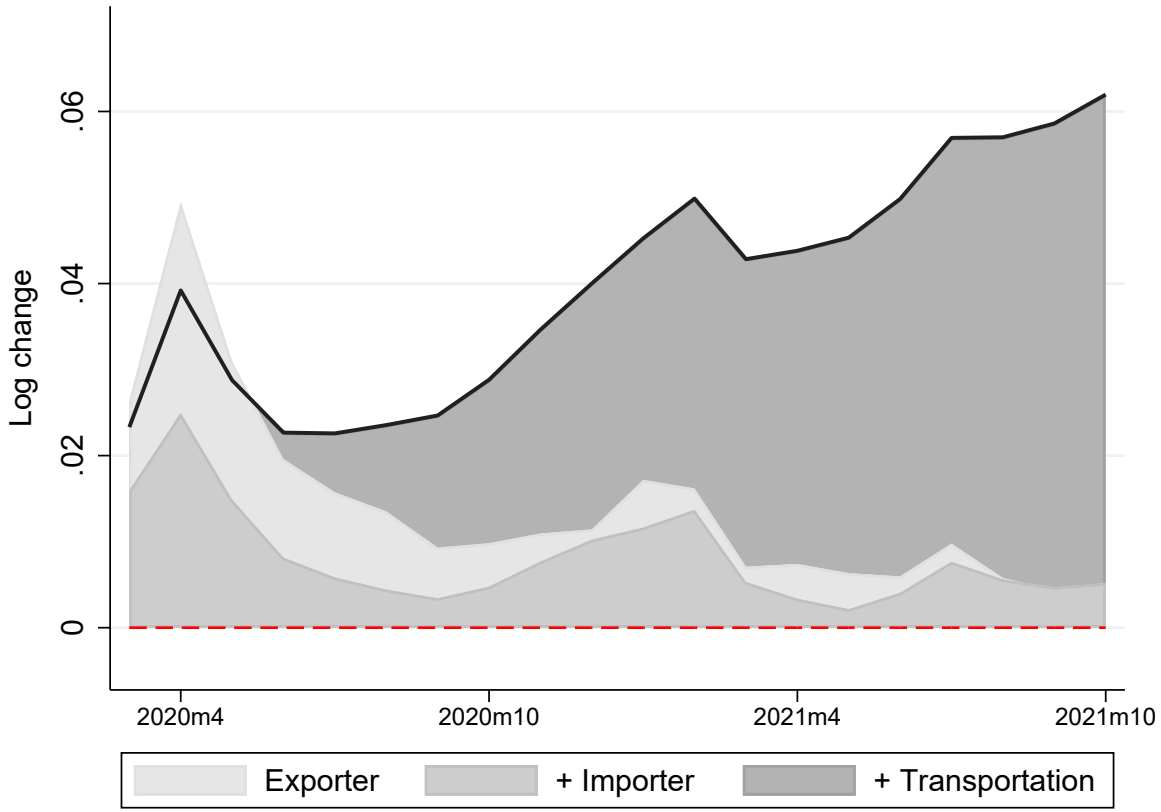
Back Consumer Goods

Decomposition: Import Prices of Intermediate Goods



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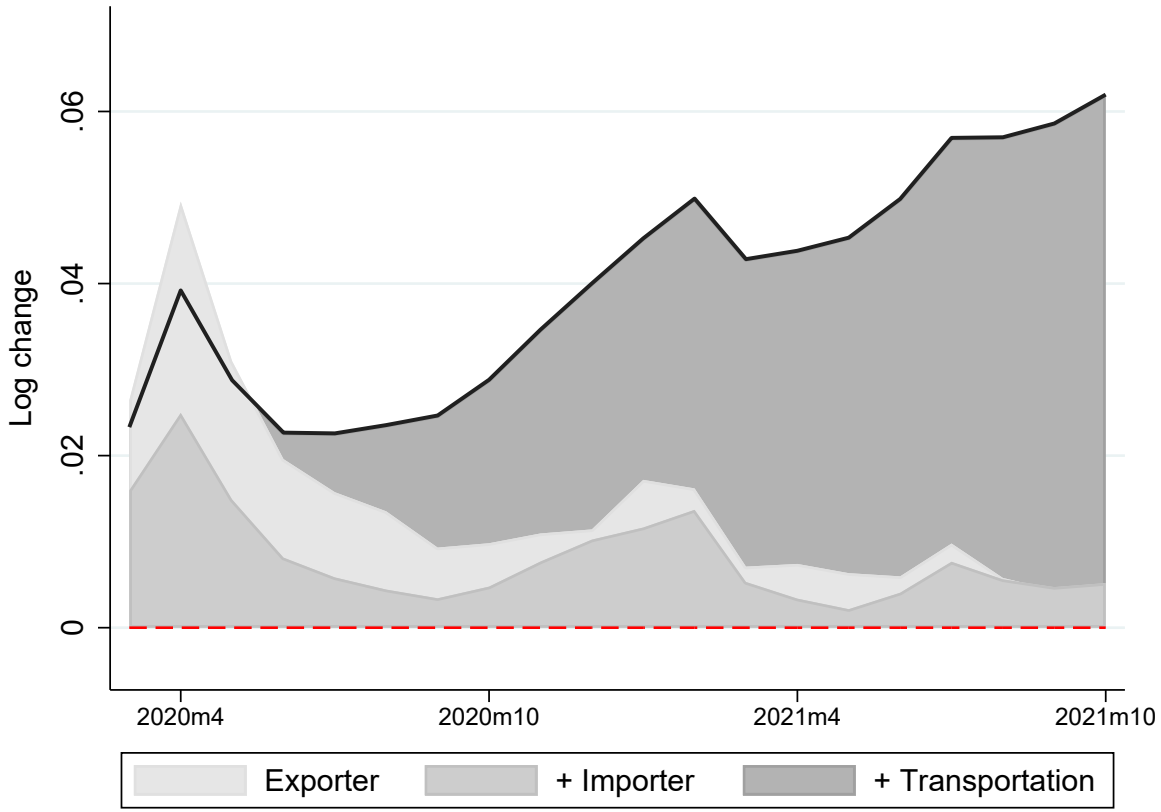
Back Consumer Goods

Decomposition: Import Prices of Intermediate Goods



- The price effect in April 2020 is explained fully by exporter mobility.
- Transportation effects explained 90% in October 2021

Back Consumer Goods

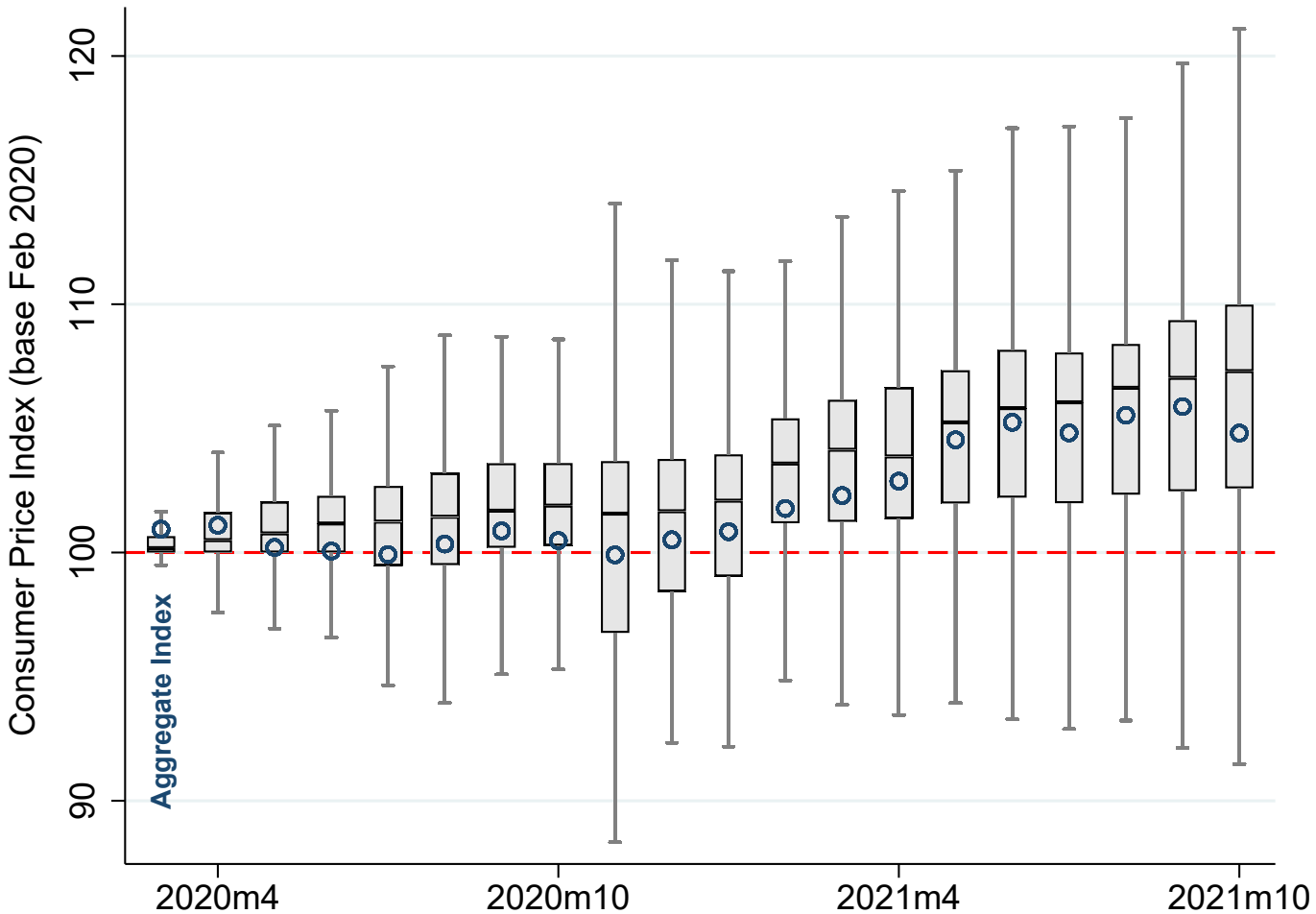
Complexity of the Supply Chains

- Did products with **larger numbers of supplier** countries or larger numbers of supplier cities experience differential shocks?
  - Similar mean and standard deviation for exporter mobility changes

Import Prices and Inflation

- We compute the relationship between inflation and changes in consumer import prices at the product level.
- We use product-level CPI from Colombia's DANE (Colombia's office of statistics).
    - Product codes based on COICOP, a classification by spending purpose.
    - 188 goods and services, restricted to 60 matched to imports.
    - Change of base to February 2020 to line it up with mobility changes.

Monthly Distribution of Consumer Price Indices over Goods with Positive Imports



Relationship Between Import Price Increases (Observed and Predicted) and Consumer Price Indices

	(1)	(2)	(3)	(4)
	Observed		Predicted	
Δ log import price	0.013**	0.009**	0.575***	0.568**
	(0.006)	(0.005)	(0.168)	(0.226)
Time FE	Yes	Yes	Yes	Yes
Goods FE		Yes		Yes
N	1,126	1,126	1,126	1,126
R^2	0.102	0.667	0.104	0.670

- Direct pass-through from import prices rises due to exporter mobility shocks: about 60%

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Conclusion

- We study the impact of local trade disruptions shocks at exporter location, exporter port, importer location during the pandemic
  - We find that local declines in human mobility relative to before the pandemic were associated with lower import values, quantities and higher prices
  - Port efficiency was negatively affected by mobility shocks as well and lead to an increase in prices
- We estimate the short-term elasticity of substitution between sub-national locations, which is a useful parameter for policy making
- We estimate the pass-through of import prices to domestic inflation

Colombia's Import Variables During the Pandemic - Estimation

- We estimate the equation below for January 2018-October 2021.

$$\log m_{ijkt} = \sum_{s=01/2020}^{10/2021} \alpha^s \times 1\{t = s\} + \delta^I_{ijkm} + \delta^S_{ijk} \times t + \varepsilon_{ijkt}$$

$\Rightarrow$ m_{ijkt} are import variables at the exporter(i)-importer (j)-product(k)-time(t) level

$\Rightarrow$ δ^I_{ijkm}: are exporter(i)-importer (j)-product(k)-month(m) fixed effects and δ^S

$\Rightarrow$ $\delta^S_{ijk} \times t$: are exporter(i)-importer (j)-product(k)-specific linear trends

$\Rightarrow$ ε_{ijkm} is an idiosyncratic error

- We plot the α^ss $\Longrightarrow$ Average deviations from pre-pandemic trends.

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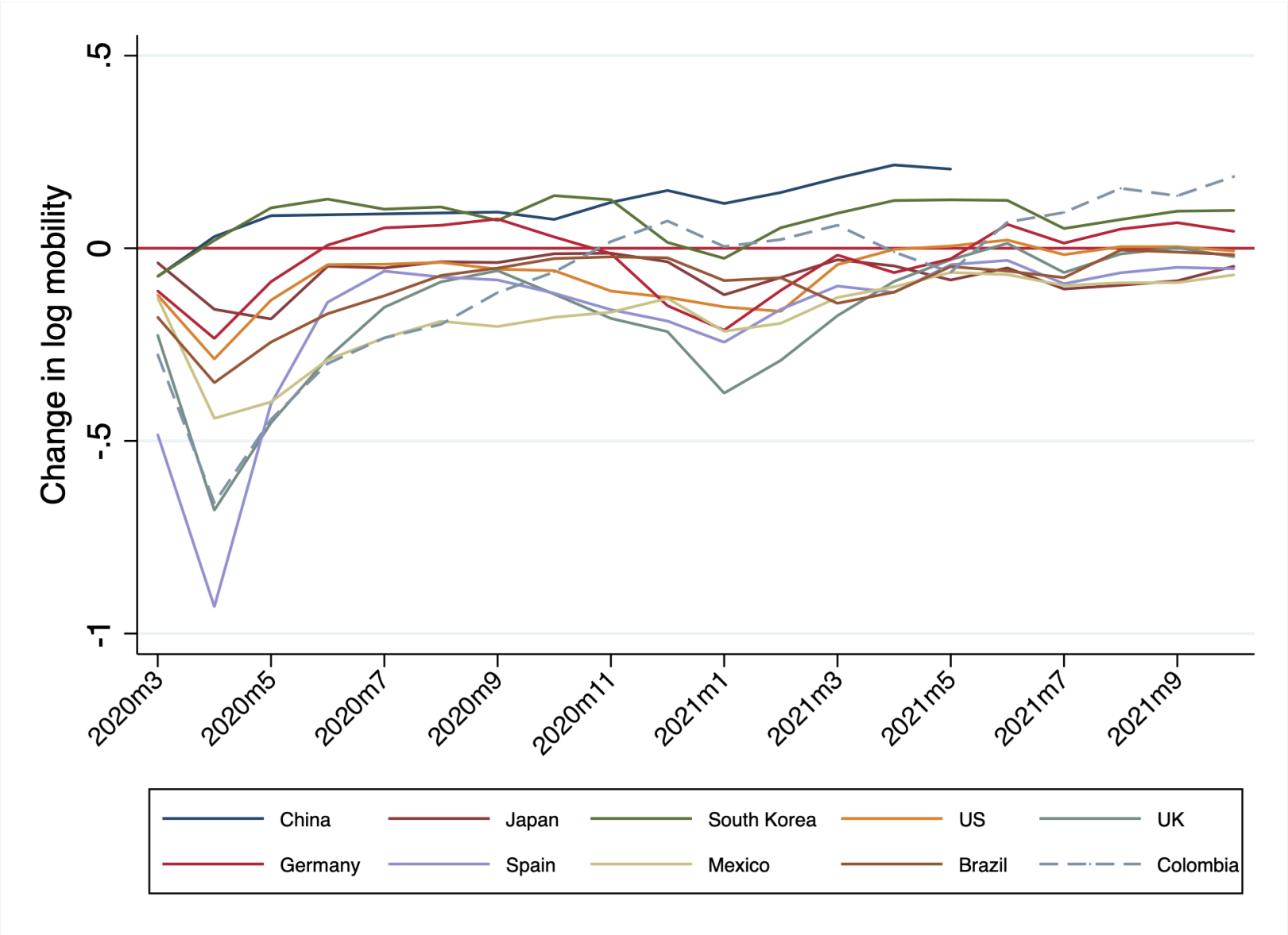
Aggregate Changes in Mobility



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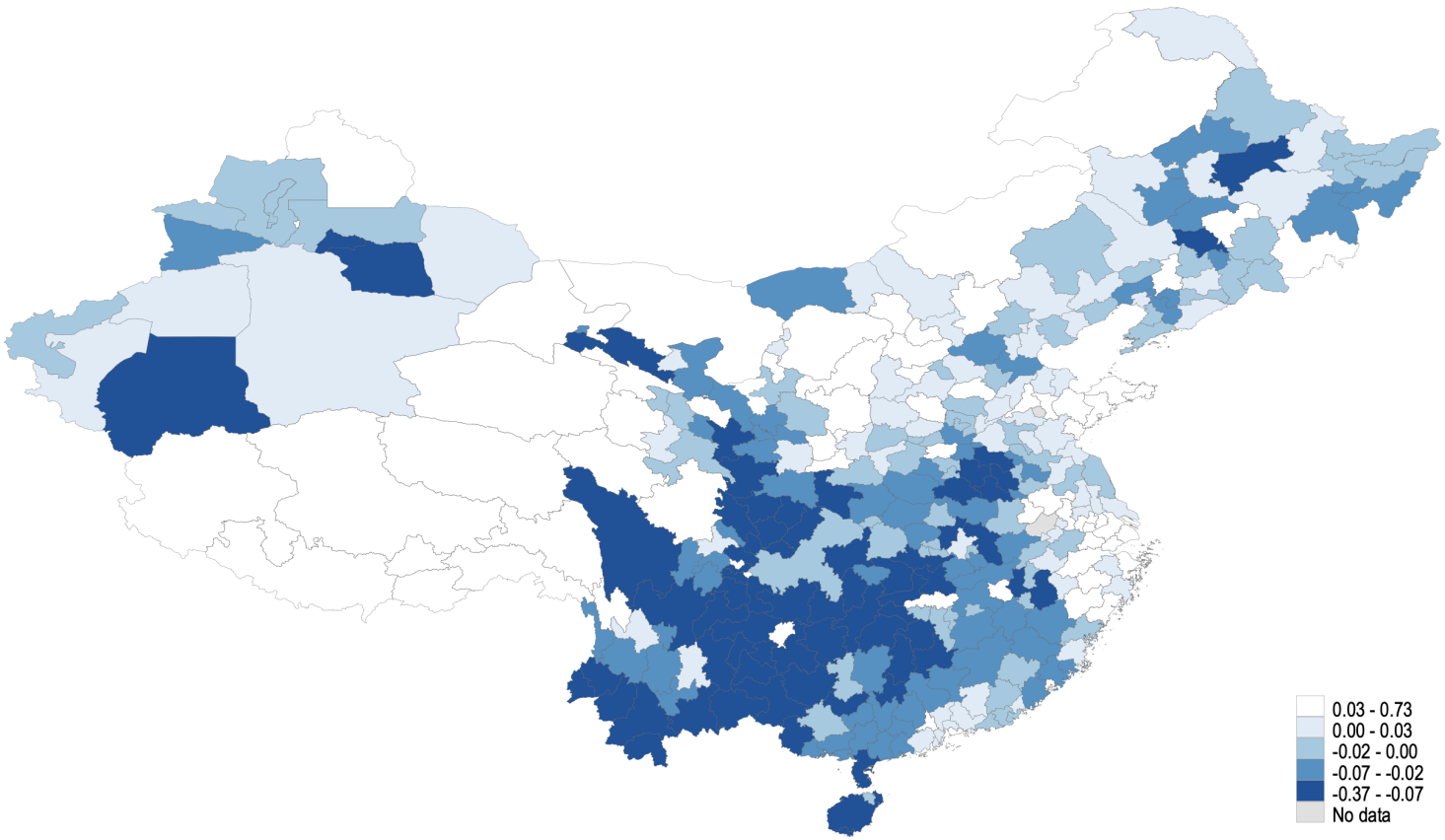
Changes in Mobility Relative to Pre-pandemic Reference, China



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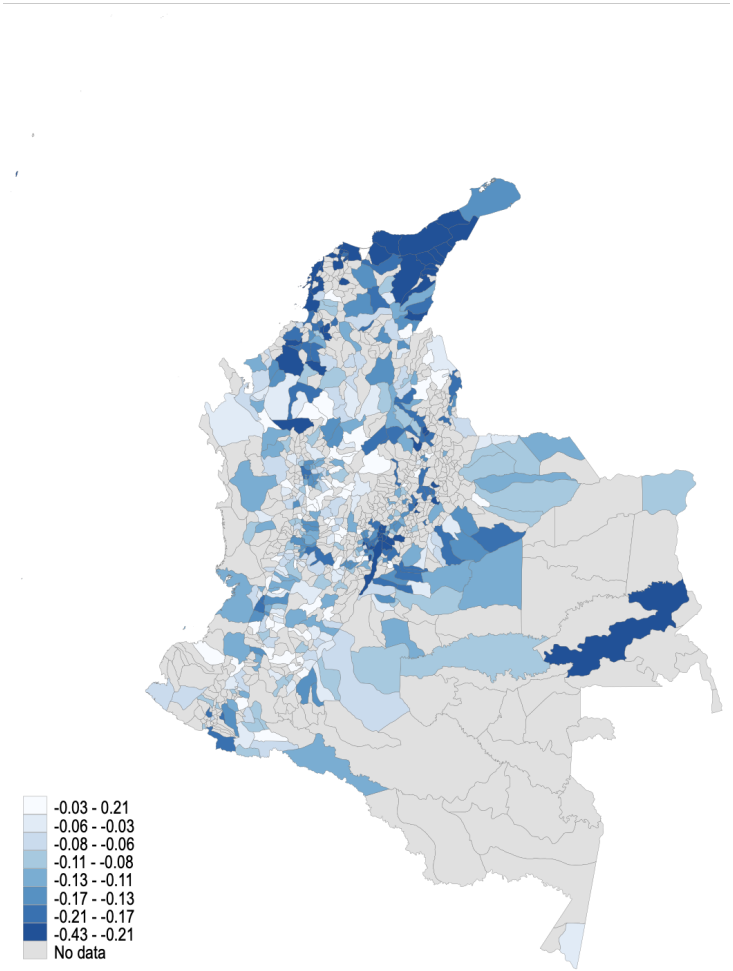
Changes in Mobility Relative to Pre-pandemic Reference, Colombia



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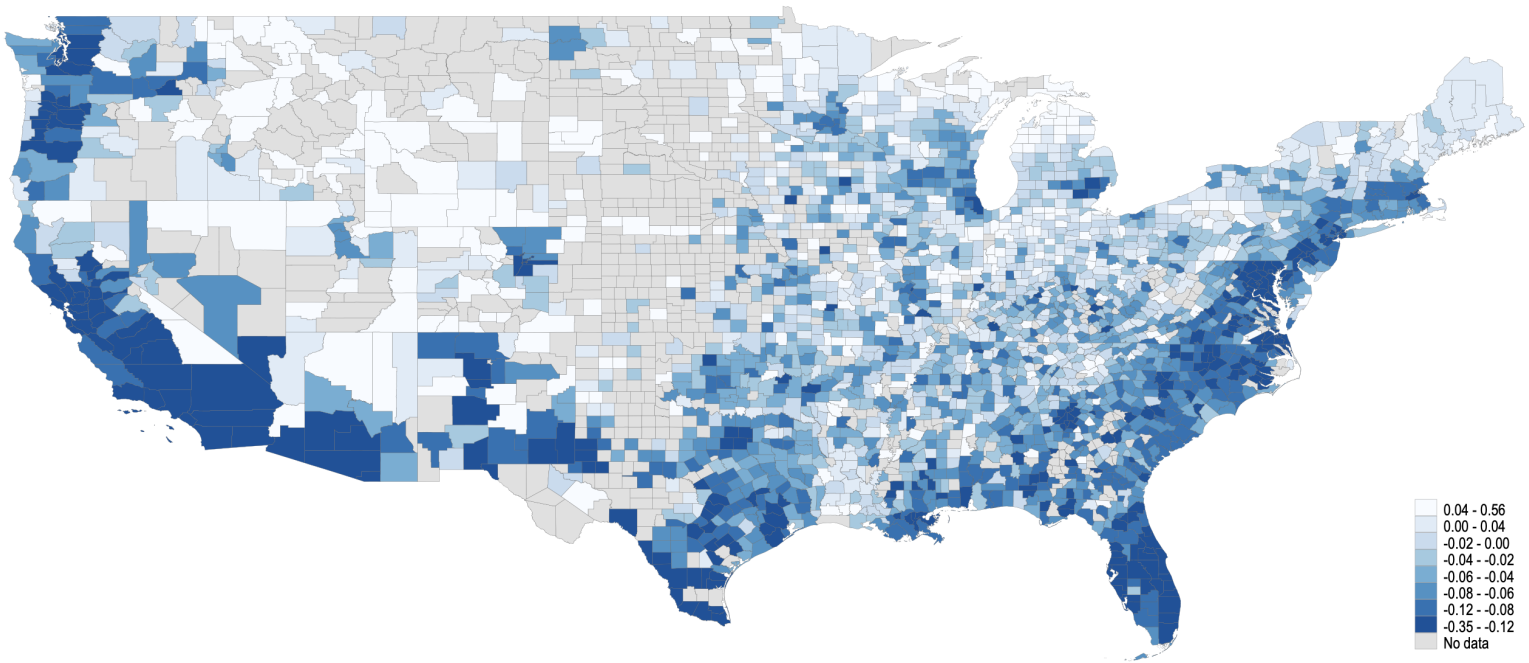
Changes in Mobility Relative to Pre-pandemic Reference, US



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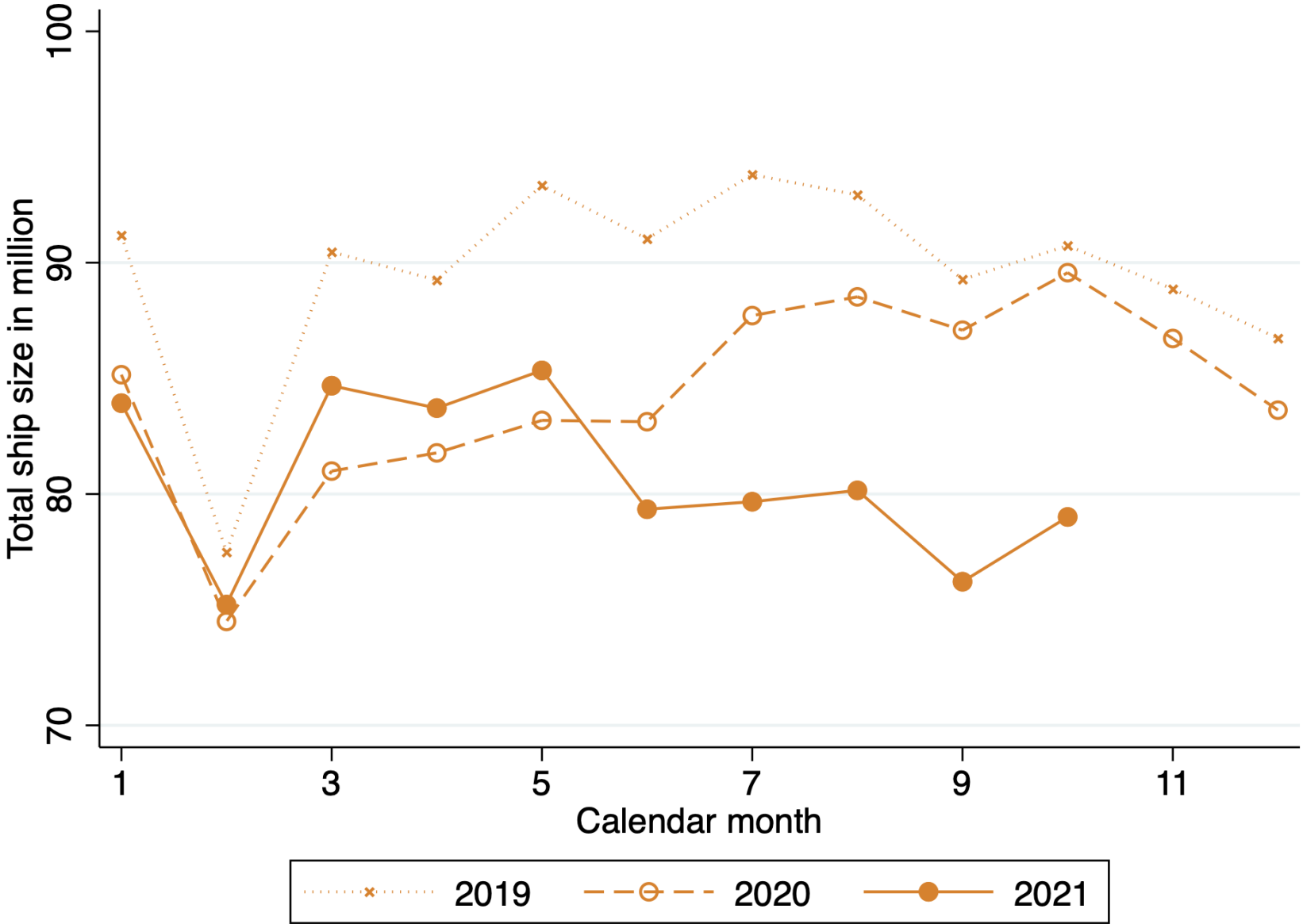
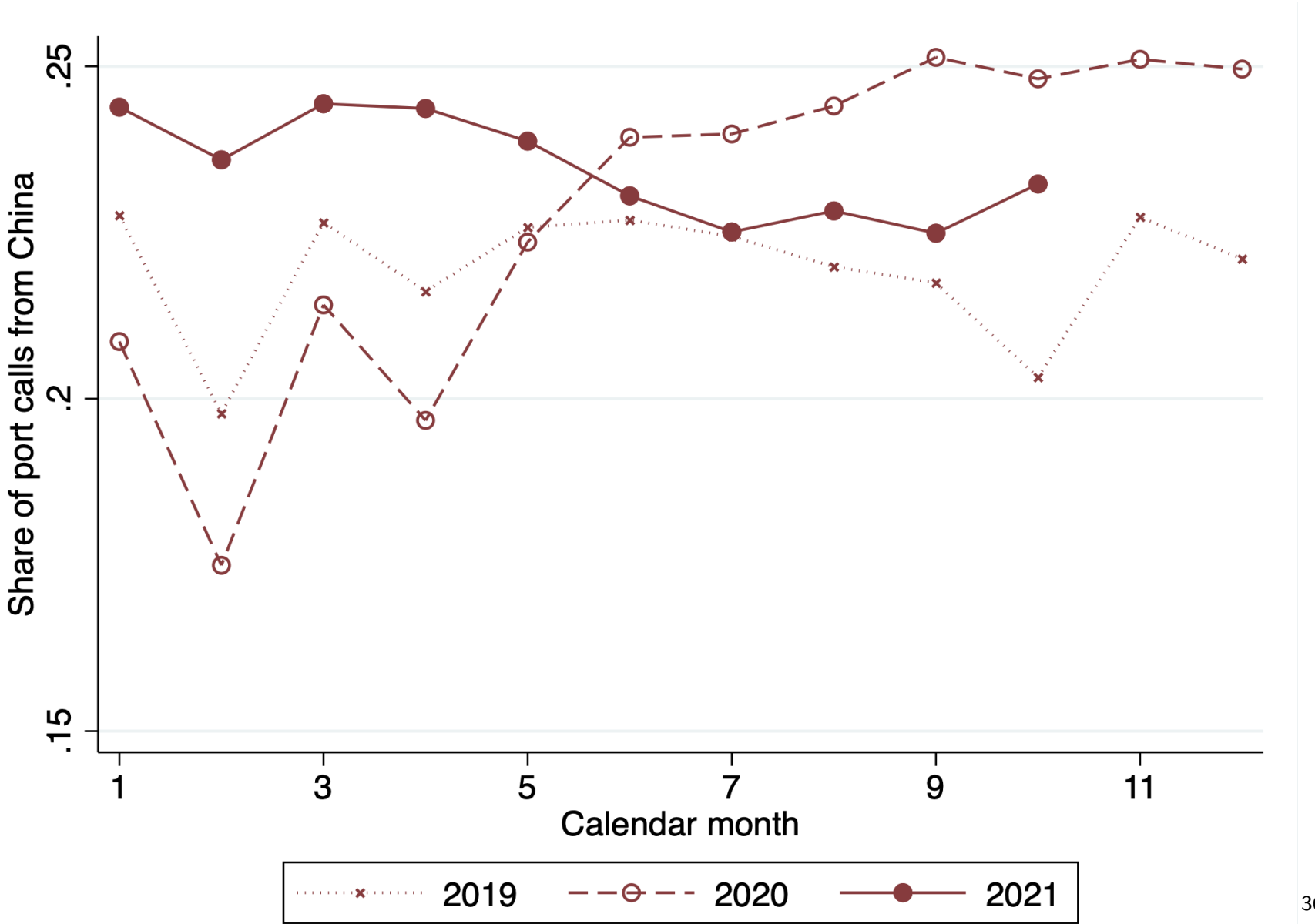
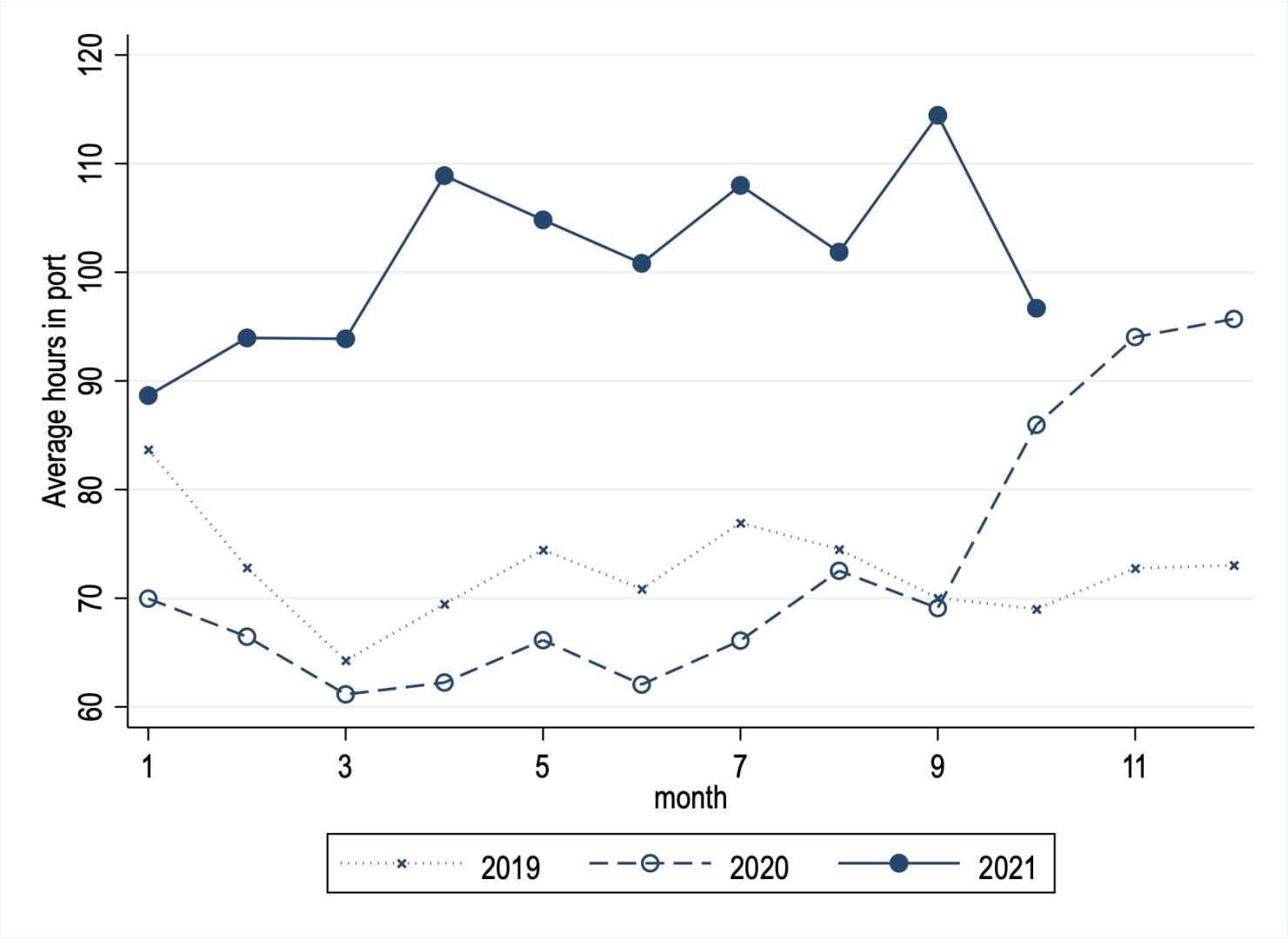
Total Tonnage: TEU Units



Share of Calls from China



Number of Hours in Los Angeles Port



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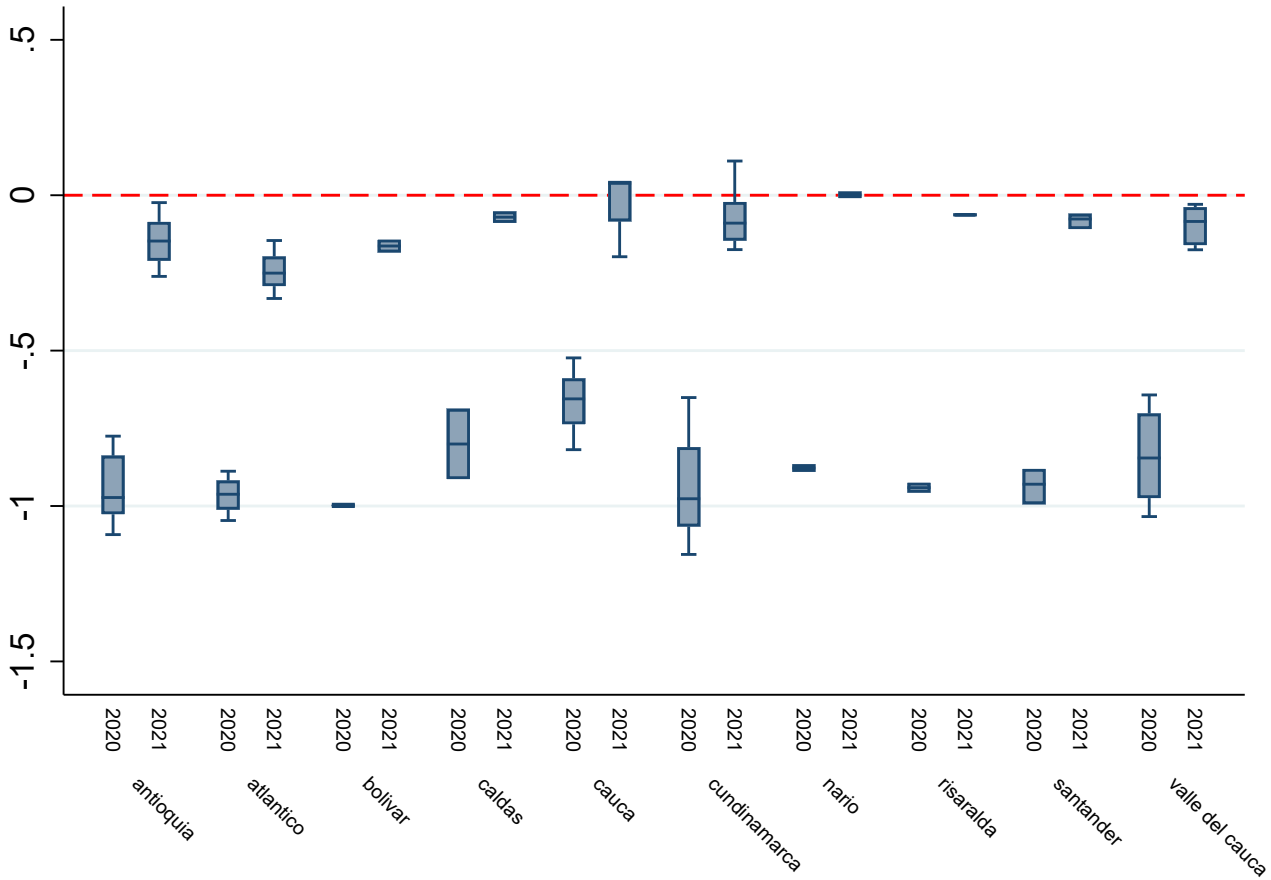
Change in Importer Mobility over Time and within Departments (April 2020 vs April 2021)



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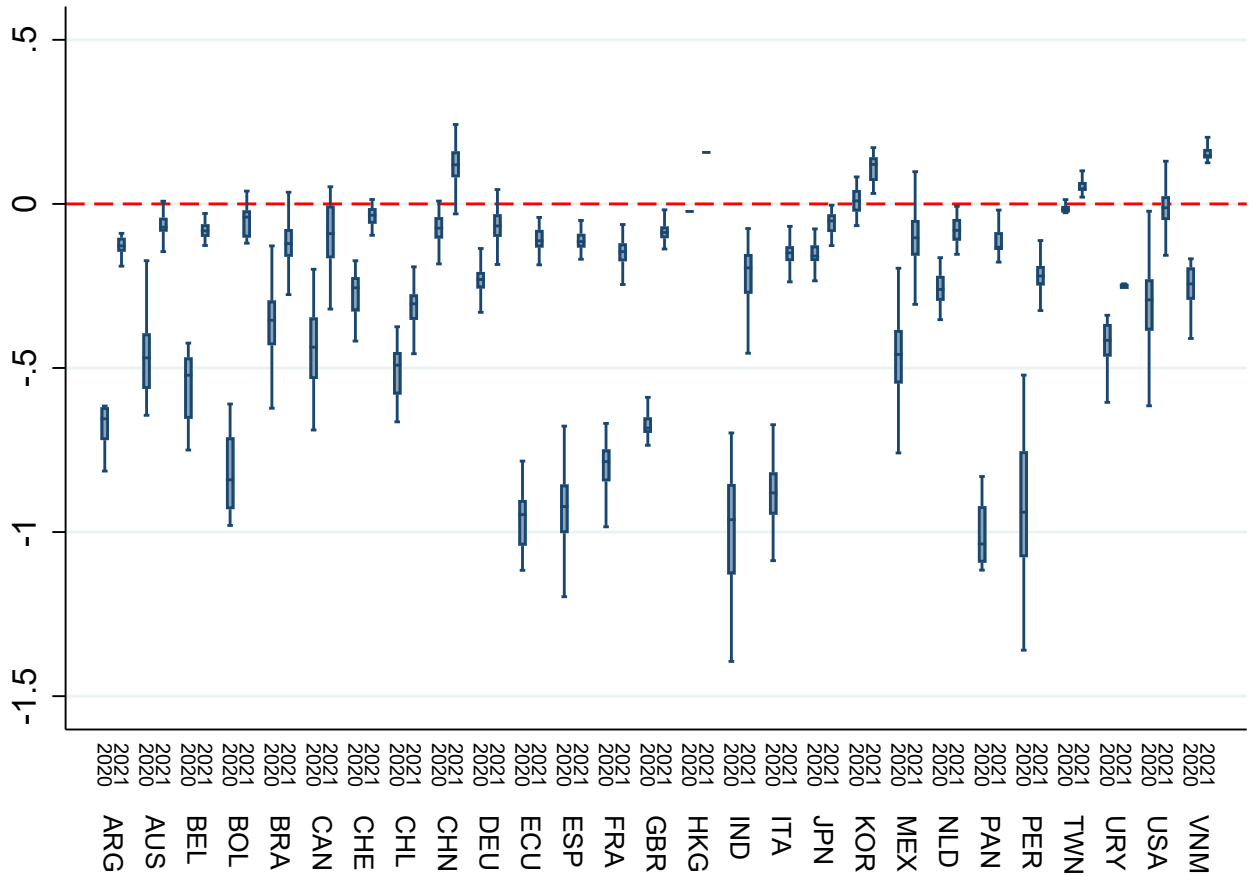
Change in Exporter Mobility over Time and within Countries (April 2020 vs April 2021)



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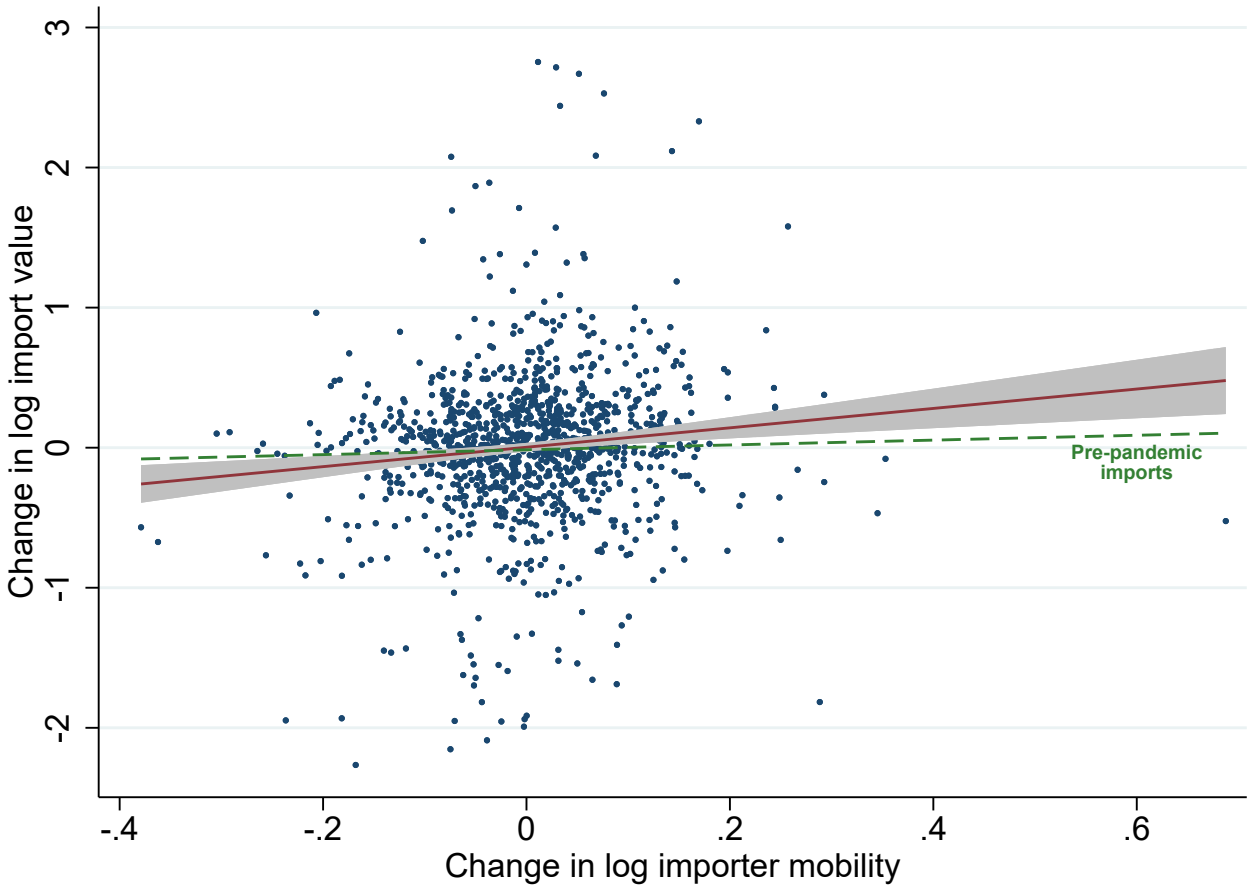
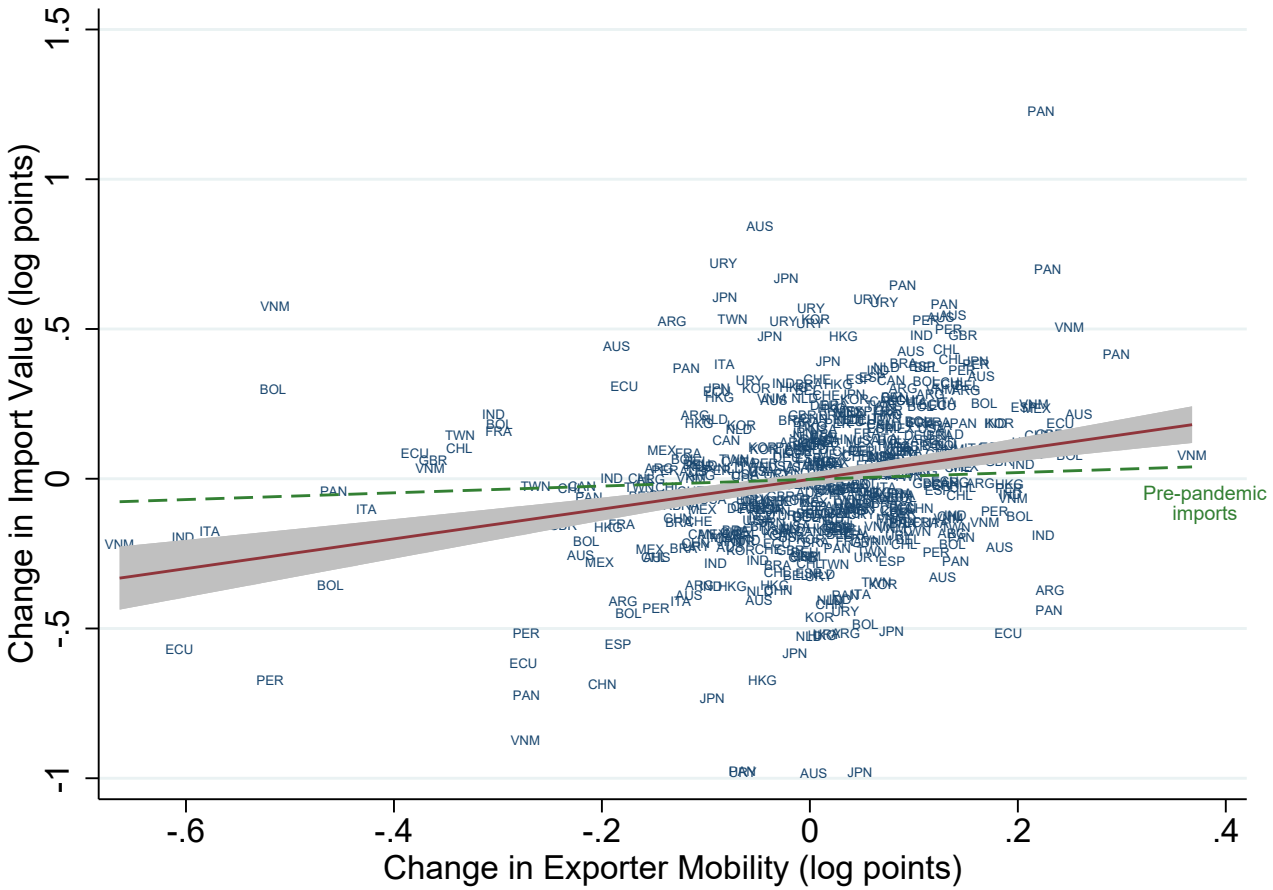
Local Mobility and Import Values



Local Mobility and Import Values



Local Importer Mobility and Import Values

	(1)	(2)	(3)	(4)	(5)	(6)
Import Values:	Pandemic period (2020-2021)			Pre-pandemic period (2018-2019)		
Importer Mobility (2020-2021)	0.879***	0.429***	0.692***	0.029	0.072	0.173
	(0.079)	(0.129)	(0.197)	(0.061)	(0.105)	(0.153)
Month F.E.	Yes	Yes	No	Yes	Yes	No
Year F.E.	No	Yes	No	No	Yes	No
Time F.E.	No	No	Yes	No	No	Yes
Observations	1,155	1,155	1,155	1,155	1,155	1,155
R^2	0.120	0.132	0.139	0.255	0.274	0.278

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Local Exporter Mobility and Import Values

	(1)	(2)	(3)	(4)	(5)	(6)
Import Values	Pandemic period (2020-2021)			Pre-pandemic period (2018-2019)		
Exporter Mobility (2020-2021)	0.468***	0.081	0.101	0.053	-0.003	-0.003
	(0.058)	(0.063)	(0.068)	(0.055)	(0.061)	(0.067)
Country F.E.	Yes	Yes	Yes	Yes	Yes	Yes
Month F.E.	Yes	Yes	No	Yes	Yes	No
Year F.E.	No	Yes	No	No	Yes	No
Time F.E.	No	No	Yes	No	No	Yes
Observations	32,380	32,380	32,380	33,498	33,498	33,498
R^2	0.018	0.023	0.024	0.008	0.008	0.008

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Descriptive Statistics - Baseline Sample

- Distribution of variables used in exporter-importer regressions:

log changes	Mean	SD	p10	p25	p50	p75	p90	N
Import Values	-0.16	1.53	-1.89	-0.92	-0.14	0.61	1.52	77351
Import Quantities	-0.18	1.78	-2.13	-1.00	-0.14	0.67	1.69	77351
Import Prices	0.03	1.17	-1.08	-0.39	0.01	0.42	1.15	77351
Importer Mobility	-0.27	0.28	-0.61	-0.44	-0.18	-0.08	-0.01	77351
Exporter Mobility	-0.15	0.17	-0.32	-0.22	-0.13	-0.03	0.03	77351

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Robustness: Alternative Fixed Effects

	(1)	(2)	(3)	(4)	(5)	(6)
{Dependent Variable:	Import Value	Import Quantity	Import Price	Import Value	Import Quantity	Import Price
Importer Mobility	0.309**	0.465***	-0.157***	0.014	0.077	-0.063
	(0.147)	(0.167)	(0.055)	(0.210)	(0.232)	(0.062)
Exporter Mobility	1.199***	1.447***	-0.248**	1.232***	1.498***	-0.267**
	(0.214)	(0.311)	(0.110)	(0.234)	(0.331)	(0.127)
Fixed Effects	Exporting country-Main entry port-Time			Exporting country-Main entry port-Department Time Product-Time		
N	86,180	86,180	86,180	76,281	76,281	76,281
R^2	0.086	0.079	0.029	0.248	0.244	0.164

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Robustness: Alternative Standard Errors Clustering

	(1)	(2)	(3)	(4)	(5)	(6)
{Dependent Variable:	Import Value	Import Quantity	Import Price	Import Value	Import Quantity	Import Price
Importer Mobility	0.357**	0.400**	-0.043	0.357*	0.400*	-0.043
	(0.174)	(0.197)	(0.049)	(0.185)	(0.218)	(0.069)
Exporter Mobility	1.372***	1.632***	-0.260*	1.372***	1.632***	-0.260*
	(0.245)	(0.365)	(0.142)	(0.234)	(0.328)	(0.137)
Clustering	Exporting country-time and Importer location-time			Exporting country-time and Importer department-time		
N	77,351	77,351	77,351	77,351	77,351	77,351
R^2	0.219	0.216	0.152	0.219	0.216	0.152

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Robustness: Pre-trend Controls

	(1)	(2)	(3)	(4)	(5)	(6)
{Dependent Variable:	Import Value	Import Quantity	Import Price	Import Value	Import Quantity	Import Price
Importer Mobility	0.391**	0.537***	-0.148*	0.497***	0.512***	-0.013
	(0.171)	(0.181)	(0.081)	(0.099)	(0.100)	(0.061)
Exporter Mobility	1.427***	1.754***	-0.311*	0.201	0.342**	-0.140**
	(0.260)	(0.395)	(0.161)	(0.129)	(0.172)	(0.067)
Sample	Balanced	Balanced	Balanced	Full	Full	Full
Pre-period control	Yes	Yes	Yes	Yes	Yes	Yes
N	64,579	64,579	64,579	257,049	257,049	257,049
R^2	0.236	0.230	0.162	0.147	0.147	0.107

Back

Additional heterogeneous effects: upstreamness from Antras et al. (2012), naics4

	(1) Quantity	(2) Price
Importer mobility	0.40***	0.02
	(0.07)	(0.05)
Importer mobility $\times$ *Upstreamness*	-0.12*	-0.03
	(0.06)	(0.04)
Exporter mobility	0.37***	-0.10**
	(0.13)	(0.04)
Exporter mobility $\times$ *Upstreamness*	0.07***	0.02
	(0.03)	(0.02)
Observations	530,366	530,366
R-squared	0.10	0.08

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Additional heterogeneous effects: price stickiness from Nakamura and Steinsson (2008), naics4

	(1) Quantity	(2) Price
Importer mobility	0.39***	0.04
	(0.08)	(0.06)
Exporter mobility	0.36***	-0.11***
	(0.12)	(0.04)
Exporter mobility × Price stickiness	0.03	0.04*
	(0.04)	(0.02)
Observations	486,894	486,894
R-squared	0.10	0.08

Back

Additional heterogeneous effects: markups from de Loecker et al. (2018), naics2

	(1) Quantity	(2) Price
Importer mobility	0.41***	0.02
	(0.07)	(0.05)
Exporter mobility	0.34***	-0.13***
	(0.12)	(0.04)
Exporter mobility $\times$ *Markups*	-0.03	-0.04**
	(0.03)	(0.02)
Observations	536,143	536,143
R-squared	0.10	0.08

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Additional heterogeneous effects: inventory intensity from US Census, Fajgelbaum et al. (2020), naics4

	(1) Quantity	(2) Prices
Importer mobility	0.40***	0.03
	(0.07)	(0.05)
Importer mobility × Inventory intensity	0.14**	0.01
	(0.06)	(0.03)
Exporter mobility	0.35***	-0.12***
	(0.13)	(0.04)
Observations	524,115	524,115
R-squared	0.10	0.08

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Additional heterogeneous effects: differentiated vs homogeneous goods from Rauch (1999)

	Quantity	Price
Importer mobility	0.24***	0.08
	(0.07)	(0.06)
Importer mobility $\times D(differentiated = 1)$	0.26***	-0.09*
	(0.10)	(0.05)
Exporter mobility	0.35***	-0.10**
	(0.12)	(0.04)
Observations	537,100	537,100
R-squared	0.10	0.08

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Additional results: congestion controls

- In the model, we allow for the possibility of short-run decreasing returns to scale when there is a short-run fixed production factor such as capital.
- We construct a supply-side-induced congestion measure and a demand-side-induced congestion measure.

Additional results: supply-side-induced congestion

- US and China are two countries that export good k.
- A shock in US will affect the demand in China.

$$\hat{S}_{ckt} = \sum_{\tilde{c} \in C|c} s^{2018}_{X,\tilde{c}k} \hat{x}_{\tilde{c}t}, \tag{1}$$

where $s^{2018}_{X,\tilde{c}k}$ are the exporter share of country $\tilde{c}$ in world trade of product k in 2018, and $\hat{x}_{\tilde{c}t}$ is the country-level mobility change at t.

- We interpret a decrease in this measure as an indication of an increase in demand for exporter j.

Additional results: demand-side-induced congestion

- Mexico and China are two countries that import good k.
- Shocks in Mexico will affect the demand for good for k, and thus price for China. We proxy for this mechanism as follows:

$$\hat{D}_{ckt} = \sum_{\tilde{c} \in C|c} s^{2018}_{M,\tilde{c}k} \hat{x}_{\tilde{c}t}, \tag{2}$$

where $s^{2018}_{M,\tilde{c}k}$ are the importer share of country $\tilde{c}$ in world trade of product k in 2018.

Additional Results: Congestion Controls

	(1)	(2)	(3)	(4)	(5)	(6)
		Consumer Goods			Intermediate Goods	
Dependent Variable:	Import Value	Import Quantity	Import Price	Import Value	Import Quantity	Import Price
Importer Mobility	-0.557*	-0.601*	0.043	0.696***	0.771***	-0.076
	(0.307)	(0.353)	(0.250)	(0.186)	(0.202)	(0.077)
Exporter Mobility	0.383	1.315***	-0.932***	1.721***	2.213***	-0.492***
	(0.334)	(0.387)	(0.190)	(0.323)	(0.404)	(0.138)
Congestion, demand side	-0.970	-5.022**	4.052***	-2.459**	-2.790***	0.332
	(2.866)	(2.359)	(1.266)	(1.139)	(0.994)	(0.508)
Congestion, supply side	3.611**	6.267***	-2.656	0.418	-0.045	0.464
	(1.835)	(1.409)	(1.861)	(0.798)	(0.747)	(0.512)
Observations	9,720	9,720	9,720	48,078	48,078	48,078
R-squared	0.393	0.337	0.206	0.222	0.219	0.165

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Additional Results: Interaction Between Exporter and Importer Mobility

	(1)	(2)	(3)	(4)	(5)	(6)
	Consumer Goods			Intermediate Goods		
Dependent Variable:	Import Value	Import Quantity	Import Price	Import Value	Import Quantity	Import Price
Importer Mobility	-0.539*	-0.648*	0.110	0.615***	0.574**	0.041
	(0.306)	(0.353)	(0.216)	(0.235)	(0.266)	(0.087)
Exporter Mobility	-0.298	0.778	-1.076***	1.232***	1.369***	-0.137
	(0.390)	(0.537)	(0.333)	(0.311)	(0.353)	(0.153)
Interaction	-1.032	-0.330	-0.702	-0.643	-1.404**	0.760***
	(0.686)	(1.005)	(0.521)	(0.633)	(0.683)	(0.202)
Observations	10,723	10,723	10,723	50,044	50,044	50,044
R-squared	0.400	0.351	0.218	0.224	0.221	0.163

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Additional Results: Extensive Margin Specification

- We estimate the following equation:

$$\hat{I}_{ijkt} = \beta^J \hat{x}_{jt} + \beta^I \hat{x}_{it} + FE + \varepsilon_{ijkt} \quad (3)$$

- $\hat{I}_{ijkt} = I_{ijk,t} - I_{ijk,Feb20}$ is the difference of an indicator taking the value of one if we observe a flow at the exporter-importer-product-time level.
- As with the baseline, we take the difference against February 2020, and thus the dependent variable can take three values, -1, 0, and 1.

Additional Results: Extensive Margin

	(1)	(2)	(3)	(4)
Importer Mobility	0.035***	0.035***	0.029***	0.029***
	(0.006)	(0.006)	(0.007)	(0.006)
Exporter Mobility	0.029***	0.035***	0.014*	0.020**
	(0.006)	(0.006)	(0.008)	(0.008)
Interaction			-0.047*	-0.041*
			(0.028)	(0.022)
Observations	8,877,606	8,876,178	8,877,606	8,876,178
R-squared	0.007	0.010	0.007	0.010

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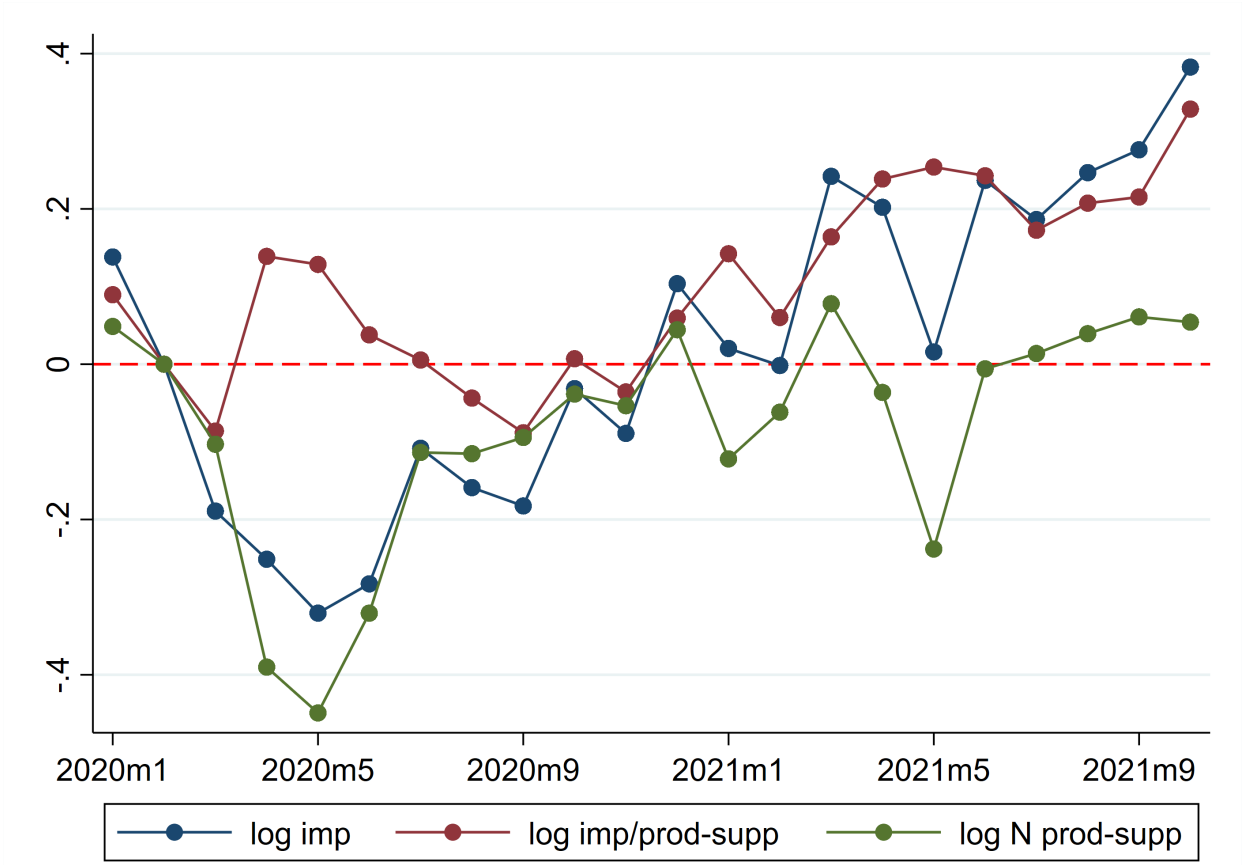
Changes in Imports and Number of Exporter-Products at the Importer Level, Compared to Feb 2020



Extensive Margin

- We can re-write import value at the importer level as follows:

$$M_{jt} = \left[\frac{M_{jt}}{N_{jt}^{IP}}\right] \times \left[N_{jt}^{IP}\right]$$

  where N_{jt}^{IP} is the number of exporters (suppliers) and products observed at t for importer j.

- Taking logs, differences with respect to the baseline period (February 2020) and averages for each month, we get:

$$\Delta\overline{\log M}_t = \Delta\overline{\log M/N^{IP}}_t + \Delta\overline{\log N^{IP}}_t$$

- We then plot each term and see that the $\Delta\overline{\log M/N^{IP}}$ term is highly correlated with the overall change beyond the initial pandemic shock (0.88 for Jul-2020 to Oct-2021).

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Port Calls and Hours at Port. Pre-trends.

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome: 2018 and 2019	Δ log hours		Δ log number of calls		Δ log hours	
Δ log mobility	0.018	0.018	-0.022	-0.022		
	(0.020)	(0.020)	(0.023)	(0.023)		
Δ log number of calls					-0.072	-0.072
					(0.087)	(0.087)
I (Year=2019)	0.025**		0.005		0.028***	
	(0.009)		(0.009)		(0.009)	
Time trend		0.002**		0.000		0.002***
		(0.001)		(0.001)		(0.001)
Constant	0.014**	0.005	-0.157***	-0.159***	-0.001	-0.011
	(0.006)	(0.009)	(0.007)	(0.010)	(0.016)	(0.018)
Observations	492	492	492	492	492	492
R-squared	0.749	0.749	0.883	0.883	0.749	0.749

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Freight Costs

Outcome: 2018 and 2019	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Δ log freight cost, unit				Δ log freight cost, weight			
Δ log mobility change	0.04	0.02	0.03	0.03	-0.01	0.00	-0.02	-0.04
	(0.03)	(0.04)	(0.04)	(0.04)	(0.03)	(0.03)	(0.03)	(0.04)
I (year=2019)	0.02**		0.03**	0.03**	0.03**		0.03**	0.04**
	(0.01)		(0.01)	(0.01)	(0.01)		(0.01)	(0.01)
Time trend		0.00				0.00*		
		(0.00)				(0.00)		
Constant	0.04***	0.03***	0.04***	0.03***	-0.03***	-0.03**	-0.03***	-0.03***
	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Observations	261,967	261,967	255,881	261,966	261,967	261,967	255,881	261,966
R-squared	0.09	0.09	0.14	0.09	0.11	0.10	0.15	0.11
Month FE	Yes	Yes			Yes	Yes		
Product FE	Yes	Yes		Yes	Yes	Yes		Yes
Exporter country FE	Yes	Yes	Yes		Yes	Yes	Yes	
Product-month FE			Yes				Yes	
Country-month FE				Yes				Yes

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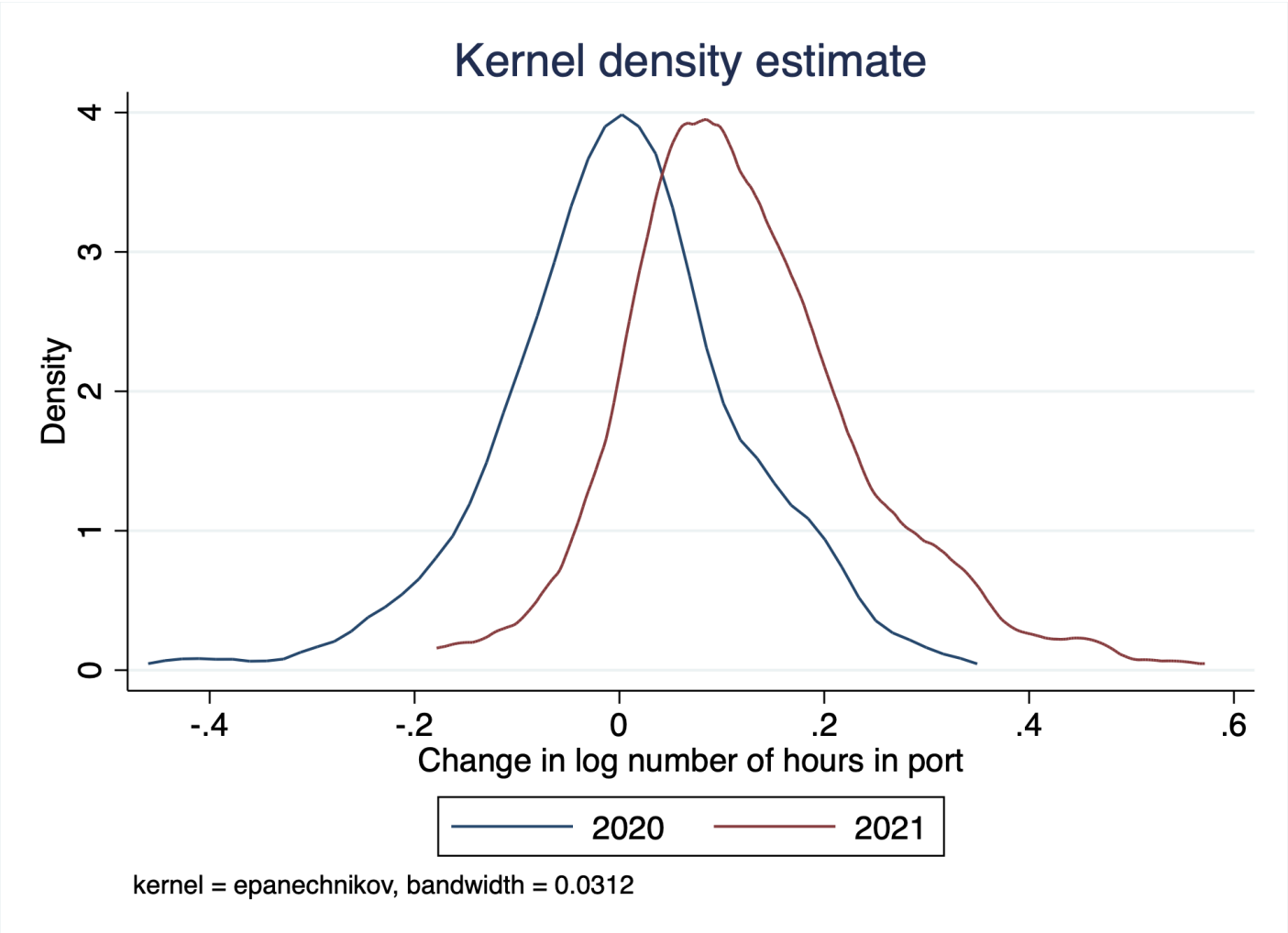
Changes in Log Number of Hours in Port, 2020 vs 2021



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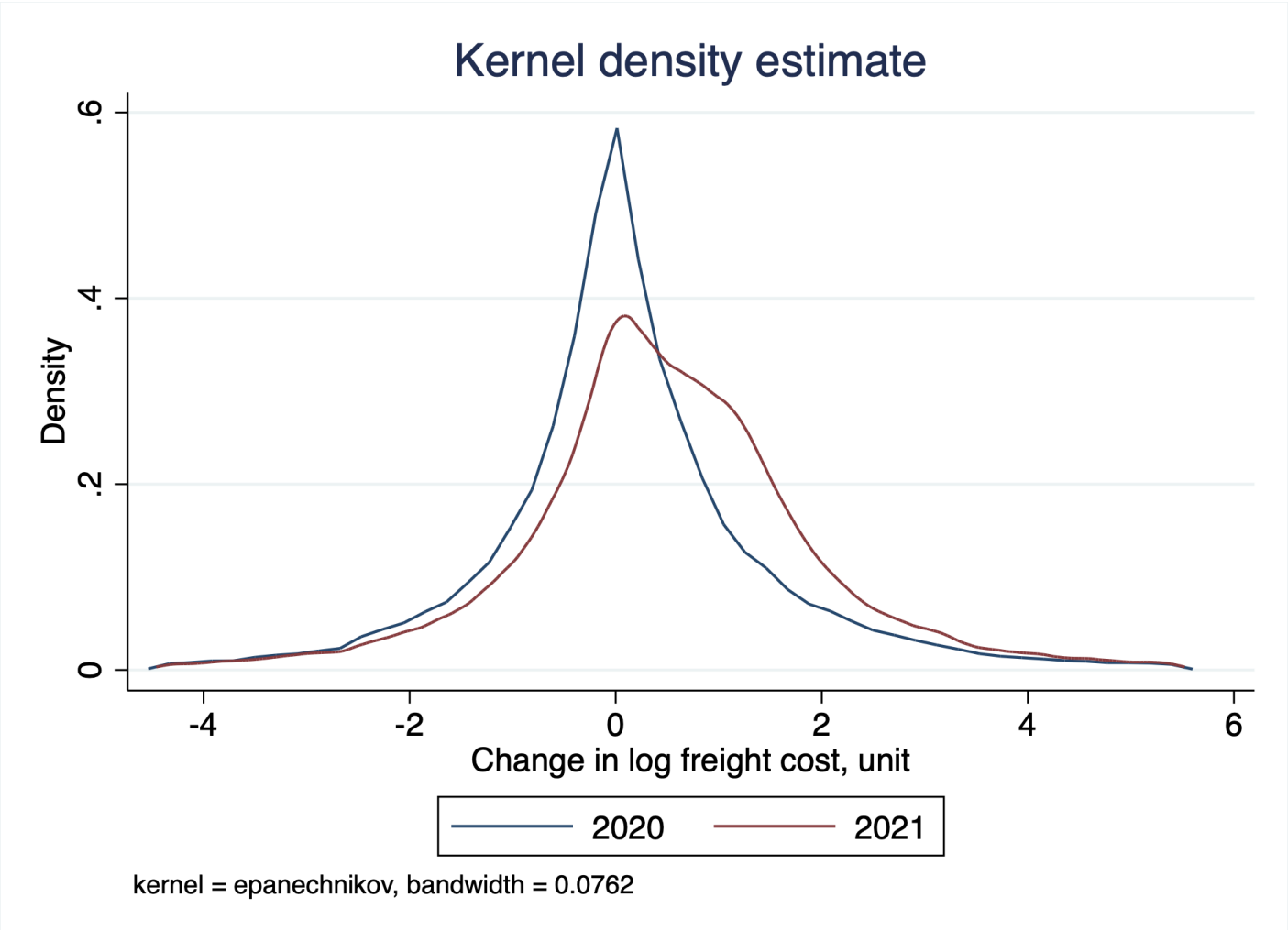
Changes in Log Freight Cost, Unit, 2020 vs 2021



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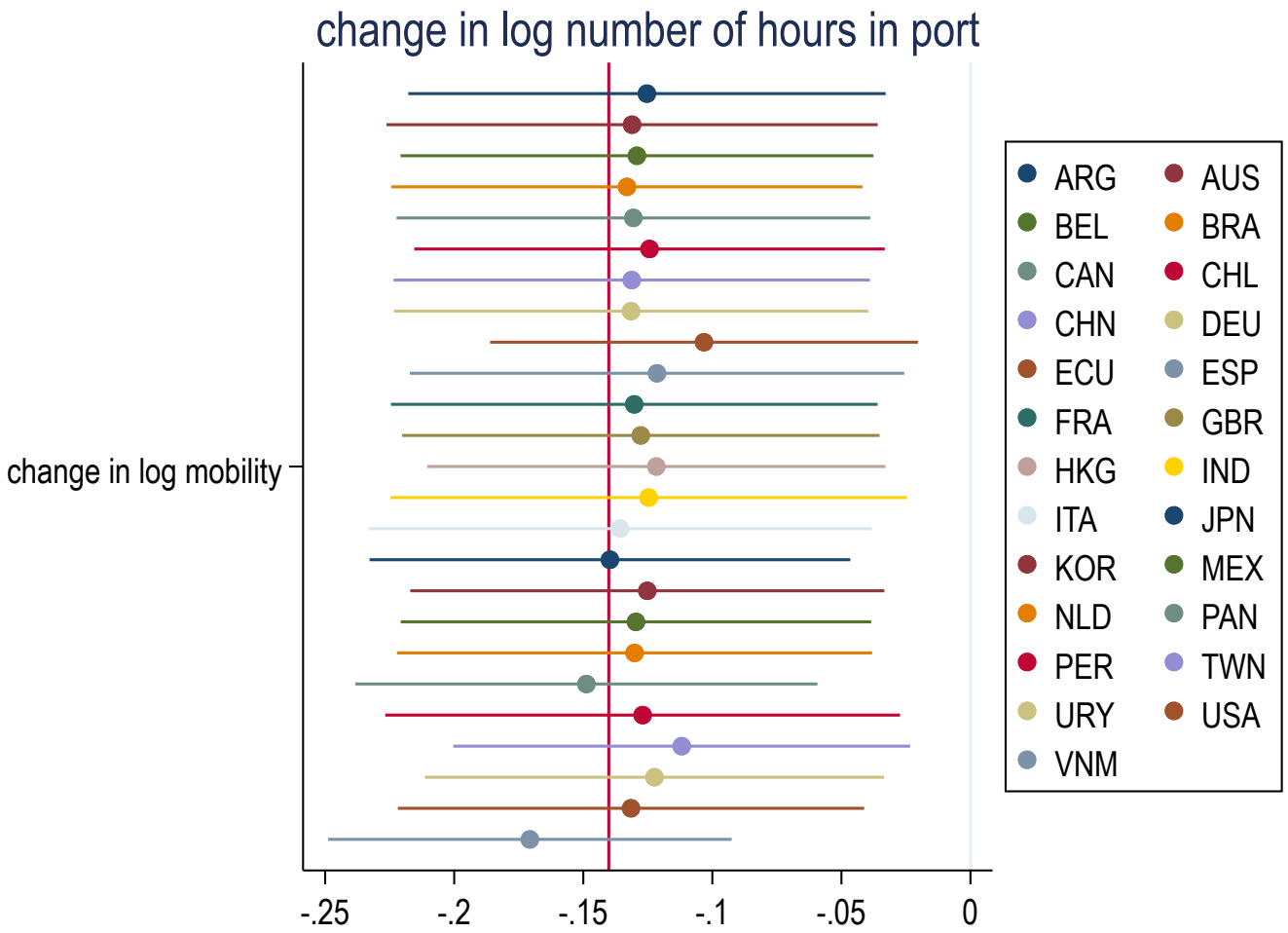
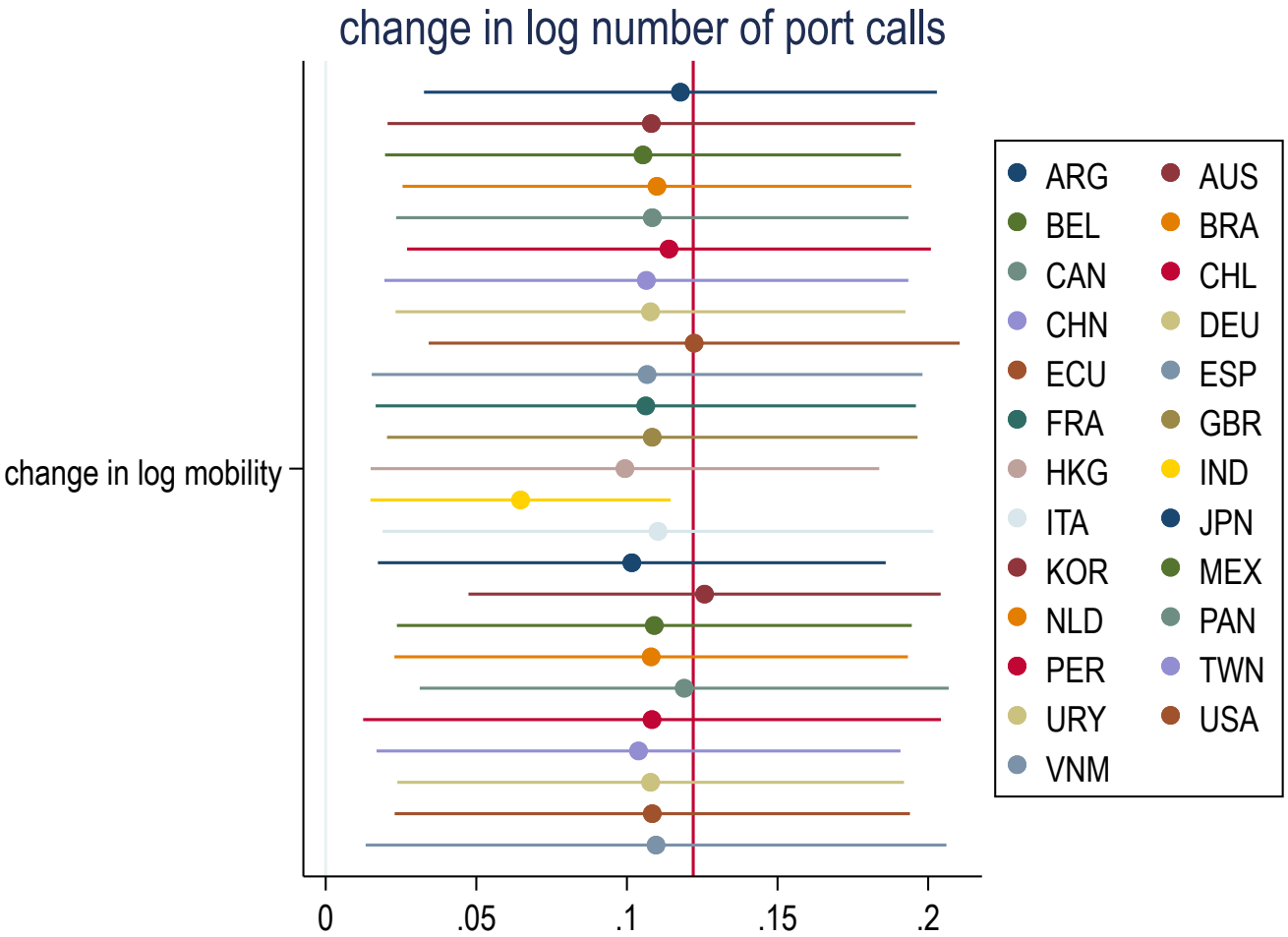
Hours in Port, Drop Country



Number of Port Calls, Drop Period



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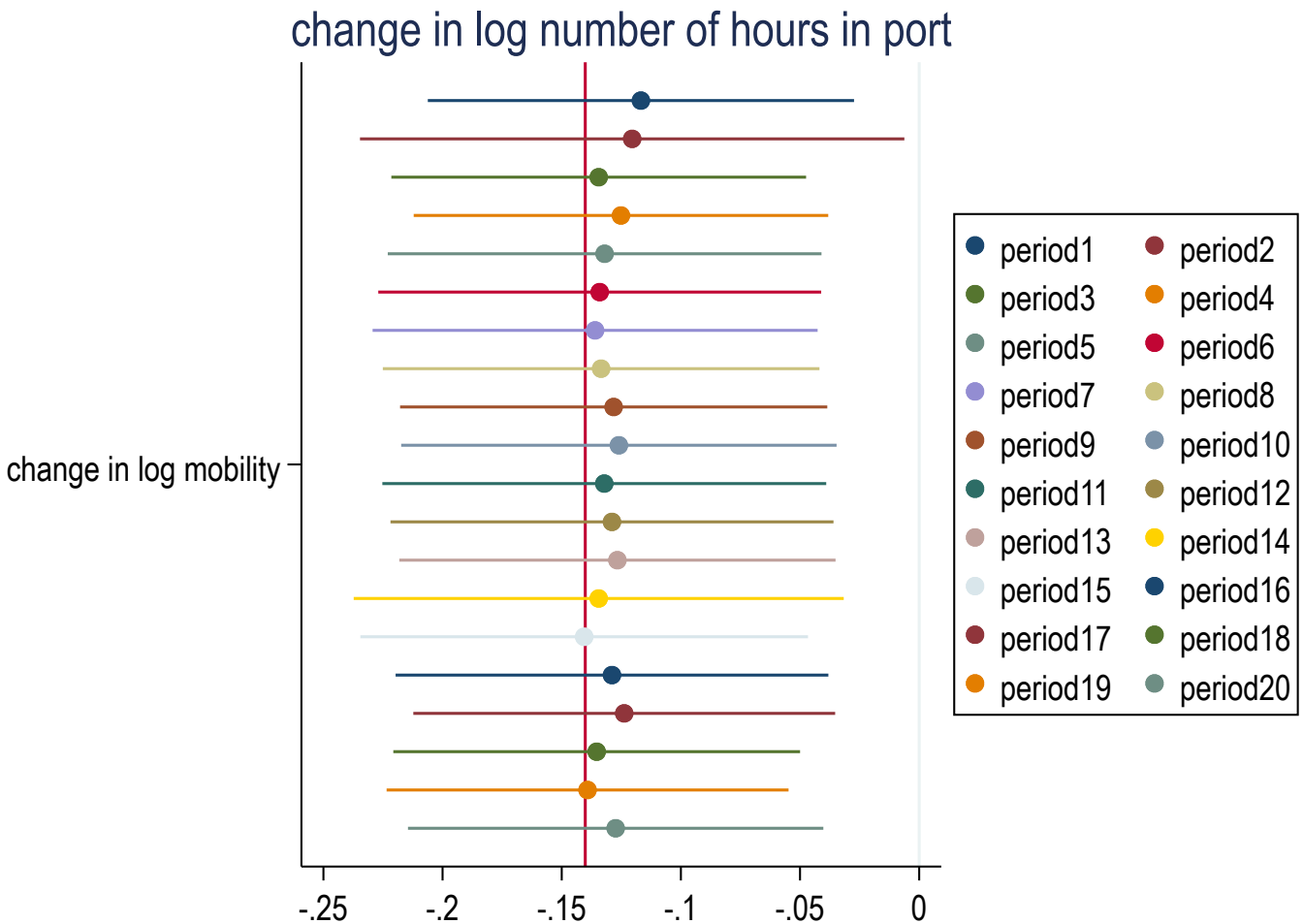
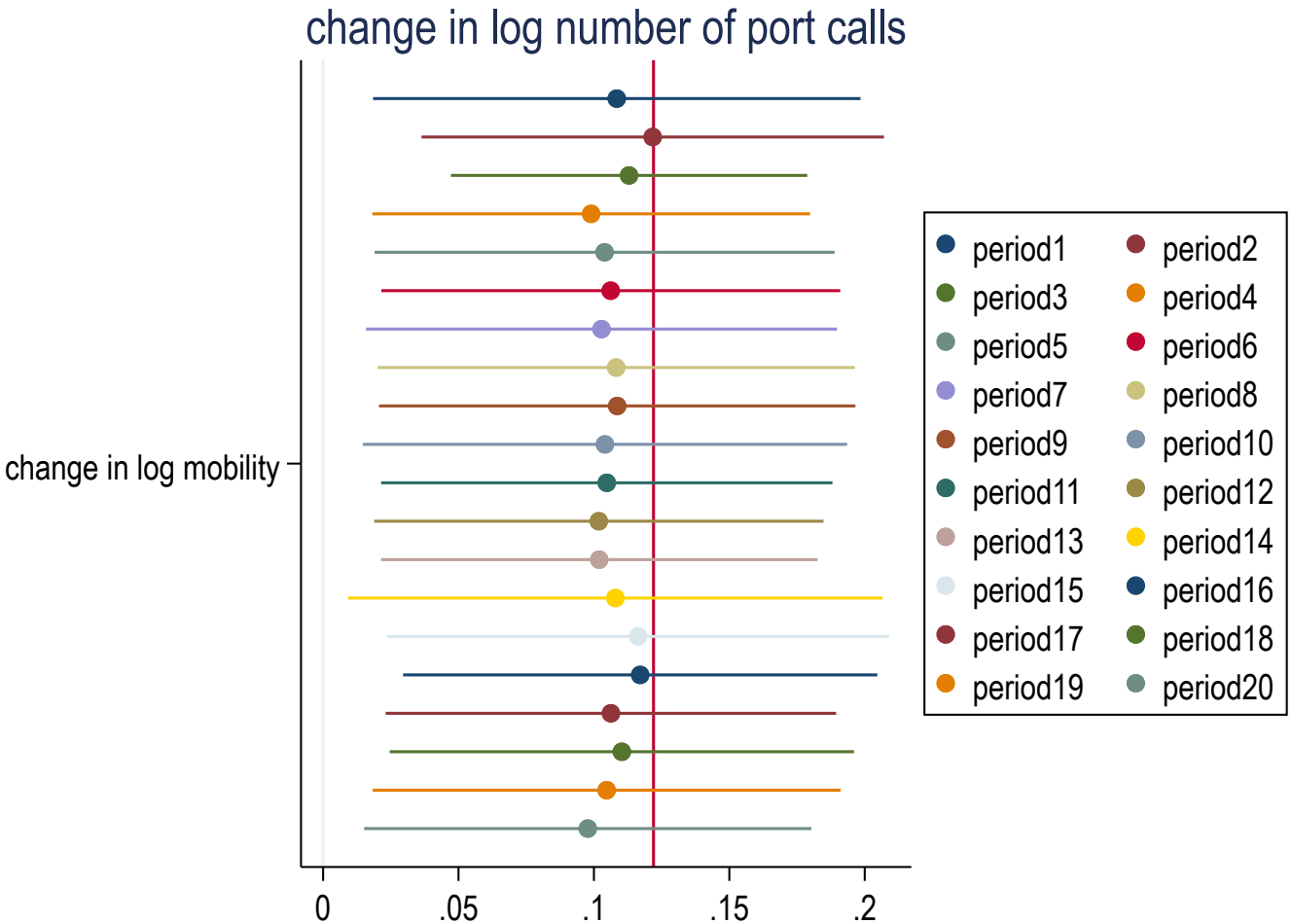
Hours in Port, Drop Period



Number of Port Calls, Drop Period



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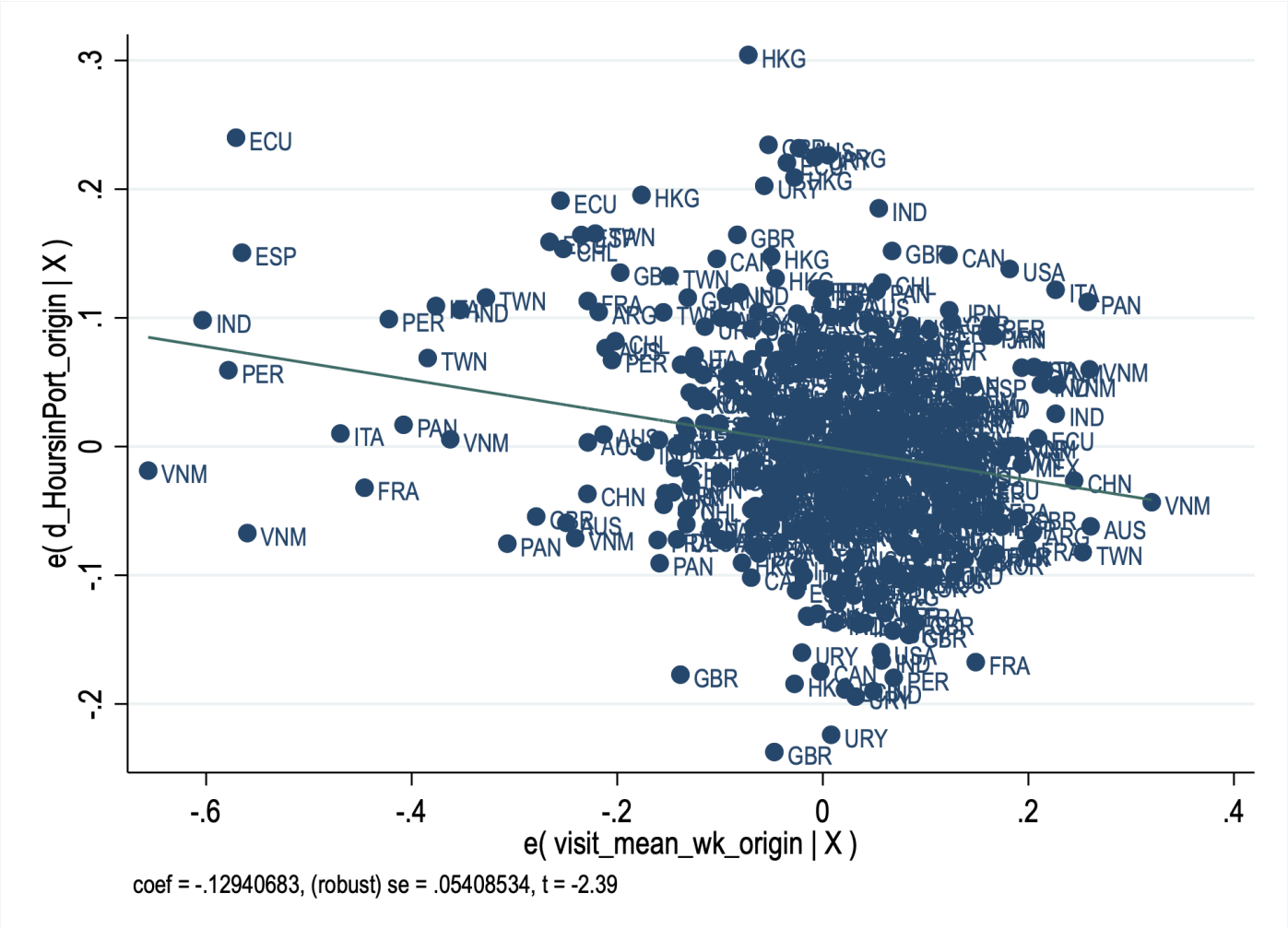
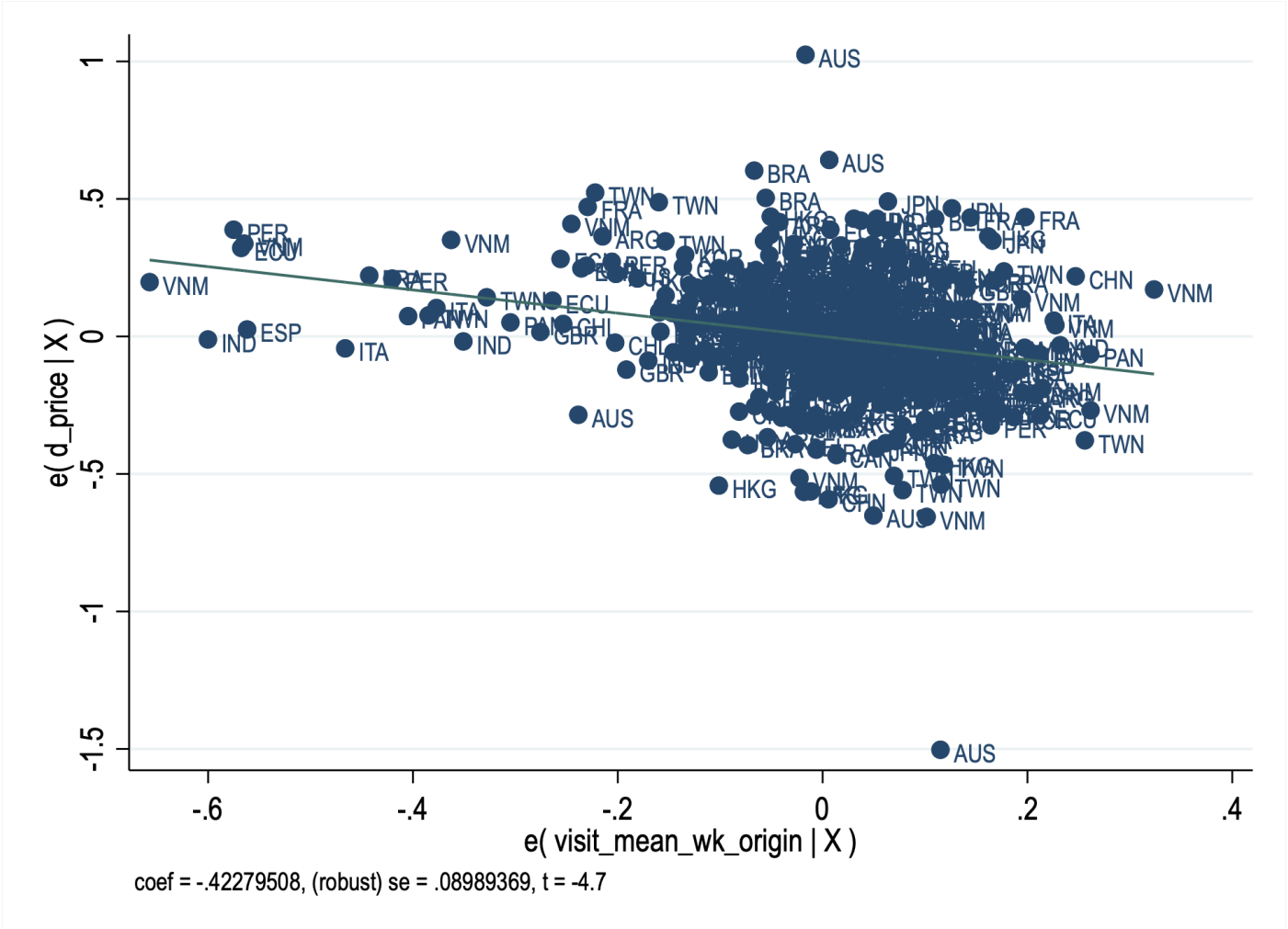
Residual Plots, Hours in Port

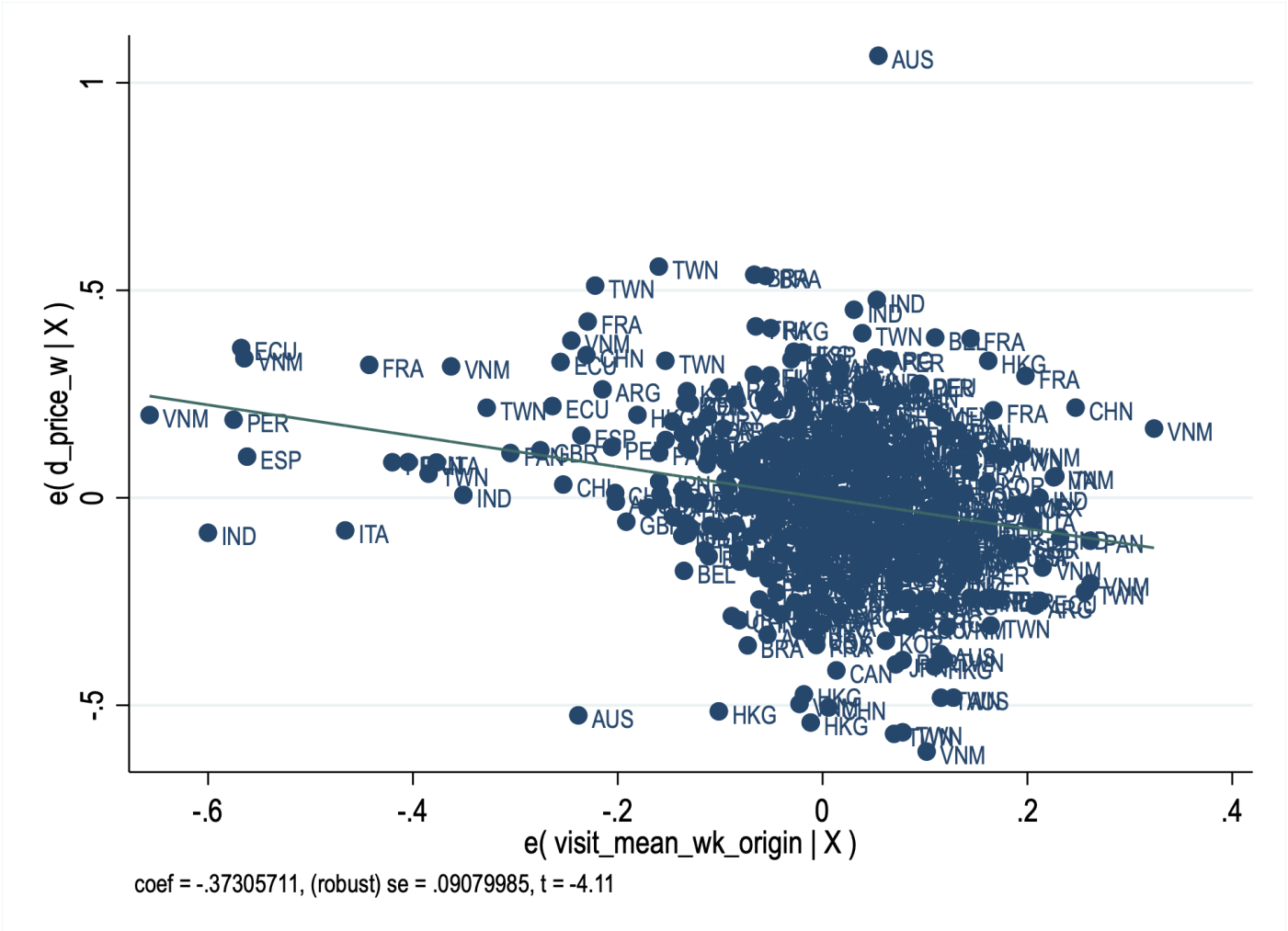


Residual Plots, Number of Port Calls

Residual Plots, Freight Cost, Unit



Residual Plots, Freight Cost, Weight



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Intermediate Countries Ports

- The majority of trade is indirect, making at least one stop along the way (Heiland et al. 2019; Ganapati et al. 2021)
- We use the optimal country-to-country shipping routes computed in Ganapati et al. (2021) to measure two intermediate country shocks
- For the first intermediate country K, the average mobility change is

$$\Delta \log(\text{mobility}^{K}_{iym}) = \sum_{k} \frac{\text{prob}(k(i))}{\sum_{k'} \text{prob}(k'(i))} \Delta \log(\text{mobility}^{\text{Ports}}_{k(i)ym})$$

- $\text{prob}(k(i))$ is the probability that the optimal route from country i to Colombia uses country k as the first intermediate stop

Intermediate Countries Ports

	(1)	(2)	(3)	(4)	(5)	(6)
Outcome:	Δ log freight cost, unit			Δ log freight cost, weight		
Δ log mobility, exporter country	-0.25**			-0.30***		
	(0.11)			(0.10)		
Δ log mobility, first intermediate		-0.53***			-0.59***	
		(0.16)			(0.15)	
Δ log mobility, second intermediate			-0.72***			-0.76***
			(0.20)			(0.20)
I (year=2021)	0.51***	0.57***	0.69***	0.55***	0.62***	0.74***
	(0.08)	(0.08)	(0.11)	(0.07)	(0.08)	(0.11)
Constant	0.02	-0.06	-0.16*	-0.04	-0.12**	-0.23**
	(0.05)	(0.06)	(0.09)	(0.04)	(0.06)	(0.09)
Observations	245,995	245,995	245,995	245,995	245,995	245,995
R-squared	0.11	0.11	0.11	0.15	0.15	0.15

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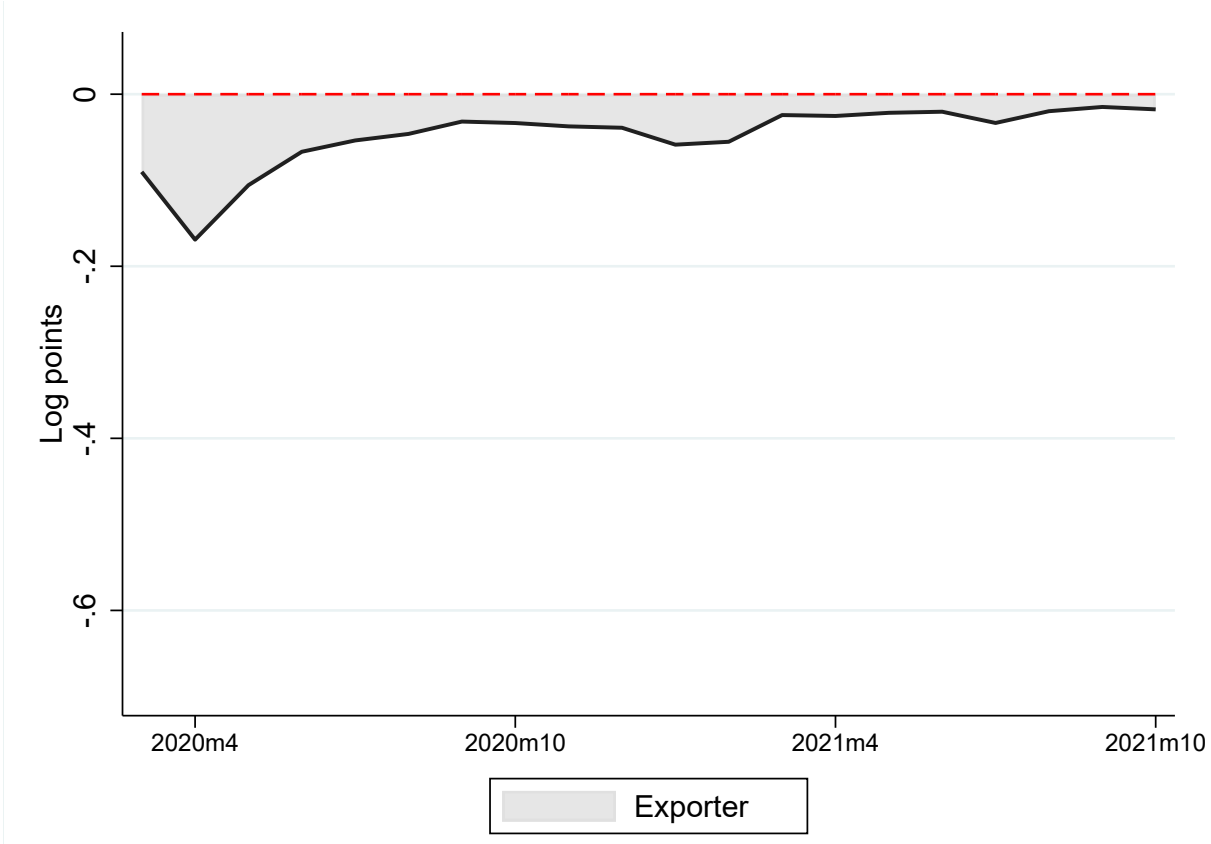
Decomposition: Import Quantities of Consumer Goods



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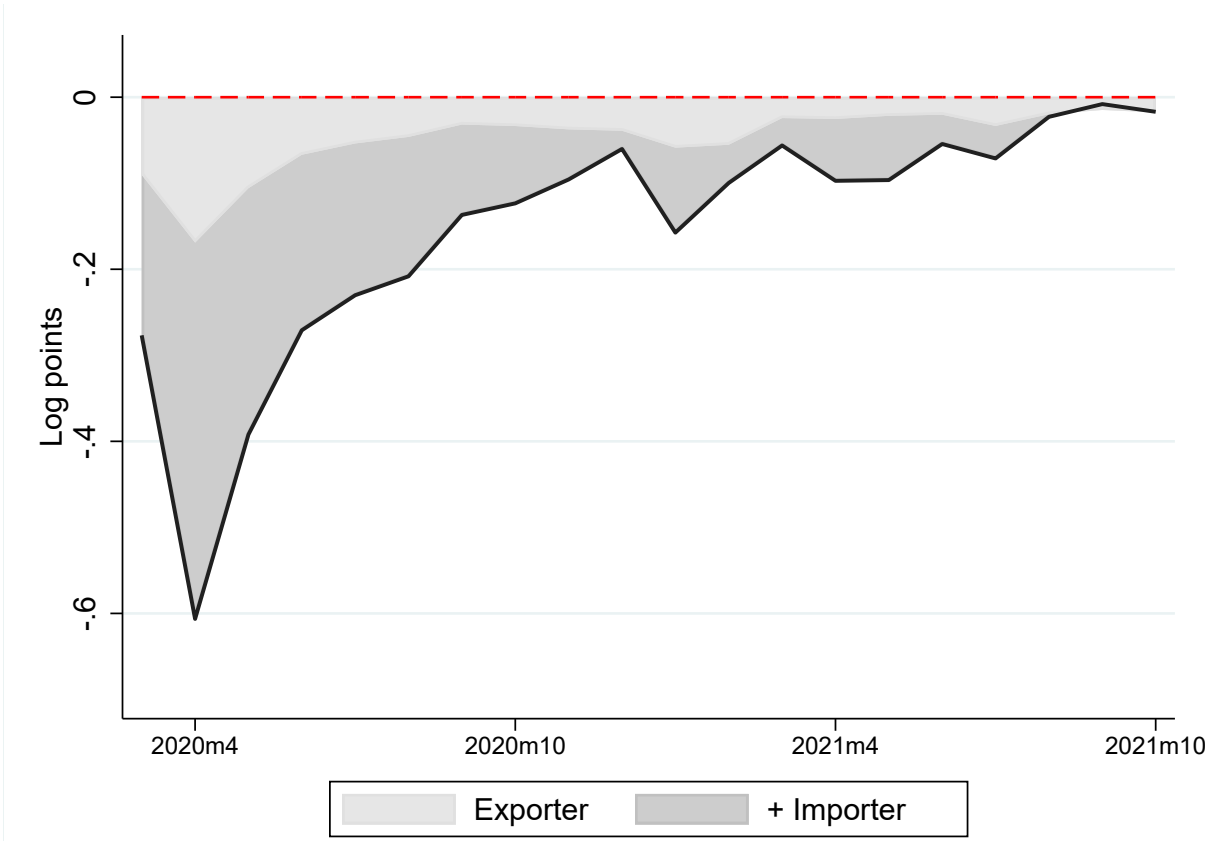
Decomposition: Import Quantities of Consumer Goods



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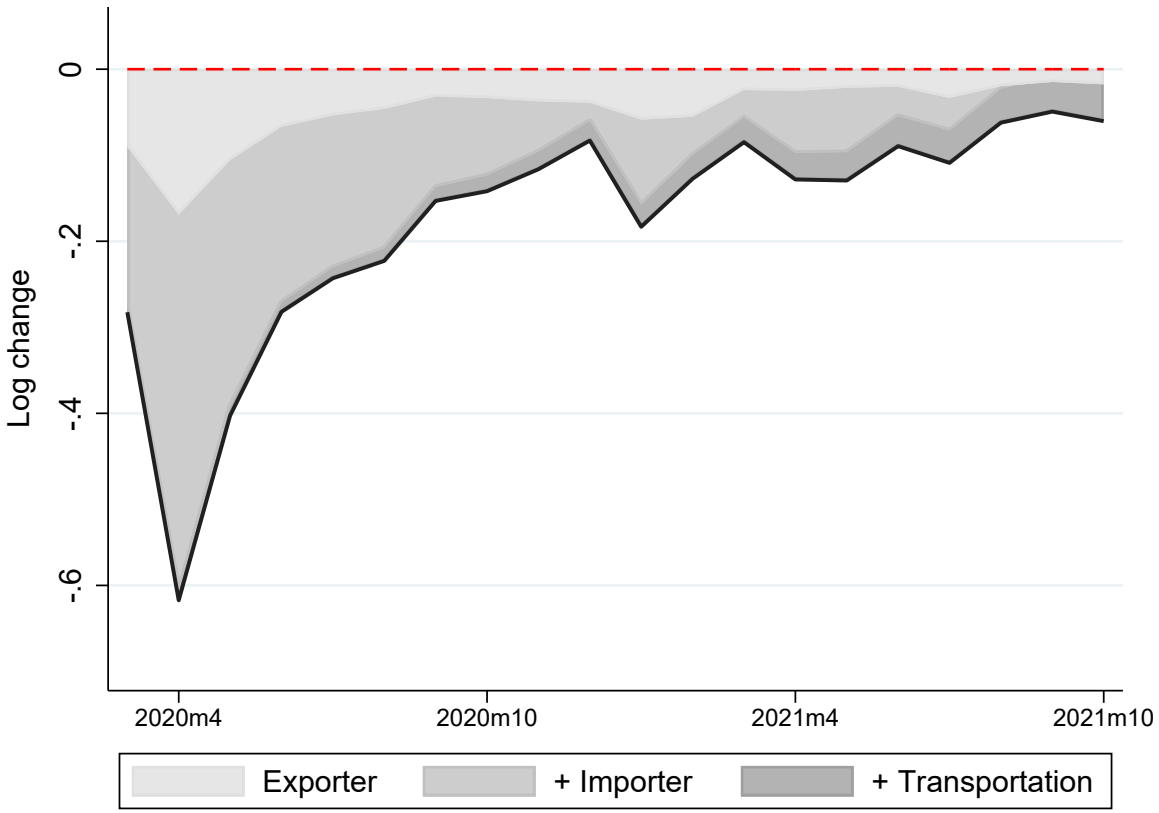
Decomposition: Import Quantities of Consumer Goods



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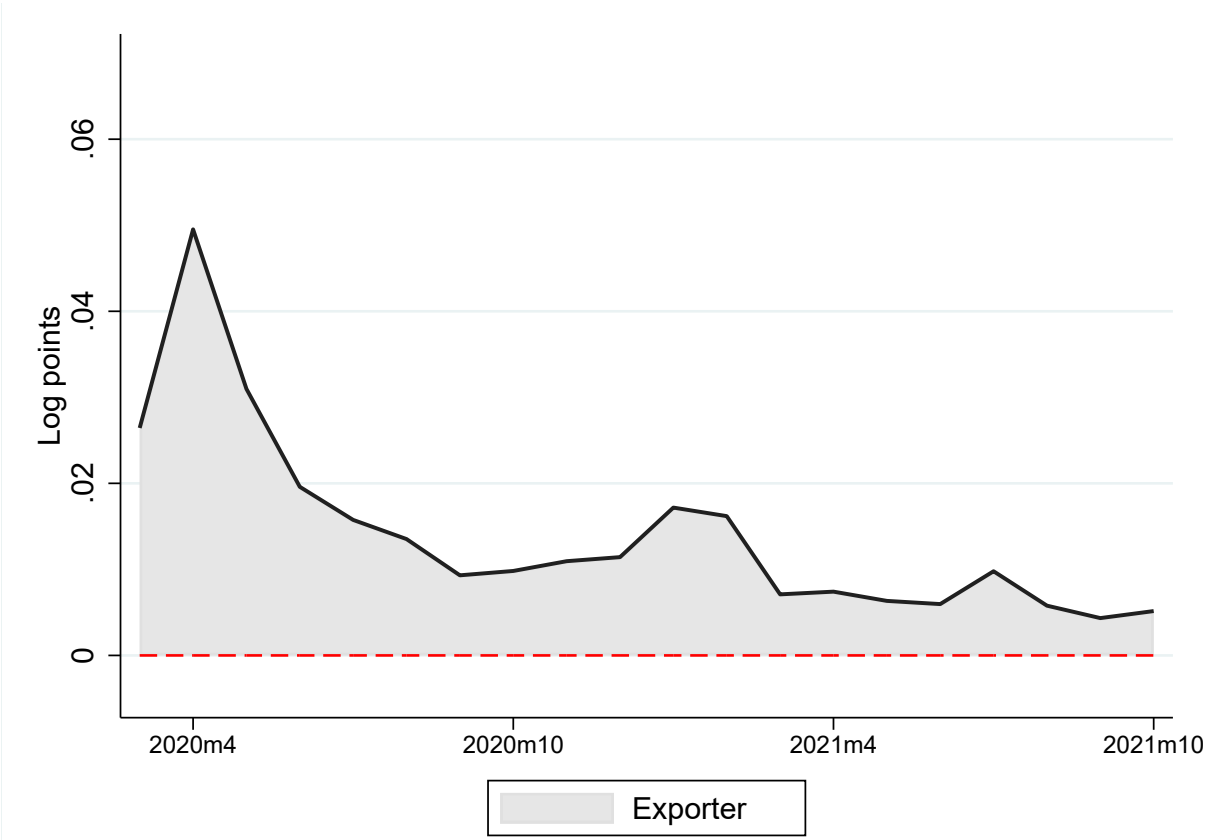
Decomposition: Import Prices of Consumer Goods



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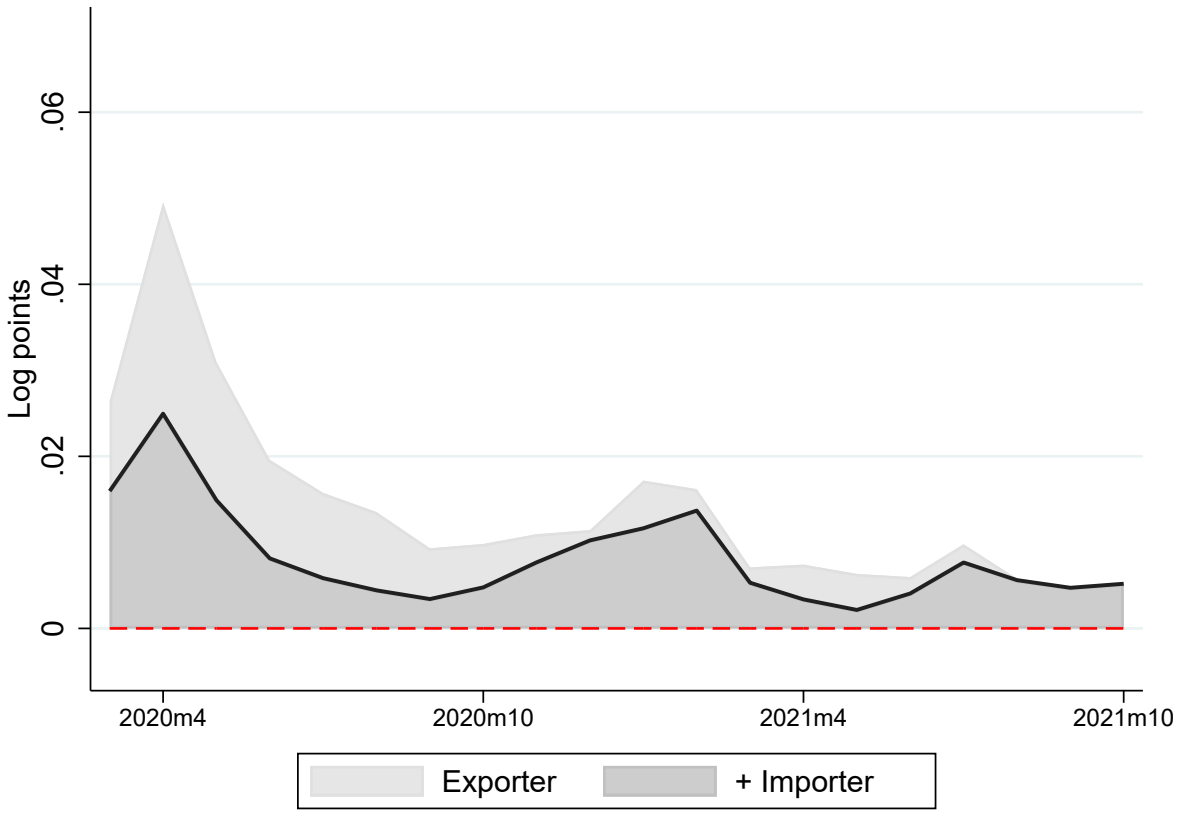
Decomposition: Import Prices of Consumer Goods



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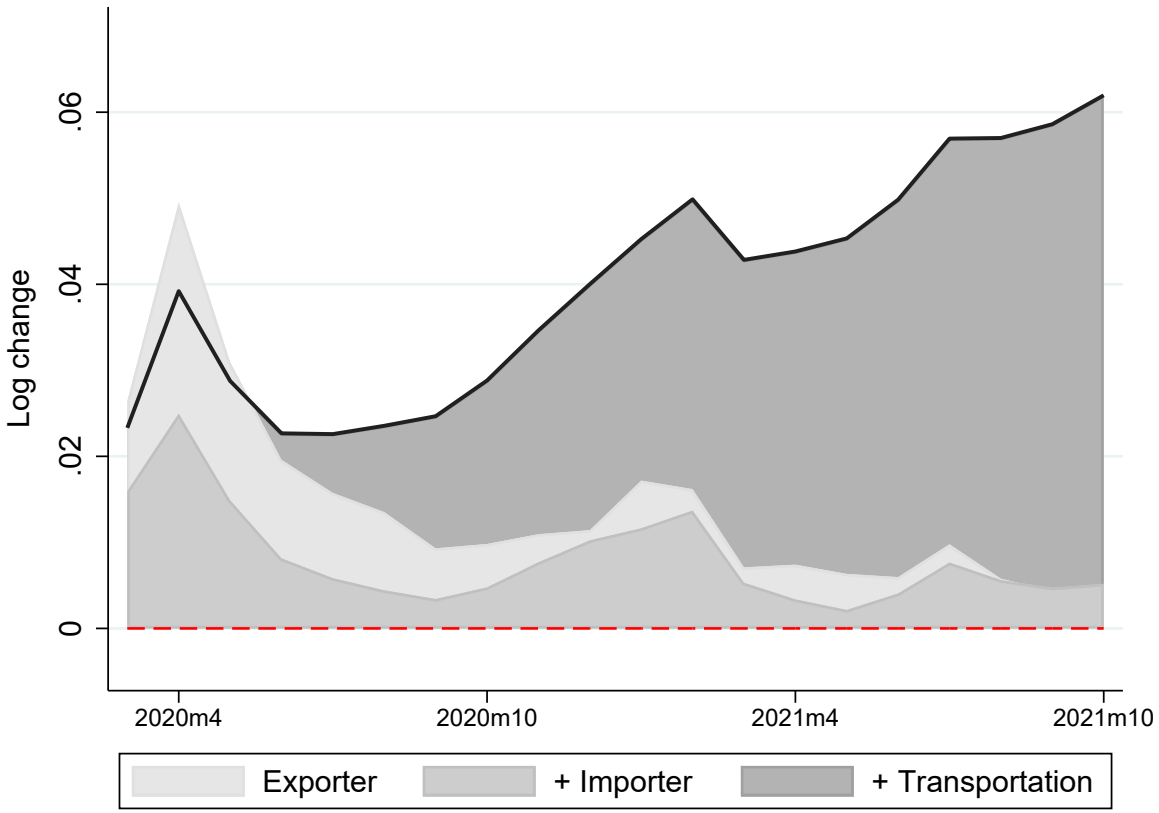
Decomposition: Import Prices of Consumer Goods



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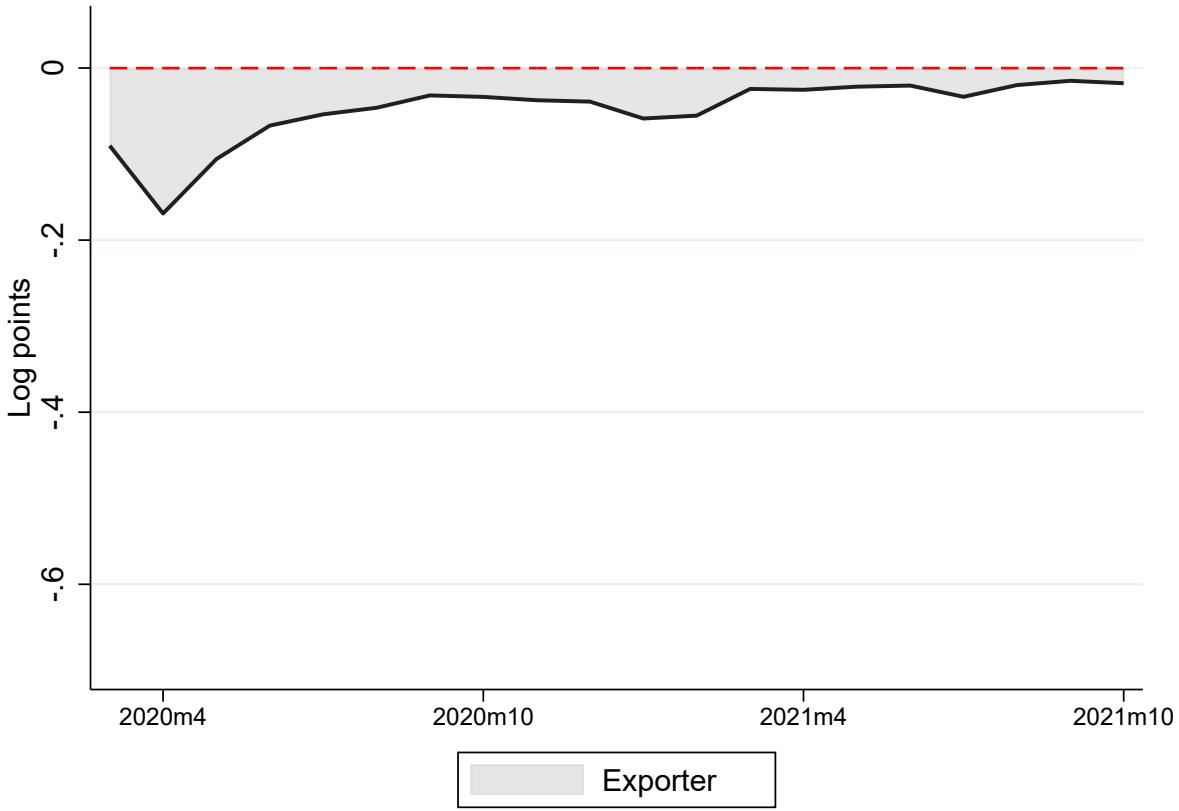
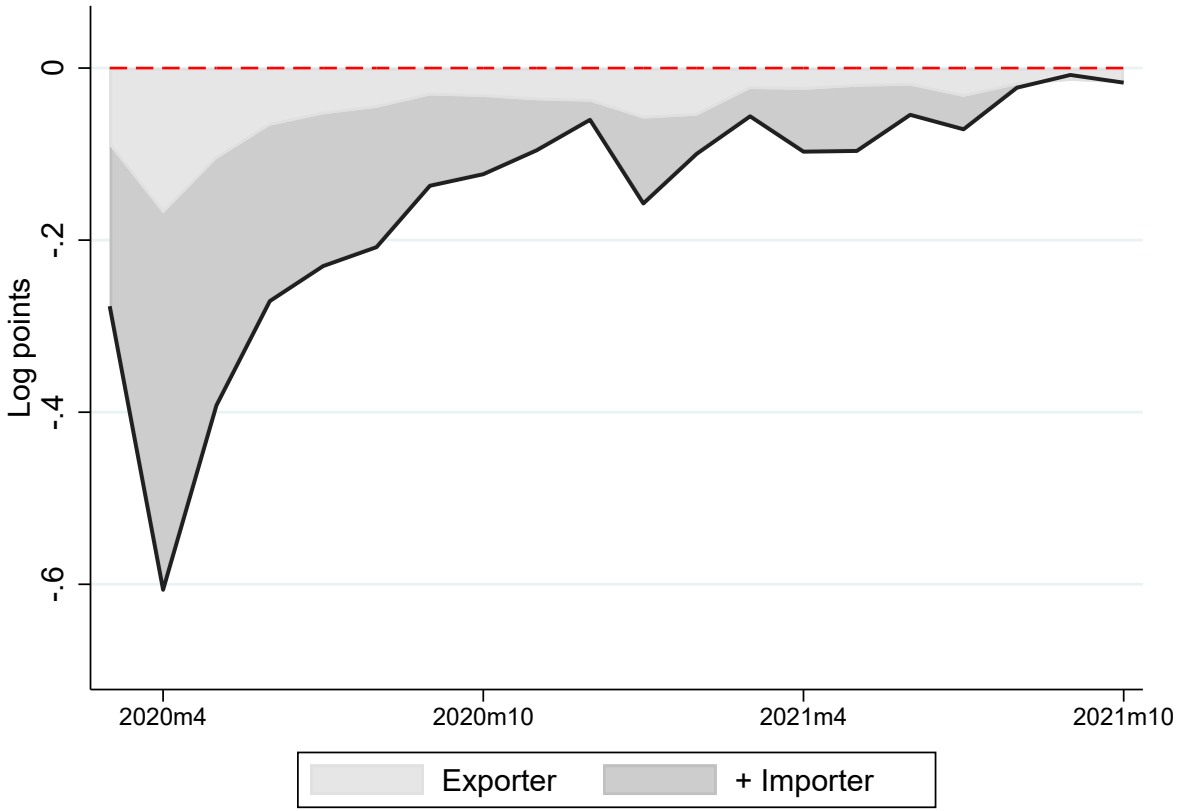
Decomposition: Import Quantities of Intermediate Goods



- Importer mobility shocks explained 67%, importer shocks 26% and port shocks 7% at the onset of the pandemic (April 2020)

Consumer Goods

Decomposition: Import Quantities of Intermediate Goods



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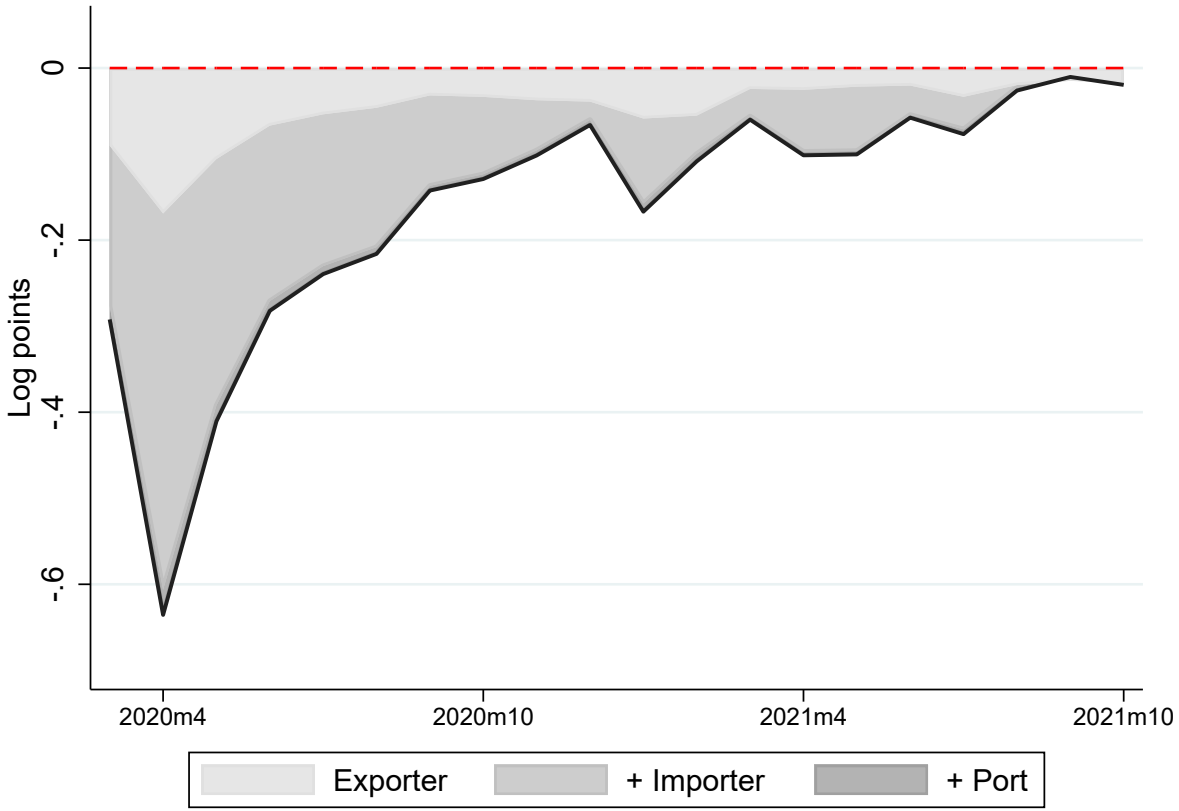
Consumer Goods

Decomposition: Import Quantities of Intermediate Goods



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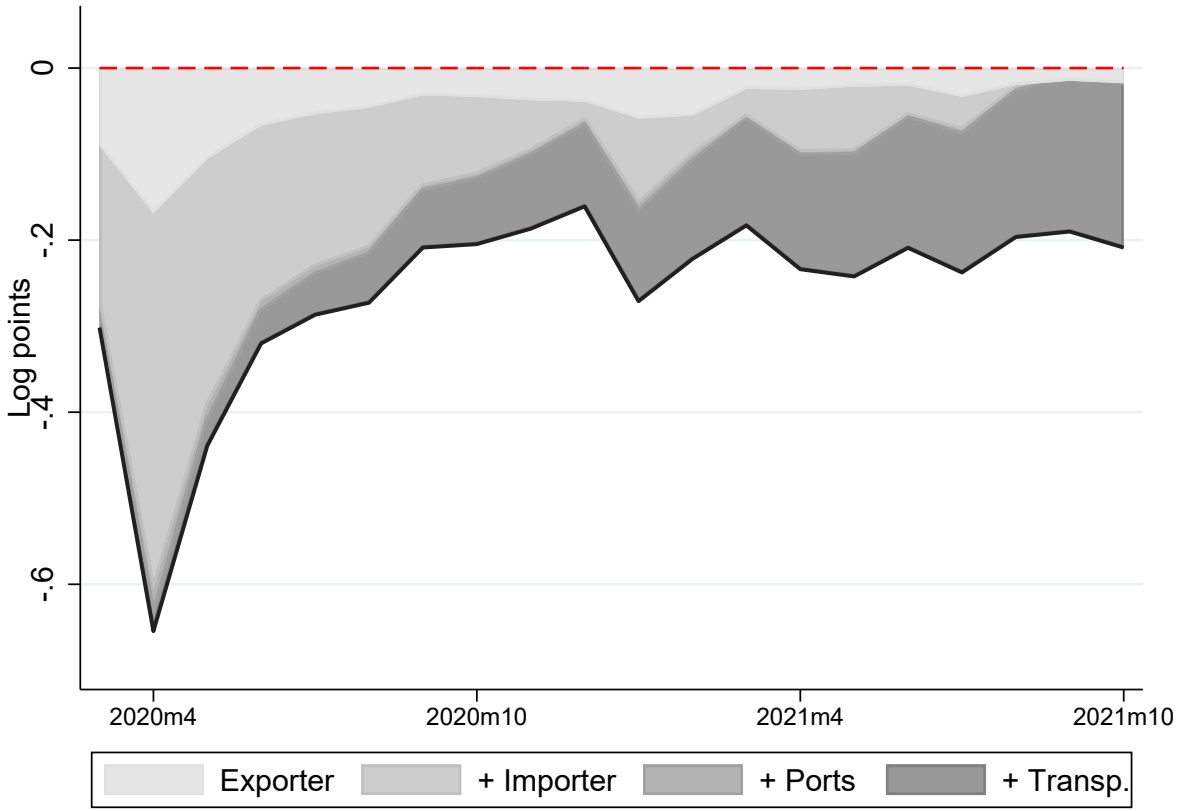
Consumer Goods

Decomposition: Import Quantities of Intermediate Goods



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Consumer Goods

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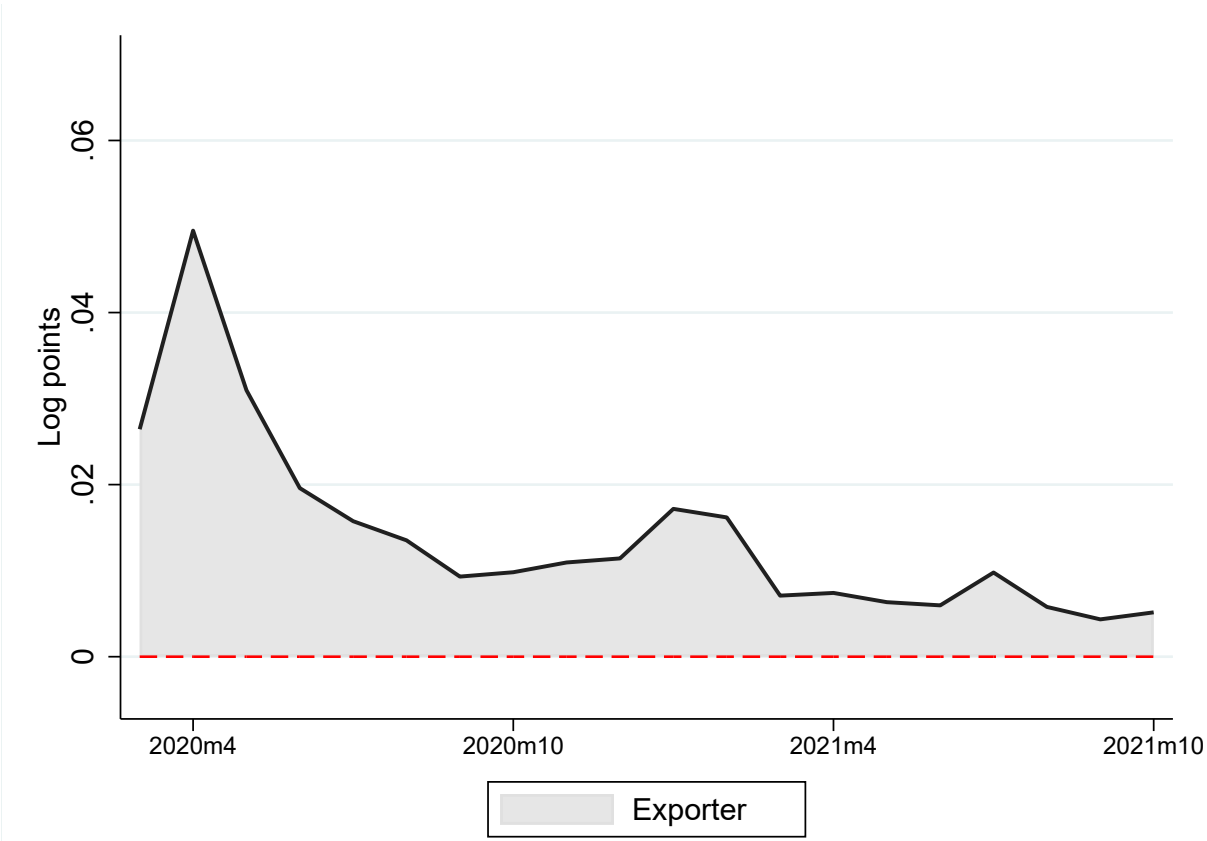
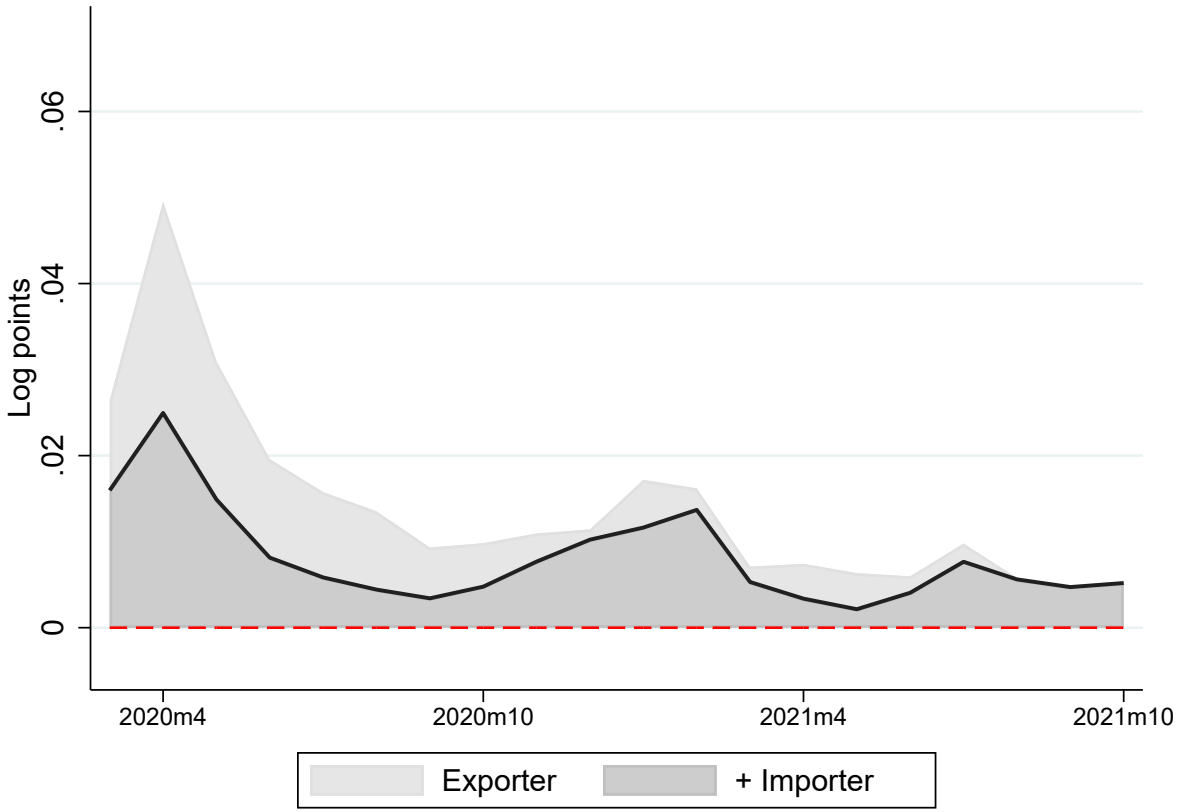


- The price effect in April 2020 is explained fully by exporter mobility.
- Transportation effects explained 90% in October 2021

Consumer Goods

Decomposition: Import Prices of Intermediate Goods



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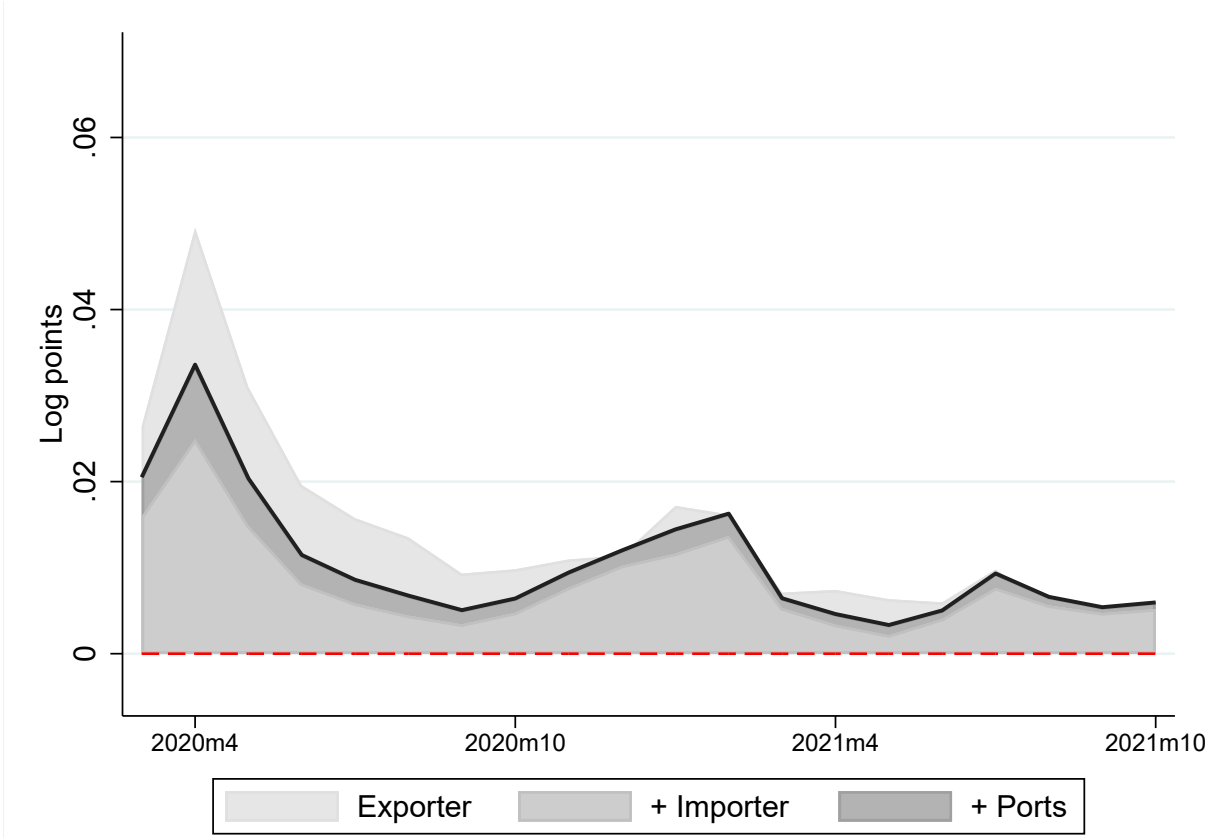
Consumer Goods

Decomposition: Import Prices of Intermediate Goods



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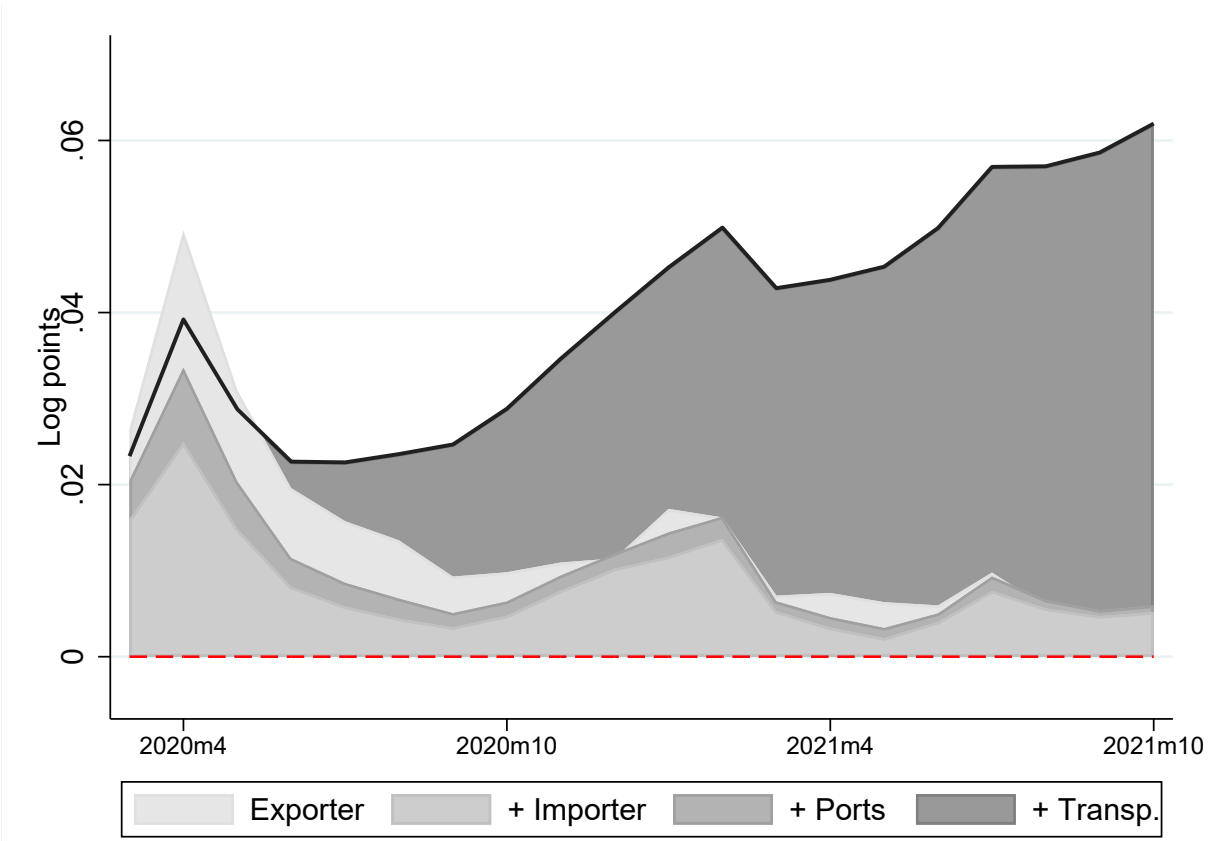
Consumer Goods

Decomposition: Import Prices of Intermediate Goods



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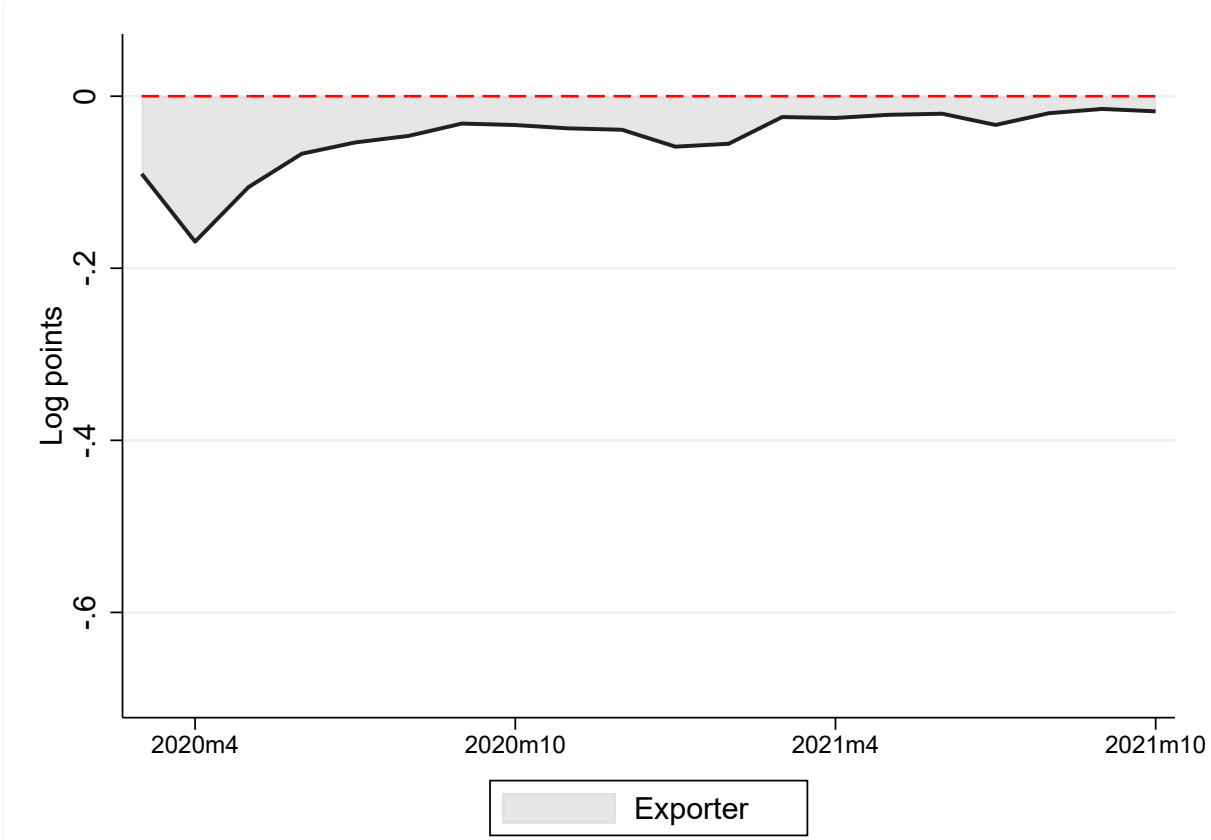
Consumer Goods

Decomposition: Import Quantities of Consumer Goods



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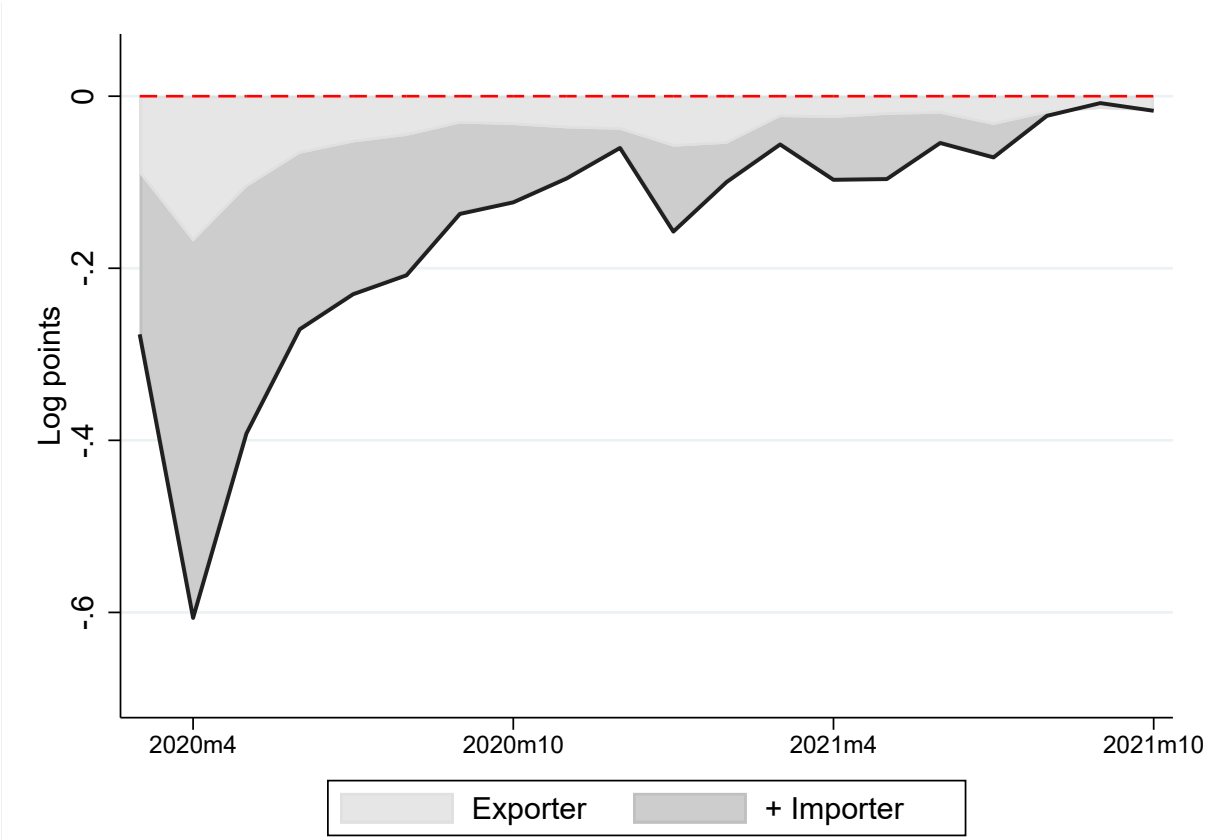
Decomposition: Import Quantities of Consumer Goods



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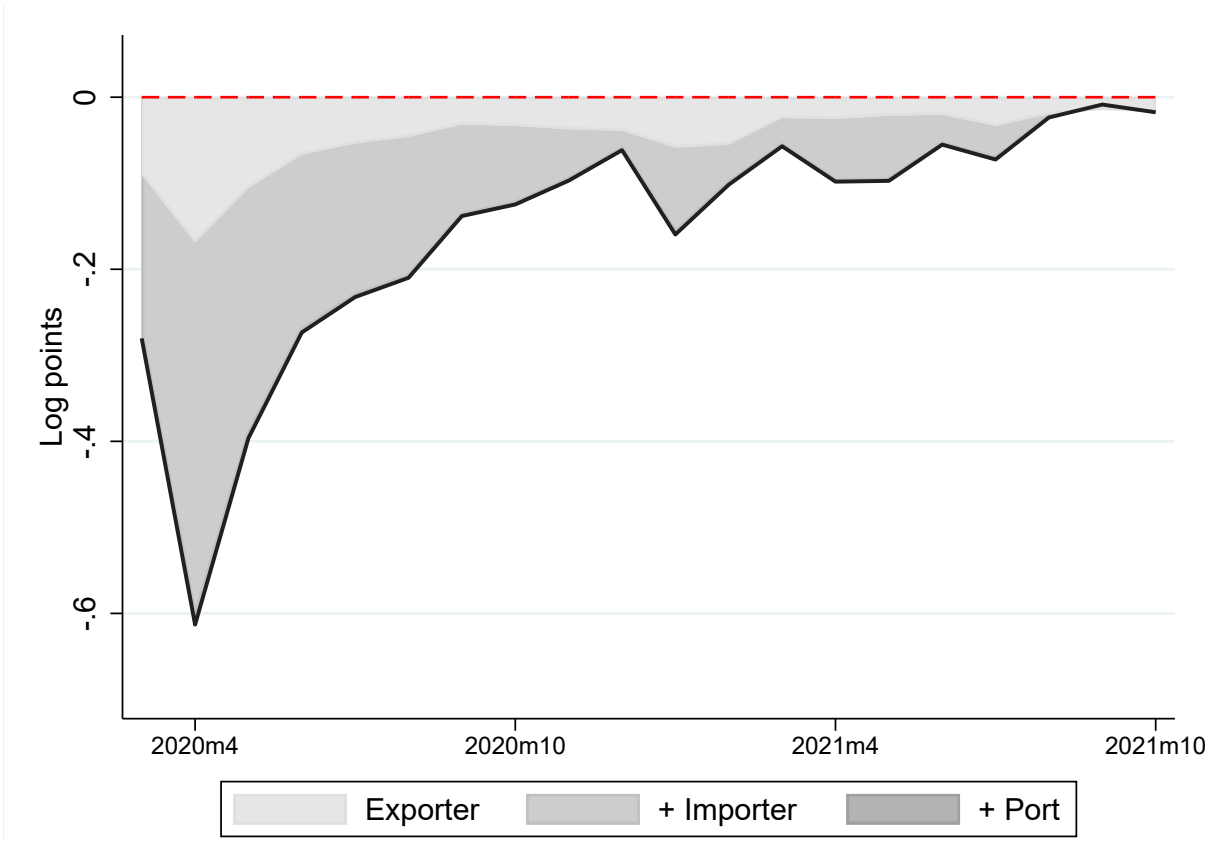
Decomposition: Import Quantities of Consumer Goods



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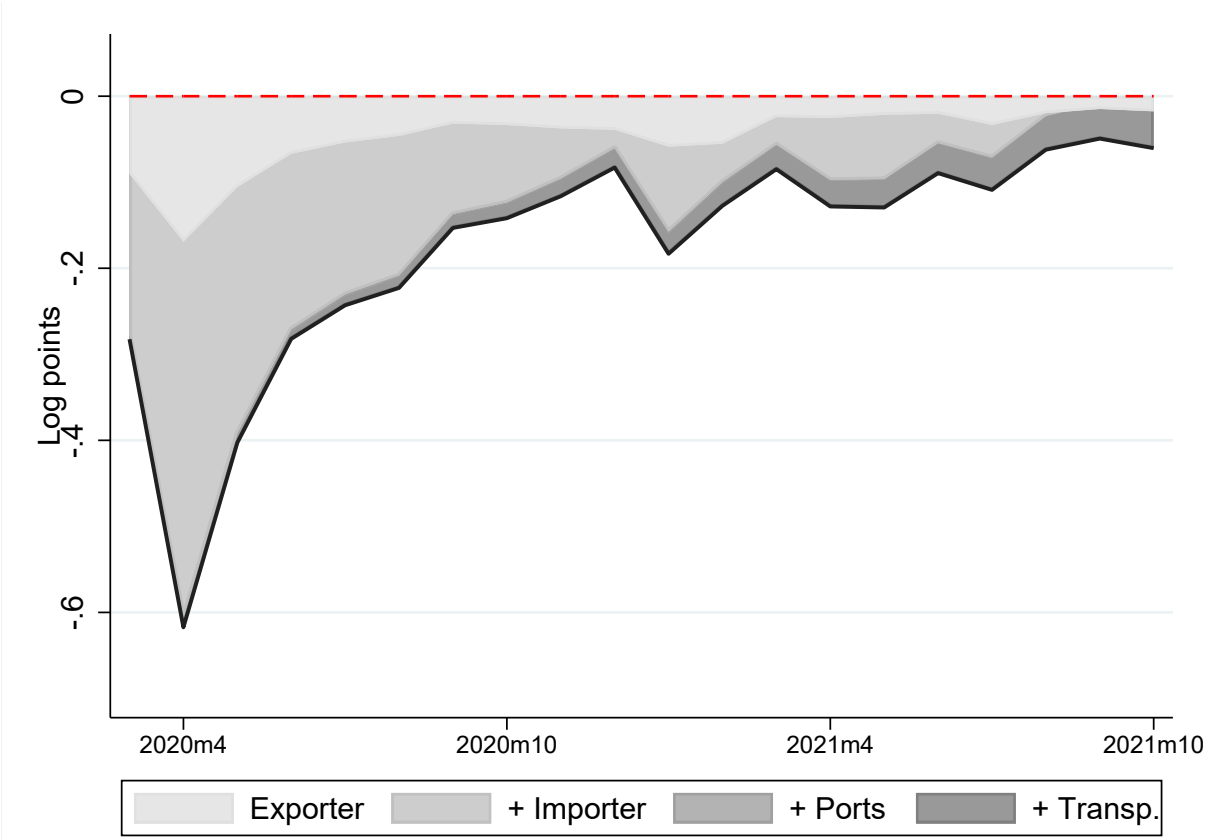
Decomposition: Import Quantities of Consumer Goods



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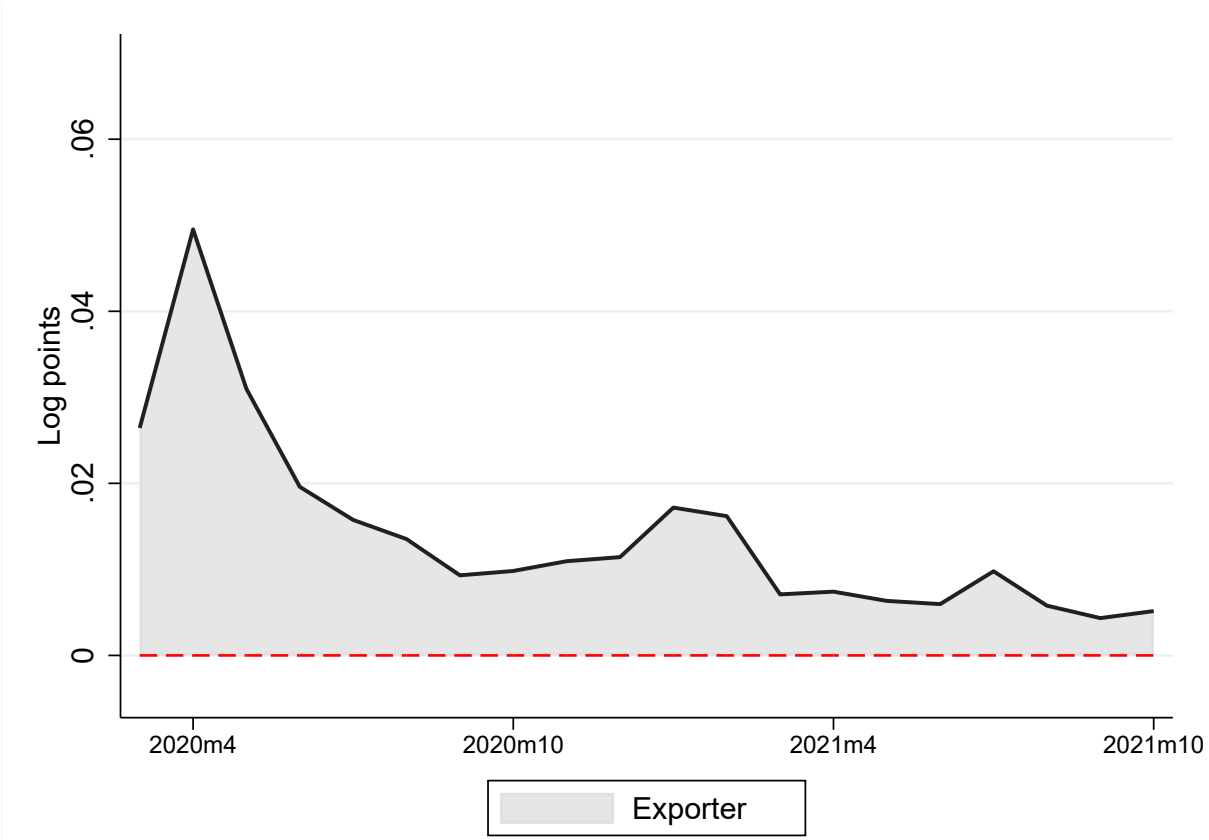
Decomposition: Import Prices of Consumer Goods



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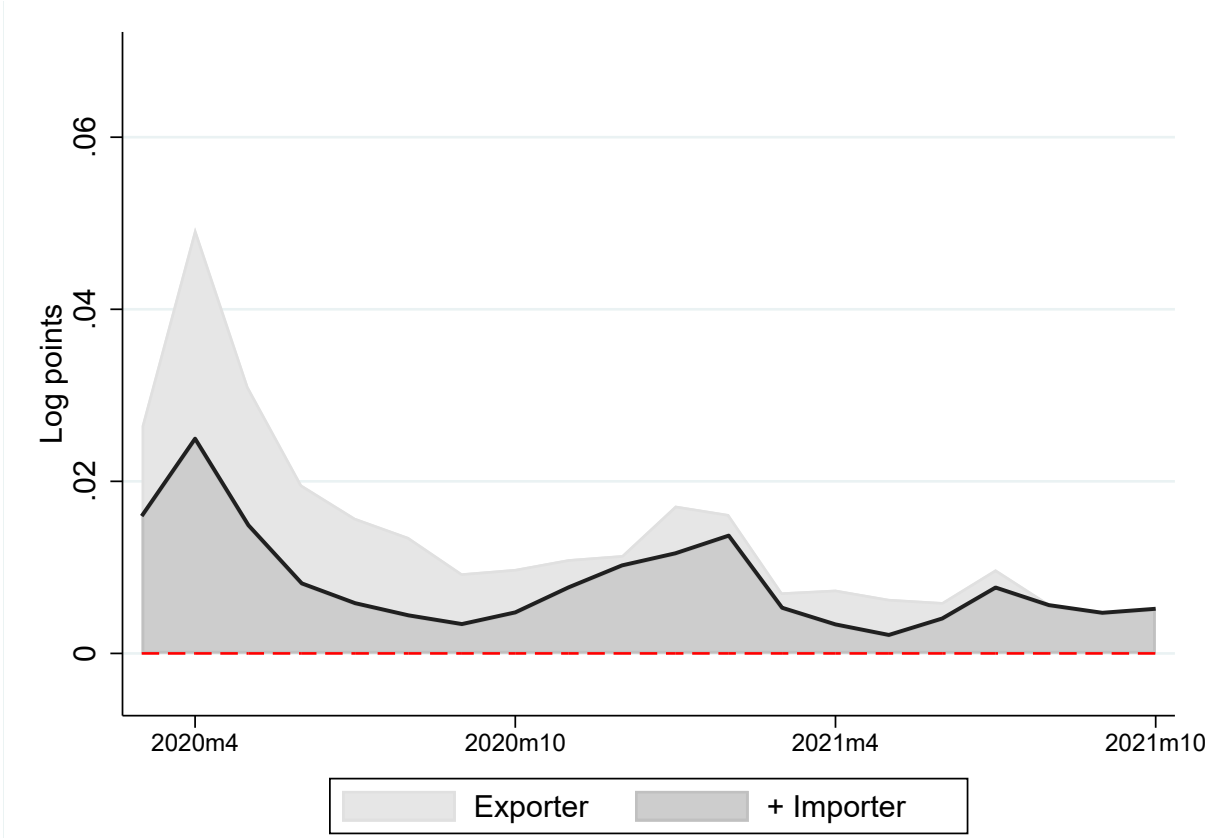

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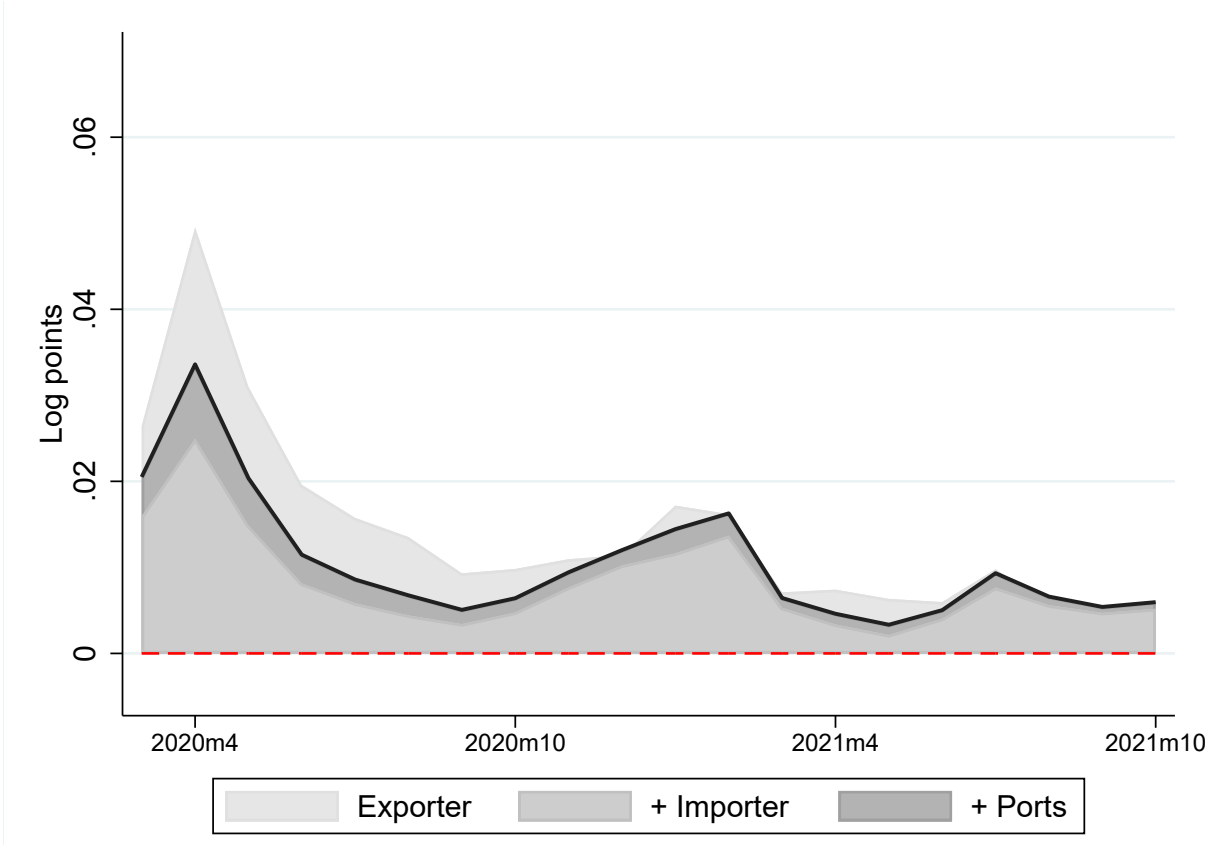

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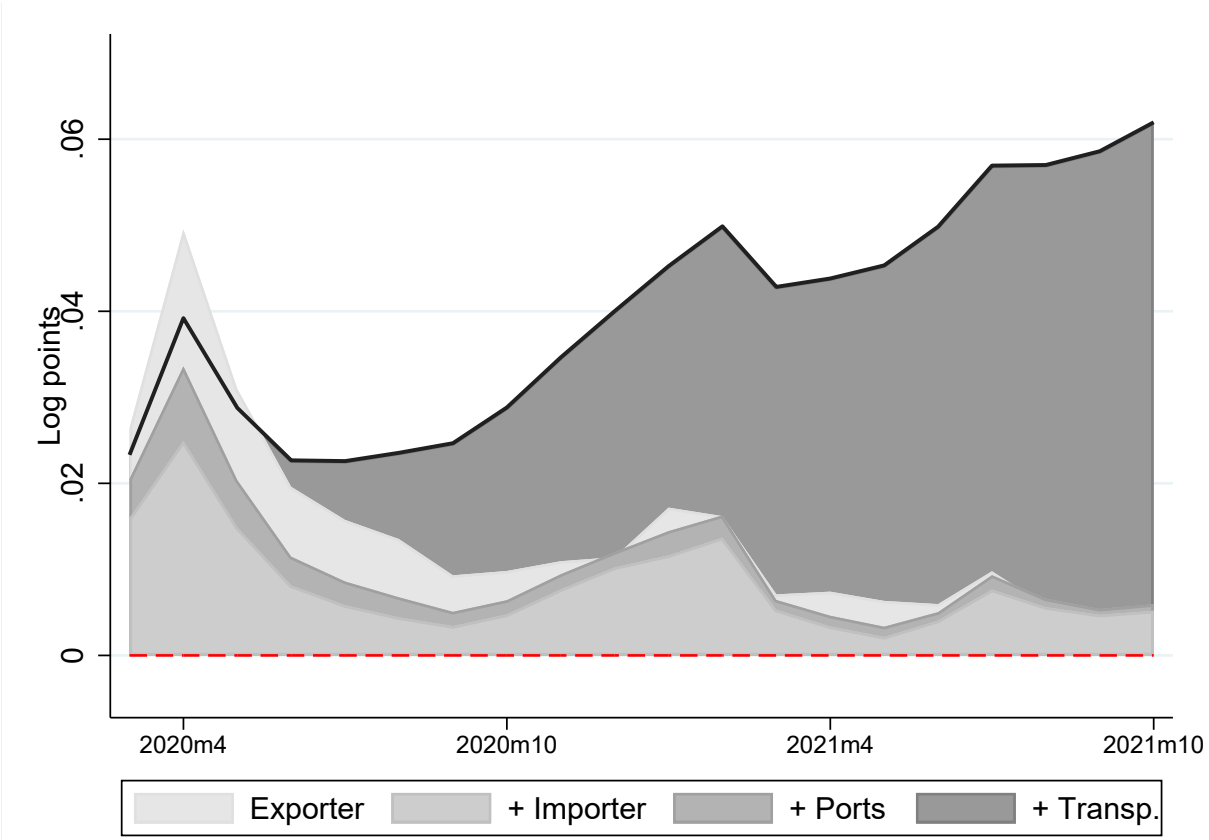
Decomposition: Import Prices of Consumer Goods



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