Lost in transit,
and other ways of working around trade sanctions

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European Bank
for Reconstruction and Development

Motivation

- Widespread use of **export sanctions** and restrictions to deprive unfriendly countries of access to critical inputs, technology, etc
  - Cold war, Iran, Russia, CHIPS Act

- Well-documented evidence of sanction busting taking place via **intermediated trade** and **product misclassification**

- This paper documents '**lost in transit'** being another mechanism used to evade export sanctions, suggesting that **exports transiting via a sanctioned country may deserve special scrutiny**

Sanctions on Russia have given rise to **intermediated trade** but **"ghost" (lost) trade** has also been reported

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Turkey's exports of military-linked goods to Russia soar

Growth in shipments of restricted parts fuels western suspicions that Turkish companies are conduit for Moscow

Finance and economics | Refined tactics

Russia's sanctions-dodging is getting ever more sophisticated

How banks are greasing the wheels of the growing grey trade

IMAGE: REUTERS

Mar 2nd 2023 · 4 min read

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ON FEBRUARY 24TH America marked the anniversary of Vladimir Putin's invasion of Ukraine by freezing the assets of a dozen

EU goods worth at least $1bn vanish in Russia 'ghost trade'

Western officials believe nation diverted sensitive exports targeted by sanctions

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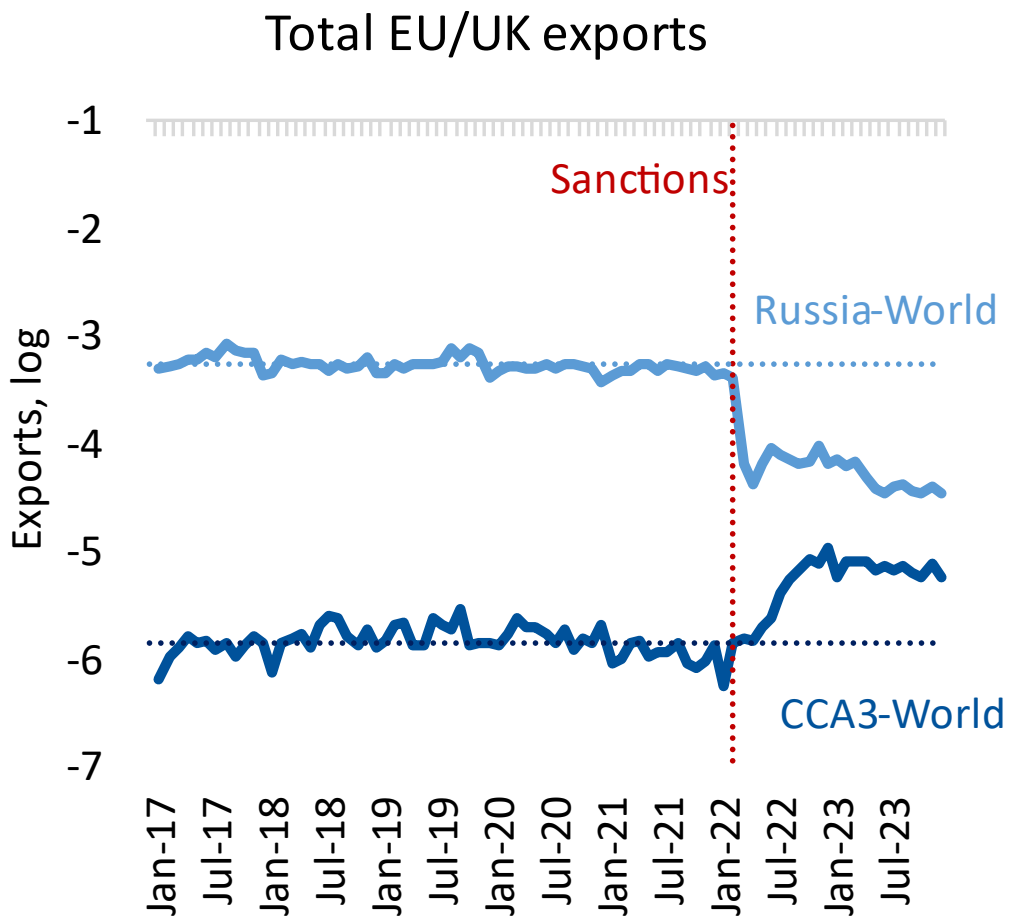
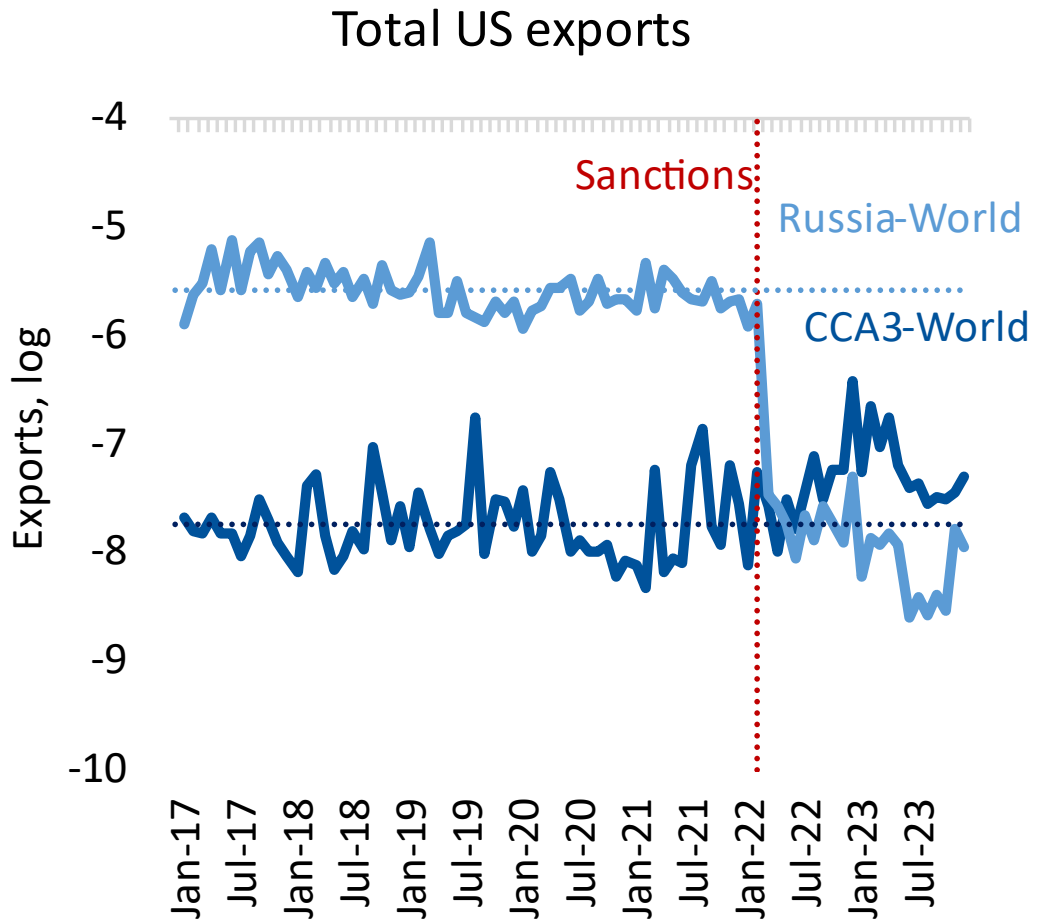
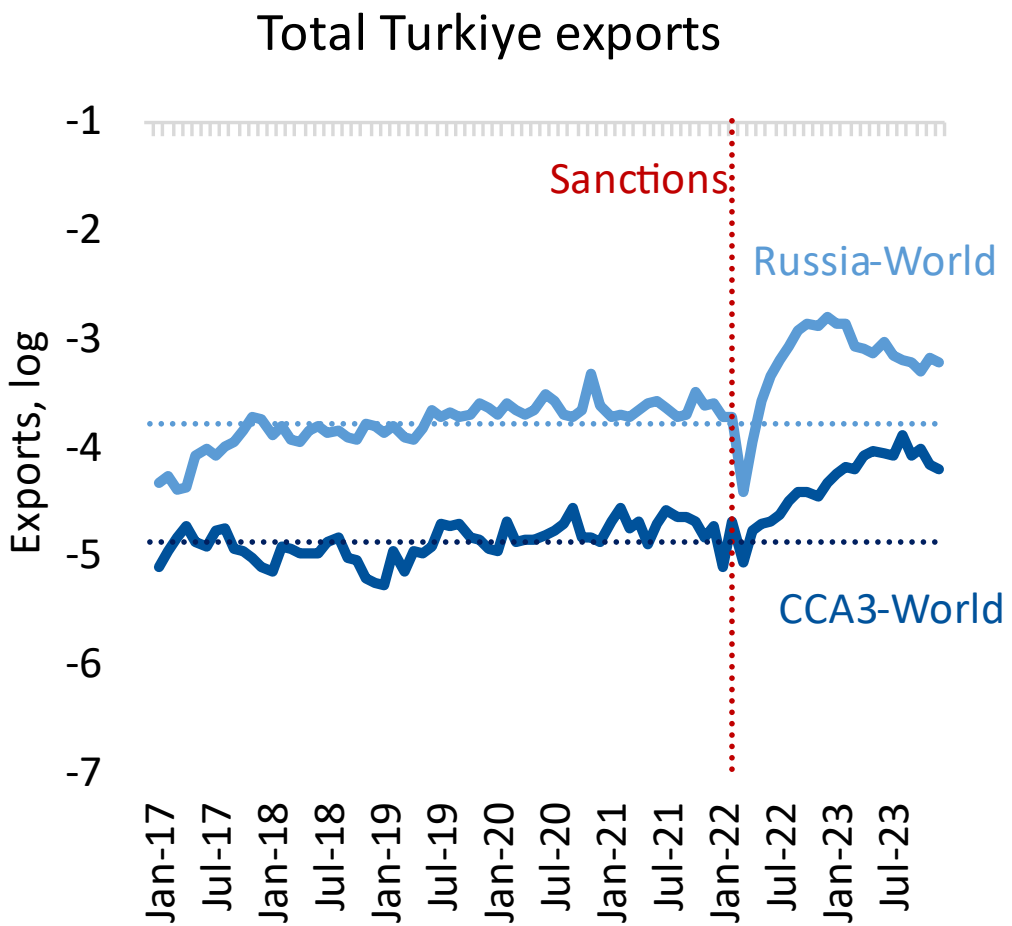
Increased prominence of Armenia, Kazakhstan & Kyrgyz Republic (CCA3) as an export destination for sanctioning economies, also some other neighbouring economies





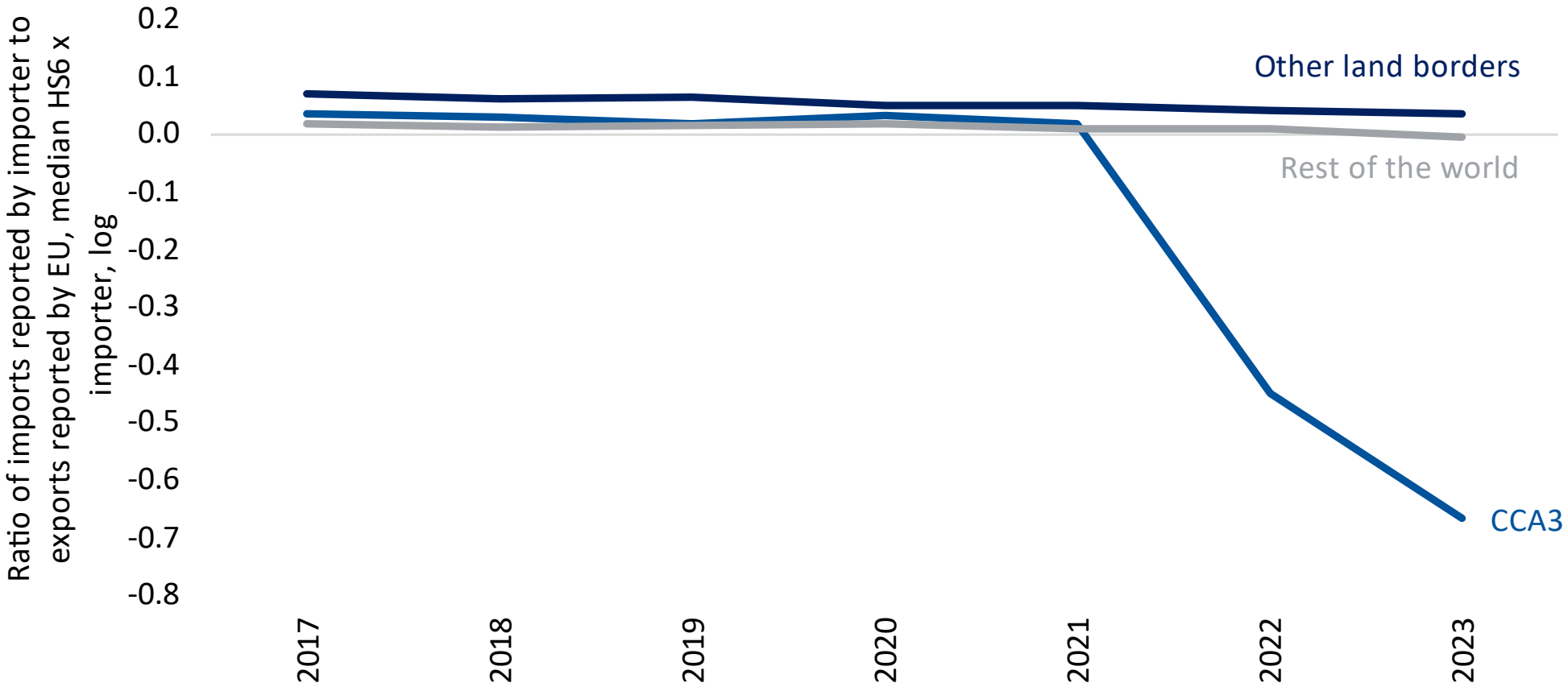
Source: Authors' calculations based on UN Comtrade. 95% confidence intervals are based on standard deviations calculated for the entire period shown. EU total is inclusive of the UK. Log(Export EU to Rus) - log(Export EU to Rest of the World) and Log(Export EU-CCA3) – log(Export EU to Rest of the World)

And trade diversion: Increased Turkish and Chinese exports to Russia – but also to CCA3



Source: Authors' calculations based on UN Comtrade and China Customs Administration. 95% confidence intervals are based on standard deviations calculated for the entire period shown. Log(Export China to Rus) - log(Export China to Rest of the World) and Log(Export China-CCA3) – log(Export China to Rest of the World)

Lost in transit: Sharp drops in a typical ratio of imports recorded by EEU and exports recorded by EU – unlike in earlier years; unlike for the rest of the world's EU imports



Authors' calculations based on UN Comtrade. Based on bilateral trade at the HS6 level in March-December of each year. The ratio of imports as reported by importer eg Armenia to the corresponding exports as reported by EU member states and the UK.

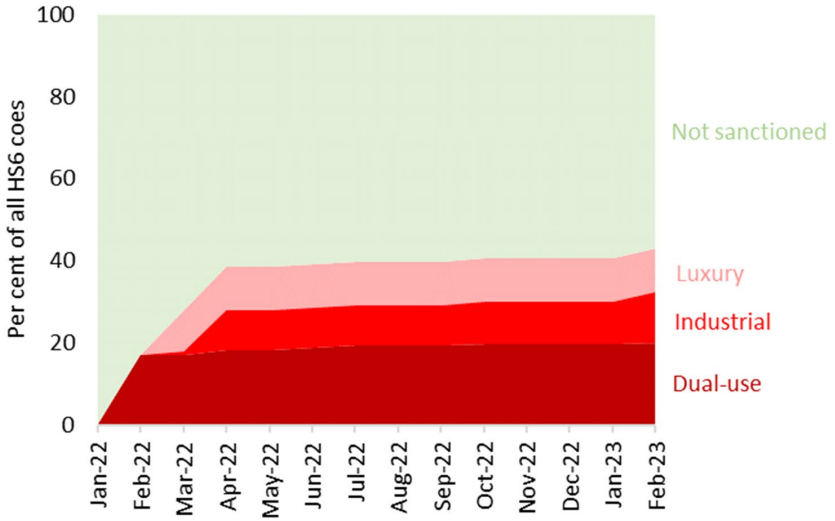
This paper

- This paper
  - Focuses on EU export sanctions imposed on Russia
  - Examines monthly bilateral trade data as reported by exporting countries
  - 5,369 product lines (HS classification); Jan 2017 – Dec 2023

- Findings
  - Russia's war on Ukraine has led to **substantial changes in trade patterns**
  - Evidence consistent with **sanction evasion** through **intermediated trade**
  - Much of it seems to involve goods **"lost in transit"** through Russia to third countries
  - Small mark-ups in unit values at the point of export
  - Limited (if any) use of **product misclassification**
  - **Lost-in-transit method is simple, inexpensive – and little-documented in the literature**
  - Restrictions on transit were partially effective in curtailing intermediated ["lost-in-transit"] trade via EEU

EU export sanctions cover vast array of goods: Distinguish between types of sanctions (luxury goods, dual-use technology, limiting industrial capacity)

- From 23 February 2022, the EU introduced 11 waves of sanctions on Russia
- Most export sanctions were in place by 15 March 2022 (when luxury goods added)
  - **Arms**, advanced and **dual-use technology** (eg weapons HS 9301)
  - **Quantum computing**, advanced **semiconductors** (eg semi-conductor media 852352)
  - **Sensitive machinery**, goods seen to enhance Russia's industrial production capacity (eg engines, pumps, 8412, 8413)
  - **Transportation** (eg containers 860900; aircraft and parts 88)
  - Various **chemicals** (eg ammonia 281420)
  - Goods for use in the **oil industry** (eg steel pipes for oil pipelines, 730411)
  - **Maritime navigation** (eg navigation instruments 9014)
  - **Luxury goods** (eg ski suits 611220)



- Trans-shipment of dual-use goods through Russia sanctioned from Feb 2023; and trans-shipment of industrial capacity goods from Jun 2023

Translated sanctions into (**fully or partially**) covered HS6 product codes

- Specific HS8 only covered (eg champagne is sparkling wines)
- "Luxury" goods above certain unit value (eg €300 for clothing)
- Various exemptions on humanitarian / environmental / oil and gas exports grounds
- Wind-down clauses: trade based on pre-existing contracts

Also look at **“similar” goods,** not sanctioned but within same HS4

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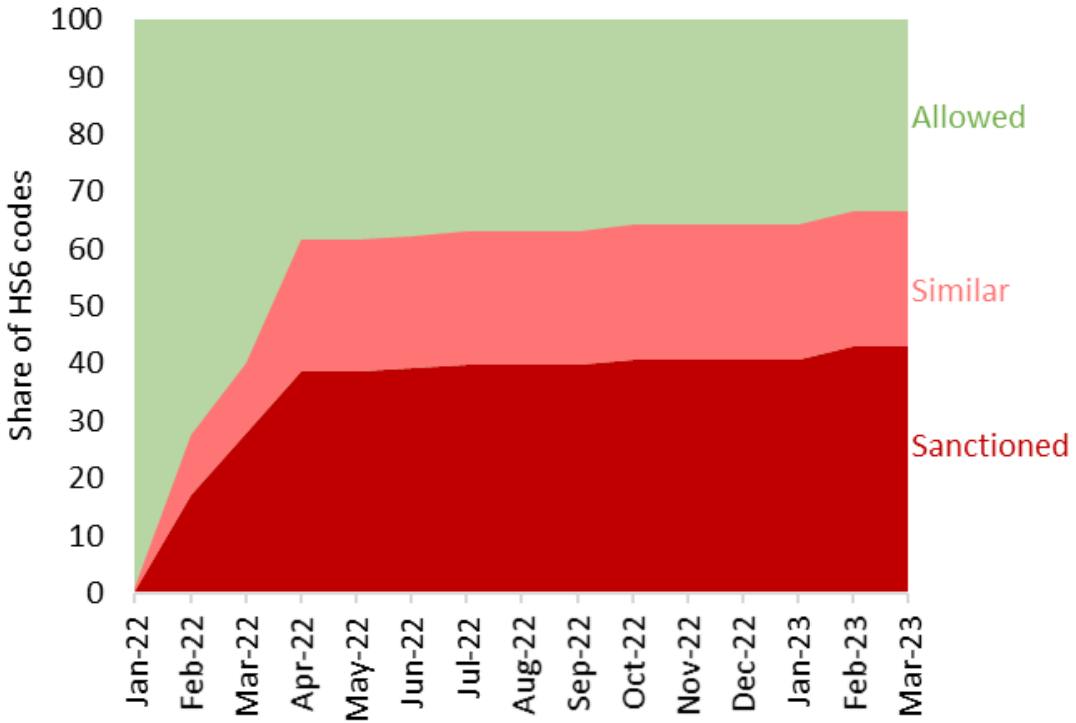
- Example: x-ray for dentistry/ medical (902213) vs non-medical (902219)



Example

HS2

22 Beverages, spirits and vinegar

HS4

2204 Wine of fresh grapes including fortified wines

HS6

220410 Sparkling wines

220421 Still wines, <2l

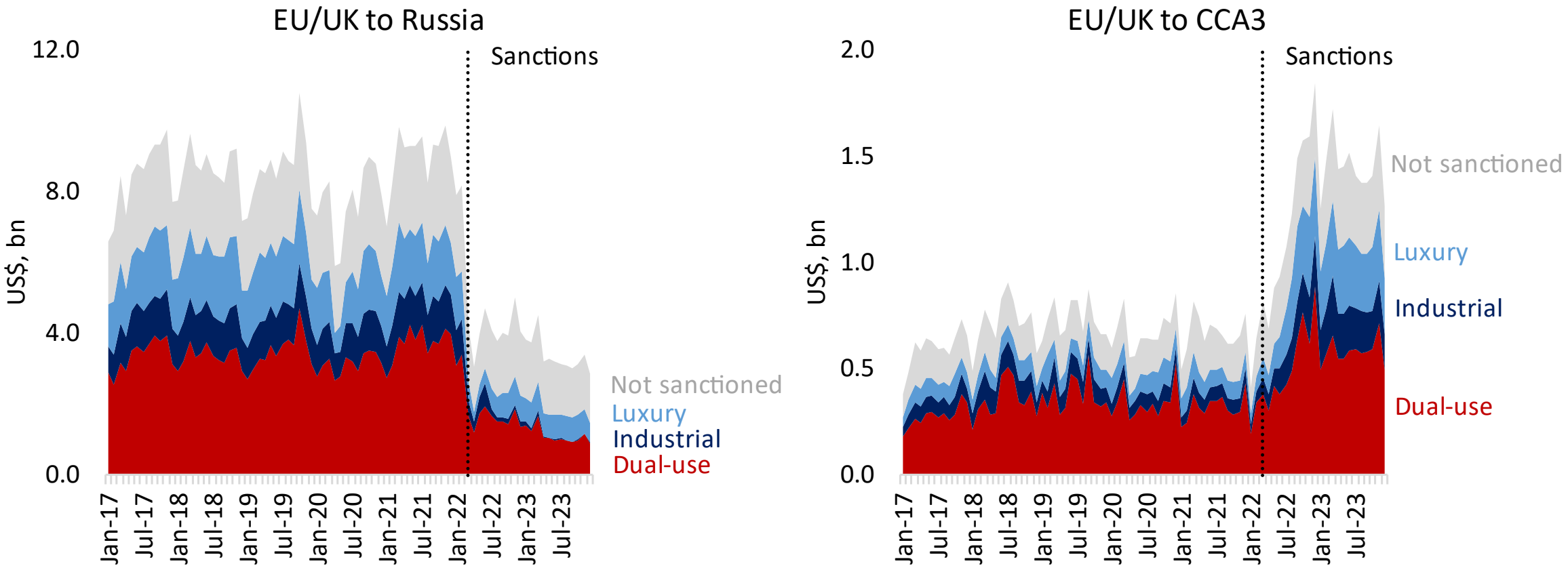
220430 Grape must

HS8

22041011 Champagne

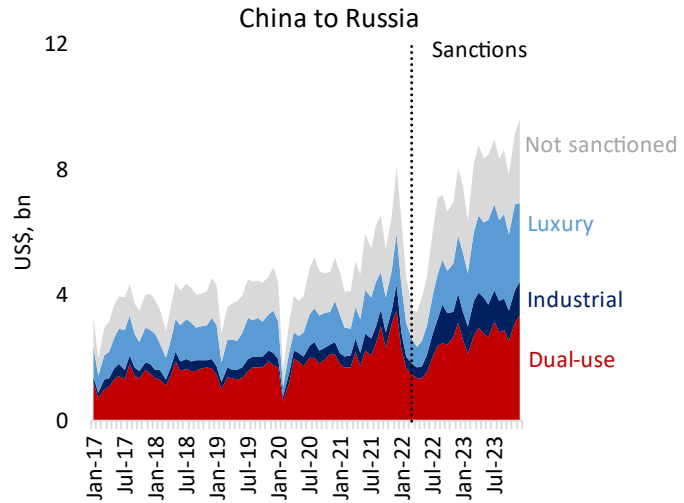
22041015 Prosecco

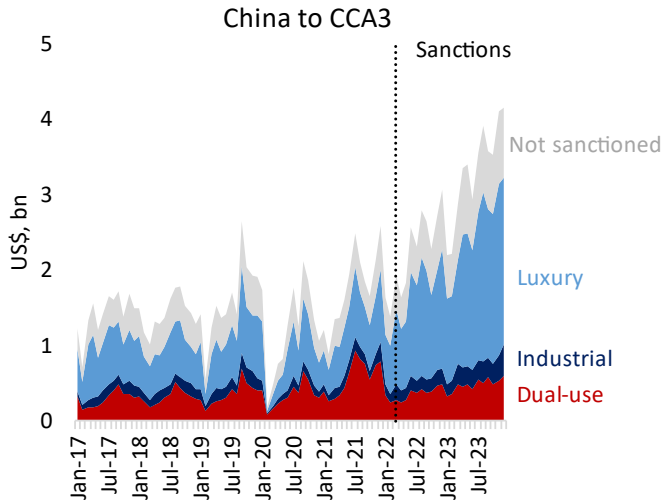
Prominence of sanctioned goods in European exports to CCA3 – although a small proportion of the drop in direct exports to Russia [note different scales]

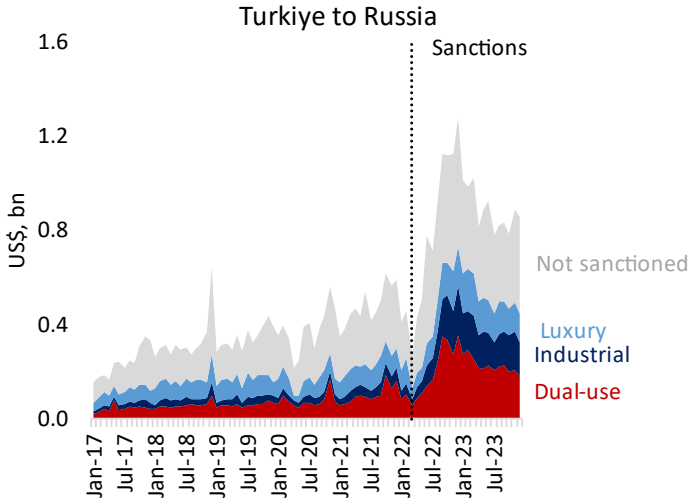


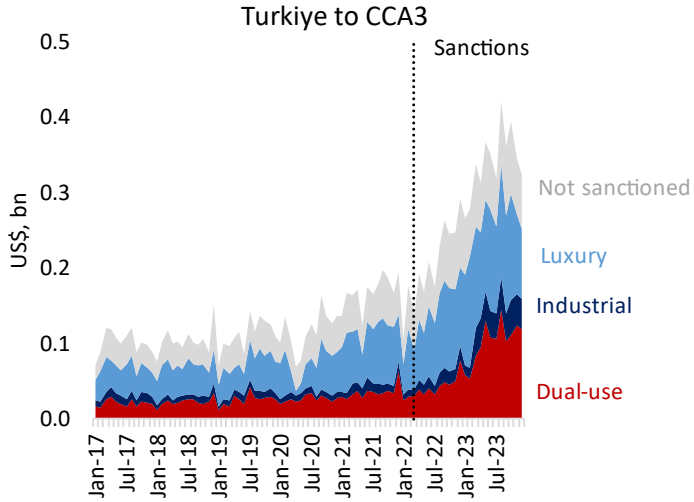
Source: Authors' calculations based on UN Comtrade. Sanctioned goods are where EU sanctions apply at least partially as of December 2022.

An marked increase in direct exports from Turkiye and China to Russia as Western brands exit – but also to CCA3 (possibly indirect routing for sensitive shipments?)









Authors' calculations based on UN Comtrade. Sanctioned goods are where EU sanctions apply at least partially as of December 2022.

Data

Monthly HS6 product-level bilateral trade data (5,369 codes), Jan 2017-Dec 2023, as reported by exporters

- EU/UK (aggregate), US, Turkiye (UN Comtrade)
- China (China Customs Administration)

Importers:

- **Russia**
- ***CCA3*: Armenia, Kazakhstan, Kyrgyz Republic (EEU members)**
- Georgia, in some specifications other neutral countries with EEU land border, Turkiye
- Rest of the world (combined or separate)

Mirror data: Look at ratios of reported imports to EU's reported exports (missing trade?)

Meet neutral neighbours: CCA3 (EEU members minus Belarus under sanctions); other land border [OLB] for transit schemes (?) incl Georgia as land corridor Armenia – Russia

	EEU customs union member	*Land border EEU*	*Land border Russia*	*Not subject to sanctions*
Belarus	X	X	X	
Kazakhstan	X	X	X	X
Kyrgyz R	X	X		X
Armenia	X			X
Azerbaijan		X	X	X
China		X	X	X
Georgia		X	X	X
Mongolia		X	X	X
North Korea		X	X	
Tajikistan		X		X
Turkmenistan		X		X
Uzbekistan		X		X

Source: Authors. EEU = Eurasian Economic Union.

Increases in exports from the EU are strongly concentrated in CCA3 but also sizable for Georgia and Uzbekistan

Average trade flows in Mar-Dec 2022-23, in % of the Mar-Dec average in 2017-21

From	World	CCA3	Armenia	Kazakhstan	Kyrgyz R.	Russia	Belarus	Azerbaijan	China	Georgia	Mongolia	N. Korea	Tajikistan	Turkmenistan	Uzbekistan
EU + UK	102	178	213	154	573	38	85	68	88	138	115	56	121	69	148
of which															
EU	102	181	212	158	570	39	88	76	83	138	117	56	120	69	148
Germany	96	195	215	171	771	32	88	107	84	155	98		130	74	137
UK	101	108	262	90	715	21	7	48	131	145	75	20	122	73	129
US	110	160	378	139	342	11	10	119	101	214	115	…	781	57	78
China	112	184	94	144	277	153	221	78		47	161	67	170	182	186
Turkiye	118	202	…	208	189	204	204	118	89	142	196		179	110	135

Source: Authors' calculations based on UN Comtrade, China customs administration. Based on bilateral trade.

Empirical specification for intermediate trade: Triple difference to check if sanctioned goods are more impacted than non-sanctioned goods

$$\text{Log}(\text{E}xports)_{pct} = \beta \;\; Sanct_{pt} x \; CountryType_c + \; \alpha_{ct} \; + \alpha_{pt} \; + \alpha_{pc} \; + \varepsilon_{pct}$$

Exports of product *p* to importing country *c* in month *t*

Focus on EU + UK as an aggregate exporter (also individually)

Sanction indicator is product-specific and time varying (set to 1 from the month following the date of the sanctions package, 0 otherwise), although little time variation and results are similar with time-invariant sanctions indicators

Triple-difference comparison between

- Sanctioned vs non-sanctioned goods (time-varying treatment)
- Before sanctions and under sanctions
- Exports to Russia (CCA3) vs other land borders (OLB) vs the rest of the world

Fixed effects:

- Importer x HS6 = accounts for structure of production and demand in importing economy
- Importer x Month = accounts for fluctuations in the aggregate demand in the importing country
- HS6 x Month = accounts for seasonality, any production issues on the exporter side

Also look at linear probability model (extensive margin); PPML and inverse hyperbolic since (intensive + extensive margins)

Rise of **intermediated exports from Europe** accompanied by drop in direct exports is more pronounced for dual-use and industrial goods vs non-sanctioned goods

VARIABLES	Trade, log	0-1	Trade, hyp	Trade, ppml
Dual-use under sanctions x CCA3	**0.322*** **	**0.0377*** **	**0.948*** **	0.0472
	(0.0453)	(0.00606)	(0.0971)	(0.0672)
Industrial under sanctions x CCA3	**0.429*** **	**0.0298*** **	**0.580*** **	**0.255** **
	(0.0591)	(0.00703)	(0.0910)	(0.107)
Luxury under sanctions x CCA3	**0.236*** **	**0.0404*** **	**0.842*** **	**0.431*** **
	(0.0496)	(0.00775)	(0.105)	(0.140)
Dual-use under sanctions x Russia	**-1.213*** **	**-0.173*** **	**-2.681*** **	**-0.518*** **
	(0.0652)	(0.0105)	(0.140)	(0.174)
Industrial under sanctions x Russia	**-2.242*** **	**-0.528*** **	**-7.039*** **	**-1.813*** **
	(0.110)	(0.0105)	(0.151)	(0.130)
Luxury under sanctions x Russia	**-0.334*** **	**0.0438*** **	0.0707	**-0.486*** **
	(0.0610)	(0.0100)	(0.124)	(0.139)
Observations	1,093,793	1,898,484	1,898,484	1,882,183
R-squared	0.931	0.774	0.895	

Standard errors are clustered at the HS6 level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels. Importer economies comprise Arm, Kaz, Kyr., Rus and the rest of the world (aggregated). Sanctioned refers to HS6 where EU sanctions apply at least partially. Sanction groupings are exhaustive and mutually exclusive. PPML drops more singleton observations than OLS.

Differential increase in European exports of (new) **similar goods to CCA3** although not to Russia directly

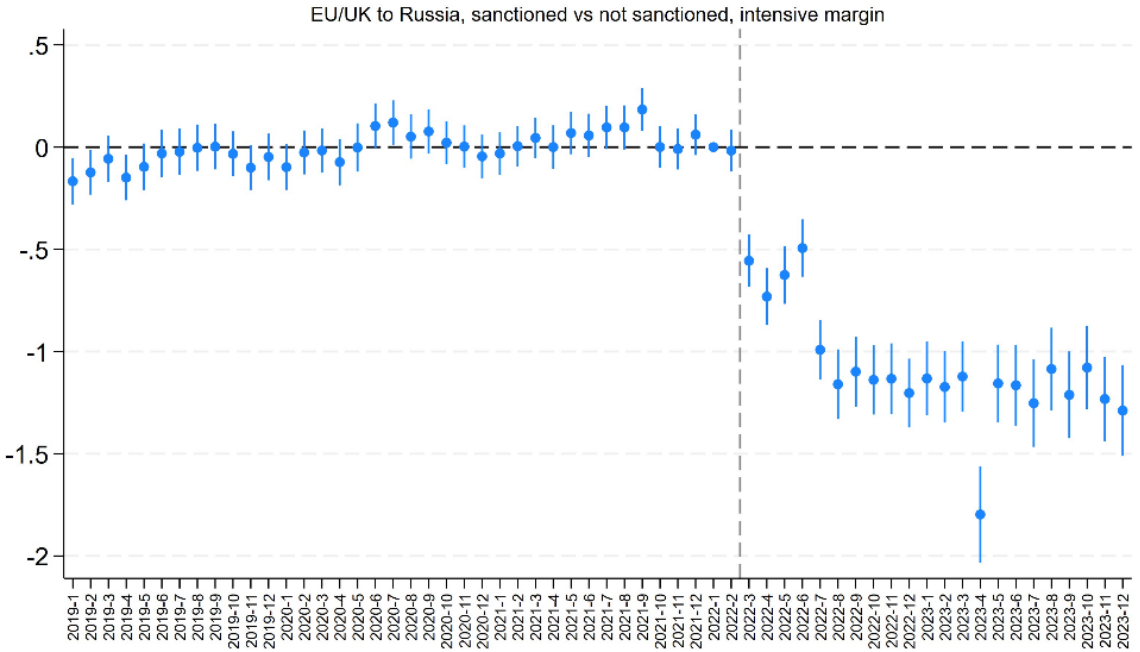
VARIABLES	Trade, log	0-1	Trade, hyp	Trade, ppml
Goods under sanctions x CCA3	**0.319*** **	**0.0420*** **	**0.907*** **	**0.221*** **
	(0.0396)	(0.00513)	(0.0720)	(0.0780)
Similar goods x CCA3	0.0520	**0.0183*** **	**0.261*** **	0.125
	(0.0463)	(0.00547)	(0.0702)	(0.0774)
Goods under sanctions x Russia	**-1.078*** **	**-0.235*** **	**-3.437*** **	**-0.640*** **
	(0.0513)	(0.00864)	(0.111)	(0.115)
Similar goods x Russia	**-0.239*** **	**-0.0470*** **	**-0.628*** **	-0.0329
	(0.0452)	(0.00804)	(0.0932)	(0.0834)
Observations	1,093,793	1,898,484	1,898,484	1,882,183
R-squared	0.931	0.771	0.893	

Standard errors are clustered at the HS6 level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels. Importer economies comprise Arm, Kaz, Kyr., Rus and the rest of the world (aggregated). Sanctioned refers to HS6 product lines where EU sanctions apply at least partially. Similar goods are not sanctioned but within the same HS4 as sanctioned. PPML drops more singleton observations than OLS.

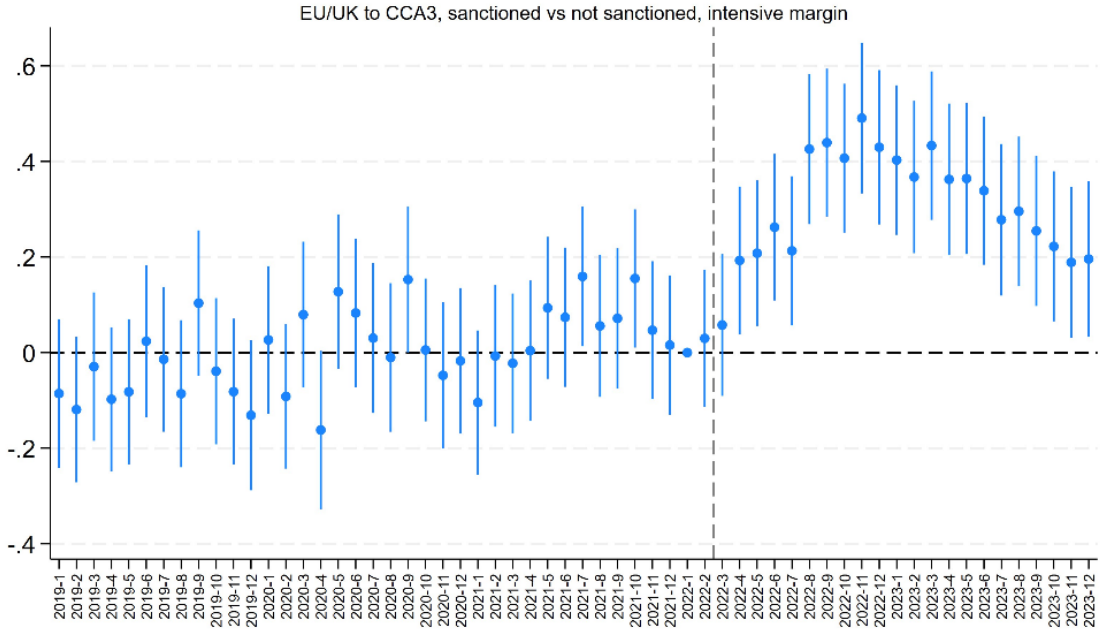
Event study: EU/UK exports of sanctioned vs non-sanctioned goods (base = Jan'22): No significant pre-trend, differential rising through Aug'22; CCA declining from mid-2023

$$\text{Log}(Exports)_{pct} = \beta Month_t x Sanct_p x CountryType_c + \alpha_{ct} + \alpha_{pt} + \alpha_{pc} + \varepsilon_{pct}$$

EU/UK exports to Russia: sanctioned vs non-sanctioned



EU/UK exports to CCA3: sanctioned vs non-sanctioned

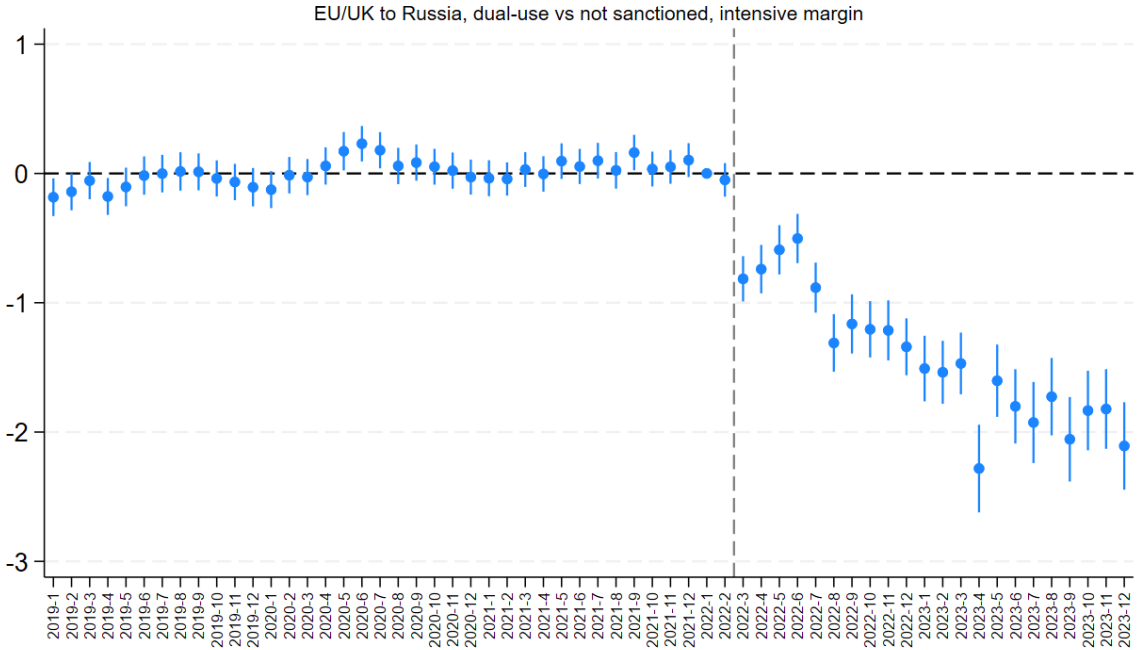


Source: Authors' calculations, UN Comtrade. Coefficients on interaction terms with each month, 95% confidence intervals based on standard errors clustered at HS6 level. Goods classified into sanctioned (where EU sanctions apply at least partially as of Dec 2022), similar (not sanctioned but within the same HS4 as sanctioned) and other. Dependent variable = log trade; non-zero trade.

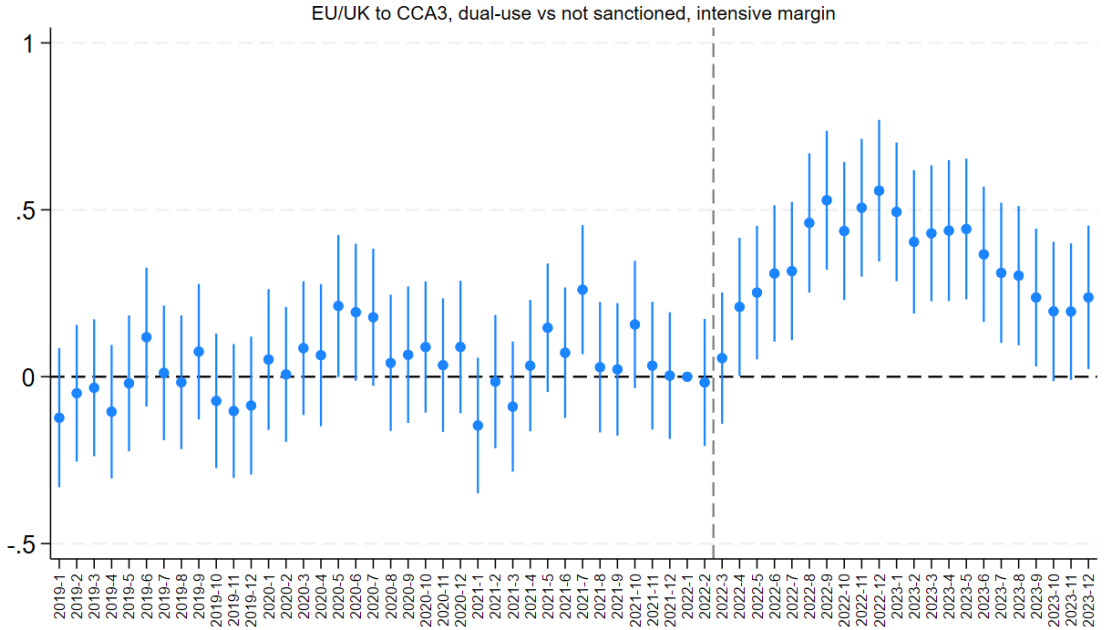
Event study: EU/UK exports of dual-use vs non-sanctioned goods (base = Jan'22): No significant pre-trend, differential rising through Aug'22; CCA declining from mid-2023

$$\text{Log}(Exports)_{pct} = \beta Month_t x Sanct_p x CountryType_c + \alpha_{ct} + \alpha_{pt} + \alpha_{pc} + \varepsilon_{pct}$$

EU/UK exports to Russia: sanctioned vs non-sanctioned



EU/UK exports to CCA3: sanctioned vs non-sanctioned



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CCA3 exports to Russia of industrial capacity goods and dual-use technology up by extra 80%+ relative to exports of non-sanctioned goods

VARIABLES	Trade, log	0-1	Trade, hyp	Trade, ppml
Dual-use under sanctions x Russia	**1.239*** **	**0.0599*** **	**1.060*** **	**1.233*** **
	(0.116)	(0.0105)	(0.119)	(0.173)
Industrial under sanctions x Russia	**0.683*** **	**0.0518*** **	**0.756*** **	0.00942
	(0.157)	(0.0125)	(0.141)	(0.304)
Luxury under sanctions x Russia	0.176	**0.0336*** **	**0.555*** **	**1.443*** **
	(0.116)	(0.0119)	(0.130)	(0.386)
Observations	188,084	734,664	734,664	385,130
R-squared	0.849	0.779	0.826	

Standard errors are clustered at the HS6 level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels. Importer economies comprise Russia and the rest of the world (aggregated). Sanctioned refers to HS6 product lines where EU sanctions apply at least partially. Sanction groupings are exhaustive and mutually exclusive. PPML drops more singleton observations than OLS.

Exit of Western exporters created opportunities: China's exports of industrial and dual-use sanctioned goods to Russia have increased by extra 50% relative to other goods

VARIABLES	Trade, log	0-1	Trade, hyp	Trade, ppml
Dual-use under sanctions x CCA3	**0.228*** **	**0.0366*** **	**0.571*** **	**0.167** **
	(0.0426)	(0.00693)	(0.111)	(0.0742)
Industrial under sanctions x CCA3	**-0.109***	0.00817	**-0.209** **	-0.0206
	(0.0561)	(0.00658)	(0.0865)	(0.116)
Luxury under sanctions x CCA3	**0.301*** **	**0.0235*** **	**0.498*** **	**0.278*** **
	(0.0521)	(0.00761)	(0.108)	(0.0976)
Dual-use under sanctions x Russia	**0.493*** **	**0.0397*** **	**0.961*** **	**0.182** **
	(0.0397)	(0.00760)	(0.0971)	(0.0823)
Industrial under sanctions x Russia	**0.560*** **	**0.0763*** **	**1.004*** **	**0.261** **
	(0.0571)	(0.0106)	(0.131)	(0.112)
Luxury under sanctions x Russia	**-0.131*** **	0.0101	0.0140	0.137
	(0.0449)	(0.00836)	(0.0955)	(0.113)
Observations	806,513	1,534,680	1,534,680	1,492,993
R-squared	0.921	0.768	0.879	

St. errors clustered at the HS6 level. *, **, *** = significance at the 10%, 5% and 1% levels. Importers comprise Arm, Kaz, Kyr., Rus, rest of the world (aggregated). Sanctioned refers to HS6 product lines where EU sanctions apply at least partially. Sanction groupings are exhaustive and mutually exclusive. All regressions include month x importer, month x HS6 and HS6 x importer FE. PPML drops more singleton observations than OLS.

Exit of Western exporters created opportunities: Turkiye's exports of industrial and dual-use sanctioned goods to Russia have increased by extra 50-65% relative to other goods

VARIABLES	Trade, log	0-1	Trade, hyp	Trade, ppml
Dual-use under sanctions x CCA3	**0.411*** **	**0.0560*** **	**0.767*** **	0.172
	(0.0565)	(0.00773)	(0.101)	(0.132)
Industrial under sanctions x CCA3	**0.489*** **	**0.0163***	**0.259** **	0.188
	(0.0768)	(0.00835)	(0.101)	(0.205)
Luxury under sanctions x CCA3	**0.387*** **	**0.0243*** **	**0.509*** **	**0.240***
	(0.0593)	(0.00873)	(0.102)	(0.125)
Dual-use under sanctions x Russia	**0.528*** **	**0.0782*** **	**1.186*** **	0.216
	(0.0646)	(0.0104)	(0.120)	(0.162)
Industrial under sanctions x Russia	**0.641*** **	**0.0369*** **	**0.713*** **	**0.686*** **
	(0.0912)	(0.0118)	(0.138)	(0.106)
Luxury under sanctions x Russia	**-0.177*** **	0.00469	-0.0489	-0.154
	(0.0634)	(0.0114)	(0.117)	(0.115)
Observations	516,348	1,366,260	1,366,260	1,244,383
R-squared	0.902	0.760	0.860	

St. errors clustered at the HS6 level. *, **, *** = significance at the 10%, 5% and 1% levels. Importers comprise Arm, Kaz, Kyr., Rus, rest of the world (aggregated). Sanctioned refers to HS6 product lines where EU sanctions apply at least partially. Sanction groupings are exhaustive and mutually exclusive. All regressions include month x importer, month x HS6 and HS6 x importer FE. PPML drops more singleton observations than OLS.

Lost-in-transit: Difference-in-difference and triple-difference analysis

Annual bilateral trade of individual EU / UK economies with every partner where exports and imports records are available for HS6

For each HS6 product *p*, exporter *e*, importer *i and year t*:

Diff-in-diff: Has imports / exports ratio dropped more for EU exports to CCA3 vs other economies post-sanctions (same products)?

$$\text{Log}(Imports\ to\ Exports\ Ratio)_{pect} = \beta\ \ PostSanctions_{pt} x\ ImporterType_c + \alpha_{pet} + \alpha_{pec} + \varepsilon_{pect}$$

Product-exporter-time and product-exporter-importer fixed effects

Triple diff: Was the drop in imports-exports ratio for EU-CCA3 trade more pronounced for various types of sanctioned goods?

$$\text{Log}(Imports\ to\ Exports\ Ratio)_{pect} = \beta\ \ PostSanctions_{pt} x\ ImporterType_c x ProductType_p + \alpha_{pet} + \alpha_{pec} + \alpha_{ect} + \varepsilon_{pect}$$

Product-exporter-time, product-exporter-importer and exporter-importer-time fixed effects

Exporter-importer-time differences out country-level trends in import-export ratios established in the difference-in-difference analysis

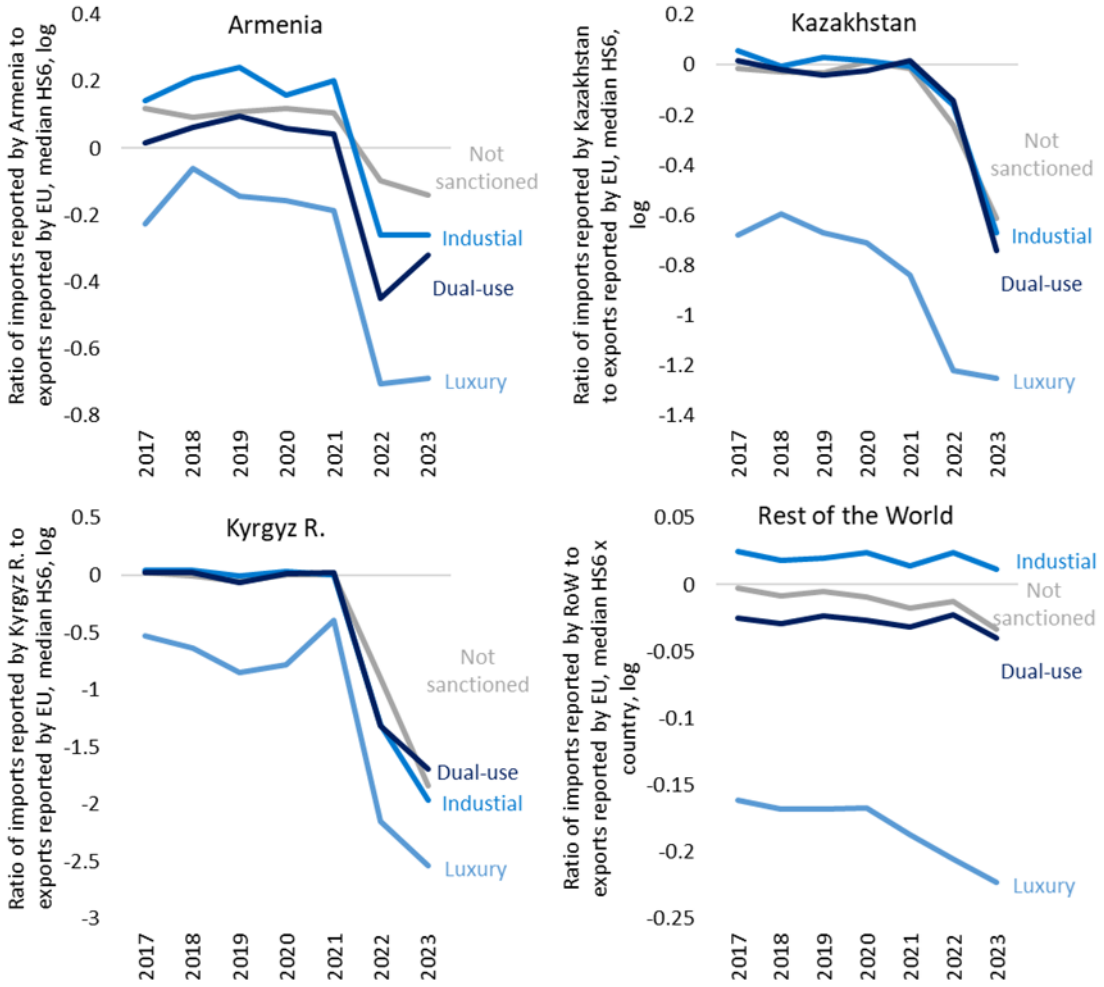
Lost-in-transit: 60%+ drop in imports-to-exports ratio for CCA3 post-sanctions; with extra 18-30% drop for sanctioned vs non-sanctioned goods

Similar but small effects for other land border economies (an order of magnitude smaller)

VARIABLES	All goods	Dual-use	Industrial	Luxury	Not sanctioned	Triple difference
Post-sanctions x CCA3	**-0.613*** **	**-0.680*** **	**-0.840*** **	**-0.666*** **	**-0.481*** **	
	(0.0166)	(0.0326)	(0.0459)	(0.0431)	(0.0223)	
Post-sanctions x OLB	**-0.0687*** **	**-0.102*** **	**-0.144*** **	-0.0168	**-0.0464*** **	
	(0.00729)	(0.0142)	(0.0218)	(0.0170)	(0.0106)	
Post-sanctions x CCA3 x Dual-use						**-0.175*** **
						(0.0392)
Post-sanctions x OLB x Dual-use						**-0.0495*** **
						(0.0178)
Post-sanctions x CCA3 x Industrial						**-0.309*** **
						(0.0501)
Post-sanctions x OLB x Industrial						**-0.0933*** **
						(0.0239)
Post-sanctions x CCA3 x Luxury						**-0.218*** **
						(0.0469)
Post-sanctions x OLB x Luxury						0.0285
						(0.0202)
Observations	15,214,036	3,866,976	1,889,780	2,331,169	7,126,111	15,212,703
R-squared	0.628	0.597	0.621	0.672	0.629	0.632

Authors' calculations based on UN Comtrade. Based on bilateral trade at the HS6 level. First five regressions include exporter x HS6 x importer and exporter x year x product fixed effects. Triple-difference regressions also include exporter x year x importer fixed effect. OLB refers to other land borders. Control group is all other countries.

Lost in transit: Sharper drops in a typical ratio of imports recorded by CCA3 and exports recorded by EU for sanctioned goods are also seen in raw data



Authors' calculations based on UN Comtrade. Based on bilateral trade at the HS6 level in March-December of each year. The ratio of imports as reported by importer eg Armenia to the corresponding exports as reported by EU member states and the UK.

Pairs with zero imports and non-zero exports: Probability increased by around 6pp for CCA3 after sanctions

Similar but small effects for other land border economies (an order of magnitude smaller)

Dep. var: zero imports and positive exports reported	All goods	Dual-use	Industrial	Luxury	Not sanctioned	Triple difference
Post-sanctions x CCA3	**0.0622*** **	**0.0546*** **	**0.0664*** **	**0.0668*** **	**0.0634*** **	
	(0.00158)	(0.00303)	(0.00427)	(0.00382)	(0.00238)	
Post-sanctions x OLB	**0.0194*** **	**0.0152*** **	**0.0253*** **	**0.0199*** **	**0.0199*** **	
	(0.000821)	(0.00162)	(0.00226)	(0.00198)	(0.00123)	
Post-sanctions x CCA3 x Dual-use						**-0.0125*** **
						(0.00367)
Post-sanctions x OLB x Dual-use						**-0.00453** **
						(0.00202)
Post-sanctions x CCA3 x Industrial						-0.00115
						(0.00467)
Post-sanctions x OLB x Industrial						**0.00550** **
						(0.00256)
Post-sanctions x CCA3 x Luxury						-0.000916
						(0.00441)
Post-sanctions x OLB x Luxury						0.00259
						(0.00235)
Observations	29,432,653	7,097,156	3,685,806	4,541,577	14,108,114	29,432,387
R-squared	0.637	0.614	0.624	0.646	0.647	0.645

Authors' calculations based on UN Comtrade. Based on bilateral trade at the HS6 level. First five regressions include exporter x HS6 x importer and exporter x year x product fixed effects. Triple-difference regressions also include exporter x year x importer fixed effect. OLB refers to other land borders. Control group is all other countries.

Imports recorded with zero exports recorded: Also a differential drop for CCA3 under sanctions, more so for "misclassification" into dual-use or industrial categories

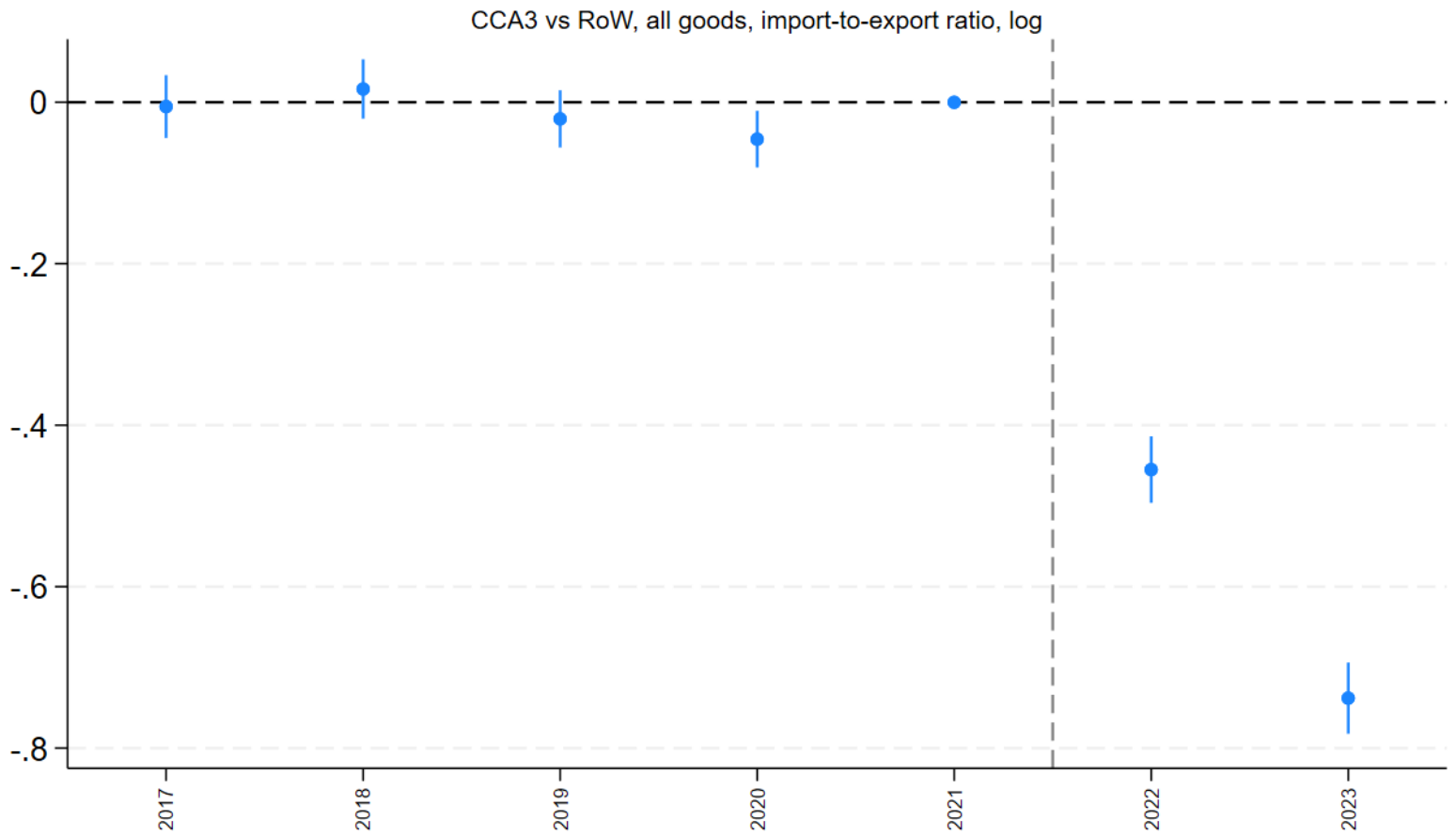
Similar but small effects for other land border economies (an order of magnitude smaller)

Dep. var: zero exports and positive imports reported	All goods	Dual-use	Industrial	Luxury	Not sanctioned	Triple difference
Post-sanctions x CCA3	**-0.0955*** **	**-0.111*** **	**-0.118*** **	**-0.0735*** **	**-0.0903*** **	
	(0.00173)	(0.00331)	(0.00549)	(0.00379)	(0.00241)	
Post-sanctions x OLB	**-0.0207*** **	**-0.0144*** **	**-0.0197*** **	**-0.0291*** **	**-0.0211*** **	
	(0.000879)	(0.00170)	(0.00276)	(0.00198)	(0.00131)	
Post-sanctions x CCA3 x Dual-use						**-0.0131*** **
						(0.00407)
Post-sanctions x OLB x Dual-use						**0.00819*** **
						(0.00212)
Post-sanctions x CCA3 x Industrial						**-0.0253*** **
						(0.00574)
Post-sanctions x OLB x Industrial						0.00248
						(0.00299)
Post-sanctions x CCA3 x Luxury						**0.0248*** **
						(0.00445)
Post-sanctions x OLB x Luxury						**-0.00722*** **
						(0.00241)
Observations	29,432,653	7,097,156	3,685,806	4,541,577	14,108,114	29,432,387
R-squared	0.689	0.672	0.689	0.685	0.698	0.693

Authors' calculations based on UN Comtrade. Based on bilateral trade at the HS6 level. First five regressions include exporter x HS6 x importer and exporter x year x product fixed effects. Triple-difference regressions also include exporter x year x importer fixed effect. OLB refers to other land borders. Control group is all other countries.

Event study: No significant differential pre-trend for import-to-export ratios in EU-CCA3 trade

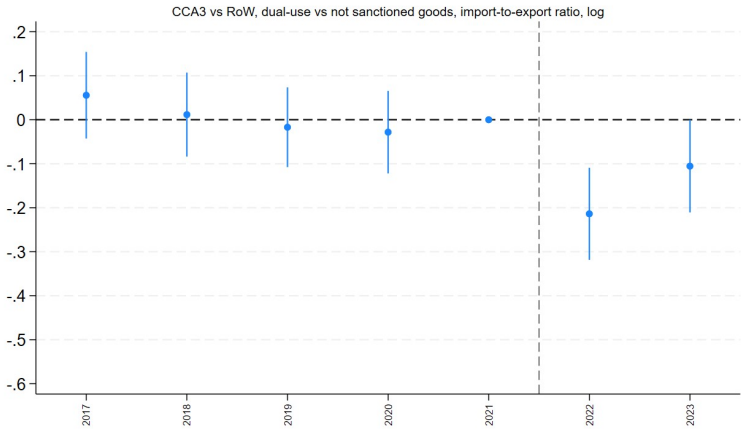
$$\text{Log}(Imp/Exp)_{pect} = \beta \;\; Year_t x \; ImporterType_c + \alpha_{pet} + \alpha_{pec} + \varepsilon_{pect}$$

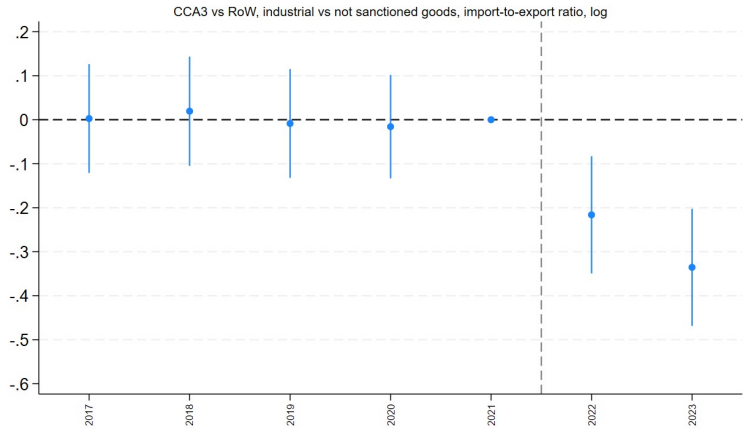


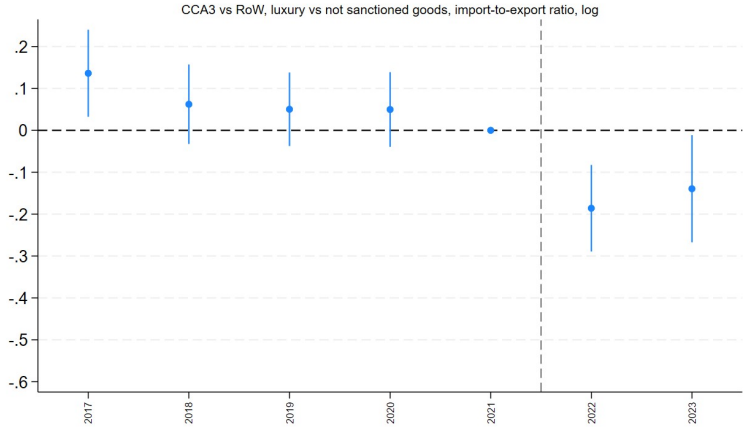
Authors' calculations based on UN Comtrade. Derived from a difference-in-difference regression with exporter x HS6 x importer and exporter x year x product fixed effects. Coefficients on year interacted with CCA3 as importer.

Event study, triple difference: A starker change in pattern for dual-use (vs non-sanctioned) goods in 2023 than for industrial or luxury goods

$$\text{Log}(Imp/Exp)_{pect} = \beta \;\; Year_t x \; ImporterType_c x ProductType_p + \alpha_{pet} + \alpha_{pec} + \alpha_{ect} + \varepsilon_{pect}$$







Authors' calculations based on UN Comtrade. Derived from a triple-difference regression with exporter x HS6 x importer, exporter x year x product and exporter x year x importer fixed effects. Coefficients on year interacted with CCA3 importer and product type as shown.

EEU intermediated trade (including lost-in-transit) replaces < 10% of reduction in direct imports, more important for selected products, 50-60% could be lost-in-transit

"Substitution ratios" > 50% for 450+ product groups, amounts range from small to >US$ 100 mln

Large-engine internal-combustion vehicles (870324): to CCA3 ↑ US$ 274 mln (from ≈nil); to Russia ↓ US$ 606 mln, substitution 45%

For portable computers (847130), substitution ratio > 100%, US$ 84 mln increase to CCA3

Examples of large loss in transit: tractors (870120), vehicles and parts, computers, printers (844331), mobile phones (851712)

Change in export volumes, Mar-Dec 2022-23 relative to the average of Mar-Dec 2017-21, in real US$ billion

	Total					Dual-use		Industrial		Luxury		Not sanctioned	
	Russia	CCA3	Armenia	Kyrgyz R.	Kazakhstan	Russia	CCA3	Russia	CCA3	Russia	CCA3	Russia	CCA3
EU/UK	-65.2	5.3	0.9	1.5	3.0	-28.3	1.6	-11.7	0.8	-13.3	1.7	-11.8	1.2
USA	-5.7	0.4	0.1	0.1	0.2	-2.1	0.1	-0.6	0.1	-0.8	0.1	-2.2	0.1
China	20.4	11.4	0.0	8.1	3.4	4.3	-0.3	4.8	0.7	6.2	8.6	5.0	2.4
Turkiye	4.3	1.4	0.0	0.4	1.0	1.3	0.5	1.0	0.2	0.4	0.6	1.6	0.3
CCA3	4.2					2.2		0.2		1.4		0.4	

Authors' calculations based on UN Comtrade, China customs administration. Based on bilateral trade at the HS6 level.

Banks and sanctions: Goods typically more reliant on letters of credit saw smaller (albeit significant) increases in EU exports to CCA3, similar drops in exports to Russia

Crozet et al (2022): credit intensity is **beneficial** to trade during increased uncertainty; **harmful** during financial turmoil

	Trade, log		0-1		Trade, PPML	
VARIABLES	LC intensive	LC not intensive	LC intensive	LC not intensive	LC intensive	LC not intensive
Goods under sanctions x CCA3	**0.191*** **	**0.439*** **	**0.0136** **	**0.0588*** **	0.0606	**0.248*** **
	(0.0442)	(0.0539)	(0.00564)	(0.00733)	(0.0866)	(0.0806)
Goods under sanctions x Russia	**-0.801*** **	**-1.200*** **	**-0.221*** **	**-0.203*** **	**-0.664*** **	**-0.696*** **
	(0.0592)	(0.0786)	(0.0106)	(0.0128)	(0.0812)	(0.170)
Observations	594,995	492,377	1,055,796	828,660	1,048,613	819,652
R-squared	0.928	0.934	0.774	0.767		

Standard errors are clustered at the HS6 level. *, **, *** denote statistical significance at the 10%, 5% and 1% levels. Index of letter-of-credit intensity (HS4) from "International trade and letters of credit: A double-edged sword in times of crises" (Crozet, Demir and Javorcik, 2022, *IMF Economic Review).*

Unit values of exports to CCA3 / Russia increased more under sanctions compared with pre-sanctions and exports of the same products to other destinations

Diff-in-diff: $\text{Log}(UnitValue)_{pct} = \beta PostSanctions_{pt} * ImporterType_c + \alpha_{pt} + \alpha_{pc} + \varepsilon_{pct}$

Triple diff: $\text{Log}(UnitValue)_{pct} = \beta PostSanctions_{pt} * ImporterType_c * ProductType_p + \alpha_{pt} + \alpha_{pc} + \alpha_{ct} + \varepsilon_{pct}$

Dep. var: log of unit values	Difference-in-difference				Triple difference			
Exporters	EU	China	Turkiye	CCA3	EU	China	Turkiye	CCA3
Post-sanctions x CCA3	**0.0341*** **	-0.00655	**0.108*** **					
	(0.00926)	(0.00850)	(0.0112)					
Post-sanctions x Russia	**0.105*** **	**0.0722*** **	**0.204*** **	**0.700*** **				
	(0.0113)	(0.00766)	(0.0111)	(0.0317)				
Post-sanctions x CCA3 x Dual-use					-0.0206	-0.0370	**0.139*** **	
					(0.0244)	(0.0245)	(0.0325)	
Post-sanctions x Russia x Dual-use					**0.0820** **	**0.107*** **	**0.108*** **	**0.551*** **
					(0.0359)	(0.0213)	(0.0336)	(0.0928)
Post-sanctions x CCA3 x Industrial					-0.0416	0.00882	**0.176*** **	
					(0.0280)	(0.0262)	(0.0346)	
Post-sanctions x Russia x Industrial					**0.267*** **	**0.153*** **	**0.0670** **	0.0942
					(0.0513)	(0.0244)	(0.0315)	(0.105)
Post-sanctions x CCA3 x Luxury					-0.0111	**0.0771*** **	**-0.0969*** **	
					(0.0266)	(0.0204)	(0.0272)	
Post-sanctions x Russia x Luxury					**-0.297*** **	0.0274	**0.0787*** **	**-0.213*** **
					(0.0319)	(0.0197)	(0.0299)	(0.0804)
Observations	1,023,815	775,978	481,130	174,474	1,023,815	775,978	481,125	174,474
R-squared	0.933	0.948	0.941	0.881	0.934	0.948	0.942	0.884

Standard errors are clustered on products. *, **, *** denote statistical significance at the 10%, 5% and 1% levels.

Conclusions

- Evidence suggestive of s**anctioned goods finding their way to the Russian market**
  - **I**n sizeable quantities although not as large as trade diversion to China

- **Intermediated trade** used to evade sanctions; a lot of it = goods get "**lost in transit**" through Russia
  - **Lost-in-transit method is simple, inexpensive – and little-documented in the literature**

- Overall, **the replacement rate is low**, though it may be high in particular products

- In the case of exports sanctions, incentives are not aligned: free rider problem
  - Considering restrictions on transit as part of sanctions – although they may be painful for (landlocked) third countries
  - Need for systems (eg for trade finance) that record routing, unit values

Annex: India, a major neutral trading partner: No significant changes in imports / exports ratios

	India		
VARIABLES	Annual	Monthly	
Post-sanctions x Sanctioned	-0.0111	0.0101	
	(0.0236)	(0.0183)	
Post-sanctions x Unrestricted transit x Sanctioned			0.0101
			(0.0197)
Post-sanctions x Semi-restricted transit x Sanctioned			0.0147
			(0.0277)
Post-sanctions x Restricted transit x Sanctioned			0.00680
			(0.0259)
Observations	157,023	816,001	816,001
R-squared	0.521	0.279	0.279

Authors' calculations based on UN Comtrade. Based on bilateral trade at the HS6 level.