

Coalition Formation in Coercive Trade

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October 17, 2025

Coercive Trade Policy

- Export controls and sanctions are examples of coercive trade policies.
- Coercion is implemented by restricting trade with the target.

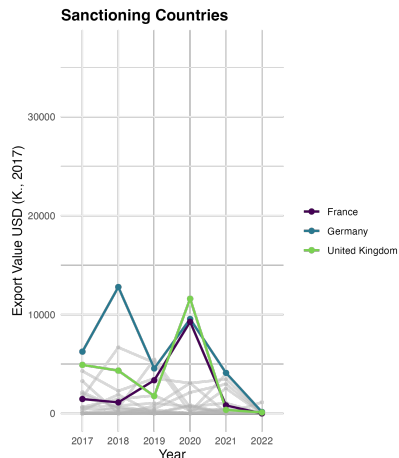
Trade Restrictions

- Trade restrictions cause less trade.

Trade restrictions $\uparrow \longrightarrow$ Trade $\downarrow$

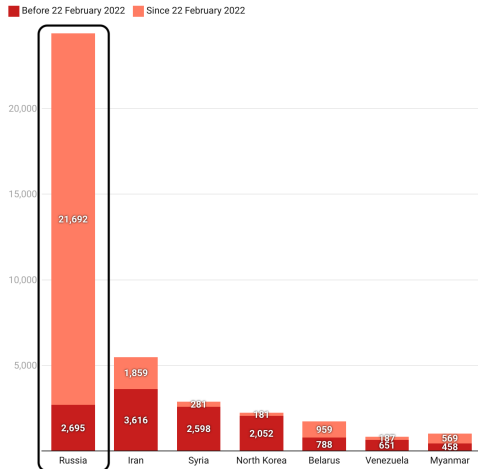
Export Controls $\uparrow \rightarrow$ Trade $\downarrow$

- Common High Priority List



TIER 4.A: Semiconductor Manufacturing Equipment

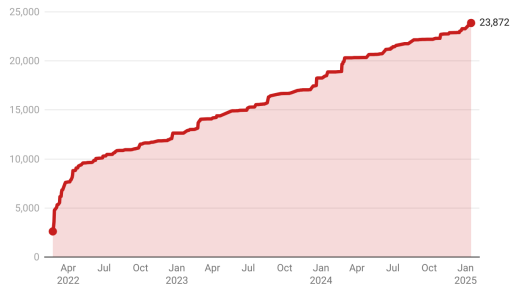
More than 24,000 Sanctions on Russia



Source: Castellum.AI • Created with Datawrapper

Total Sanctions Against Russia

22 February 2022 - 19 January 2025



Includes available Australia, Canada, EU, France, Switzerland, UK, and US sanctions.

Source: Castellum.AI • Created with Datawrapper

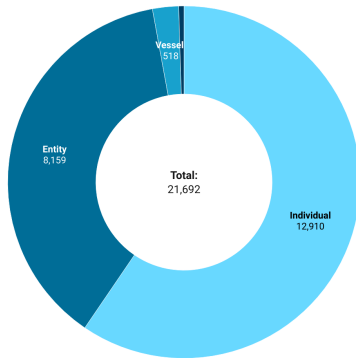
Source: Castellum.AI (2025)

“Love of Variety”

Sanctions Targeting Russia by Type

Since 22 February 2022

Individual (12,910) Entity (8,159) Vessel (518) Aircraft (105)



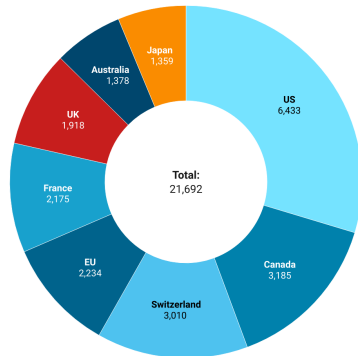
Includes designations from: Australia, Canada, EU, France, Japan, Switzerland, UK, and US.

Source: Castellum.AI • Created with Datawrapper

Who Sanctioned Russia

Since 22 February 2022

US (6,433) Canada (3,185) Switzerland (3,010) EU (2,234) France (2,175)
UK (1,918) Australia (1,378) Japan (1,359)

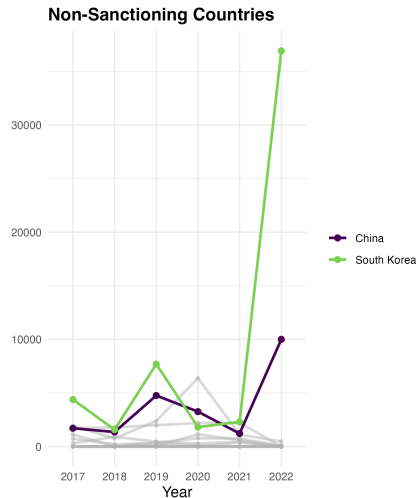
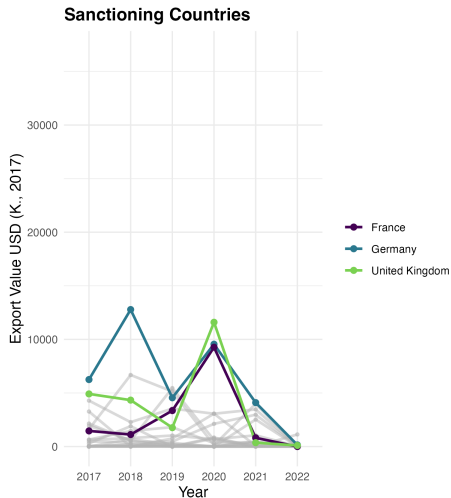


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Strategic Problem

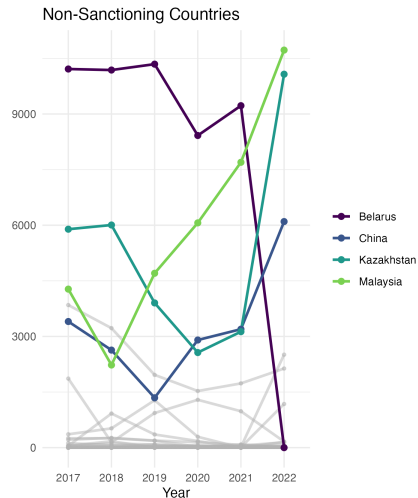
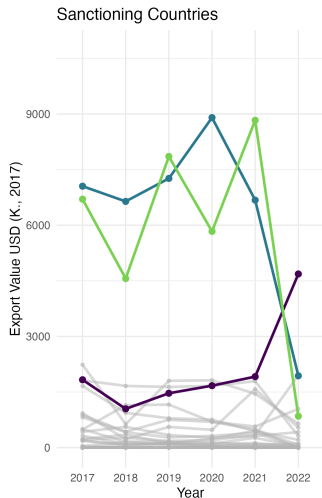
Third-Party Trade ↑



TIER 4.A: Semiconductor Manufacturing Equipment

Strategic Problem

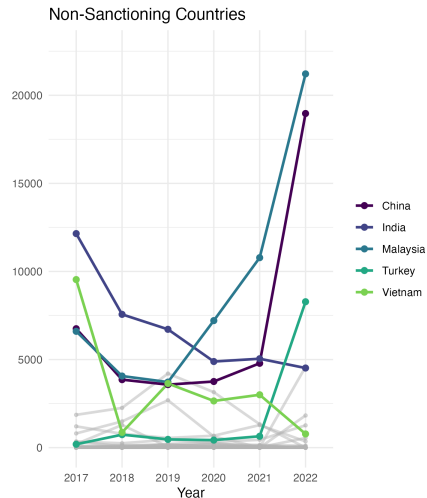
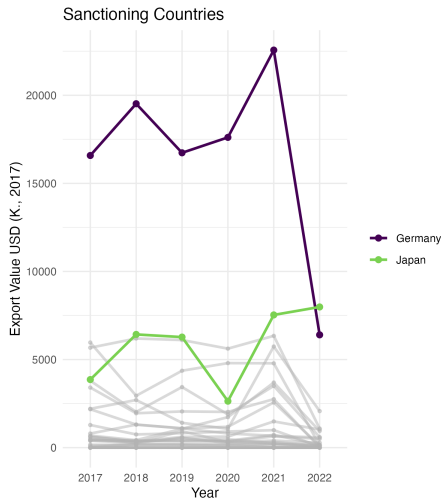
Third-Party Trade ↑



TIER 3.B: Spherical Roller Bearings

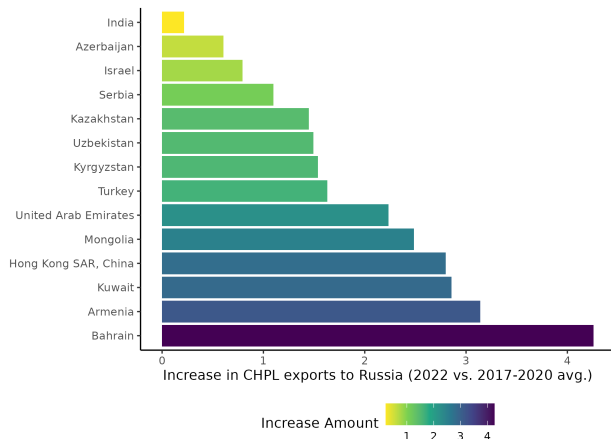
Strategic Problem

Third-Party Trade ↑



TIER 3.B: Tapered Roller Bearings

Strategic Problem



- Bahrain: 70 times
- Armenia: 23 times
- Kuwait: 17 times
- United Arab Emirates: 9 times
- Hong Kong SAR, China: 16 times

Outline

1 Strategic Problem

2 Theory

3 Model

4 Summary

Strategic Problem

- Trade restrictions may shift and increase target-state trade via intermediaries.

Trade restrictions $\uparrow \longrightarrow$ Trade with **substitute countries** $\uparrow$

Research Questions

- Why do some neutral states comply with trade controls while others evade them?
- When and why do trade controls succeed or fail as instruments of coercion?

Theory

- Trade controls create **price disparities** that incentivize intermediaries to arbitrage through circumvention.

Theory

- Intermediaries evade trade controls when arbitrage profits outweigh detection costs.
- Arbitrage rents arise from price disparities generated by trade controls.
- As trade controls tighten, price differentials widen, amplifying incentives to arbitrage.
- Yet when enforcement raises circumvention costs to prohibitive levels, intermediaries are effectively deterred and revert to compliance.

Model

- Cournot quantity competition
- Arbitrage model adapted from the smuggling model in Martin and Panagariya (1984)

Cournot Model

- **Players:** Two coalitions of states
 - *A*: Coercive trade coalition enforcing export controls
 - *B*: Circumvention coalition evading controls
- **Strategy / Actions:** Each coalition simultaneously chooses export quantities of a homogeneous good

$$X_A, X_B \in \mathbb{R}^+$$

- **Payoffs / Profit Functions:** Total revenue minus costs, with asymmetric marginal costs:

$$\pi_A = p(X_A, X_B)X_A - c_A(t)X_A,$$

$$\pi_B = p(X_A, X_B)X_B - c_B X_B,$$

where

$$c_A(t) = c_A(0) + f(t), \quad f(t) > 0, f'(t) > 0.$$

Export control level t is exogenous.

Cournot Model

- **Market / Price Function:** Linear inverse demand in the target state:

$$p(t) = \begin{cases} a - b(X_A + X_B), & t = 0 \\ a' - b'(X_A + X_B), & t > 0 \end{cases}, \quad a' \geq a, \quad b' \leq b$$

WLOG, set $b = b' = 1$.

- **Solution Concept:** Cournot/Nash equilibrium
- **Equilibrium quantities:**

$$(X_A^*(t), X_B^*(t)) = \frac{1}{3} \begin{cases} (a - 2c_A(0) + c_B, a + c_A(0) - 2c_B), & t = 0 \\ (a' - 2c_A(t) + c_B, a' + c_A(t) - 2c_B), & t > 0 \end{cases}$$

Cournot Model

- **Equilibrium prices:**

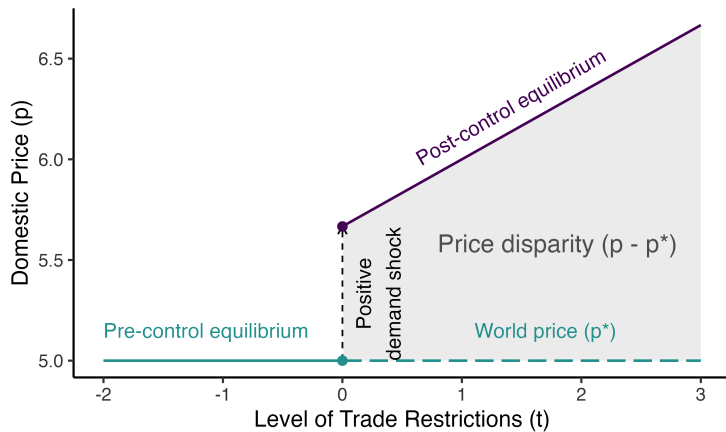
$$p^* = \frac{1}{3}(a + c_A(0) + c_B), \quad t = 0$$

$$p = \frac{1}{3}(a' + c_A(0) + f(t) + c_B), \quad t > 0$$

- **Comparative Statics:**

$$p'(t) > 0, \quad p > p^*, \quad p'(p^*) = 1$$

Price Disparity



Arbitrage Model

● Players

- A representative circumvention state $i \in B$
- Small economy importing restricted good from coalition A and potentially re-exporting to the target state

● Strategy / Actions:

- Re-export quantity M_{1S}
- Circumvention effort β ($0 < \beta \leq 1$)
- Domestic consumption M_{1L} is fixed and exogenous

Arbitrage Model

- **Payoffs / Expected Profit:**

$$\mathbb{E}(\pi_i) = (1 - q) \left(p - \frac{p^*}{\beta} \right) M_{1S},$$

where

$$m = \frac{M_{1S}}{M_{1L}}, \quad q = q(m, \beta), \quad q_m > 0, \quad q_\beta > 0, \quad q_{\beta m} = 0$$

- p, p^* are domestic and world prices set by quantity competition of coalitions A and B (from previous model)
- q is the probability of detection by coalition A
- Marginal profit per unit of successful re-export: $p - \frac{p^*}{\beta}$

Arbitrage Model

- **Solution Concept:** Expected profit maximization
- **First-Order Conditions:**

$$1 - q = q_m m,$$
$$q_\beta \left(p - \frac{p^*}{\beta} \right) = (1 - q) \frac{p^*}{\beta^2}$$

- **Second-Order Conditions:** Ensure strict concavity and unique interior optimum

$$R \equiv 2q_m + mq_{mm} > 0,$$
$$V \equiv q_{\beta\beta} \left(\frac{p}{p^*} \beta^2 - \beta \right) + 2q_\beta + \frac{2(1 - q)}{\beta} > 0$$

Secondary Sanctions

- **Shock / Policy Change:** Stronger enforcement targeted at state i (secondary sanctions), represented as $q \rightarrow q + \alpha$, where α denotes increased probability of detection.
- **Comparative Statics α :**

$$\frac{\hat{\beta}}{d\alpha} = -\frac{R + q_m}{\beta(q_m q_\beta + VR)} < 0,$$
$$\frac{\widehat{M_{1S}}}{d\alpha} = -\frac{V - q_\beta}{m(q_m q_\beta + VR)} < 0,$$

with $R, V > 0$ as defined in the second-order conditions.

- **Intuition:**
 - Increased enforcement raises detection probability, effectively increasing re-routing costs
 - Optimal re-export volume M_{1S} and circumvention effort β decline
 - Circumvention becomes prohibitively costly; circumvention costs outweighs gains from exploiting price gaps

Primary Sanctions

- **Shock / Policy Change:** Tighter primary export controls by coalition A , represented as a trade restriction parameter $t > 0$.
Prices p and p^* are taken as given by the small-economy assumption ($\hat{p}^* = 0$).
- **Comparative Statics t :**

$$\frac{\hat{\beta}}{dt} = \frac{R\beta p'(t)}{p^* \left(q_m - \frac{VR}{q\beta} \right)}, \quad (1)$$

$$\frac{\widehat{M_{1S}}}{dt} = - \frac{\beta^2 p'(t)}{mp^* \left(q_m - \frac{VR}{q\beta} \right)}, \quad (2)$$

where the signs depend on the sensitivity of detection probability q to m and β .

Primary Sanctions

High q_m or q_β (responsive q):

- $\hat{\beta}/dt > 0, \widehat{M_{1S}}/dt < 0$
- Tighter primary sanctions reduce re-export volume; risk of detection dominates arbitrage gains

Low q_m or q_β (unresponsive q):

- $\hat{\beta}/dt < 0, \widehat{M_{1S}}/dt > 0$
- Tighter primary sanctions may perversely increase re-export; low detection risk encourages circumvention

Effectiveness of primary sanctions hinges on **detection sensitivity**

Summary

- Intermediaries evade trade controls when arbitrage profits outweigh detection costs.
- Arbitrage rents arise from price disparities generated by trade controls.
- As trade controls tighten, price differentials widen, amplifying incentives to arbitrage.
- Yet when enforcement raises circumvention costs to prohibitive levels, intermediaries are effectively deterred and revert to compliance.

Thank You

Thank you!

References I

Martin, L. and Panagariya, A. (1984). Smuggling, trade, and price disparity: A crime-theoretic approach. *Journal of International Economics*, 17(3-4):201–217.