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Geoeconomic Shocks and Finland’s Position in Global Value Chains

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Abstract

This paper studies how geoeconomic shocks affect bilateral trade, and what they imply for the position of a small open economy in global value chains. It combines monthly UN Comtrade imports at the 4-digit HS level for 2015–2024 with measures of import and export restrictions from the Global Trade Alert database and the country-level geopolitical risk index of Caldara and Iacoviello (2022). The estimation uses a two-stage structural gravity model: a first stage estimated by Poisson pseudo-maximum likelihood with reporter-partner-product, reporter-product-time and partner-product-time fixed effects, and a second stage relating the recovered multilateral resistance components to geopolitical risk.

Direct policy restrictions carry the larger effect: an additional import restriction is associated with roughly 16 percent lower bilateral trade and an additional export restriction with roughly 3 percent. Geopolitical risk in the partner country is associated with a more moderate reduction, and the association is about forty percent larger on the subsample of structurally vulnerable products, defined by concentrated sourcing, reliance on non-EU suppliers, and limited substitutability. Such products account for a stable 28–30 percent of Finland’s goods imports over the period.

Tiivistelmä

Geoekonomiset sokit ja Suomen asema globaaleissa arvoketjuissa

Tässä tutkimuksessa tarkastellaan, miten geoekonomiset sokit vaikuttavat kahdenväliseen kauppaan ja mitä vaikutuksia niillä on pienen avoimen talouden asemaan globaaleissa arvoketjuissa. Tutkimuksessa yhdistetään kuukausittaisia UN Comtrade -tuontitietoja HS4-tuotetasolla vuosilta 2015–2024 Global Trade Alert -tietokannan tuonti- ja vientirajoituksia kuvaaviin tietoihin sekä Caldaran ja Iacoviellon (2022) maakohtaiseen geopoliittisen riskin indeksiin. Estimoinnissa käytetään kaksivaiheista rakenteellista gravitaatiomallia. Ensimmäinen vaihe estimoidaan Poissonin pseudo-maximum likelihood -menetelmällä (PPML) käyttäen viejä–tuoja–tuote-, tuoja–tuote–aika- ja viejä–tuote–aika-kiinteitä vaikutuksia. Toisessa vaiheessa estimoidut multilateraalisen resistenssin komponentit yhdistetään geopoliittiseen riskiin.

Tulosten mukaan suorilla kauppapoliittisilla rajoituksilla on selvästi suurempi vaikutus kauppaan kuin yleisemmällä geopoliittisella riskillä. Yhden uuden tuontirajoituksen käyttöönotto on yhteydessä noin 16 prosenttia pienempään kahdenväliseen kauppaan ja uuden vientirajoituksen käyttöönotto noin 3 prosenttia pienempään kauppaan. Kauppakumppanin geopoliittisen riskin kasvu on yhteydessä maltillisempaan kaupan vähenemiseen. Yhteys on noin 40 prosenttia voimakkaampi rakenteellisesti haavoittuvien tuotteiden kohdalla. Näille tuotteille ovat ominaisia keskittyneet hankintalähteet, riippuvuus EU:n ulkopuolisista toimittajista ja rajalliset mahdollisuudet korvata tuontia vaihtoehtoisilla lähteillä. Haavoittuvien tuotteiden osuus Suomen tavaratuonnista pysyi vuosina 2015–2024 vakaasti noin 28–30 prosentissa.

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FT **Maria Wang** on Elinkeinoelämän tutkimuslaitoksen vanhempi tutkija.

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Keywords: Geopolitical risk, Gravity model, Trade restrictions, Supply-chain vulnerability, Economic security, Finland

Asiasanat: Geopoliittinen riski, Gravitaatiomalli, Kaupan rajoitukset, Toimitusketjujen haavoittuvuus, Taloudellinen turvallisuus, Suomi

JEL: F13, F14, F51

1 Introduction

For much of the late 20th and early 21st century, global economic integration was guided by a logic of efficiency and interdependence. Firms optimized production networks according to cost advantages, and governments promoted trade liberalization and global value chain (GVC) participation as engines of growth. This period of globalization relied on the implicit assumption that political stability and open markets were enduring features of the international system.

That assumption has eroded. The 2008–2009 financial crisis, the COVID-19 pandemic, Russia's invasion of Ukraine, and escalating U.S.–China technological competition have each demonstrated how economic interdependence can be leveraged for strategic or coercive purposes. The resulting shift toward geoeconomics, where states use economic instruments to achieve geopolitical goals, has altered the foundations of global trade. Supply chains are no longer evaluated solely in terms of cost efficiency, but also through the lenses of resilience, security, and strategic autonomy.

For small, open economies such as Finland, these shifts carry profound implications. Finland's prosperity and technological competitiveness rely heavily on the smooth functioning of international trade and access to critical inputs, from metals and components to advanced technologies and energy materials. As global trade becomes more fragmented, understanding where vulnerabilities lie within Finland's value chains is essential for designing effective industrial and innovation policy. The transition from efficiency-oriented globalization to resilience-oriented geoeconomics requires new analytical tools and forward-looking frameworks.

This paper studies how future crises such as armed conflicts, trade restrictions, or financial tensions could reshape Finland's position in international trade networks, and to identify possible strategies to mitigate adverse effects.

Specifically, the study addresses three interrelated questions. First question is: how do global crises and geopolitical tensions affect international trade flows? The second question goes into more detailed level to study which materials, components, and product types are most vulnerable to disruptions, specifically for Finland. In addition, the paper discusses how trade patterns between politically aligned, opposing, and neutral countries evolve during crises.

Methodologically, the analysis combines a quantitative gravity model of trade with data on geopolitical risk and trade policy interventions to evaluate how external shocks influence bilateral trade patterns. The approach allows distinguishing between general trade declines and crisis-specific effects, and assessing how the impacts differ across product groups (such as critical raw materials, investment goods, and green transition products). The results indicate that direct trade policy restrictions have economically large negative effects on bilateral trade, while broader geopolitical risk in partner countries reduces trade more moderately. These effects are amplified for structurally vulnerable products. The paper further documents, descriptively, a sharp post-2022 reallocation of EU import shares away from Russia and toward Western and (to a smaller extent) China-aligned partners.

The remainder of this paper proceeds as follows. Section 2 outlines the conceptual background, highlighting how the geoeconomic turn challenges traditional views of trade interdependence. Section 3 describes the data, constructs the classification of vulnerable imports, documents Finland's exposure to such products, and introduces the bloc classification used to describe trade reallocation around 2022. Section 4 presents the empirical methodology and identification strategy. Section 5 reports baseline results for the full sample and the vulnerable subsample. Section 6 reports sensitivity checks and a brief descriptive note on bloc-level trade reallocation. Section 7 discusses the implications for policy and future research.

2 Background

Geoeconomic crises refer to sudden or sustained disruptions in international economic relations that originate from geopolitical tensions or strategic policy actions rather than market fundamentals. Such crises can include sanctions, export controls, trade wars, supply-chain blockages, or armed conflicts that impede trade flows.

Empirical research has documented various channels through which these shocks propagate:

- **Direct trade barriers:** Tariffs, sanctions, and embargoes reduce bilateral flows by increasing transaction costs or prohibiting exchange altogether.

- **Indirect uncertainty effects:** Elevated geopolitical risk reduces firms' willingness to invest, insure shipments, or enter new markets.
- **Supply-chain contagion:** Disruptions at upstream stages, such as in energy, semiconductors, or logistics, can cascade across industries and borders.
- **Reconfiguration and relocation:** In response, firms engage in *friend-shoring* or *near-shoring* to minimize exposure to politically sensitive regions.

Geoeconomic fragmentation has emerged as a central concern in international economics, reflecting a broader reconfiguration of cross-border integration across trade, finance, technology, and other channels of interdependence (Aiyar et al., 2023). Within this literature, a key analytical starting point is the measurement of geopolitical risk. Caldara and Iacoviello (2022) define geopolitical risk in terms of the threat, realization, and escalation of adverse events associated with wars, terrorism, and interstate tensions that affect international relations. Using a news-based index, they show that elevated geopolitical risk predicts lower investment, lower employment, and a higher probability of economic disasters.

Recent empirical work shows that geopolitical tensions exert substantial effects on trade. Using the Caldara-Iacoviello index in a gravity framework, Mulabdic and Yotov (2025) find that increases in geopolitical risk reduce trade by roughly 30% to 40%, with effects comparable to a rise in global tariffs of up to 14%. Their results also point to pronounced sectoral heterogeneity: services trade appears most vulnerable, agriculture follows, and the effects on manufacturing are more moderate. Beyond contemporaneous trade losses, the broader quantitative literature suggests that fragmentation may also generate longer-run costs through weaker technology diffusion, slower innovation, and lower growth. Góes and Bekkers (2022), for example, show that the welfare costs of geopolitical conflict become substantially larger once dynamic innovation channels are taken into account, while Cerdeiro et al. (2021) emphasize that technological decoupling can produce sizable output losses through disruptions to trade, productivity, and knowledge spillovers.

Fragmentation is increasingly visible in observed trade patterns. Gopinath et al. (2025) document that, since the onset of the war in Ukraine, trade between geopolitically distant blocs has declined relative to trade within blocs. At the same time, a group of nonaligned "connector" economies has gained importance as an intermediary between rival camps. This suggests that fragmentation should not be understood simply as a collapse of globalization, but rather as a reorganization of trade through new intermediaries and altered supply-chain geography. Relatedly, Hakobyan et al. (2023) show that the burden of such fragmentation is distributed unevenly across countries, with emerging market and developing economies often facing larger losses than advanced economies because of their trade structure and geopolitical exposure.

Financial fragmentation appears to follow a similar logic. Catalán et al. (2024) show that investment funds allocate smaller portfolio shares to countries that are geopolitically more distant from the source country. They also identify an investment-diversion effect, whereby countries may receive additional capital when rival destinations become geopolitically less attractive. More broadly, recent work has argued that geopolitical tensions can reshape not only trade flows but also the cross-border allocation of capital and broader macro-financial conditions (International Monetary Fund, 2023).

For a small open economy such as Finland, these developments are especially consequential because prosperity depends heavily on access to imported intermediate inputs, external technologies, and resilient supply chains. Ali-Yrkkö et al. (2025) show that about one quarter of Finland's intermediate imports can be regarded as vulnerable, while dependence on the Eastern bloc has declined sharply in recent years. At the same time, the transition from fossil fuels toward renewable energy creates new dependencies in critical raw materials and components used in wind turbines, solar panels, and batteries, areas in which China occupies a strong market position.

Methodologically, the gravity model remains one of the main empirical tools for identifying the effects of geoeconomic shocks on bilateral flows. Berthou and Stumpner (2024), for example, apply a structural gravity framework and a two-step empirical strategy to distinguish the direct trade-friction effects of lockdown policies from indirect effects operating through economic activity. The same family of methods has also proved flexible beyond trade narrowly defined. Couttenier et al. (2025), for instance, develop a gravity framework for violence to analyze how spatial frictions and borders shape the spread of armed conflict. Taken together, this literature suggests that geoeconomic fragmentation is best understood not as a single shock, but as a multidimensional restructuring of trade, finance, technology, and security linkages, with heterogeneous consequences across sectors, countries, and policy domains.

3 Data

Several complementary data sources are combined to study how geopolitical risk influences international trade dynamics. The empirical setup parallels Berthou and Stumpner (2024) but extends their framework to a longer pre- and post-pandemic period and replaces lockdown stringency with a measure of geopolitical risk.

The country-level Geopolitical Risk Index (GPRC) developed by Caldara and Iacoviello (2022) is used as the primary explanatory variable capturing the geopolitical environment. The index measures the frequency of newspaper articles covering geopolitical tensions, threats, and wars, and is available monthly for a broad set of countries.

The GPRC index is merged with detailed UN Comtrade data on bilateral imports at the 4-digit HS level.

Additionally, to control time-varying trade policy interventions, indicators of export and import restrictions are constructed from the Global Trade Alert (GTA) database. The GTA provides detailed information on trade-related measures by country, partner, date of implementation, and product coverage.

The export and import restrictions index generation follows the classification used in Berthou and Stumpner (2024), grouping the following measures:

Export restrictions*: export bans, licensing requirements, quotas, subsidies, taxes, and other export-related non-tariff measures.*

Import restrictions*: import bans, incentives, licensing, monitoring, quotas, tariffs, tariff quotas, and other import-related non-tariff measures.*

The final panel covers monthly bilateral trade flows from January 2015 through December 2024, that is 120 months, between the 43 economies for which the country-level GPRC index is available. This restriction is binding: the country-level GPRC index is published only for a limited set of mostly large and middle-income economies, and countries without an index value cannot enter either side of the regression. The same restriction applies to reporters and partners, and it shapes the composition of the geopolitical blocs introduced in Section 3.3.

Table 1: Descriptive statistics

Variable	**Observations**	**Mean**	**Std. Dev.**	**Min**	**Max**	**% zeros**
Export restrictions	73,798,424	0.053	0.329	0	56	95.3
Import restrictions	73,798,424	0.224	0.606	0	45	82.1
Geopolitical risk: partner	73,798,424	0.407	0.659	0	8.801	0.8
Geopolitical risk: reporter	73,798,424	0.339	0.589	0	8.705	1.1

Table 1 shows summary statistics of the variables, reported at the country-pair–product–month level used in the regressions. One thing to note is that the export and import restrictions variables have a large share of zeros in the data. These observations did not have any entries of product-level trade restrictions in the GTA database.

Figure 1 plots the monthly GPRC series for six focus countries, including Finland. Three features stand out. First, the differences in level across countries are large and persistent: the United States averages 2.50 and records the highest readings for most of the sample, fluctuating between roughly 1.5 and 3.5 without any single dominant episode, whereas Finland averages 0.06 and never exceeds 0.55. Because the second-stage regressions absorb country means, it is the within-country movement rather than these level gaps that identifies the coefficients. Second, the invasion of Ukraine dominates the series, and does so in common: all six countries peak in March 2022, the month after the invasion, with Russia at 8.80 and Ukraine at 8.71, the two highest readings anywhere in the panel, the United States at 6.90, and Germany and China at 2.66 and 2.48. Third, the spike is transitory for most countries but not for the two belligerents. Ukraine settles after 2022 in a range of roughly one to two, well above the 0.1 to 0.5 band it occupied between 2016 and 2021, and Russia likewise remains elevated through the end of the sample.

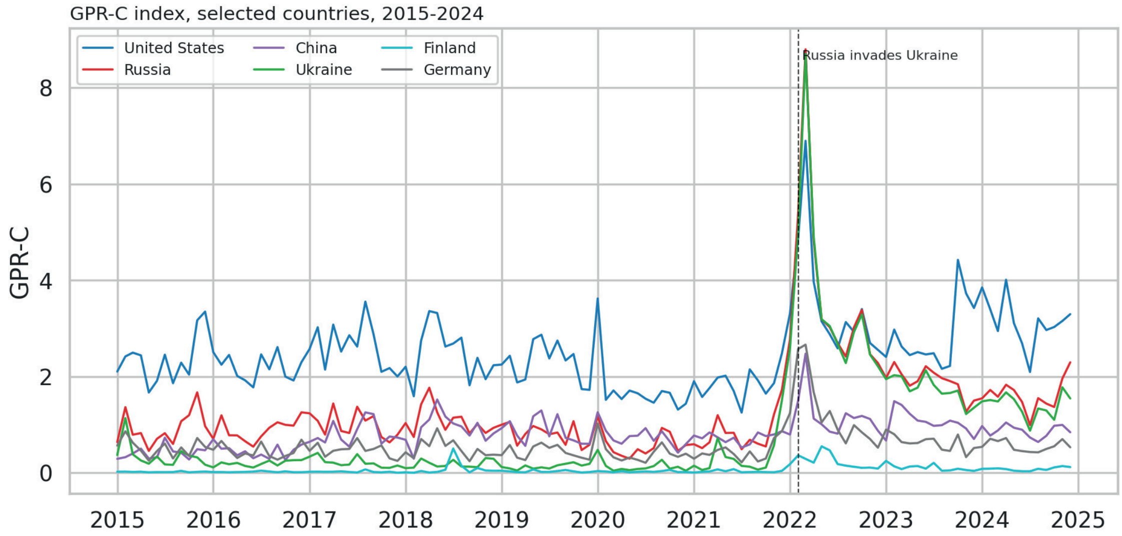

Figure 1: Monthly Caldara–Iacoviello GPRC index

3.1 Vulnerable imports

To capture heterogeneity in exposure to supply disruptions, a subset of products is classified as vulnerable. These correspond to intermediate goods whose supply is structurally exposed to external shocks due to concentrated sourcing, dependence on non-aligned suppliers, and limited substitutability.

The classification follows the methodology developed in recent European policy work (Arjona et al., 2023; Ali-Yrkkö et al., 2025). For each product, three indicators are constructed. First, the concentration of imports across source countries is measured using the Herfindahl–Hirschman Index (HHI), where higher values indicate reliance on a small number of suppliers. Second, the share of imports originating from outside the European Union is computed, capturing exposure to geographically and politically distant partners. Third, substitutability is proxied by comparing imports from non-EU countries to the country's own exports of the same product. A higher ratio suggests that domestic production could, in principle, substitute for disrupted imports, whereas low values indicate limited substitution capacity.

A product is classified as vulnerable if it simultaneously satisfies three conditions: (i) high supplier concentration (HHI above 0.4), (ii) a majority of imports sourced from outside the EU (above 50 percent), and (iii) low substitutability, defined as imports from non-EU countries exceeding domestic export capacity (ratio greater than or equal to one). This approach identifies products that are both exposed to external shocks and difficult to replace in the short run.

In the empirical analysis, this classification is used to examine whether the effects of geopolitical risk are stronger for structurally vulnerable supply chains. Specifically, the second-stage regressions are re-estimated on the subsample of vulnerable products, which allows an assessment of whether crisis-driven trade disruptions are amplified in segments of the economy that are more dependent on concentrated and externally exposed suppliers.

3.2 Finland's vulnerable imports

Applying the classification to Finnish import data shows how the vulnerability concept maps onto a concrete small open economy. The flows that satisfy the three criteria for Finland are aggregated between 2015 and 2024 using UN Comtrade data, and the resulting patterns are documented by product, partner, and over time.

Over this period, the share of Finland's total goods imports that qualifies as vulnerable has been remarkably stable at roughly 28–30 percent, with a temporary increase to 32.6 percent in 2022 driven by the energy price shock (Figure 2). In 2024, vulnerable imports amounted to about 21 billion euros.

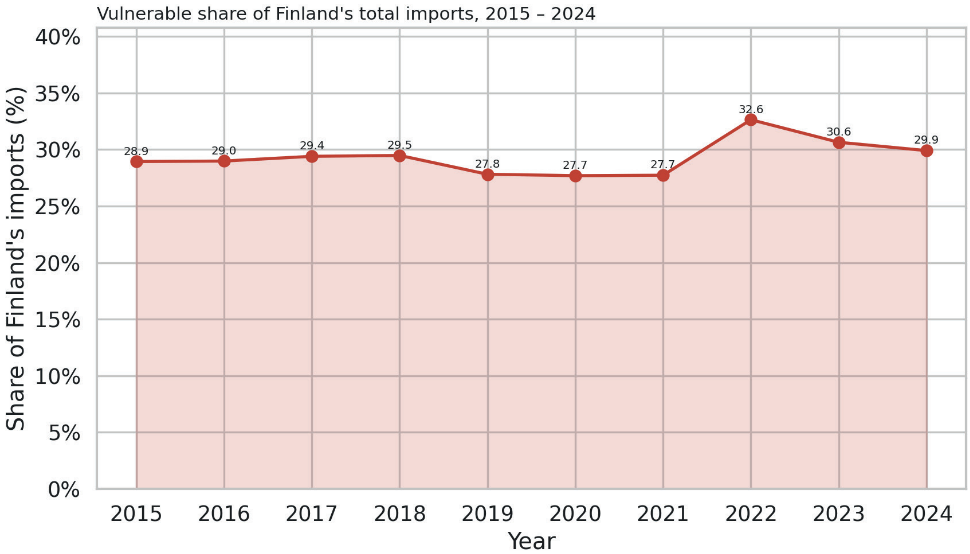

Figure 2: Share of Finland's total goods imports classified as vulnerable, 2015–2024. Source: UN Comtrade, own calculations.

The composition is dominated by a small set of products (Figure 3). Crude petroleum (HS 2709) alone accounted for 5.0 billion euros, or nearly one quarter of all vulnerable imports. The remaining top positions are occupied by computers and data-processing equipment (HS 8471), telephones and communication apparatus (HS 8517), petroleum gases (HS 2711), electric batteries (HS 8507), copper and nickel ores (HS 2603, 2604), nickel mattes (HS 7501), and coal (HS 2701). Broadly, energy products, machinery and electronics, and metals and ores together account for the bulk of the vulnerable trade volume (Figure 4).

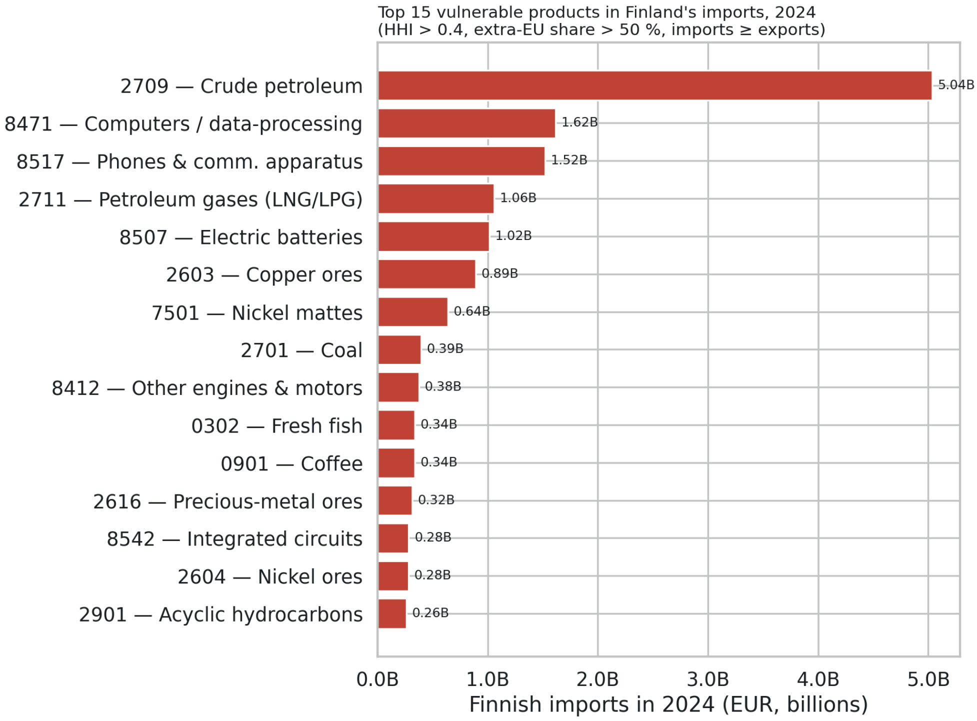

Figure 3: Top 15 vulnerable products in Finland's imports in 2024, by import value. Source: UN Comtrade, own calculations.

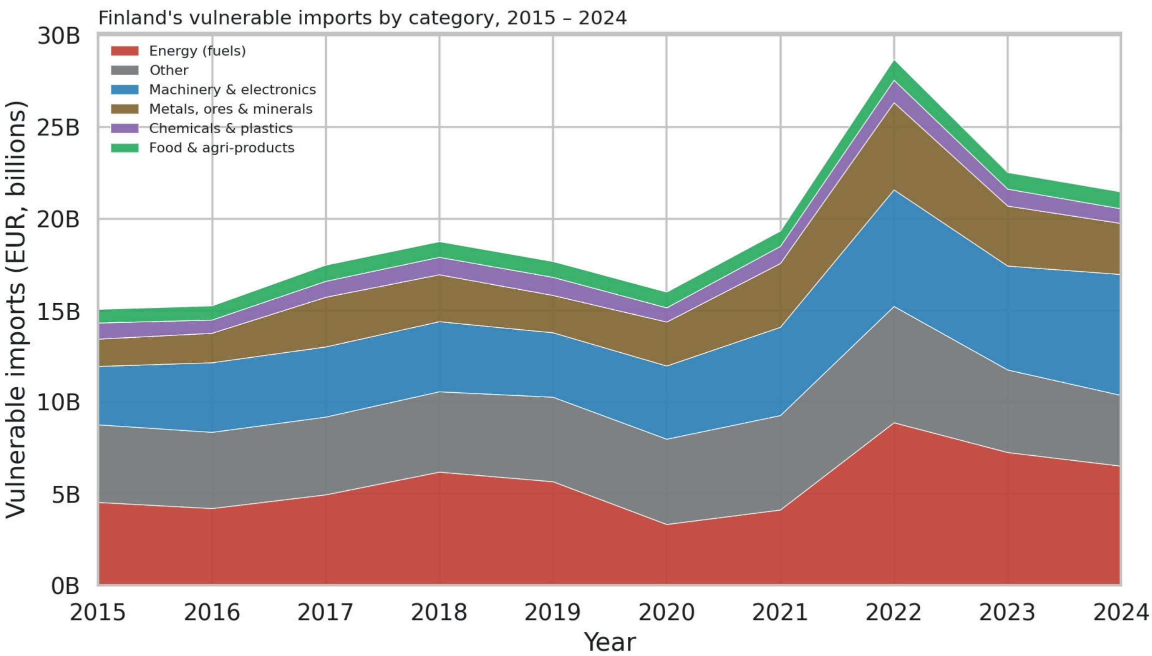

Figure 4: Composition of Finland's vulnerable imports by broad product category, 2015–2024. Source: UN Comtrade, own calculations.

Supplier concentration is pronounced and differs sharply across product groups. Energy-related vulnerable imports are concentrated in a small set of Western suppliers: in 2024 Norway alone provided roughly 80 percent of Finland's crude petroleum imports and more than half of its petroleum-gas imports, with the United Kingdom, the United States, and Guyana making up most of the remainder. Vulnerable imports of electrical and electronic products are, by contrast, heavily concentrated in East Asia. China supplied around 70 percent of telephones and communication apparatus, 90 percent of electric batteries, and over 40 percent of computers and data-processing equipment, with Thailand, Vietnam, and South Korea as secondary sources. Metals and ores are more diversified across non-EU partners such as Canada, Brazil, Peru, and Australia. Figure 5 summarizes these supplier shares within each of the most important vulnerable products.

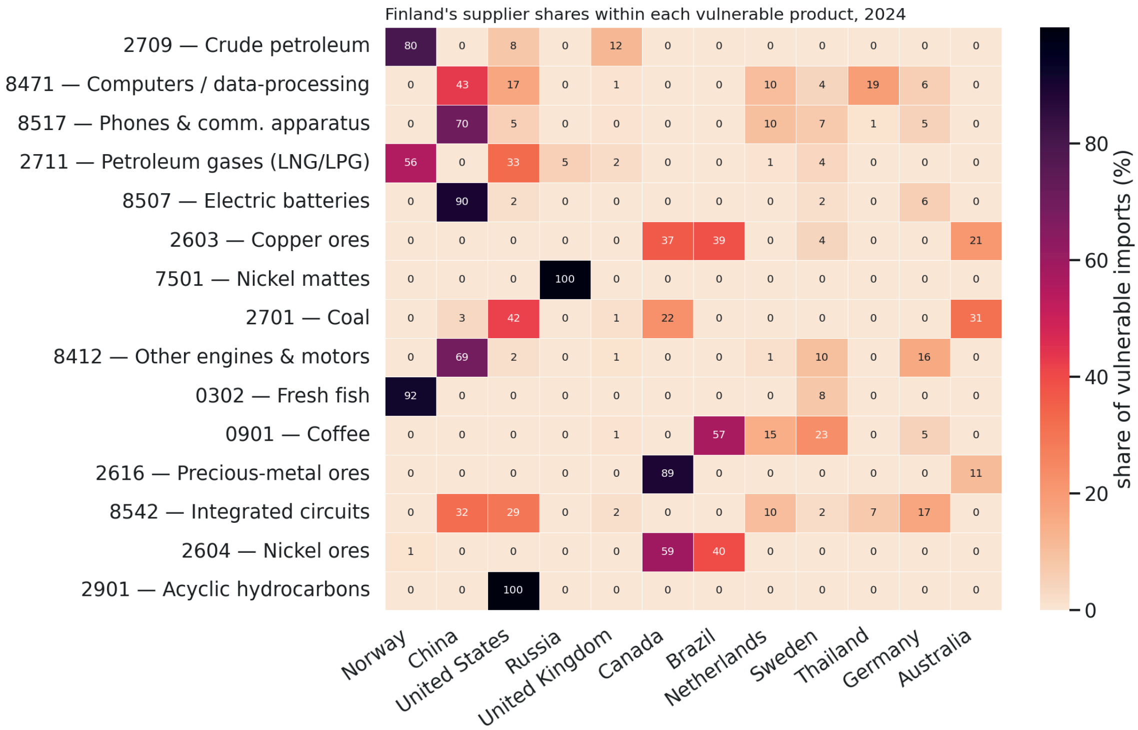

Figure 5: Supplier shares within each of Finland's top vulnerable products in 2024 (rows sum to 100 percent across the displayed partners). Source: UN Comtrade, own calculations.

The historical pattern of vulnerable imports illustrates how geopolitical events have already reshaped Finland's exposure. Russia accounted for between 30 and 37 percent of Finland's vulnerable imports throughout 2015–2019, primarily through crude petroleum, coal, and petroleum gases. Following the full-scale invasion of Ukraine and the associated EU sanctions, Russia's share collapsed to 13.4 percent in 2022, 5.0 percent in 2023, and 3.5 percent in 2024. The reallocation has been absorbed mainly by Norway and the United States, together with smaller volumes from Guyana and the United Kingdom. At the same time, the rapid growth of vulnerable imports linked to the energy transition, batteries, semiconductors, and other electronics, points to a reconfiguration of dependencies rather than a reduction in overall exposure. These patterns mirror the broader literature on *friend-shoring* and bloc reconfiguration discussed in Section 2, and provide the empirical backdrop for analyzing how geopolitical risk affects trade in structurally exposed products.

3.3 Geopolitical blocs

Trading partners differ in their geopolitical alignment. To describe how EU import patterns rearranged around Russia's invasion of Ukraine, each country is classified into one of five mutually exclusive geopolitical blocs based on its voting behaviour at the United Nations General Assembly resolutions concerning the invasion. The classification is taken from earlier work on Finnish import dependence (Ali-Yrkkö et al., 2025) and is held fixed throughout the sample period. Table 2 summarises the composition in the analysis sample.

Table 2: Geopolitical blocs in the analysis sample

Bloc	n	Countries in sample
Western	19	AUS, BEL, CAN, DEU, DNK, ESP, FIN, FRA, GBR, HUN, ISR, ITA, KOR, NLD, NOR, POL, PRT, SWE, USA
China-aligned	4	CHN, IDN, VEN, VNM
Non-aligned	18	ARG, BRA, CHE, CHL, COL, EGY, HKG, IND, JPN, MEX, MYS, PER, PHL, SAU, THA, TUN, TUR, ZAF
Russia	1	RUS
Ukraine	1	UKR
Total	43	

Classification based on UN General Assembly voting patterns on resolutions concerning the Russian invasion of Ukraine. Countries that voted in favour are classified as Western; countries that voted against, abstained with the China–Russia group, or were absent are classified as China-aligned; remaining countries are Non-aligned. Russia and Ukraine are split out from the China-aligned and Western sets respectively to isolate the responses of the two countries directly involved in the conflict. The classification reflects alignment as of 2023 and does not vary over time.

Two features of the composition are worth noting. First, the Western bloc dominates the sample: nineteen of the forty-three countries are Western-aligned, including all the EU members with Comtrade coverage. Second, the China-aligned bloc is sparsely populated, with only four countries (China, Indonesia, Venezuela and Vietnam), even though the underlying classification in Ali-Yrkkö et al. (2025) contains fifty-one China-aligned economies. The discrepancy reflects the GPR-data restriction described in Section 3: most China-aligned economies in the source taxonomy (including Iran, the United Arab Emirates, Belarus, Kazakhstan, Pakistan, Algeria, and a range of smaller economies in Africa, Central Asia, and the Caribbean) do not have a Caldara–Iacoviello GPRC index and therefore drop out of the panel. The Non-aligned bloc is more diverse and includes several economically large countries that took ambiguous positions on the conflict, notably Switzerland, Japan, India, Brazil, Turkey and Saudi Arabia.

The bloc indicator is used only for the descriptive trade-reallocation evidence in Section 6.3; the regressions throughout do not condition on it.

4 Empirical strategy

The empirical analysis utilizes the gravity model of international trade, which has evolved from an empirical regularity into one of the most robust analytical frameworks in economics. Initially inspired by Newton's law of gravitation (Tinbergen, 1962; Pöyhönen, 1963), the model links bilateral trade flows to countries' economic size and the distance between them. Subsequent theoretical work (Anderson, 1979; Bergstrand, 1985, 1989; Anderson and van Wincoop, 2003) provided strong microeconomic foundations, showing that trade depends not only on bilateral costs but also on multilateral resistance relative to all trading partners.

Recent developments have extended the model to account for firm heterogeneity, value-added linkages in global supply chains, and dynamic responses to shocks. Empirical methods such as Poisson Pseudo-Maximum Likelihood (PPML) estimation (Santos Silva and Tenreyro, 2006) have improved robustness, while new data sources and computational tools enable real-time monitoring of trade and resilience.

The object of interest is the effect of the GPRC index on trade. This index is defined at the country and time level, and it is absorbed by the multilateral resistance terms in the gravity equation. As such, the estimation is done in two stages, following Berthou and Stumpner (2024) but applied to the effect of crises and with one departure: where they estimate both stages by OLS, PPML is used in the first stage and OLS in the second.

First, the gravity equation is estimated:

$$Y_{ijst} = exp(XR_{ijst} + \beta_2 MR_{ijst} + \nu_{ijs} + \nu_{ist} + \nu_{jst}) + \varepsilon_{ijst}$$

Where XR and MR are measures of export and import restrictions, as retrieved from the Global Trade Alert database. The fixed effects ν are in reporter-partner-product, reporter-product-time and partner-product-time level. The estimated fixed effects are utilized in the second stage estimations:

$$\widehat{\nu_{ist}} = \alpha_1 GPRC_{it} + \psi_{is} + \psi_{st} + \varepsilon_{ist}$$

$$\widehat{\nu_{jst}} = \alpha_2 GPRC_{jt} + \psi_{js} + \psi_{st} + \varepsilon_{ist}$$

The reason for using PPML in the first stage is that trade flows are highly skewed and heteroskedastic. Estimating the gravity equation in levels with a log link avoids the inconsistencies that may arise from log-linear OLS under heteroskedasticity (Santos Silva and Tenreyro, 2006).

The second stage is estimated by OLS because the dependent variables are estimated fixed effects, not trade flows themselves. In this stage, the objective is to explain variation in the recovered multilateral resistance components using the GPRC index and other controls.

It is worth being explicit about zero trade flows, since PPML is commonly motivated by its ability to accommodate them. The data contain no zero import values: UN Comtrade records only positive reported flows, so reporter-partner-product-month combinations without trade are absent from the data rather than entered as zeros. The usual zero-retention argument for PPML therefore does not apply here, and the estimates should be read as conditional on trade being observed. This also means that the extensive margin lies outside the scope of the analysis. A trade relationship that ceases entirely drops out of the sample instead of appearing as a zero, so the coefficients reported here capture the intensive-margin response of continuing flows and are likely to understate the total effect of geopolitical risk on trade.

Another caveat concerns the risk measure itself. The GPRC index captures the perceived intensity of geopolitical tension rather than a count of events, and may co-move with macroeconomic conditions the second-stage fixed effects do not absorb. One overlap deserves particular note: the keyword list in Caldara and Iacoviello (2022) includes *sanction*, *embargo*, *blockade* and *quarantine*, terms that also describe the GTA interventions entering the first stage. The two entail different granularities and are not formally collinear, but the partner-side estimate may absorb sanctions-driven variation that GTA does not soak up. None of these concerns can be resolved within the present design. Separating the sanctions-related GTA interventions from purely news-driven variation in the index, and extending the analysis to the extensive margin, are left for future work.

5 Results

Table 3 presents the results from the first and second stage estimations. The first stage is estimated by Poisson pseudo-maximum likelihood (PPML) on bilateral trade, and the second stage by OLS on the recovered fixed effects.

In the first stage the dependent variable is the trade flow itself, so the log link gives the usual interpretation: a one-unit increase in a regressor multiplies expected trade by $\exp(\beta)$, that is by $(\exp(\beta) - 1) \times 100$ percent, which is the form reported below.

The second stage requires more care, because its dependent variable is not trade but an estimated fixed effect from the first stage. In the structural gravity framework these terms are composites rather than trade flows: the reporter-product-time effect combines the importer's product-level expenditure with its inward multilateral resistance, and the partner-product-time effect combines the exporter's product-level supply capacity with its outward multilateral resistance. Since the first stage has a log link, these fixed effects are measured in log points, and the second-stage coefficients are therefore semi-elasticities of the composites. Reading them as percentage changes in bilateral trade requires the further assumption that the composite passes proportionally into trade, holding the remaining gravity terms fixed. For this reason the second-stage estimates are described as effects on the recovered multilateral resistance components, and the corresponding trade magnitudes are treated as indicative rather than exact.

The first-stage results indicate that trade policy restrictions have economically meaningful and statistically significant effects on trade. The coefficient on the export restriction index is -0.033, implying that an additional export restriction is associated with a reduction in trade flows of approximately 3.2 percent. The coefficient on the import restriction index is larger, at -0.178, corresponding to an estimated reduction of about 16.3 percent. Both effects are statistically significant at conventional levels. Given that both restriction variables are highly skewed and take the value zero in most observations, these estimates should be interpreted primarily as the effect of moving from no restrictions to the introduction of a restriction. In this sense, direct trade policy restrictions have a sizeable negative association with bilateral trade, especially on the import-restriction side.

Turning to the second-stage results, geopolitical risk is negatively associated with the recovered gravity components on both sides, although the evidence is more moderate than for direct policy restrictions. The coefficient on partner-country geopolitical risk is negative and statistically significant. The estimate of -0.017 implies that a one-unit increase in the partner-country GPRC index lowers the partner-product-time component by about 1.7 log points, which corresponds to a reduction in trade of the same order under the proportionality assumption discussed above. Since the GPRC index typically varies by less than one unit in most observations, the implied effect for a realistic change in geopolitical risk is smaller, but still economically relevant. The coefficient on reporter-country geopolitical risk is also negative and larger in absolute value, at -0.028, but it is estimated far less precisely and clears the 5 percent level only marginally ($p = 0.048$). The partner side is therefore treated as the better-identified of the two margins throughout.

Table 3: Baseline results

	1st stage Import value	2nd stage (1) fe_ist	2nd stage (2) fe_jst
Export restriction index	-0.033*** (0.002)		
Import restriction index	-0.178*** (0.005)		
GPRC reporter		-0.028* (0.014)	
GPRC partner			-0.017** (0.006)
Observations	72,872,353	5,040,477	4,535,965

Standard errors in parentheses, clustered at country pair–time level in the 1st stage and country–time level in the 2nd stage. * p<0.05, ** p<0.01, *** p<0.001.

Table 4 shows the results for the subset of vulnerable imports, as defined in Section 3.1. In this case, the importers only include EU countries, and the products classified as vulnerable, so the number of observations is much lower than in the baseline. The effect of the partner countries' GPRC index is similar as with all imports, although the trade decline is now slightly stronger.

Table 4: Results for vulnerable products

	2nd stage (1) fe_ist	2nd stage (2) fe_jst
GPRC reporter	0.028* (0.014)	
GPRC partner		-0.024*** (0.006)
Observations	340,003	2,083,521

Standard errors in parentheses, clustered at country–time level. * p<0.05, ** p<0.01, *** p<0.001.

In Table 4, the estimated coefficient for reporter's geopolitical risk is positive and statistically significant at the 5 percent level, in contrast to the baseline where it was negative. As the reporters are now only EU countries, which have very low GPRC indices in general and little within-sample variation in them, this sign reversal is not read as evidence that domestic risk raises vulnerable imports; the partner side remains the more informative margin.

Overall, the results suggest that while both policy restrictions and geopolitical risk hinder trade, the direct imposition of trade restrictions has a substantially larger impact. At the same time, elevated geopolitical risk in partner countries contributes to a moderate but economically meaningful reduction in trade flows.

6 Sensitivity

This section probes the baseline along two dimensions: the choice of trade variable (value versus net weight, Section 6.1) and the functional form of the GPRC measure (a continuous index versus a tail-risk indicator, Section 6.2). Section 6.3 closes with a brief descriptive note on how EU import shares rearranged across partner blocs after 2022.

6.1 Net weight of imports

To assess whether the baseline findings depend on the choice of trade variable, the model is re-estimated using the *net weight* of imports (kilograms) rather than the customs value (USD). Trade values reflect both quantities and prices, so price movements driven by inflation, exchange-rate fluctuations, or composition effects could in principle confound the GPRC coefficients. Net weight isolates the physical volume of trade and is therefore a useful complement to the value-based estimates.

The empirical specification is otherwise identical to the baseline. In the first stage, the dependent variable Y_{ijst} is replaced by the net weight of bilateral imports, estimated by PPML with the same set of fixed effects as before. The second stage then regresses the recovered importer-product-time and partner-product-time fixed effects on the GPRC indices. The results are reported in Table 5.

Table 5: Robustness: net weight of imports, all products

	2nd stage (1) fe_ist	2nd stage (2) fe_jst
GPRC reporter	-0.044*** (0.012)	
GPRC partner		-0.019** (0.007)
Observations	4,815,988	4,472,939

Standard errors in parentheses, clustered at country–time level. Stage 1 estimated by PPML on net weight (kg) of imports; stage 2 by OLS on the recovered fixed effects. * p<0.05, ** p<0.01, *** p<0.001.

The pattern of results is consistent with the baseline. Partner-country geopolitical risk is again negatively and significantly associated with trade, with a coefficient of -0.019, close to the -0.017 obtained for trade values. The coefficient on reporter-country geopolitical risk is likewise negative and statistically significant (-0.044), and is both larger in absolute value and more precisely estimated than the -0.028 of the value specification. This suggests that periods of elevated domestic geopolitical risk are associated with reductions in physical import volumes even where value effects are more muted, consistent with quantity adjustments occurring alongside or ahead of fully observed price responses.

The exercise is repeated on the subsample of vulnerable products. The results are reported in Table 6.

In the vulnerable subsample, the partner-country coefficient remains negative at -0.017 and statistically significant at the 5 percent level ($p = 0.03$), though it is smaller in absolute value than the -0.024 obtained in the value-based specification and less precisely estimated. The reporter-side coefficient is small, positive, and not statistically different from zero. Precision is the binding constraint here: the vulnerable-products subset is small (roughly 336,000 reporter-side and 2.1 million partner-side cells), so the volume-based vulnerable estimates are read as corroborating the value-based result rather than establishing it independently. The central finding that elevated partner-country geopolitical risk reduces bilateral trade flows is supported in the full sample for both values and volumes, and in the vulnerable subset for both as well, although the vulnerable-weight estimate is the weakest of the four.

Table 6: Robustness: net weight of imports, vulnerable products

	2nd stage (1) fe_ist	2nd stage (2) fe_jst
GPRC reporter	0.003 (0.015)	
GPRC partner		-0.017* (0.008)
Observations	335,723	2,072,050

Standard errors in parentheses, clustered at country–time level. * p<0.05, ** p<0.01, *** p<0.001.

6.2 Tail-risk indicator

A second concern is functional form: the baseline specification imposes a linear relationship between the GPRC index and the recovered trade component, which would understate the effect if the relevant variation is concentrated in extreme-risk episodes. The model is re-estimated replacing the continuous GPRC index with a country-specific top-5 percent indicator, equal to one when GPRC is at or above the 95th percentile of its own country distribution. This isolates whether the trade response is driven by crisis-like tail events rather than ambient variation. Table 7 reports the results.

Table 7: Robustness: top-5 percent GPRC indicator (full sample)

	2nd stage (1) fe_ist	2nd stage (2) fe_jst
high GPRC reporter	0.004 (0.008)	
high GPRC partner		-0.010 (0.008)
Observations	5,040,477	4,535,965

Standard errors in parentheses, clustered at country–time level. * p<0.05, ** p<0.01, *** p<0.001.

Both coefficients are small and statistically indistinguishable from zero. This contrasts with the baseline estimates on the continuous index (-0.017 for partner GPRC, significant at 1 percent) and indicates that the trade response is not concentrated in the right tail of the GPRC distribution. Instead, the effect appears to be a broad-based response to graduated changes in geopolitical risk, which the binary tail indicator cannot pick up. This is reassuring: the baseline result is not an artefact of a handful of extreme months amplified by a linear functional form.

Repeating the exercise on net weight gives a slightly different picture, reported in Table 8. The partner-side tail indicator is negative at -0.016 and significant at the 5 percent level ($p = 0.047$), while the reporter-side coefficient remains small and insignificant. Physical import volumes therefore do show some response to tail episodes even though values do not, which is consistent with the value-versus-volume pattern in Section 6.1. The tail estimate is nonetheless smaller in absolute value than the -0.019 obtained on the continuous index for the same outcome, so even here the graduated variation carries more of the association than the extreme months do.

6.3 Trade reallocation across blocs around 2022

As a descriptive postscript to the sensitivity analysis, this section documents how EU import shares across partner blocs rearranged around Russia's invasion of Ukraine, using the bloc classification introduced in Section 3.3.

Figure 6 plots, for each of the twelve EU member states in the reporter sample, the share of total imports going to each partner bloc, separately for the pre-invasion window 2015m1–2022m1 and the post-invasion window 2022m2–2024m12. The right panel reports the percentage-point change between the two windows. Russia's share falls to close to zero for every EU reporter, dropping by up to ten percentage points for the most exposed importers. The lost share is absorbed primarily by the Western bloc and, to a smaller extent, by the China-aligned

Table 8: Robustness: top-5 percent GPRC indicator, net weight of imports

	2nd stage (1) fe_ist	2nd stage (2) fe_jst
high GPRC reporter	0.006	
	(0.011)	
high GPRC partner		-0.016*
		(0.008)
Observations	4,815,988	4,472,939

Standard errors in parentheses, clustered at country–time level. Stage 1 estimated by PPML on net weight (kg) of imports; stage 2 by OLS on the recovered fixed effects. * p<0.05, ** p<0.01, *** p<0.001.

bloc. The non-aligned share moves only modestly. The figure is descriptive, in that it makes no attempt to separate price effects, product mix, or composition, but it shows that the bloc dimension is informative about how EU import patterns rearranged around the invasion.

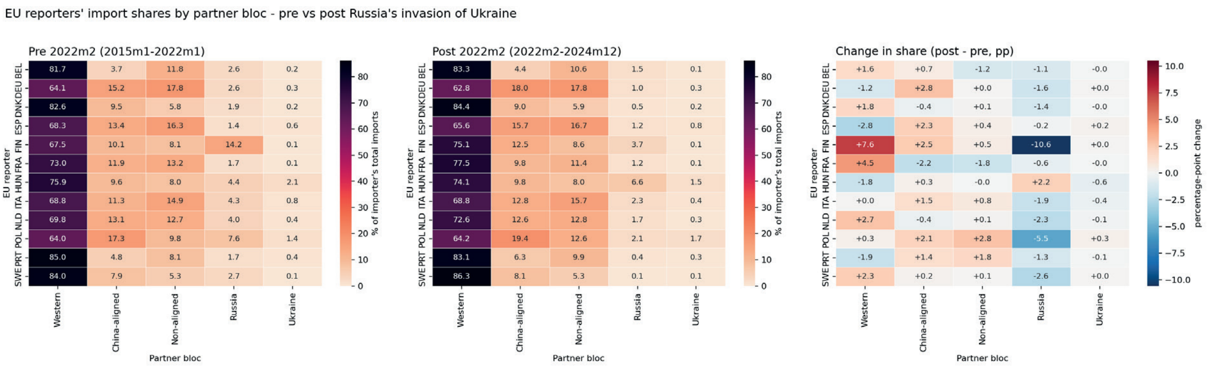

Figure 6: Import shares of EU reporters by partner bloc, pre vs post Russia's invasion of Ukraine. Left and middle panels show each EU reporter's bloc shares, expressed as a percentage of the reporter's total imports across the five displayed blocs, separately for 2015m1–2022m1 and 2022m2–2024m12; rows sum to 100 percent in each panel. The right panel reports the percentage-point change between the two windows. EU reporters cover the twelve EU member states that appear as reporters in the analysis sample.

7 Discussion and conclusions

This paper examined how geoeconomic shocks shape international trade flows, with a particular focus on the position of small open economies such as Finland in global value chains. Using the geopolitical risk measure of Caldara and Iacoviello (2022), a two-stage gravity model was estimated in which direct policy restrictions enter the first stage as country-pair-product-time variation, while broader geopolitical risk operates through the recovered reporter-product-time and partner-product-time fixed effects in the second stage.

Four findings stand out. First, direct trade policy restrictions carry the largest effects. An additional import restriction is associated with a fall in bilateral trade of roughly 16 percent and an additional export restriction with roughly 3 percent, an asymmetry consistent with import-targeted measures binding more directly on observed flows.

Second, broader geopolitical risk also weighs on trade, but far more moderately and asymmetrically. Risk in the partner country is negatively and robustly associated with trade, whereas risk in the importing country is estimated much less precisely, so the partner side is the better identified of the two margins.

Third, the response is stronger for *vulnerable* products, defined by high supplier concentration, heavy reliance on non-EU sources, and limited substitutability. The partner-side association is roughly forty percent larger on this subsample, consistent with structural exposure to concentrated and distant suppliers amplifying the effect precisely where short-run substitution is hardest. Such products matter for Finland: they account for 28 to 30 percent of goods imports throughout the period, with energy concentrated in a narrow set of Western suppliers and electronics heavily reliant on East Asia, particularly China.

Fourth, EU import shares rearranged sharply around Russia's invasion of Ukraine. Russia's share collapses for every EU reporter and is absorbed primarily by Western and, to a smaller extent, China-aligned partners. This underscores that the partner-side estimate is an average across structurally different partner groups.

The robustness checks reinforce the pattern. Measuring trade by net weight rather than by value leaves the partner-side result intact in both the full sample and the vulnerable subsample, so the effect reflects an adjustment in physical volumes rather than a valuation artefact. Replacing the continuous index with a tail indicator weakens it, indicating that the association is carried by graduated variation in risk rather than by a handful of extreme months.

Taken together, the results have several implications. The asymmetry between restriction effects and the more moderate role of geopolitical risk suggests that explicit policy measures, rather than ambient tension alone, are the proximate driver of large trade contractions. For small open economies, the stronger response on vulnerable products implies that resilience policy should be targeted. Policy that treats all imports alike will spend effort where adjustment is already easy; diversifying suppliers, building strategic stocks, or supporting domestic capacity is most valuable in those categories where supplier concentration and limited substitutability already constrain adjustment. For Finland, this reinforces the case for monitoring concentration and EU-external sourcing in critical raw materials, components for the green and digital transitions, and other strategic inputs.

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