Beyond security: The trade implications of joining NATO

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Abstract

Russia's full-scale invasion of Ukraine in February 2022 raised a critical question: do military alliances strengthen or fracture trade ties when war breaks out? This paper shows they strengthen them. Using monthly bilateral trade data through August 2025, we find that NATO members traded approximately 9–15% more with one another after the invasion relative to non-NATO pairs – a premium that persisted and grew through 2025. These effects are not limited to the war period: applying a disaggregated structural gravity framework over 1948–2022, we estimate that NATO accession generates 12–27% increases in bilateral exports, concentrated in dual-use, differentiated, and intermediate goods consistent with defence-industrial supply-chain. Moreover, there is synergy between security and economic cooperation as the effect of NATO is strenghened by the EU membership.

Keywords: trade, geopolitics, NATO, security
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Non-technical summary

Focus

NATO is usually understood as a military alliance, not as an economic institution. Yet the North Atlantic Treaty also commits members to reduce conflict in their international economic policies and to encourage economic collaboration. This paper asks whether NATO membership strengthens trade between member countries, and whether this effect becomes more important during periods of geopolitical conflict.

Contribution

The paper makes three main contributions. First, it provides new causal evidence on the economic effects of security alliances. It shows that NATO membership has sizeable trade effects even after controlling for EU membership, preferential trade agreements, defence alliances, country-specific shocks and bilateral fixed factors.

Second, the paper connects long-run institutional change with recent geopolitical shocks. This allows the paper to examine both the long-run effects of NATO accession and the short-run resilience of trade among NATO members during wartime.

Third, the paper goes beyond aggregate trade flows by studying product-level mechanisms. Using disaggregated HS6 trade data, it identifies where the NATO trade premium is strongest and whether the effects are concentrated in dual-use, differentiated and intermediate goods.

Findings

The paper finds that NATO membership significantly increases trade between member countries. Across long-run specifications, NATO accession raises bilateral exports by approximately 12–27%. These effects are robust across alternative samples, control groups, dynamic specifications and falsification tests.

The results also show that NATO membership mattered during the Russia–Ukraine war. After Russia's full-scale invasion in 2022, trade between NATO members increased by around 9–15% relative to comparable non-NATO pairs, and this premium persisted and grew through 2025.

The paper further finds that NATO and EU membership are complementary over the long run. The NATO–EU interaction is positive in long-horizon specifications, indicating that security cooperation and deep economic integration reinforce each other.

Finally, the effects are not evenly distributed across products. The NATO trade premium is concentrated in dual-use, differentiated and intermediate goods, including technology-intensive categories such as electronics, computers, sensors, lasers, aerospace and propulsion.

> *They will seek to eliminate conflict in their international economic policies and will encourage economic collaboration between any or all of them.*
>
> Article 2, North Atlantic Treaty (1949)

1 Introduction

NATO is a military alliance with no formal economic mandate. Yet, since its formation in 1949, estimates suggest that membership has increased bilateral trade by 12–23% (Li et al., 2024; Jackson and Shepotylo, 2024). These effects exceed those of many preferential trade agreements and approach the estimated gains from EU membership. Much less is known, however, about whether NATO continues to shape trade during periods of war. When Russia launched its full-scale invasion of Ukraine in February 2022, it raises an immediate question: does NATO membership continue to promote commerce when military conflict erupts on the alliance's eastern flank? The evidence presented in this paper suggests the answer is yes. Between 2022 and 2025, trade between NATO members grew significantly faster than trade between non-NATO pairs, even controlling for EU integration and global time trends. This paper documents the increased trade and investigates why.

While a large literature documents the trade effects of formal economic institutions, such as the WTO, the EU, and preferential trade agreements, the economic consequences of security alliances remain comparatively underexplored. This gap is notable in light of the North Atlantic Treaty's explicit emphasis on economic cooperation alongside collective defence, suggesting that economic integration was embedded in the alliance's original design. Yet contemporary policy debates focus largely on defence spending and burden-sharing, leaving the broader economic dimension of NATO relatively neglected. Despite having structured the postwar international order for more than seven decades, systematic evidence on whether NATO membership causally increases trade between member states remains surprisingly limited. In principle, security alliances may affect trade through multiple channels: by reducing political risk, strengthening policy coordination and credibility, facilitating information sharing, and promoting interoperability and standardisation that spills over into civilian and dual-use production.

The existing empirical evidence on alliances and trade is mixed. A substantial strand of research finds that military alliances and broader political–diplomatic alignment increase trade, reduce volatility, and reinforce the effects of trade agreements or defence pacts, with outcomes shaped by institutional quality and sectoral characteristics (Gowa and Mansfield, 2004; Long and Leeds, 2006; Mansfield and Bronson, 1997). In contrast, other studies report small or statistically insignificant alliance effects, highlight the possibility of reverse causality from trade to alliances, and reach mixed conclusions regarding the trade–conflict nexus (Mityakov et al., 2013; Fordham, 2010). Much of this divergence reflects differences in identification strategies and data aggregation. Focusing specifically on NATO enlargement, several fundamental questions remain unresolved. In particular, there is limited causal evidence on whether NATO accession increases trade once multilateral resistance and staggered enlargement dynamics are properly accounted for, little understanding of how such effects interact with economic integration through the EU, and scarce evidence on the sectoral and value-chain channels through which alliance-driven trade operates. Moreover, it remains unclear whether any trade effects are robust to major geopolitical shocks.

This paper addresses these gaps by examining four related questions. First, does NATO accession causally increase bilateral trade between member states when accounting for multilateral resistance and heterogeneous treatment timing across successive waves of enlargement? Second, does NATO membership interact with EU integration in a complementary manner, such that security and economic institutions reinforce one another? Third, through which product categories and value-chain positions do any trade effects operate, particularly in differentiated, intermediate, and dual-use goods that reflect deeper production linkages and shared standards? Fourth, do any trade-enhancing effects persist, and potentially intensify, during periods of heightened geopolitical tension, such as the Russian invasion of Ukraine in 2022–2025?

A small but growing empirical literature has begun to examine these issues. Li et al. (2024) find positive effects of NATO accession on aggregate trade flows, including some evidence of sectoral heterogeneity. Jackson and Shepotylo (2024) analyse the trade and welfare implications of alternative alliance configurations using aggregate data. While these studies provide important initial evidence, they focus primarily on aggregate outcomes and do not jointly address multilateral resistance, staggered treatment effects, sectoral transmission mechanisms, and the role of geopolitical shocks.

To address our questions, we combine a structural gravity framework (Yotov et al., 2016; Head and Mayer, 2014) with modern causal inference methods tailored to staggered policy adoption. Our identification strategy exploits the recent geopolitical shock of Russian invasion in Ukraine in 2022 while controlling for multilateral resistance and time-varying country-level shocks within a high-dimensional fixed-effects setting and analyse post-accession dynamics for recent entrants (North Macedonia, Finland, and Sweden) using high-frequency trade data from January 2017 to December 2025. We also exploit long run successive waves of NATO enlargement to implement staggered difference-in-differences estimators following Callaway and Sant'Anna (2021) to recover group-time average treatment effects and dynamic adjustment paths, allowing us to assess pre-trends and heterogeneous treatment timing across accession waves.

We then extend the analysis beyond aggregate trade flows by estimating NATO effects at the HS6 product level for over 5,500 goods. This disaggregated structural gravity approach allows us to identify sectoral transmission channels and value-chain mechanisms. In particular, we examine differentiated, dual-use, and intermediate goods - categories most plausibly linked to defence-industrial interoperability and cross-border production networks. By leveraging product-level variation, we mitigate aggregation bias (Breinlich et al., 2024) and account for heterogeneous treatment effects associated with deep integration agreements (Baier et al., 2019).

Our results can be summarised as follows. First, during the period of Russian war on Ukraine, NATO members increased their bilateral trade by 11%, largly through 5% increase in trade of the dual use goods. Second, the NATO membership increases bilateral trade between member countries, with estimates of the long-run effect in the range of 12%–27% across specifications, samples, and time periods. Third, NATO and EU membership are complementary in the long run: the NATO–EU interaction is positive and statistically significant in long-horizon specifications, increasing exports by 7%, which is consistent with synergy between security cooperation and deep economic integration. During the Russian war on Ukraine, however, the EU members of NATO actually reduced the dual used trade within the EU, likely to accomodate increased demand on the same dual use goods in Ukraine. Fourth, We estimate NATO effects for each of 5,800+ HS6 product codes. The effects are concentrated in differentiated and dual-use goods and are stronger for intermediate products, pointing to supply-chain and standards-based mechanisms rather than purely demand-driven shifts in final goods. Li and Vashchilko (2010) also examine product heterogeneity, but our second-stage approach is more systematic and reveals that the NATO premium is highest in electronics, sensors, computers, and aerospace propulsion (0.31–0.53 log points) — precisely the categories most relevant to defence-industrial interoperability. Fifth, we have not found the positive effects of NATO for new members during 2022-2025, consistent with gradual adjustment and integration results as the staggered difference in differences analysis demonstrate.

The remainder of the paper is organised as follows. Section 2 develops the conceptual framework and a structural gravity estimation methodology. Section 3 describes the data and empirical approach. Section 4 presents structural gravity results over the long horizon. Section 5 extend the results to the most recent events triggered by the Russian full-scale invation of Ukraine. Section 6 reports staggered difference-in-difference estimates and dynamic event-study evidence. Section 7 explores product-level heterogeneity and mechanism tests using disaggregated trade data. Section 8 concludes.

2 Theoretical Framework and Methodology

This section develops the empirical framework used to identify the causal impact of NATO membership on bilateral trade. Our approach integrates structural gravity estimation with modern difference-in-differences techniques to capture both the general-equilibrium structure of trade and the staggered timing of NATO accessions. We model NATO membership as a reduction in bilateral trade costs associated with enhanced security cooperation, institutional trust, and policy coordination within the alliance. The analysis is conducted at both aggregate and disaggregated levels. We estimate the model using annual data over 1948–2022 and high-frequency monthly data from January 2017 to August 2025 to examine recent accessions and the war-period dynamics. To address potential aggregation bias (Breinlich et al., 2024) and to uncover sectoral transmission channels, we further estimate the model at the product (HS6) level. This disaggregated framework allows us to compare micro-level structural effects with aggregate estimates and to explore mechanisms, including the role of military cooperation through trade in dual-use goods.

2.1 Structural Gravity Model

The empirical analysis of trade agreements using gravity equations has evolved substantially since Tinbergen's seminal contribution in 1962, which identified only modest effects of preferential arrangements (Tinbergen, 1962). Anderson's theoretical foundation in 1979 formalised trade flows within a general equilibrium framework incorporating transport costs and trade barriers (Anderson, 1979). A central breakthrough came with the introduction of multilateral resistance terms by Anderson and Van Wincoop (2003), who showed that bilateral trade depends not only on bilateral trade costs but also on countries' relative trade barriers with all partners. These multilateral resistance terms capture general-equilibrium adjustments and are essential for consistent estimation of policy effects. Ignoring them leads to biased inference regarding the impact of trade agreements or other policy interventions. The resulting structural gravity model provides a theoretically grounded framework for evaluating how institutional changes alter trade costs and reshape trade flows.

Methodological advances have further refined the empirical implementation of gravity models. Silva and Tenreyro (2006) demonstrated the advantages of Poisson Pseudo Maximum Likelihood (PPML) estimation in the presence of heteroskedasticity and zero trade flows. Baier and Bergstrand (2007, 2009) pioneered the systematic use of panel techniques to address endogeneity in the estimation of free trade agreement (FTA) effects, showing that properly specified panel gravity models yield economically significant average treatment effects. More recently, the literature has emphasised the heterogeneous and dynamic nature of trade agreement impacts. Baier et al. (2019) develop a two-stage approach demonstrating that most heterogeneity in FTA effects arises within agreements rather than across them.

The universal, structural gravity equation, which is shared across different industries and market structures, is given by

$$Y_{ij,t} = \frac{E_{i,t} M_{j,t}}{\Phi_{i,t} \Pi_{j,t}} \times \exp\left(-\theta \ln \tau_{ij,t}\right), \tag{1}$$

where $Y_{ij,t}$ denotes nominal trade flows from exporter i to importer j at time t. $E_{i,t}$ and $M_{j,t}$ represent the total expenditures of exporter i and importer j at time t. $\Phi_{i,t}$ and $\Pi_{j,t}$ are the outward and inward multilateral resistance terms, respectively. $\tau_{ij,t}$ captures bilateral trade costs between countries i and j at time t. θ is the trade elasticity with respect to trade costs.

2.2 NATO, Trade Agreements and Bilateral Trade Costs

Bilateral trade costs, among other things, depend on membership in super-national economic and political alliances, such as customs unions, common economic areas, and military alliances. We model NATO as affecting bilateral trade costs (broadly defined to include policy coordination and risk), while acknowledging additional demand/procurement channels; product-level evidence helps distinguish mechanisms. $NATO_{ij,t}$, which is an indicator variable capturing the joint membership of countries i and j in NATO at time t. We control for economic bilateral relationships by including preferential trade agreements (PTA), $PTA_{ij,t}$, which is an indicator variable capturing the presence of a PTA between countries i and j at time t. We also control for generic defence alliances. Finally, we control for EU membership, as there is significant overlap between membership in the EU and NATO. Following the structural gravity literature, we also have exporter-time and importer-time fixed effects $\pi_{i,t}$ and $\chi_{j,t}$, respectively, to account for time-varying factors specific to each exporter and importer. Pair-fixed effects are denoted by τ_{ij} to control for time-invariant bilateral factors. Moreover, $\varepsilon_{ij,t}$ is an idiosyncratic error term; standard errors are clustered at the country-pair.

Our baseline unit is exporter–importer–year (and exporter–importer–month for high-frequency analysis); in disaggregated models it is exporter–importer–product–time. The full specification is given as:

$$\begin{aligned} Y_{ij,t} = \exp(&\gamma^{NATO} NATO_{ij,t} + \gamma^{EU} EU_{ij,t} + \delta^{PTA} PTA_{ij,t} + \delta^{Def} \text{Defense}_{ij,t} \\ &+ \pi_{i,t} + \chi_{j,t} + \tau_{ij}) + \varepsilon_{ij,t}, \end{aligned} \tag{2}$$

To handle heteroskedasticity and accommodate zero trade flows, the model is estimated by PPML with high-dimensional fixed effects Silva and Tenreyro (2006); Correia et al. (2020). Following Head and Mayer (2014), multilateral resistance terms, which account for macroeconomic shocks, are absorbed by exporter-time and importer-time fixed effects and time-invariant bilateral trade costs are absorbed by pair fixed effects, so identification comes from within-pair changes in NATO joint membership over time.

2.3 Identification: EU vs. NATO Accession Timelines

The suggested methodology identifies the effect of NATO expansion within a bilateral country-pair, controlling for multilateral resistance terms that capture country-specific shocks and general equilibrium effects. However, NATO accession is not randomly assigned and may correlate with joining other international treaties, such as alternative defence alliances and preferential trade agreements. We control for those factors by explicitly including such variables in the regression model 2.

One particular concern is the correlation between NATO and EU accession. While many EU members are also NATO members, the membership in the two multilateral organisations is driven by very different factors. In fact, joining the EU and NATO are not as highly correlated in a statistical sense, as shown in the correlation Table 1, nor are they synchronised in a policy and economic sense as described in the Online Appendix OA2. EU accession is typically a reform-intensive and lengthy process linked to economic policy and regulations; NATO accession is more rapid, national security and geopolitically driven.

Table 1: Correlation Matrix

	NATO	EU	Defense	RTA
NATO	1.0000	0.5039	0.3911	0.2260
EU	0.5039	1.0000	0.2969	0.2703
Defense	0.3911	0.2969	1.0000	0.3140
RTA	0.2260	0.2703	0.3140	1.0000

2.4 Addressing Staggered Difference-in-Differences Bias

Identifying the causal impact of NATO membership presents additional challenges. Accessions occurred in multiple waves, implying staggered treatment timing and potentially heterogeneous dynamic effects across countries and periods. A simple comparison of members and non-members would therefore conflate pre-existing differences with treatment effects. To address this, we adopt a difference-in-differences (DID) framework. Traditional DID approaches estimate the average treatment effect by comparing outcomes before and after treatment between a treated group and a control group (Card and Krueger, 1994). However, in contexts where treatment adoption is staggered over time across different units, as is the case with NATO expansions, standard DID estimators may yield biased results. Recent advances in difference-in-differences (DID) methodology have focused on addressing the limitations of traditional approaches, particularly in settings with multiple time periods and variation in treatment timing (Baker et al., 2022; Roth et al., 2023). These advances aim to improve the accuracy, robustness, and interpretability of DID estimates (Sun and Abraham, 2021; Callaway and Sant'Anna, 2021; De Chaisemartin and d'Haultfoeuille, 2020). However, a key issue with staggered DID designs is that traditional two-way fixed effects (TWFE) regressions can produce biased estimates due to treatment effect heterogeneity. This bias arises because the TWFE estimator implicitly weights different treatment effects in ways that can be difficult to interpret and may lead to misleading conclusions Goodman-Bacon (2021).

Several alternative estimators have been developed to address the limitations of TWFE in staggered DID designs (Sun and Abraham, 2021; Callaway and Sant'Anna, 2021; De Chaisemartin and d'Haultfoeuille, 2020). Imputation-based estimators impute counterfactual outcomes for treated units based on trends in outcomes for untreated units. Doubly robust estimators are consistent if either a model for the propensity score or a model for the outcome evolution is correctly specified. Some estimators exploit variation in treatment timing to identify treatment effects, while sensitivity analysis methods assess the robustness of DID estimates to violations of the parallel trends assumption.

We apply the staggered DID estimator by (Callaway and Sant'Anna, 2021) as a complementary approach to the structural gravity estimation outlined above. This estimator helps mitigate the bias arising from treatment effect heterogeneity in staggered DID designs where the timing of treatment (NATO membership implementation) varies across country pairs.

3 Data and Empirical Strategy

We employ three datasets to provide a long-term view, heterogeneity analysis, and causal inference analysis on the effects of NATO accession. Directions of Trade (DOTS) by the IMF collects aggregate data on bilateral trade from 1948, providing a long-term perspective. Detailed, product-level annual COMTRADE data have been collected consistently across a large number of countries since 1988. Finally, Trade Data Monitor data from January 2017 to August 2025 has been collected monthly for 103 countries, allowing us to track NATO trade during the Russian war on Ukraine and the accession of the new NATO members, Finland and Sweden.

Table 2: Summary statistics

Variable	N	Mean	SD	Min	Max
Panel A: Directions of Trade, 1948–2022					
Export, bln USD	1,801,935	0.221	3.502	0	582.539
NATO	1,801,935	0.013	0.115	0	1
EU	1,801,935	0.009	0.096	0	1
Defense	1,801,935	0.073	0.259	0	1
PTA	1,801,935	0.114	0.318	0	1
Ideal point distance	1,479,164	0.957	0.786	0.0	5.534
Panel B: COMTRADE HS6, 1988–2022					
Export, mln USD	173,034,897	1.971	65.07	0	116720
NATO	173,034,897	0.176	0.381	0	1
EU	173,034,897	0.168	0.374	0	1
Defense	173,034,897	0.305	0.461	0	1
PTA	173,034,897	0.503	0.500	0	1
G	173,034,897	396.487	792.668	0	2,020
Ideal point distance	161,898,346	0.997	0.903	0.0	5.136
Panel C: TDM Export, monthly, Jan 2017 – Dec 2025					
Export, mln USD	2,839,917	61.86	663.3	0	56520
NATO	2,839,917	0.034	0.18	0	1
War	2,839,917	0.44	0.50	0	1
NATO × War	2,839,917	0.015	0.12	0	1
EU	2,839,917	0.027	0.16	0	1
EU × War	2,839,917	0.012	0.11	0	1
Panel D: TDM Export HS6, annual, 2017–2025					
Export, mln USD	69,162,688	2.531	91.03	0	117500
NATO	69,162,688	0.212	0.409	0	1
War	69,162,688	0.460	0.498	0	1
NATO × War	69,162,688	0.104	0.305	0	1
EU	69,162,688	0.196	0.397	0	1
EU × War	69,162,688	0.087	0.282	0	1
Dual-use	69,162,688	0.212	0.409	0	1
PTA	69,162,688	0.594	0.491	0	1
Defense	69,162,688	0.321	0.467	0	1

Table 2 reports summary statistics for the three datasets. Section OA1 in the Online Appendix presents the sample composition over time. A practical limitation in long-horizon trade analysis is that early DOTS coverage is incomplete: the longest series are available for a relatively small set of countries, and the panel is unbalanced due to the emergence and dissolution of states over time. In addition, consistent HS6-level trade data are only available from 1988 onward. To address these constraints, we organise the analysis into two main samples. The first sample focuses on the earlier postwar period and NATO's initial formation, using aggregate trade flows and concentrating on the subset of countries with reliable coverage. The second sample covers the modern period from 1988 onward, which overlaps with major NATO enlargement in Central and Eastern Europe; for this period, we conduct both aggregate and HS6-level analyses. Therefore, we use DOTS for aggregate bilateral trade over 1948–2022 (our longest consistent aggregate series) and COMTRADE for HS6 product-level trade over 1988–2022.

We also use more recent data in Jan, 2017- Dec, 2025. The dataset include only countries that reported their trade statistics in all time periods, resulting in 104 reporting countries. Summary statistics for the sample of aggregate bilateral exports and product level (HS6) bilateral exports are presented in panels C and D of the table.

Information on preferential trade agreements is taken from Mario Larch's RTA database. Data on formal military alliances come from the Correlates of War (COW) Alliance dataset (v4.1; Gibler, 2008) and the Alliance Treaty Obligations and Provisions (ATOP) dataset (v5.1). NATO membership dates are compiled from publicly available sources. We construct a harmonised alliance indicator as follows: if either COW or ATOP records an alliance for a dyad-year, we code the indicator as 1, and 0 otherwise. In our main specifications, we focus on defence pacts as the strongest form of alliance. Alliance data are available through 2018; for 2019–2022, we extend the series by assuming no changes in recorded alliance status.

4 Structural Gravity Estimates

4.1 Aggregate PPML Analysis

To assess the causal impact of NATO membership on trade, within a structural gravity framework and accounting for staggered accession, we first examine aggregate bilateral flows over 1948–2022. Table 3 presents the estimated effects of NATO membership on aggregate bilateral exports with a full set of fixed effects. In Models (i)-(iv), we present regression results with an increasing number of controls accounting for the interplay of trade policy and security arrangements. The results of NATO membership are consistently positive and significant; the impact size ranges from 0.271 to 0.505 log points, declining as more controls are added. The unconditional NATO impact has the largest coefficient, while controlling for preferential trade agreements and defence alliances (including NATO) reduces its size due to complementarity across different policy types. We also specifically control for EU membership, as there is considerable overlap in the coverage and timing between NATO and EU membership. We consider Model (iv) our baseline model, which reports that NATO generates additional exports by 0.271 log points relative to an average military alliance. The effect is strongly statistically significant and robust. These findings highlight the economic benefits of NATO membership in fostering trade.

Moreover, the control variables provide additional information. Defence agreements are consistently positive and significant across all models, affirming the trade-enhancing effects of military cooperation. PTAs generally have a significant, positive effect on exports, further underscoring the role of economic partnerships in promoting trade. EU membership is particularly beneficial for bilateral exports, especially between NATO members, demonstrating the synergy between economic and security cooperation. Model (v) reports that the interaction between EU and NATO membership has a positive, statistically significant effect on exports of 0.106 log points.

The complementarity between NATO and EU membership may operate through several mutually reinforcing channels. Most fundamentally, NATO reduces conflict risk through collective defence, while EU economic interdependence raises the costs of political disputes, making cross-border commercial relationships more credible. Long and Leeds (2006) show that alliances linking security and economic cooperation generate larger trade gains than pure defence pacts because the two commitments reinforce each other. When a country is covered by both NATO's Article 5 and EU treaty obligations, firms face lower political risk when making relationship-specific investments. This is reinforced by lower transaction costs and stronger institutional trust: the EU reduces tariff, regulatory, and legal frictions, while NATO signals political reliability through intelligence sharing, joint exercises, and long-term security planning. A further channel is standards harmonisation, with NATO's interoperability requirements through NATO Standardization Agreements (STANAG) complementing EU civilian product standards, especially for dual-use goods that must satisfy both military and commercial procurement requirements.

This result is important for EU–UK relations after Brexit. The UK government's proposed reset of the Trade and Cooperation Agreement includes security and defence cooperation, and recent discussion of UK participation in EU military procurement illustrates why this matters. Our results suggest that a narrow security agreement would be less beneficial than a wider EU–UK arrangement. Defence procurement depends on common standards, trusted supply chains, regulatory predictability, and access to wider industrial networks, especially in dual-use sectors such as aerospace, electronics, cyber, and advanced manufacturing. UK access to EU procurement schemes could therefore support both defence capability and high-value trade, but the gains would be larger if linked to broader cooperation on regulation, customs frictions, industrial policy, research, and standards. The implication is that security cooperation has the strongest economic effect when embedded in wider institutional and economic integration, rather than treated as a separate defence-only arrangement.

A potentially omitted confounder is the degree of political alignment between the governments of the trading pair. If countries with similar foreign-policy preferences are more likely both to join NATO and to trade with each other, estimates that omit political alignment could attribute to NATO what is, in fact, driven by broader ideological proximity. To address this concern, we augment our baseline specification with a measure of bilateral political distance based on countries' *ideal points* in international politics (constructed as the absolute difference in the ideal-point scores

Table 3: Impact of NATO on aggregate bilateral exports: PPML two-way fixed effect

	Aggregate Bilateral Exports, USD							
	DoT:1948-2022						DoT: 1988-2022	
	(i)	(ii)	(iii)	(iv)	(v)	(vi)	(vii)	(viii)
NATO	0.505***	0.494***	0.354***	0.271***	0.221***	0.263***	0.201***	0.193***
	(0.050)	(0.049)	(0.049)	(0.055)	(0.061)	(0.062)	(0.053)	(0.060)
PTA		0.123***	0.104***	0.105***	0.103***	0.156***	0.069**	0.068**
		(0.030)	(0.030)	(0.031)	(0.031)	(0.02)	(0.030)	(0.031)
EU			0.247***	0.220***	0.158***	0.156***	0.120***	0.110**
			(0.032)	(0.032)	(0.045)	(0.033)	(0.032)	(0.045)
Defense				0.166***	0.174***	0.153**	0.102**	0.104**
				(0.043)	(0.044)	(0.058)	(0.050)	(0.051)
EU × NATO					0.106**			0.016
					(0.050)			(0.049)
Ideal Point						-0.0155		
Distance						(0.012)		
Observations	1,613,088	1,613,088	1,613,088	1,613,088	1,613,088	1,341,205	1,042,616	1,042,616
Pseudo R^2	0.901	0.901	0.901	0.901	0.901	0.867	0.904	0.904
Reporter-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Partner-Year FE	✓	✓	✓	✓	✓	✓	✓	✓
Pair FE	✓	✓	✓	✓	✓	✓	✓	✓

Heteroskedasticity-robust standard-errors clustered at reporter-partner level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

of countries i and j in year t, Bailey et al. (2017)). Reassuringly, including the ideal-point difference leaves the estimated NATO effect essentially unchanged in magnitude and statistical significance. Moreover, the ideal-point difference itself is small and statistically insignificant, suggesting that, conditional on our pair-fixed effects and exporter- and importer-time fixed effects, time-varying political distance does not explain bilateral trade patterns in our setting.

Models (vii) and (viii) report the results for a restricted sample covering the period 1988-2022. It serves two purposes. First, we would like to see whether the second wave of enlargement was economically beneficial for the Eastern European countries that joined over the 1999-2020 period. Second, we would like to have a benchmark model for comparing aggregate and disaggregated results, with the data at HS6 level available only in 1988-2022. The results show a strong, positive, and statistically significant impact of NATO membership on bilateral trade, with a smaller effect of 0.193-0.201 log points. However, it should be noted that the estimated coefficients are smaller for all variables, including PTA, EU and defence. Moreover, there is no statistically significant interaction between the EU and NATO membership for this sample. It may indicate the weaker influence of the bilateral trade and security policies due to the formation of the World Trade Organization accompanied by significant trade liberalization across the globe, which made bilateral preferences less beneficial.

Table 4 reports dynamic specifications that lag all policy variables by one period and, in columns

(iii) and (vi), additionally include lagged bilateral exports to account for persistence in trade flows. Across both samples, the lagged NATO coefficient remains positive and statistically significant, indicating that the trade effect of NATO membership is not driven by contemporaneous shocks or short-run simultaneity. Using the full DOTS sample (1948–2022), the estimated semi-elasticity on lagged NATO ranges from 0.147 to 0.224. In the post-1988 sample, the corresponding estimates are slightly smaller but still robust—between 0.125 and 0.147. Importantly, introducing the lagged dependent variable does not materially affect the NATO coefficient, while the lagged export term itself is small and statistically insignificant, suggesting that the main results are not an artifact of omitted trade persistence.

Table 4: Robustness: Dynamic policy effects

	Aggregate Bilateral Exports, USD					
	DoT:1948-2022			DoT: 1988-2022		
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
Lag NATO	0.223***	0.147**	0.224***	0.147***	0.125**	0.144***
	(0.053)	(0.059)	(0.054)	(0.051)	(0.056)	(0.051)
Lag PTA	0.113***	0.111***	0.112***	0.070**	0.069**	0.070**
	(0.032)	(0.032)	(0.031)	(0.032)	(0.032)	(0.031)
Lag EU	0.234***	0.146***	0.234***	0.107***	0.082*	0.108***
	(0.031)	(0.045)	(0.031)	(0.030)	(0.043)	(0.030)
Lag Defense	0.153***	0.164***	0.152***	0.093*	0.097**	0.096**
	(0.041)	(0.042)	(0.041)	(0.048)	(0.049)	(0.047)
Lag EU $\times$ Lag NATO		0.159***			0.043	
		(0.050)			(0.046)	
Lag Export			0.0001			-0.0003
			(0.0003)			(0.0002)
Observations	1,572,535	1,572,535	1,572,535	1,009,381	1,009,381	1,009,381
Pseudo R^2	0.900	0.900	0.900	0.904	0.904	0.904
Reporter-Year FE	✓	✓	✓	✓	✓	✓
Partner-Year FE	✓	✓	✓	✓	✓	✓
Pair FE	✓	✓	✓	✓	✓	✓

Heteroskedasticity-robust standard-errors clustered at reporter-partner level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.2 Disaggregate PPML Analysis

We further look at the results from the HS6 bilateral trade flows in 1988-2022 using the COMTRADE sample. We introduce bilateral-product fixed effects in addition to the reporter-year and partner-year fixed effects. The results, reported in Table 5, show a strong, positive and statistically significant effect of the NATO membership on exports in the range of 0.126-0.269 log points. All important conclusions remain valid, including the positive interplay of economic policies and security arrangements and the statistically significant additional impact of NATO membership on the EU members of 0.069 log points.

When all alliance controls are included but without separating the NATO-EU overlap (column iv), EU membership is more trade-promoting than NATO — 35% versus 21 percent. However, the order of magnitude is comparable. Morevoer, once the synergy is explicitly accounted for through the EU×NATO interaction in column (v), the pure effects of each alliance become nearly identical — around 20 percent for NATO-only pairs and 18 percent for EU-only pairs, a difference that is not statistically meaningful. The more striking finding is the complementarity between the two: country pairs that belong to both NATO and EU trade approximately 52 percent more with each other, which is substantially above what simple addition of the two separate effects would predict (around 38 percent). This suggests that NATO and EU membership reinforce each other rather than merely stack — shared security and economic integration together generate trade gains that neither alliance produces on its own.

Table 5: Impact of NATO on exports: Disaggregated PPML TWFE estimation

	Product level (HS6) Bilateral Export, USD. COMTRADE. 1988-2022				
	(i)	(ii)	(iii)	(iv)	(v)
NATO	0.269***	0.268***	0.166***	0.142***	0.126***
	(0.044)	(0.044)	(0.042)	(0.051)	(0.038)
PTA		0.095***	0.094***	0.094***	0.069***
		(0.023)	(0.023)	(0.023)	(0.016)
EU			0.209***	0.203***	0.099***
			(0.030)	(0.032)	(0.034)
Defense				0.046	0.059**
				(0.055)	(0.028)
EU × NATO					0.069**
					(0.035)
Observations	173,034,894	173,034,894	173,034,894	173,034,894	173,020,170
Pseudo R^2	0.292	0.292	0.292	0.292	0.934
Reporter-Year FE	✓	✓	✓	✓	✓
Partner-Year FE	✓	✓	✓	✓	✓
Pair=product FE	✓	✓	✓	✓	✓

Heteroskedasticity-robust standard-errors clustered at reporter-partner level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

4.3 Alternative Control Groups

A central requirement for credible difference-in-differences identification is that treated and control units satisfy the parallel trends assumption. Because the choice of comparison group can affect both the plausibility of this assumption and the interpretation of the resulting estimates, we systematically vary the definition of the control group to examine the robustness of the NATO effect. Conceptually, there is a trade-off in group construction: restricting the sample to more homogeneous sets of countries (such as European or OECD members) may strengthen the case for similar pre-treatment dynamics, but it also narrows the support for identification and risks attenuating the estimated effect if variation is reduced. Conversely, allowing broader samples or directional specifications increases the available variation but may introduce greater heterogeneity in economic structure, institutional arrangements, and exposure to geopolitical shocks, thereby raising concerns about deviations from parallel trends. Excluding dominant economies such as the United States or the founding NATO members serves as an additional test of whether the results are driven by influential outliers or by the general treatment effect of joining the alliance.

To explore these issues, we re-estimate the baseline specification (2) on several alternative subsamples, each capturing a distinct comparison structure:

$$\text{Sample 1:}\quad (i,j) \in \text{OECD} \times \text{OECD} \tag{3}$$
$$\text{Sample 2:}\quad (i,j) \in \text{Europe} \times \text{Europe} \tag{4}$$
$$\text{Sample 3:}\quad (i \in \text{All} \cup j \in \text{NATO}) \tag{5}$$
$$\text{Sample 4:}\quad (i,j) \neq \text{USA} \tag{6}$$
$$\text{Sample 5:}\quad (i,j) \notin \text{NATO founders} \tag{7}$$
$$\text{Sample 6:}\quad i \in \text{OECD}, j \in \text{NATO} \tag{8}$$

Table 6: Alternative control groups

	Export, USD					
	Both OECD	Both Europe	Partner NATO	No US	No Founders	OECD to NATO
	(i)	(ii)	(iii)	(iv)	(v)	(vi)
NATO	0.207***	0.317***	0.318***	0.275***	0.256***	0.303***
	(0.073)	(0.062)	(0.088)	(0.048)	(0.057)	(0.091)
PTA	0.132***	0.232***	0.152***	0.087***	0.097***	0.218***
	(0.029)	(0.078)	(0.033)	(0.032)	(0.037)	(0.039)
Defense	-0.018	0.037	-0.053	0.225***	0.323***	-0.098
	(0.055)	(0.050)	(0.089)	(0.033)	(0.038)	(0.093)
EU	0.176***	0.156***	0.174***	0.222***	0.244***	0.111**
	(0.041)	(0.050)	(0.041)	(0.030)	(0.042)	(0.052)
Observations	79,659	46,391	253,635	1,588,461	1,373,392	56,700
Pseudo R^2	0.898	0.877	0.913	0.880	0.878	0.908
Reporter-Year FE	✓	✓	✓	✓	✓	✓
Partner-Year FE	✓	✓	✓	✓	✓	✓
Pair FE	✓	✓	✓	✓	✓	✓

Heteroskedasticity-robust standard-errors clustered at reporter-partner level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

The results, presented in Table 6, demonstrate a high degree of stability across all control-group configurations. In every subsample, the NATO coefficient remains positive and statistically significant, providing consistent evidence that NATO membership is associated with higher bilateral exports. The magnitude of the effect varies somewhat across samples, and these differences are informative. The estimates are largest in the European-only sample, which is consistent with the stronger plausibility of the parallel trends assumption in a geographically and institutionally integrated region, but also reflects the fact that NATO's trade-facilitating mechanisms may operate more intensively where political, regulatory, and economic interdependence is already substantial. When the United States is excluded, the coefficient remains sizeable (around 0.275), indicating that the results are not an artefact of U.S. trade patterns, which account for a large share of NATO-wide trade flows. Similarly, excluding NATO founders does not materially alter the estimates, suggesting that the observed NATO premium is not driven by legacy members with long-standing institutional ties.

Finally, controlling for EU membership yields coefficients in the range of 0.17–0.22 across specifications, but NATO effects remain substantial even after accounting for this economic integration channel. This indicates that NATO facilitates trade in ways that are distinct from EU single-market mechanisms, consistent with the view that security alliances reduce uncertainty, improve expectations of contract enforcement, and support long-term exchange relationships.

4.4 Falsification Test: Random Country Assignment

To further assess whether the estimated NATO effect reflects a genuine causal relationship rather than spurious correlations, we implement a falsification test in which "placebo NATO membership'' is randomly assigned to non-NATO countries. The logic of this test is straightforward: if the estimated effect of real NATO membership is in fact driven by unobserved global trends, common shocks, or latent geopolitical characteristics that are not specific to the alliance itself, then assigning NATO membership at random should, on average, reproduce similar coefficient patterns. Conversely, if the estimated NATO effect captures something distinctive about membership in the actual alliance, the placebo variable should perform poorly and exhibit high variability across iterations.

The design proceeds in several steps. In each iteration, ten countries are randomly drawn from the pool of non-NATO states and assigned randomly generated "joining years'' between 1950 and 2022. A placebo bilateral indicator is then constructed in direct analogy to the real NATO variable. The baseline PPML specification is then augmented to include both the true NATO indicator and the placebo indicator, allowing us to isolate whether the placebo term picks up any systematic association with trade flows that might call the main identification into question. This exercise is repeated one hundred times with replacement, providing a distribution of placebo coefficients against which the stability of the real NATO effect can be assessed.

Formally, we estimate the extended specification:

$$X_{ijt} = \exp(\beta_1 \text{NATO}_{ijt} + \beta_2 \text{NATO}^{\text{placebo}}_{ijt} + \beta_3 \text{EU}_{ijt} + \beta_4 \text{RTA}_{ijt} + \beta_5 \text{Defense}_{ijt} + \alpha_{ij} + \gamma_{it} + \delta_{jt}) + \varepsilon_{ijt}, \tag{9}$$

where $\text{NATO}^{\text{placebo}}_{ijt}$ equals one when both countries are NATO members and the observation occurs after their assigned placebo accession year.

Table 7: Placebo test summary table

Statistic	NATO Coef	Placebo Coef	NATO p-value	Placebo p-value
Mean	0.2707	0.0521	0	0.3218
Median	0.2707	0.0143	0	0.1923
Std Dev	0.0005	0.4703	NA	NA
Min	0.2662	-1.9867	0	0.0000
Max	0.2717	1.1754	0	0.9979

The results from this falsification exercise, summarised in Table 7, provide several insights. First, the coefficient on real NATO membership is remarkably stable: across the one hundred iterations the mean coefficient is 0.2707, with an extremely small standard deviation of 0.0005, and it remains statistically significant at the one tenth-percent level in every single iteration. This reproducibility underscores that the estimated NATO premium is not sensitive to the inclusion of randomly generated placebo treatments and is therefore unlikely to be an artefact of model instability or sample composition.

By contrast, the placebo coefficients behave in a manner consistent with noise. The average placebo estimate is small (0.0521), the median is close to zero, and the dispersion is very large, with a standard deviation of 0.4703 and a range spanning from approximately -2.0 to 1.2. Mean p-values are comfortably above conventional significance levels, suggesting that the placebo term does not systematically predict bilateral trade. The high variance and lack of consistent statistical significance indicate that any occasional positive or negative estimates arise purely from random assignment rather than reflecting a coherent underlying relationship.

Taken together, these results strengthen the credibility of the causal interpretation. The stability of the real NATO coefficient, combined with the erratic and generally insignificant behaviour of the placebo term, suggests that the estimated effects are specific to actual NATO membership rather than to unobserved factors correlated with arbitrary groupings of countries. The overall pattern across this and the preceding robustness checks supports the conclusion that NATO membership independently and substantially promotes bilateral trade.

4.5 Additional Robustness Checks

In addition to the baseline specifications reported in the main text, we conduct further robustness checks in Online Appendix OA3. These exercises assess whether the estimated NATO trade premium is sensitive to (i) the choice of sample period (e.g., excluding early Cold War years or focusing on the post–Cold War era), (ii) restricting the analysis to a balanced panel of country pairs observed in all years, and (iii) trimming the distribution of trade flows by progressively excluding small shipments and focusing on larger bilateral relationships. Across all of these alternative samples and specifications, the NATO coefficient remains positive and economically meaningful, reinforcing the conclusion that our main findings are not driven by period selection, sample composition, or outliers in the trade-flow distribution.

5 NATO Trade Resilience During the Russia-Ukraine War (2022–2025)

In this section of the analysis, we turn to higher-frequency monthly data to examine how NATO membership shapes trade responses to recent geopolitical developments. Moving beyond long-run structural effects, we focus on two contemporary phenomena: the Russian invasion of Ukraine in February 2022 and the most recent wave of NATO accessions. The war represents a major geopolitical shock that may have altered trade patterns among allied and non-allied countries, while the accession of Finland, Sweden, and North Macedonia provides an opportunity to assess the short-run trade implications of new NATO membership.

Using monthly bilateral trade flows (January 2017 - December 2025), we first evaluate whether NATO membership influenced trade during the war period, controlling for EU integration and time-varying multilateral trade resistance. We then assess whether NATO effects are distinct from

EU-related integration effects and estimate country-specific trade responses for recent entrants to the Alliance. This analysis complements our long-run results by examining whether NATO membership also matters in periods of acute geopolitical uncertainty.

The panel is balanced at the reporter-partner-year-month level, with zero trade flows explicitly included. The sample covers 108 months across the period, providing high-frequency variation to identify war-period effects. We define two key treatment variables. NATO membership *(Dnato)* equals 1 for bilateral trade flows where both reporter and partner are NATO members. North Macedonia has been treated since March 2020; Finland since April 2023; and Sweden since March 2024. *War* is an indicator equal to 1 from February 2022 onward. *NATO-War interaction* is the main treatment variable, equal to $Dnato \times War$, measuring the differential trade effect of NATO membership during the war period. We construct analogous EU membership variables (EU, $EU \times war$) to control for EU integration effects, which may differ during the conflict at the EU border. Similar to the previous analysis, we estimate Poisson pseudo-maximum-likelihood (PPML) models of the form:

$$X_{ijt} = \exp(\beta \times Dnato \times war_{ijt} + \gamma \times EU \times war_{ijt} + \alpha_{ij} + \delta_{it} + \theta_{jt}) + \varepsilon_{ijt} \tag{10}$$

The δ_{it} terms absorb all time-varying reporter characteristics (e.g., GDP, trade policy, sanctions), while θ_{jt} terms absorb partner characteristics.

To assess parallel trends and treatment effect dynamics, we estimate event study specifications allowing effects to vary by year:

$$X_{ijt} = \exp\left(\sum_{s \neq 2021} \beta_s \times Dnato \times war_{ijt} \times \mathbb{1}[year = s] + controls + FE\right) + \varepsilon_{ijt} \tag{11}$$

with 2021 as the reference year (pre-war). This reveals the time path of treatment effects and tests for pre-trends.

5.1 Baseline Results

Because NATO and EU memberships overlap substantially, isolating the independent trade effect of NATO requires careful controls. In addition, the war in Ukraine may have generated spillovers affecting countries beyond those directly involved, potentially influencing trade patterns across multiple alliances. To address these concerns, we estimate a sequence of increasingly demanding specifications. First, we introduce EU–war interaction terms to disentangle NATO-specific effects from broader European integration responses. Second, we incorporate high-dimensional fixed effects (bilateral-pair, reporter–time, and partner–time) to absorb time-varying multilateral trade resistance and global shocks. Third, we allow for NATO–EU interaction terms to assess whether security and economic integration jointly shape trade during the war period.

Table 8 uses bilateral monthly data and shows how bilateral trade between the NATO members changed during the war in Ukraine. The estimated effect is approximately 9-10% higher exports

Table 8: NATO-War Effects with High-Dimensional Fixed Effects

	Export, USD				
	Pair FE (i)	Pair FE + EU (ii)	Full FE (iii)	Full FE + EU (iv)	Full FE + Interact (v)
NATO × War	0.247***	0.209***	0.096***	0.092**	0.099**
	(0.011)	(0.018)	(0.035)	(0.042)	(0.045)
EU × War		0.069***		0.013	0.046
		(0.019)		(0.038)	(0.042)
NATO × EU × War					-0.042
					(0.044)
Observations	2,326,593	2,326,593	2,323,479	2,323,479	2,323,479
Pseudo R^2	0.982	0.982	0.988	0.988	0.988
Pair FE fixed effects	✓	✓	✓	✓	✓
Reporter-Time FE fixed effects			✓	✓	✓
Partner-Time FE fixed effects			✓	✓	✓

Standard errors clustered at the reporter-partner level.
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*
Trade data from trade monitors, Jan 2017–Dec 2025.

value on average, after absorbing all exporter- and importer-level time variation. The coefficient is significant in all model specifications, and it is virtually unchanged when a separate EU × War term or a NATO × EU × War triple interaction is added. The EU × War coefficient is positive and significant in the partial fixed-effects specification (column (ii)), but it becomes small and statistically indistinguishable from zero once multilateral resistance terms are included.

Table 9 reports PPML estimates at the product level. Each panel moves from left to right by adding war-interacted controls, with all specifications absorbing bilateral pair fixed effects and multilateral fixed effects throughout.

The NATO × War coefficient ranges from 0.114*** in the (column i) to 0.084* once preferential trade agreements (PTA), EU membership, defense spending, and their NATO × EU interaction are jointly controlled for (column (v)). None of the additional war-interacted controls -PTA × War, EU × War, Defense × War, or NATO × EU × War -approach statistical significance, which implies that the export stimulus during the war period is specific to NATO membership and is not proxying for broader trade-agreement depth, European integration, or defense-expenditure levels.

Panel B extends the analysis at product level by adding a triple-difference term, NATO × War × Dual-use, and its interactions with the EU and NATO × EU terms. Two results stand out. First, the triple interaction NATO × War × Dual-use is positive and highly significant across all five specifications, ranging from 0.032 (column (i)) to 0.059 (column (v)). This indicates that the war-period export premium accruing to NATO pairs is markedly larger for dual-use goods than for other products, a gap that widens as the specification becomes more saturated. Second, the baseline NATO × War coefficient loses statistical significance once the dual-use interaction is included (0.066 and 0.064 in columns (iv)–(v)), implying that the aggregate NATO effect documented in Panel B

Table 9: NATO-War Effects with High-Dimensional Fixed Effects

	Export, USD				
	(i)	(ii)	(iii)	(iv)	(v)
Panel A: Product level annual, HS6, 2017–2025					
NATO × War	0.114***	0.104***	0.102**	0.081*	0.084*
	(0.037)	(0.040)	(0.046)	(0.042)	(0.049)
PTA × War		0.022	0.020	0.013	0.014
		(0.021)	(0.021)	(0.022)	(0.023)
EU × War			0.009	−0.001	0.009
			(0.041)	(0.048)	(0.066)
Defense × War				0.036	0.034
				(0.049)	(0.052)
NATO × EU × War					−0.010
					(0.050)
Observations	62,866,213	62,866,213	62,866,213	62,866,213	62,866,213
Pseudo R^2	0.970	0.970	0.970	0.970	0.970
Pair=Product FE	✓	✓	✓	✓	✓
Reporter-Year FE	✓	✓	✓	✓	✓
Partner-Year FE	✓	✓	✓	✓	✓
Panel B: Product level annual with dual-use interactions, HS6, 2017–2025					
NATO × War	0.104***	0.094**	0.087*	0.066	0.064
	(0.037)	(0.040)	(0.046)	(0.043)	(0.050)
NATO × War × Dual-use	0.032***	0.033***	0.048***	0.048***	0.059***
	(0.010)	(0.010)	(0.016)	(0.016)	(0.020)
PTA × War		0.022	0.021	0.014	0.014
		(0.021)	(0.021)	(0.022)	(0.023)
EU × War			0.018	0.008	0.003
			(0.042)	(0.049)	(0.067)
Dual-use × EU × War			−0.027	−0.027	0.018
			(0.017)	(0.017)	(0.021)
Defense × War				0.036	0.035
				(0.049)	(0.052)
NATO × EU × War					0.009
					(0.053)
Dual-use × NATO × EU × War					−0.064**
					(0.030)
Observations	62,866,213	62,866,213	62,866,213	62,866,213	62,866,213
Pseudo R^2	0.970	0.970	0.970	0.970	0.970
Pair=Product FE	✓	✓	✓	✓	✓
Reporter-Year FE	✓	✓	✓	✓	✓
Partner-Year FE	✓	✓	✓	✓	✓

Standard errors clustered at the reporter-partner-product level.
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1
Trade Data Monitor, annual HS6, 2017–2025. All controls interacted with the war indicator (year ≥ 2022).

is concentrated in dual-use product categories. The remaining war-interacted controls - PTA, EU, and Defense - continue to be insignificant. The most saturated specification (column v) also reveals a negative and significant Dual-use $\times$ NATO $\times$ EU $\times$ War term (-0.064^{**}), suggesting that the dual-use export boost is partially offset for country pairs that are simultaneously NATO and EU members, suggesting that EU countires reduced their trade in dual use goods, likely re-directing it to Ukraine.

5.2 Event Study: Dynamic Effects

Figure 1 presents the event-study estimates of NATO's impact on exports, allowing effects to vary by year. The plot addresses two concerns: (1) parallel trends in the pre-period, and (2) heterogeneous treatment effects over time. Figure 1 demonstrates that the NATO members have significantly increased trade with each other after 2022, with the largest increase observed during the initial stage of the conflict in 2022-2023. However, the cumulative effect has been growing throughout the whole period and reached its maximum in 2025.

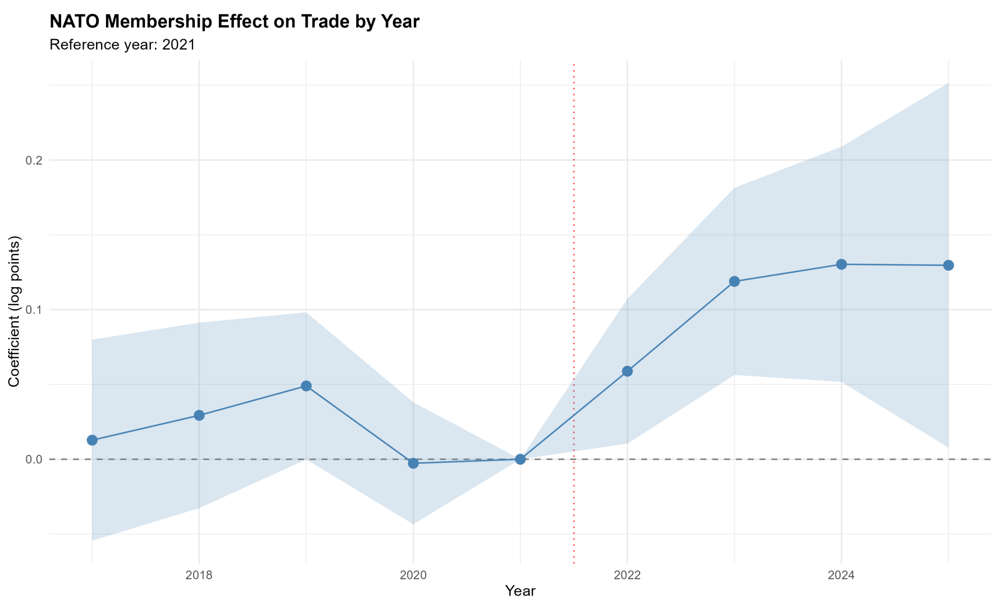

Figure 1: NATO Membership Effect Over Time

Notes: Point estimates and 95% confidence intervals from Poisson regression with year-specific NATO membership effects. The reference year is 2021. The specification includes bilateral pair, reporter-time, and partner-time fixed effects. Standard errors clustered at the pair level.

6 Staggered NATO Enlargement and Aggregate Trade

As highlighted in recent literature on staggered difference-in-differences, the estimated effect may differ from the causal impact due to the possibility of negative weights. Therefore, we expand our analysis to the doubly-robust method of Callaway and Sant'Anna (2021) to dissect the previous analysis results into components. We apply this to a balanced panel, which dictates that we split the sample into two periods: 1948-1987 and 1988-2022. Using only a balanced panel for the whole period would eliminate important observations for the second wave of NATO enlargement. When newly created countries or countries started reporting trade statistics, they would be eliminated from the analysis.

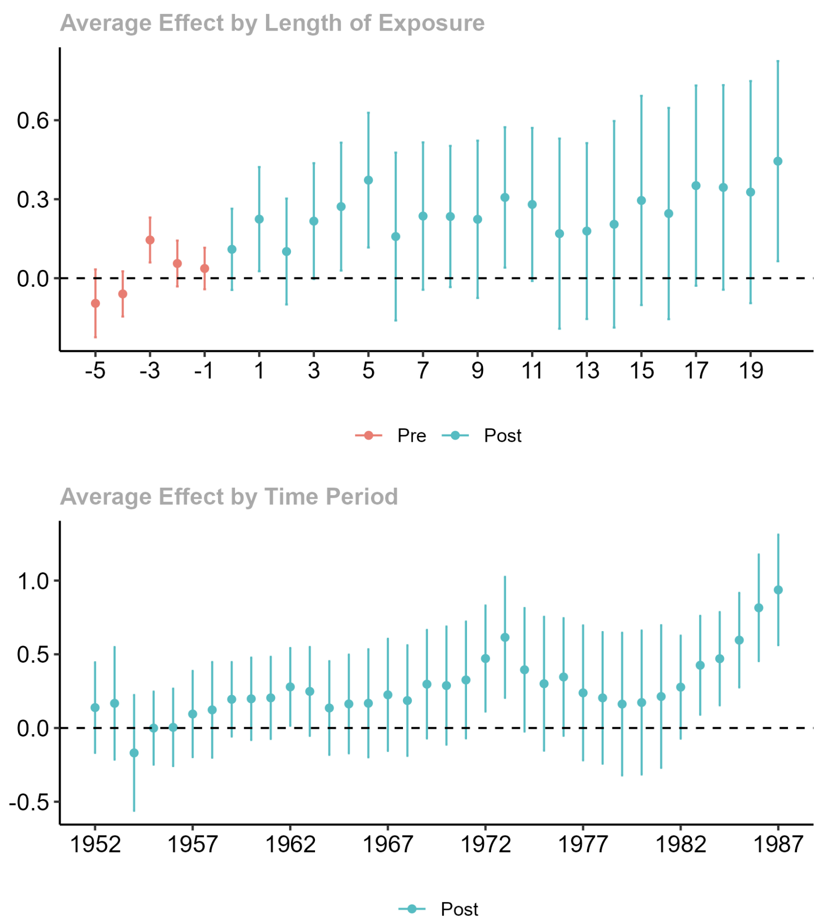

Figure 2: Staggered DID: NATO formation and first waves of enlargement in 1948-1987

6.1 Cold War Period: 1948-1987

For the earlier period (1948–1987), Figure 2 presents the results by time since NATO membership, and time period, allowing for a granular examination of the trade effects. Each point in the figure represents an average treatment effect on the treated estimate, and the vertical lines show corresponding confidence intervals, offering a visual representation of the estimates.

Event study analysis shows that in the Cold War era, there was some evidence of the anticipation effect 3 years before NATO accession. There is a steady increase in the impact up to 5 years after accession, with a positive but not statistically significant effect afterwards, with the exception of several time periods. The modest impact could be attributed to the lower levels of global economic integration during this era, as well as the stronger impact of economic institutions such as GATTs, European Economic Community (EEC/EU) and bilateral defence agreements, such as the US-UK Mutual Defence Agreement (1958).

However, looking at the calendar impact, a statistically significant and positive effect emerges at the beginning of the 70s and in the later years of this sample, in 1982-1987, following the invasion of Afghanistan by the Soviet Union and the increased cooperation of the Western Allies to counter the more aggressive policy of the Warsaw Pact. Figure 3 confirms that the periods of increased trade between the NATO members coincide with the spikes in military expenditure to GDP ratio at the end of the 60s in the US and the beginning of the 80s in most NATO members.

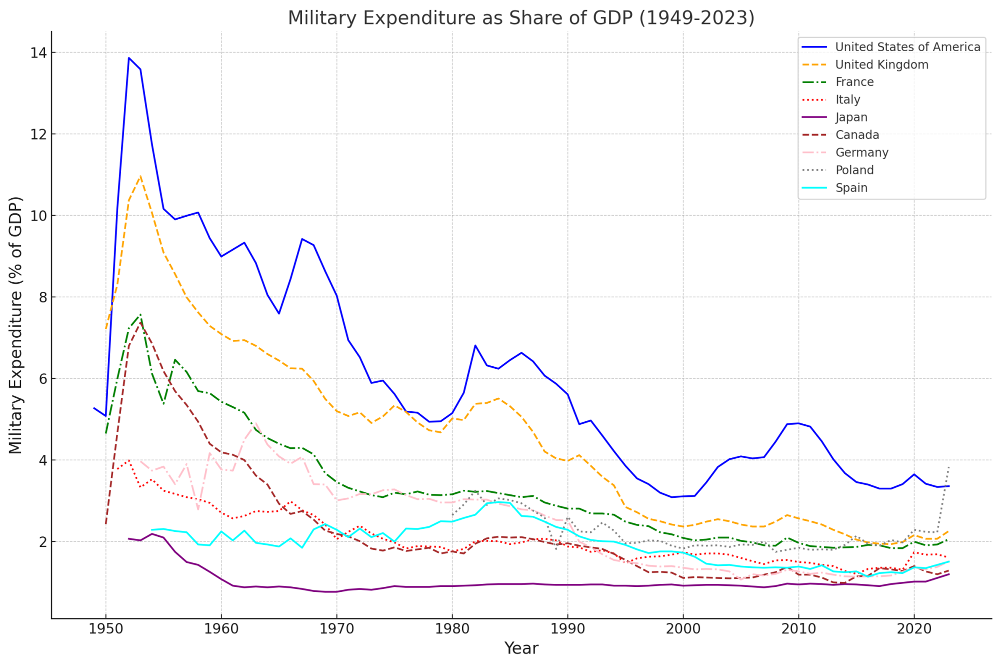

Figure 3: Military expenditures to GDP ratio in 1949-2023

Source: SIPRI Military Expenditure Database

6.2 Second Wave of NATO Enlargement: 1988-2022

The second wave of enlargement, driven by the collapse of the Warsaw Pact, the democratisation of Eastern Europe, and the desire to be protected against Russian aggression, led to a period of very active cooperation among NATO countries and to substantial economic growth in the former communist bloc. Among other things, it led to accelerated trade growth, driven by both EU integration and NATO enlargement. Figure 4 displays the estimated effects of NATO enlargement on exports, using a SDID framework applied to countries that joined NATO during the 1988–2022 period. The figure is structured similarly to Figure 2, with separate panels reporting results by the length of time since joining and by calendar year.

The top panel focuses on the evolution of the effect over time since a country joined NATO.

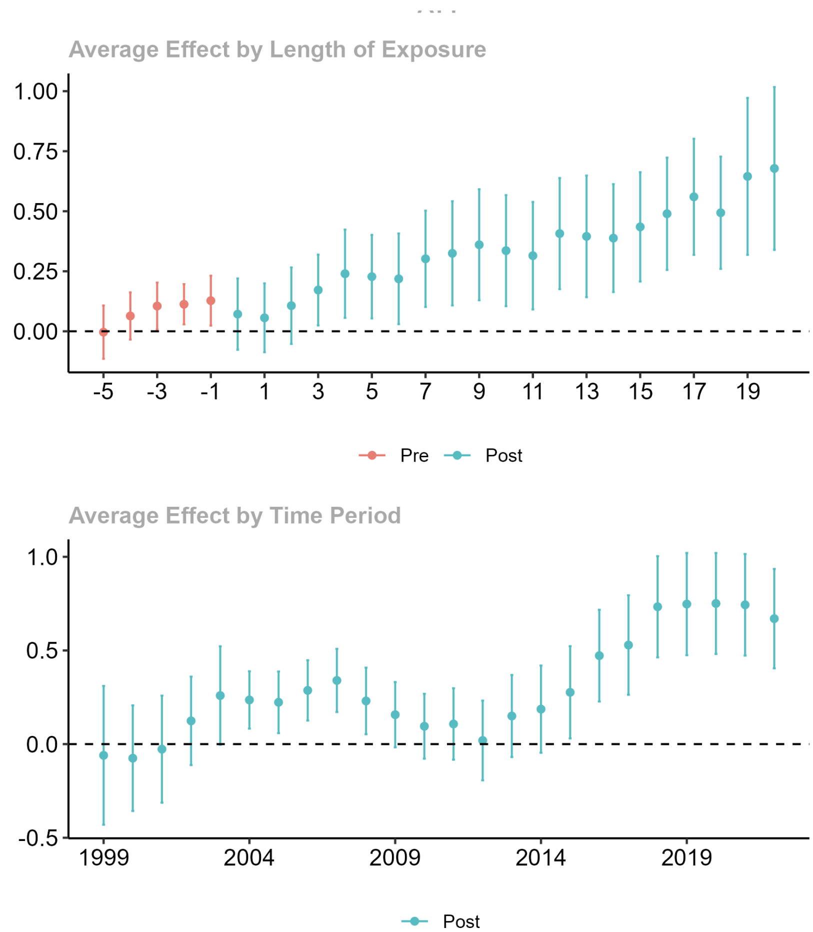

Figure 4: Staggered DID: Second wave of NATO enlargement in 1988-2022

Before membership, estimates hover around zero, but we also observe a small anticipation effect beginning 3 years before accession. However, after accession, the trajectory turns upward very strongly. Within approximately five to ten years of joining, the effect on exports becomes both larger in magnitude and statistically significant, and it continues to grow over subsequent decades. By the 15- to 20-year mark, the point estimates often exceed 0.5 or more log points, with confidence intervals that remain significantly above zero. This long-term positive trend underscores that the trade benefits linked to NATO membership accumulate steadily over time.

In the bottom panel, results are organised by calendar year. Here, too, the pattern is one of initially insignificant effects that give way to increasingly substantial and significant positive impacts as the years advance. By the turn of the century and into the early 2000s, the average treatment effects often surpassed 0.5 and remained statistically significant. The period coincided with the Second Iraq War and the war on terror by President George Bush, when the NATO coalition played a significant role in the US military operations in the Middle East and South Asia.

An even stronger impact of trade between the NATO members began after 2014, when Russia invaded Ukraine and illegally occupied Crimea and part of the Donbas region. It led to a more active role for NATO in confronting new security challenges on a much larger scale than during the 90s-00s period. These patterns suggest a changing global trade environment, one in which NATO membership in the post-Cold War era is associated with more immediate and robust export gains. The increase in the bilateral NATO exports can also be linked to an increase in the military expenditures to GDP in the European countries since the Russian invasion of Ukraine in 2014 and even more significantly since 2016, when President Trump demanded that other NATO members spend more on defence or leave NATO.[1]

Further analysis on the newly accepted countries presented in Table A9 in the online appendix demonstrates the insignificant short-run accession effects for Montenegro, Finland and Sweden are consistent with the long-run gradual build-up documented in this section. A further explanation for the statistically insignificant estimates obtained for Finland and Sweden, beyond the long-term effect discussed above, may lie in their pre-accession trade integration. Both countries were already deeply embedded in European and transatlantic trade networks prior to joining NATO, having been long-standing members of the European Union and the Single Market. Given this high baseline level of integration, NATO accession may have offered limited additional scope for trade creation, at least in the short run, such that no immediate effect is detectable in the data.

Overall, Figure 4 indicates that for countries joining NATO between 1988 and 2022, membership consistently leads to measurable and statistically significant increases in exports. The benefits unfold over time and become more pronounced as global markets mature and member countries deepen their trade ties within the alliance.

7 Trade Mechanisms and Product-Level Heterogeneity

Military alliances, such as NATO, can act as catalysts for closer economic ties between member countries, especially in industries vital for mutual defence. These alliances build trust, security, and policy coordination, which, in turn, reduce trade costs, enhance contract enforcement, and increase trade in sensitive goods. The outcome is increasingly integrated supply chains and collaborative efforts in strategic sectors. Empirical evidence supports the positive impact of military alliances on trade (Mansfield and Bronson, 1997; Jackson and Shepotylo, 2024; Li et al., 2024).

Informal institutions, including trust and reputation mechanisms, play a critical role in facilitating the development of commerce, especially in environments with high transaction costs, such as those involving the development of military and security goods (Greif, 1993). These institutions offer alternative ways to mitigate risks, enforce contracts, and foster cooperation among economic actors. Security alliances, by fostering trust and reducing perceived risks, are beneficial for businesses operating across borders. This is particularly crucial in defence-related industries where sensitive technologies and information are exchanged. The shared security protocols and commitments of an alliance serve as a credible guarantee for contract enforcement and protect against opportunistic behaviour by governments (Long and Leeds, 2006). This, in turn, fosters confidence

[1] See for instance Sevastopulo and Dyer (2016)

in cross-border investments and long-term partnerships.

Trust, often strengthened by political alliances, is a critical driver of international trade. It helps mitigate information asymmetries, improves contract enforcement, and reduces perceived risks, encouraging firms to engage in cross-border transactions via collective enforcement mechanisms (Greif, 1994; Anderson and Marcouiller, 2002). Reduced information asymmetry, due to shared intelligence and collaborative platforms within the alliance, improves transparency and facilitates better decision-making for businesses. Furthermore, stable political environments and robust institutions, including strong property rights protection and efficient legal systems, contribute to reduced trade costs and increased trade. They also help to resolve asymmetry of information, trust and security issues. (Nunn and Trefler, 2015; Levchenko, 2007; Fernandes et al., 2022). Similar to bilateral and multilateral preferential trade agreements, these factors also help reduce trade policy uncertainty (Handley and Limao, 2015).

Increased trust and reduced risk encourage firms to integrate their supply chains across allied nations, enabling the efficient flow of goods, services, and expertise. This integration strengthens the collective industrial base and enhances the alliance's capacity to meet mutual defence needs (Gowa and Mansfield, 2004). The alliance framework provides a platform for collaboration in research and development, joint production, and technology transfer in strategic industries. This collaborative ecosystem fosters innovation and specialisation, leading to more advanced and interoperable defence capabilities (Schmid et al., 2017). The alliance's combined economic strength and market size attract foreign direct investment in key industries, further bolstering production capacity and technological advancement for mutual defence (Li and Vashchilko, 2010). Based on these arguments, we expect that the effect of NATO on trade is more pronounced for sensitive products which can be used for military purposes, for more differentiated goods with higher asymmetric information and contract enforcement issues, as well as for intermediate goods due to participation in global value chains, encouraged by military production and government contracts between the alliance members.

7.1 NATO and Exports: Heterogeneity of the Effect

To address potential aggregation bias, we use product-level trade data, which provides a more granular view of the effects of NATO membership than aggregate country-level data. We estimate the structural gravity model 2 for each HS6 product using the PPML method, resulting in more than 6500 regression coefficients for NATO membership. We find that, on average, the effect of NATO on exports at the HS6 level is 0.161 log points with an average standard error of 0.007. It is higher than the average impact of PTAs and defence alliances but smaller than that of EU membership. Figure 5 provides a summary of how the estimated impact of NATO, EU, PTA, and defence alliances on exports varies across a large number of products. Specifically, it presents the distribution of more than 5,800 individual coefficient estimates, each derived from a separate PPML regression run at the HS6 product level.[2]

These distributions highlight several key insights. First, the distribution of the defence alliance coefficients is considerably more negative than the distribution of the rest of the coefficients. The distribution of the PTA coefficients is positively skewed and more concentrated around the mean of 0.15. The distribution of the EU coefficients has the highest mean (0.183) and the lowest mean standard error. As a result, when comparing the distributions of the EU and NATO coefficients, the NATO distribution has a longer, fatter tail on the right, indicating a relatively small number of products in which the effect of NATO membership has a very strong positive impact.

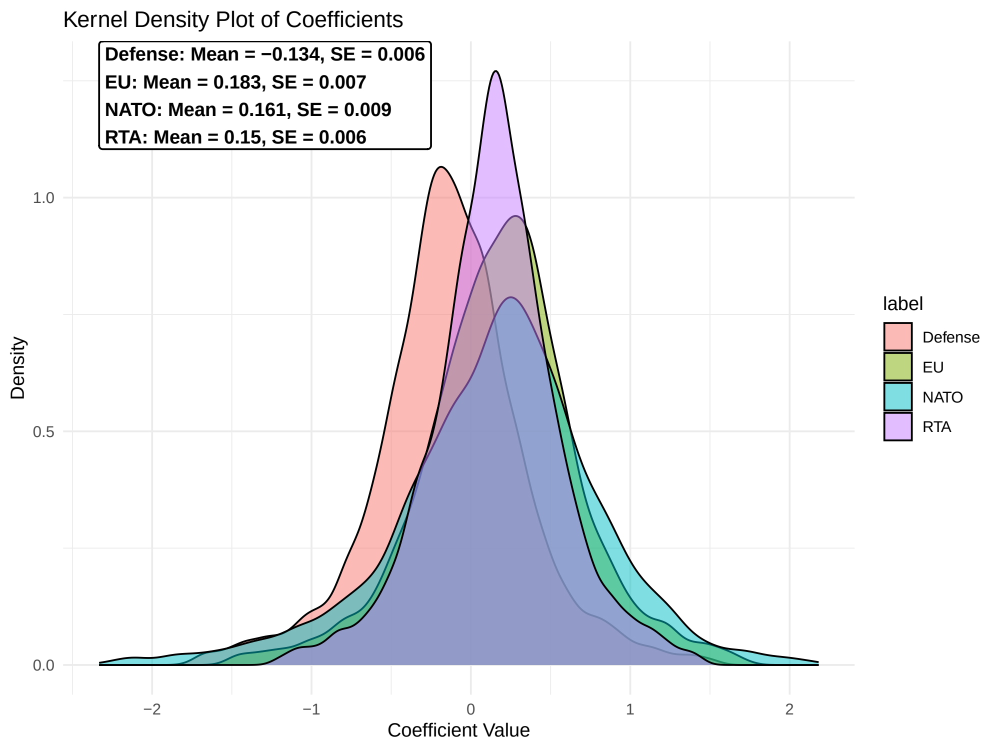

Figure 5: Distribution of the coefficients

7.2 Dual Use Goods, Product Differentiation and Supply Chains

Table 10 summarises a two-step heterogeneity analysis based on HS6-level estimates of the NATO trade effect described in the previous sub-section. In the first step, we estimate our baseline structural-gravity specification separately for each HS6 product code $\hat{\gamma}_{h,NATO}$, which yields an estimated NATO semi-elasticity capturing the product-specific average treatment effect of joint NATO membership on bilateral exports for that HS6 code. This procedure produces a cross-section of approximately 5,850 product-level coefficients (one per HS6 code), which we interpret as a “distribution” of NATO effects across products. In the second step, we explain systematic

[2]We trim the distribution to remove the lowest 1st and highest 99th percentiles of the distribution of the coefficients.

variation in these estimated effects by regressing $\hat{\gamma}_{h,NATO}$ on observable product characteristics. Specifically, we relate product-level NATO effects to (i) an indicator for whether the product is classified as dual-use (based on the EU dual-use control lists and their HS concordances, which vary over time), and to finer dual-use categories (e.g., nuclear, electronics, sensors/lasers); (ii) the Rauch classification to distinguish differentiated from homogeneous/reference goods; and (iii) the BEC classification to identify intermediate inputs.

This second-stage approach allows us to test whether NATO-related trade effects are disproportionately concentrated in products plausibly linked to alliance interoperability, regulated technologies, and supply-chain trade in inputs, rather than being uniform across all goods.[3]

The results in Table 10 show substantial heterogeneity in the estimated NATO trade effect across HS6 products, and this heterogeneity is systematically related to product characteristics. In column (i), the baseline NATO effect for non–dual-use products is positive (0.124) and highly significant, while the interaction term indicates that the NATO effect is significantly larger for dual-use products: the additional effect for dual-use goods is 0.125, implying an overall NATO semi-elasticity of roughly 0.249 for dual-use categories (baseline plus interaction). This pattern is consistent with the view that alliance membership is particularly relevant for goods subject to security-related coordination and technology controls.

Columns (ii)–(iv) extend the analysis to other product characteristics. The positive and significant interactions with differentiated goods (about 0.15–0.16) indicate that products that are harder to substitute and more relationship-intensive exhibit larger estimated NATO effects, consistent with reduced uncertainty or lower transaction costs among alliance partners. We also find a positive and statistically significant interaction with intermediate goods (0.137), suggesting that NATO-related effects are stronger for inputs used in production, consistent with deeper supply-chain trade among members. Importantly, these results describe differences in estimated NATO effects across product types; they do not, on their own, identify a single mechanism.

Column (v) further disaggregates dual-use products into EU control-list categories. The largest incremental NATO effects are concentrated in technology-intensive groups—electronics (0.365), computers (0.534), sensors and lasers (0.454), aerospace and propulsion (0.313), and materials processing (0.220) – all of which are statistically significant. By contrast, some categories (e.g., telecommunications, marine, and navigation/avionics) have positive point estimates but are imprecisely estimated and not statistically distinguishable from zero in this specification. Overall, the evidence indicates that NATO membership is associated with particularly strong trade effects in dual-use and technology-intensive product groups, and more broadly in differentiated and intermediate goods, consistent with alliance-related coordination and interoperability channels operating alongside standard economic integration mechanisms.

[3] The EU dual-use lists and their time-varying HS mappings are described at https://policy.trade.ec.europa.eu/help-exporters-and-importers/exporting-dual-use-items_en.

Table 10: NATO coefficients and dual-use goods

Dependent Variable:	Average treatment effect: $\gamma_{h,NATO}$				
Model:	(i)	(ii)	(iii)	(iv)	(v)
Variables					
NATO	0.124***	0.024	0.023	0.019	0.124***
	(0.009)	(0.017)	(0.017)	(0.040)	(0.009)
NATO x Dual use	0.125***	0.111***	0.107***	0.107***	
	(0.029)	(0.029)	(0.029)	(0.029)	
NATO x Differentiated goods		0.163***	0.153***	0.157***	
		(0.020)	(0.020)	(0.042)	
NATO x Intermediate goods			0.137***	0.137***	
			(0.036)	(0.036)	
NATO x Reference goods				0.004	
				(0.044)	
NATO x Dual use x Nuclear					0.199**
					(0.081)
NATO x Dual use x Special materials and related equipment					-0.053
					(0.045)
NATO x Dual use x Materials processing					0.220***
					(0.049)
NATO x Dual use x Electronics					0.365***
					(0.117)
NATO x Dual use x Computers					0.534***
					(0.185)
NATO x Dual use x Telecommunications					0.117
					(0.131)
NATO x Dual use x Sensors and lasers					0.454***
					(0.083)
NATO x Dual use x Navigation and avionics					0.348
					(0.217)
NATO x Dual use x Marine					0.106
					(0.124)
NATO x Dual use x Aerospace and propulsion					0.313***
					(0.085)
Fit statistics					
Observations	5,793	5,580	5,580	5,580	5,793
R^2	0.00372	0.01711	0.01937	0.01937	0.01267
Adjusted R^2	0.00355	0.01676	0.01884	0.01867	0.01096

Heteroskedasticity-robust standard-errors in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

8 Conclusion

This paper provides new evidence on the economic consequences of security alliances by estimating the causal impact of NATO membership on international trade. Using a structural gravity framework combined with staggered difference-in-differences methods, we show that NATO accession generates economically meaningful and statistically robust increases in bilateral trade among member states. These effects are not short-lived: they emerge gradually, strengthen over time, and remain positive even during periods of heightened geopolitical tension, including the Russian invasion of Ukraine in 2022–2025.

Our findings reveal three central patterns. First, NATO membership increases trade between members, with long-run effects that are economically sizable across specifications and samples. Second, NATO and EU membership are complementary: the interaction between security and economic integration is positive and statistically significant, indicating that defence cooperation and deep market integration reinforce one another rather than operate as substitutes. Third, trade gains are concentrated in strategically sensitive sectors, particularly dual-use, differentiated, and intermediate goods, consistent with mechanisms rooted in interoperability, shared standards, and supply-chain integration rather than purely demand-driven shifts in final goods.

The sectoral evidence points to deeper structural changes within the alliance. Trade in dual-use goods, such as advanced electronics, sensors, and specialised components, expands disproportionately among NATO members, suggesting that alliance membership fosters a trusted institutional environment for the exchange of strategically relevant products. Similarly, increased trade in differentiated and intermediate goods indicates closer integration into cross-border production networks, including defence-industrial supply chains. These patterns support the view that security cooperation can shape the organisation of value chains by reducing uncertainty, aligning regulatory frameworks, and strengthening institutional trust.

The persistence of these trade-enhancing effects during the Ukraine war further underscores NATO's stabilising role. Even amid heightened geopolitical risk and global supply-chain disruption, alliance membership is associated with stronger trade linkages among members. This suggests that security alliances may function not only as deterrence mechanisms but also as anchors of economic resilience in periods of systemic stress.

While our sectoral analysis provides compelling evidence that NATO-related trade expansion is concentrated in dual-use, differentiated, and intermediate goods, we acknowledge certain limitations in identifying the precise underlying mechanisms. The observed patterns—specifically the growth in complex and strategically sensitive product categories—strongly suggest that military interoperability and the formation of alliance-centered production networks are the primary drivers of these trade flows. However, as our methodology relies on HS6-level product classifications rather than direct firm-to-firm linkages, these findings should be interpreted as strong indirect evidence of supply-chain integration. Future research utilizing granular transaction-level or firm-level data would be valuable to further deconstruct these micro-foundations and confirm the extent to which security alignment facilitates specific corporate-level partnerships and deep-tier supplier integration.

The event study analysis reveals a statistically significant anticipation effect occurring approximately three years prior to formal NATO accession. This 'pre-membership boost' likely reflects the rigorous institutional and military alignment required during the accession process. For many candidate countries, particularly in the post-1988 waves, the road to membership involved participation in the Partnership for Peace (PfP) program and the Membership Action Plan (MAP).

These frameworks mandate preliminary institutional reforms, the adoption of Western legal and technical standards, and initial investments in military interoperability.

Taken together, our results highlight NATO's dual role as both a security institution and a driver of economic integration. In an era characterised by strategic rivalry, industrial policy activism, and the reconfiguration of global value chains, the economic implications of security alliances have become increasingly salient. For prospective member states, NATO accession entails not only collective defence commitments but also measurable integration into trusted production networks, particularly in sectors of strategic importance. For policymakers in existing member states, the findings suggest that defence cooperation and economic integration should be viewed as mutually reinforcing pillars of geopolitical strategy.

More broadly, this paper contributes to three strands of literature: the economic effects of security alliances, the interaction between geopolitics and international trade, and the trade consequences of NATO enlargement. Future research may further examine how alliance membership reshapes procurement networks, technological diffusion, and firm-level trade patterns, as well as how security institutions interact with emerging forms of economic statecraft. As trade and geopolitics become increasingly intertwined, understanding the economic dimensions of security alliances will remain central to both academic research and policy design.

References

Anderson, J. E. (1979). A theoretical foundation for the gravity equation. *The American economic review*, 69(1):106–116.

Anderson, J. E. and Marcouiller, D. (2002). Insecurity and the pattern of trade: An empirical investigation. *Review of Economics and statistics*, 84(2):342–352.

Anderson, J. E. and Van Wincoop, E. (2003). Gravity with gravitas: A solution to the border puzzle. *American economic review*, 93(1):170–192.

Baier, S. L. and Bergstrand, J. H. (2007). Do free trade agreements actually increase members' international trade? *Journal of International Economics*, 71(1):72–95.

Baier, S. L. and Bergstrand, J. H. (2009). Bonus vetus OLS: A simple method for approximating international trade-cost effects using the gravity equation. *Journal of International Economics*, 77(1):77–85.

Baier, S. L., Yotov, Y. V., and Zylkin, T. (2019). On the widely differing effects of free trade agreements: Lessons from twenty years of trade integration. *Journal of International Economics*, 116:206–226.

Bailey, M. A., Strezhnev, A., and Voeten, E. (2017). Estimating Dynamic State Preferences from United Nations Voting Data. *Journal of Conflict Resolution*, 61(2):430–456.

Baker, A. C., Larcker, D. F., and Wang, C. C. (2022). How much should we trust staggered difference-in-differences estimates? *Journal of Financial Economics*, 144(2):370–395.

Breinlich, H., Novy, D., and Santos Silva, J. (2024). Trade, gravity, and aggregation. *Review of Economics and Statistics*, 106(5):1418–1426.

Callaway, B. and Sant'Anna, P. H. (2021). Difference-in-differences with multiple time periods. *Journal of econometrics*, 225(2):200–230.

Card, D. and Krueger, A. (1994). Minimum wages and employment: A case study of the fast-food industry in new jersey and pennsylvania. *American Economic Review*, 84(4):772–793.

Correia, S., Guimarães, P., and Zylkin, T. (2020). Fast poisson estimation with high-dimensional fixed effects. *The Stata Journal*, 20(1):95–115.

De Chaisemartin, C. and d'Haultfoeuille, X. (2020). Two-way fixed effects estimators with heterogeneous treatment effects. *American economic review*, 110(9):2964–2996.

Fernandes, A. M., Kee, H. L., and Winkler, D. (2022). Determinants of global value chain participation: Cross-country evidence. *The World Bank Economic Review*, 36(2):329–360.

Fordham, B. O. (2010). Trade and asymmetric alliances. *Journal of Peace Research*, 47(6):685–696.

Gibler, D. M. (2008). International military alliances, 1648~ 2008.

Goodman-Bacon, A. (2021). Difference-in-differences with variation in treatment timing. *Journal of econometrics*, 225(2):254–277.

Gowa, J. and Mansfield, E. D. (2004). Alliances, imperfect markets, and major-power trade. *International Organization*, 58(4):775–805.

Greif, A. (1993). Contract enforceability and economic institutions in early trade: The Maghribi Traders' Coalition. *American Economic Review*, 83(3):525.

Greif, A. (1994). Cultural Beliefs and the Organization of Society: A Historical and Theoretical Reflection on Collectivist and Individualist Societies. *Journal of Political Economy*, 102(5):912–950.

Handley, K. and Limao, N. (2015). Trade and Investment under Policy Uncertainty: Theory and Firm Evidence. *American Economic Journal-Economic Policy*, 7(4):189–222.

Head, K. and Mayer, T. (2014). Gravity Equations: Workhorse, Toolkit, and Cookbook. *Handbook of International Economics*, 4:131.

Jackson, K. and Shepotylo, O. (2024). Political alliances and trade: Europe in a polarized world. *European Journal of Political Economy*, 85:102612.

Levchenko, A. A. (2007). Institutional quality and international trade. *The Review of Economic Studies*, 74(3):791–819.

Li, B., Ge, Y., and Lin, Y.-m. (2024). Military alliance and international trade: Evidence from nato enlargement. *The World Economy*, 47(3):930–956.

Li, Q. and Vashchilko, T. (2010). Dyadic military conflict, security alliances, and bilateral fdi flows. *Journal of International Business Studies*, 41:765–782.

Long, A. G. and Leeds, B. A. (2006). Trading for security: Military alliances and economic agreements. *Journal of Peace Research*, 43(4):433–451.

Mansfield, E. D. and Bronson, R. (1997). Alliances, preferential trading arrangements, and international trade. *American Political Science Review*, 91(1):94–107.

Mityakov, S., Tang, H., and Tsui, K. K. (2013). International politics and import diversification. *The Journal of Law and Economics*, 56(4):1091–1121.

Nunn, N. and Trefler, D. (2015). Domestic institutions as a source of comparative advantage. *Handbook of International Economics*, 4(2013-05).

Roth, J., Sant'Anna, P. H., Bilinski, A., and Poe, J. (2023). What's trending in difference-in-differences? a synthesis of the recent econometrics literature. *Journal of Econometrics*, 235(2):2218–2244.

Schmid, J., Brummer, M., and Taylor, M. Z. (2017). Innovation and alliances. *Review of Policy Research*, 34(5):588–616.

Sevastopulo, D. and Dyer, G. (2016). Trump brands nato 'obsolete' ahead of tough wisconsin primary.

Silva, J. S. and Tenreyro, S. (2006). The log of gravity. *The Review of Economics and statistics*, pages 641–658.

Sun, L. and Abraham, S. (2021). Estimating dynamic treatment effects in event studies with heterogeneous treatment effects. *Journal of econometrics*, 225(2):175–199.

Tinbergen, J. (1962). Shaping the world economy: Suggestions for an international economic policy. *The Twentieth Century Fund*.

Yotov, Y. V., Piermartini, R., Larch, M., et al. (2016). *An advanced guide to trade policy analysis: The structural gravity model*. WTO iLibrary.

9 Appendix

9.1 A1: Sample composition

Country Name	Country Code	1948	1988	2022
Aruba	ABW			✓
Afghanistan	AFG		✓	✓
Angola	AGO	✓	✓	✓
Albania	ALB		✓	✓
United Arab Emirates	ARE		✓	✓
Argentina	ARG	✓	✓	✓
Armenia	ARM			✓
Antigua and Barbuda	ATG			✓
Australia	AUS	✓	✓	✓
Austria	AUT	✓	✓	✓
Azerbaijan	AZE			✓
Burundi	BDI		✓	✓
Belgium	BEL			✓
Benin	BEN		✓	✓
Burkina Faso	BFA		✓	✓
Bangladesh	BGD		✓	✓
Bulgaria	BGR	✓	✓	✓
Bahrain	BHR		✓	✓
Bahamas	BHS		✓	✓
Bosnia and Herzegovina	BIH			✓
Belarus	BLR			✓
Belize	BLZ		✓	✓
Bolivia	BOL	✓	✓	✓
Brazil	BRA	✓	✓	✓
Barbados	BRB		✓	✓
Brunei	BRN		✓	✓
Bhutan	BTN			✓
Botswana	BWA			✓
Central African Republic	CAF		✓	✓
Canada	CAN	✓	✓	✓
Switzerland	CHE	✓	✓	✓
Chile	CHL	✓	✓	✓

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(continued)

Country Name	Country Code	1948	1988	2022
China	CHN		✓	✓
Ivory Coast	CIV		✓	✓
Cameroon	CMR	✓	✓	✓
Congo (Kinshasa)	COD	✓	✓	✓
Congo (Brazzaville)	COG		✓	✓
Colombia	COL	✓	✓	✓
Comoros	COM		✓	✓
Cabo Verde	CPV		✓	✓
Costa Rica	CRI	✓	✓	✓
Cyprus	CYP	✓	✓	✓
Czechia	CZE			✓
Germany	DEU	✓	✓	✓
Djibouti	DJI		✓	✓
Dominica	DMA		✓	✓
Denmark	DNK	✓	✓	✓
Dominican Republic	DOM	✓	✓	✓
Algeria	DZA	✓	✓	✓
Ecuador	ECU	✓	✓	✓
Egypt	EGY	✓	✓	✓
Eritrea	ERI			✓
Spain	ESP	✓	✓	✓
Estonia	EST			✓
Ethiopia	ETH		✓	✓
Finland	FIN	✓	✓	✓
Fiji	FJI		✓	✓
France	FRA	✓	✓	✓
Micronesia	FSM			✓
Gabon	GAB		✓	✓
United Kingdom	GBR	✓	✓	✓
Georgia	GEO			✓
Ghana	GHA	✓	✓	✓
Guinea	GIN		✓	✓
Gambia	GMB		✓	✓
Guinea-Bissau	GNB		✓	✓
Equatorial Guinea	GNQ		✓	✓

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(continued)

Country Name	Country Code	1948	1988	2022
Greece	GRC	✓	✓	✓
Grenada	GRD		✓	✓
Guatemala	GTM	✓	✓	✓
Guyana	GUY	✓	✓	✓
Hong Kong	HKG	✓	✓	✓
Honduras	HND	✓	✓	✓
Croatia	HRV			✓
Haiti	HTI	✓	✓	✓
Hungary	HUN	✓	✓	✓
Indonesia	IDN	✓	✓	✓
India	IND	✓	✓	✓
Ireland	IRL	✓	✓	✓
Iran	IRN	✓	✓	✓
Iraq	IRQ	✓	✓	✓
Iceland	ISL	✓	✓	✓
Israel	ISR		✓	✓
Italy	ITA	✓	✓	✓
Jamaica	JAM	✓	✓	✓
Jordan	JOR	✓	✓	✓
Japan	JPN	✓	✓	✓
Kazakhstan	KAZ			✓
Kenya	KEN	✓	✓	✓
Kyrgyzstan	KGZ			✓
Cambodia	KHM		✓	✓
Kiribati	KIR			✓
Saint Kitts and Nevis	KNA		✓	✓
South Korea	KOR		✓	✓
Kuwait	KWT		✓	✓
Laos	LAO		✓	✓
Lebanon	LBN		✓	✓
Liberia	LBR		✓	✓
Libya	LBY		✓	✓
Saint Lucia	LCA		✓	✓
Sri Lanka	LKA	✓	✓	✓
Lesotho	LSO			✓

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(continued)

Country Name	Country Code	1948	1988	2022
Lithuania	LTU			✓
Luxembourg	LUX			✓
Latvia	LVA			✓
Macau	MAC		✓	✓
Morocco	MAR	✓	✓	✓
Moldova	MDA			✓
Madagascar	MDG	✓	✓	✓
Maldives	MDV		✓	✓
Mexico	MEX	✓	✓	✓
Marshall Islands	MHL			✓
North Macedonia	MKD			✓
Mali	MLI		✓	✓
Malta	MLT		✓	✓
Myanmar	MMR	✓	✓	✓
Montenegro	MNE			✓
Mongolia	MNG		✓	✓
Mozambique	MOZ	✓	✓	✓
Mauritania	MRT		✓	✓
Mauritius	MUS	✓	✓	✓
Malawi	MWI		✓	✓
Malaysia	MYS		✓	✓
Namibia	NAM			✓
Niger	NER		✓	✓
Nigeria	NGA	✓	✓	✓
Nicaragua	NIC	✓	✓	✓
Netherlands	NLD	✓	✓	✓
Norway	NOR	✓	✓	✓
Nepal	NPL		✓	✓
Nauru	NRU			✓
New Zealand	NZL	✓	✓	✓
Oman	OMN		✓	✓
Pakistan	PAK	✓	✓	✓
Panama	PAN	✓	✓	✓
Peru	PER	✓	✓	✓
Philippines	PHL	✓	✓	✓

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Country Name	Country Code	1948	1988	2022
Palau	PLW			✓
Papua New Guinea	PNG		✓	✓
Poland	POL	✓	✓	✓
Portugal	PRT	✓	✓	✓
Paraguay	PRY	✓	✓	✓
Qatar	QAT		✓	✓
Romania	ROU		✓	✓
Russia	RUS			✓
Rwanda	RWA		✓	✓
Saudi Arabia	SAU		✓	✓
Sudan	SDN	✓	✓	✓
Senegal	SEN		✓	✓
Singapore	SGP		✓	✓
Solomon Islands	SLB		✓	✓
Sierra Leone	SLE	✓	✓	✓
El Salvador	SLV	✓	✓	✓
San Marino	SMR			✓
Somalia	SOM		✓	✓
Serbia	SRB			✓
South Sudan	SSD			✓
São Tomé and Príncipe	STP		✓	✓
Suriname	SUR	✓	✓	✓
Slovakia	SVK			✓
Slovenia	SVN			✓
Sweden	SWE	✓	✓	✓
Eswatini	SWZ			✓
Seychelles	SYC		✓	✓
Syria	SYR		✓	✓
Chad	TCD		✓	✓
Togo	TGO		✓	✓
Thailand	THA		✓	✓
Tajikistan	TJK			✓
Turkmenistan	TKM			✓
Timor-Leste	TLS			✓
Tonga	TON		✓	✓

Continued on next page

(continued)

Country Name	Country Code	1948	1988	2022
Trinidad and Tobago	TTO	✓	✓	✓
Tunisia	TUN	✓	✓	✓
Turkey	TUR	✓	✓	✓
Tuvalu	TUV			✓
Tanzania	TZA	✓	✓	✓
Uganda	UGA		✓	✓
Ukraine	UKR			✓
Uruguay	URY	✓	✓	✓
United States	USA	✓	✓	✓
	UVK			✓
Uzbekistan	UZB			✓
Saint Vincent and the Grenadines	VCT		✓	✓
Venezuela	VEN	✓	✓	✓
Vietnam	VNM		✓	✓
Vanuatu	VUT		✓	✓
Samoa	WSM		✓	✓
Yemen	YEM			✓
South Africa	ZAF			✓
Zambia	ZMB	✓	✓	✓
Zimbabwe	ZWE	✓	✓	✓

9.2 A2: SDID results for 1949-1987 sample

Table A2: Staggered DID estimates: group-time (EGT), event-study, and calendar-time effects

EGT	**Group**	**Event Study**	**Calendar**
1952	0.0751		0.1384
	(0.1676)		(0.1143)
1955	0.6045***		−0.0007
	(0.0912)		(0.0883)
1982	0.5363***		0.2772*
	(0.0940)		(0.1145)
-5		−0.0955*	
		(0.0462)	

Continued on next page

Table A2 continued

EGT	Group	Event Study	Calendar
-4		-0.0597^{*} (0.0293)	
-3		0.1451^{***} (0.0302)	
-2		0.0559 (0.0329)	
-1		0.0369 (0.0276)	
0		0.1097^{*} (0.0554)	
1		0.2243^{**} (0.0687)	
2		0.1014 (0.0757)	
3		0.2167^{**} (0.0780)	
4		0.2719^{**} (0.0884)	
5		0.3725^{***} (0.0915)	
6		0.1582 (0.1090)	
7		0.2360^{*} (0.0983)	
8		0.2343^{*} (0.1013)	
9		0.2237^{*} (0.1100)	
10		0.3068^{**} (0.0973)	
11		0.2801^{**} (0.1021)	
12		0.1693 (0.1207)	

Continued on next page

Table A2 continued

EGT	Group	Event Study	Calendar
13		0.1790 (0.1315)	
14		0.2047 (0.1221)	
15		0.2953* (0.1447)	
16		0.2456 (0.1293)	
17		0.3517** (0.1343)	
18		0.3448* (0.1515)	
19		0.3269* (0.1369)	
20		0.4445*** (0.1273)	
1953			0.1673 (0.1452)
1954			−0.1689 (0.1368)
1956			0.0044 (0.0887)
1957			0.0948 (0.1021)
1958			0.1230 (0.1106)
1959			0.1946* (0.0971)
1960			0.1981* (0.0953)
1961			0.2045* (0.0931)
1962			0.2789** (0.0953)

Continued on next page

Table A2 continued

EGT	Group	Event Study	Calendar
1963			0.2482*
			(0.1026)
1964			0.1356
			(0.1117)
1965			0.1632
			(0.1254)
1966			0.1677
			(0.1193)
1967			0.2250
			(0.1415)
1968			0.1861
			(0.1415)
1969			0.2972*
			(0.1426)
1970			0.2878*
			(0.1408)
1971			0.3258*
			(0.1472)
1972			0.4713***
			(0.1371)
1973			0.6148***
			(0.1374)
1974			0.3949**
			(0.1303)
1975			0.3004
			(0.1736)
1976			0.3461*
			(0.1571)
1977			0.2384
			(0.1586)
1978			0.2043
			(0.1520)
1979			0.1622
			(0.1808)

Continued on next page

Table A2 continued

EGT	Group	Event Study	Calendar
1980			0.1729 (0.1802)
1981			0.2136 (0.1587)
1983			0.4255*** (0.1140)
1984			0.4700*** (0.1137)
1985			0.5959*** (0.1094)
1986			0.8153*** (0.1253)
1987			0.9368*** (0.1251)

Notes: Coefficients are reported with standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

9.3 A3: SDID results for 1988-2022 sample

EGT	Group	Event Study	Calendar
1999	0.3126 * ** (0.0938)		−0.0600 (0.1312)
2004	0.2744 * ** (0.0700)		0.2358 * ** (0.0536)
2009	0.6699 * * (0.2191)		0.1571* (0.0616)
-5		−0.0035 (0.0366)	
-4		0.0639 (0.0351)	
-3		0.1052 * * (0.0373)	

Continued on next page

Table A3 continued

EGT	Group	Event Study	Calendar
-2		0.1126 ∗ ∗∗ (0.0336)	
-1		0.1277 ∗ ∗∗ (0.0372)	
0		0.0715 (0.0540)	
1		0.0562 (0.0538)	
2		0.1067∗ (0.0536)	
3		0.1719 ∗ ∗ (0.0558)	
4		0.2397 ∗ ∗∗ (0.0655)	
5		0.2276 ∗ ∗∗ (0.0651)	
6		0.2185 ∗ ∗∗ (0.0656)	
7		0.3019 ∗ ∗∗ (0.0757)	
8		0.3247 ∗ ∗∗ (0.0810)	
9		0.3604 ∗ ∗∗ (0.0814)	
10		0.3359 ∗ ∗∗ (0.0839)	
11		0.3148 ∗ ∗∗ (0.0822)	
12		0.4070 ∗ ∗∗ (0.0820)	
13		0.3953 ∗ ∗∗ (0.0887)	
14		0.3880 ∗ ∗∗ (0.0845)	

Continued on next page

Table A3 continued

EGT	**Group**	**Event Study**	**Calendar**
15		$0.4349***$ (0.0885)	
16		$0.4895***$ (0.0873)	
17		$0.5601***$ (0.0903)	
18		$0.4936***$ (0.0858)	
19		$0.6451***$ (0.1224)	
20		$0.6782***$ (0.1241)	
2000			-0.0752 (0.0906)
2001			-0.0270 (0.1041)
2002			0.1240 (0.0791)
2003			$0.2593**$ (0.0978)
2005			$0.2232***$ (0.0592)
2006			$0.2868***$ (0.0570)
2007			$0.3399***$ (0.0607)
2008			$0.2305***$ (0.0662)
2010			0.0953 (0.0704)
2011			0.1074 (0.0712)
2012			0.0194 (0.0805)

Continued on next page

Table A3 continued

EGT	Group	Event Study	Calendar
2013			0.1499
			(0.0810)
2014			0.1867*
			(0.0827)
2015			0.2765***
			(0.0819)
2016			0.4723***
			(0.0914)
2017			0.5289***
			(0.0899)
2018			0.7333***
			(0.0927)
2019			0.7477***
			(0.0922)
2020			0.7509***
			(0.0976)
2021			0.7438***
			(0.0857)
2022			0.6699***
			(0.0921)

Notes: Coefficients are reported with standard errors in parentheses. $^{*}p < 0.10$, $^{**}p < 0.05$, $^{***}p < 0.01$.

9.4 A4: Analysis of the log-linear TWFE model

Dependent Variable:	Average treatment effect: $\gamma_{h,NATO}$				
Model:	(i)	(ii)	(iii)	(iv)	(v)
Variables					
NATO	0.168***	0.084***	0.083***	0.032	0.168***
	(0.009)	(0.017)	(0.017)	(0.041)	(0.009)
Dual Use	0.090***	0.081***	0.079***	0.077***	
	(0.024)	(0.025)	(0.025)	(0.025)	
NATO x Differentiated goods		0.134***	0.128***	0.179***	
		(0.019)	(0.020)	(0.042)	
NATO x Intermediate goods			0.078***	0.077***	
			(0.029)	(0.029)	
NATO x Reference goods				0.063	
				(0.045)	
NATO x Dual use x Nuclear					0.037
					(0.082)
NATO x Dual use x Special materials					-0.005
and related equipment					(0.036)
NATO x Dual use x Materials processing					0.169***
					(0.035)
NATO x Dual use x Electronics					0.184**
					(0.086)
NATO x Dual use x Computers					0.278**
					(0.122)
NATO x Dual use x Telecommunications					0.068
					(0.091)
NATO x Dual use x Sensors and lasers					0.271***
					(0.060)
NATO x Dual use x Navigation and					0.294**
avionics					(0.135)
NATO x Dual use x Marine					0.073
					(0.078)
NATO x Dual use x Aerospace and					0.313**
propulsion					(0.122)
Fit statistics					
Observations	5,986	5,759	5,759	5,759	5,986
R^2	0.00193	0.01120	0.01192	0.01240	0.00526
Adjusted R^2	0.00176	0.01085	0.01140	0.01171	0.00360

Heteroskedasticity-robust standard-errors in parentheses

*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

9.5 B: Comparing NATO and EU accession

Further

Table A4: Side-by-side comparison of the typical steps and durations for accession to the EU and the NATO.

Dimension	**European Union (EU)**	**North Atlantic Treaty Organization (NATO)**
Legal basis	Article 49, Treaty on European Union	Article 10, North Atlantic Treaty
Core criteria	"Copenhagen criteria": stable democracy & rule of law; functioning market economy; capacity to adopt and implement the EU *acquis*.	Democratic institutions; contribution to Euro-Atlantic security; ability and willingness to meet political/military obligations (MAP may support reforms but is not mandatory).
Main steps	(1) Application → (2) European Commission opinion → (3) Candidate status → (4) Screening & chapter-by-chapter negotiations on the *acquis* → (5) Accession Treaty signed → (6) Ratification by all Member States and European Parliament → (7) Membership.	(1) Application/aspiration → (2) Allies decide to invite → (3) Accession talks → (4) Accession Protocols signed by Allies → (5) Ratification by all Allies → (6) Instrument of accession deposited (U.S. is depository) → (7) Membership.
Typical duration	Often ∼10 years (driven by reforms and 35+ negotiation chapters).	Often ∼1–3 years (can be much faster or slower depending on unanimous political ratification).
Key unanimity / "veto" points	Multiple: unanimous decisions by Member States to open/close chapters and to sign the Accession Treaty; national ratifications (parliaments and, in some countries, referenda).	Two main gates: unanimous invitation by Allies; unanimous ratification of Accession Protocols by all Allied parliaments.
What drives pace?	Depth/scope of reforms (rule of law, judiciary, competition policy, etc.), administrative capacity, and domestic politics within Member States during ratification.	Geopolitics and Allied unanimity more than technical alignment; defense interoperability/readiness; bilateral issues with individual Allies.

Concrete Timelines (Recent Examples)

- **EU – Croatia: 10 years** Application (2003) → Negotiations (2005-2011) → Accession Treaty (2011) → Membership (1 July 2013).
- **NATO – Finland: 11 months** Applied (May 2022) → Accession Protocol signed (July 2022) → Membership (4 April 2023).
- **NATO – Sweden: 22 months** Applied (May 2022) → Delayed by individual Allied ratifications → Membership (7 March 2024).

9.6 C: Additional robustness checks

Alternative Time Periods To evaluate whether our main findings are sensitive to the choice of period, we re-estimate the PPML regression model on alternative samples. The rationale is that NATO's trade effects may differ between the early Cold War years and the post-Cold War era, given that the Alliance's role and membership evolved over time and its positive influence on member export levels is well established. Table A5 summarises the results. Across all specifications, the estimated coefficients on NATO membership remain positive and statistically significant. This stability holds regardless of whether we drop the early Cold War years or focus exclusively on the post-Cold War period, suggesting that the trade benefits associated with NATO membership persist even when the sample period is altered. In other words, the expansion of the Alliance and shifts in the geopolitical landscape do not drive the results; rather, the positive association between NATO membership and bilateral exports appears to be a consistent feature of transatlantic economic relations.

Table A5: Alternative time periods

	Export, USD			
	From 1960	From 1970	From 1990	Post Cold War
	(i)	(ii)	(iii)	(iv)
NATO	0.276***	0.293***	0.173***	0.157***
	(0.056)	(0.055)	(0.054)	(0.054)
PTA	0.101***	0.096***	0.070**	0.078***
	(0.031)	(0.031)	(0.029)	(0.027)
Defense	0.162***	0.152***	0.095*	0.095*
	(0.043)	(0.043)	(0.054)	(0.053)
EU	0.207***	0.189***	0.111***	0.100***
	(0.032)	(0.033)	(0.033)	(0.033)
Observations	1,527,349	1,385,750	999,190	955,445
Pseudo R^2	0.900	0.900	0.905	0.905
Reporter-Year FE fixed effects	✓	✓	✓	✓
Partner-Year FE fixed effects	✓	✓	✓	✓
Pair FE fixed effects	✓	✓	✓	✓

Heteroskedasticity-robust standard-errors clustered at reporter-partner level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Balanced Panel A further concern for causal interpretation is that missing trade observations may introduce selection bias if the availability of data is systematically related to NATO membership or to unobserved determinants of trade. In an unbalanced panel, some country pairs enter or exit the sample over time, either because small flows fall below reporting thresholds, because reporting practices change, or because political and economic shocks induce temporary interruptions in trade. If such attrition is correlated with alliance status or with latent factors that also affect trade, the estimated NATO effect could be biased.

To address this issue, we re-estimate the baseline PPML specification on a balanced panel that restricts the sample to country-pairs observed in all years of the sample. This restriction eliminates time-varying sample composition and ensures that the comparison between treated and control pairs is based on a fixed set of dyads with complete time-series information. Table A6 reports the results from this exercise.

Table A6: Balanced panel

	Export, USD Full (i) Poisson	Ln(Export, USD) Balanced OLS (ii) OLS	Export, USD Balanced PPML (iii) Poisson
NATO	0.271***	0.318***	0.340***
	(0.055)	(0.109)	(0.105)
PTA	0.105***	0.268***	0.217***
	(0.031)	(0.031)	(0.026)
Defense	0.166***	0.394***	0.059
	(0.043)	(0.060)	(0.053)
EU	0.220***	0.481***	0.206***
	(0.032)	(0.060)	(0.048)
Observations	1,613,088	225,263	301,045
Pseudo R^2	0.901	0.428	0.906
Reporter-Year FE fixed effects	✓	✓	✓
Partner-Year FE fixed effects	✓	✓	✓
Pair FE fixed effects	✓	✓	✓

Heteroskedasticity-robust standard-errors clustered at reporter-partner level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

The estimates obtained from the balanced panel closely mirror those from the full unbalanced sample, both in terms of the magnitude and statistical significance of the NATO coefficient. The persistence of a positive and economically meaningful NATO effect under the balanced-panel restriction indicates that the main findings are not driven by selective entry or exit of country pairs from the sample. This robustness check thus alleviates concerns that missing observations or differential attrition bias the estimated trade premium associated with NATO membership.

Trade Flow Size Restrictions Bilateral trade data display substantial heterogeneity in the size of observed flows, ranging from very small shipments that may be subject to greater measurement error to very large flows that could exert disproportionate influence on the estimates. If NATO membership affects different parts of the trade-flow distribution in distinct ways, or if the results are driven by outliers at either tail, the baseline estimates might not accurately reflect the average effect across all trade relationships. To examine the robustness of our findings and to shed light on potential non-linearities, we re-estimate the baseline specification while progressively excluding smaller flows and focusing on increasingly larger trade relationships.

We begin by defining the empirical distribution of strictly positive bilateral exports, and compute the 25th, 50th and 75th percentiles, denoted p_{25}, p_{50} and p_{75} respectively. We then estimate equation (**??**) on four nested samples: the full set of positive exports, $X_{ijt} > 0$ (Sample 1, equation 12); flows at or above the 25th percentile, $X_{ijt} \geq p_{25}$ (Sample 2, equation 13); flows at or above the median, $X_{ijt} \geq p_{50}$ (Sample 3, equation 14); and finally, flows in the top quartile, $X_{ijt} \geq p_{75}$ (Sample 4, equation 15).

$$\text{Sample 1:} \quad X_{ijt} > 0 \quad \text{(Full sample)} \tag{12}$$

$$\text{Sample 2:} \quad X_{ijt} \geq p_{25} \quad \text{(Above 25th percentile)} \tag{13}$$

$$\text{Sample 3:} \quad X_{ijt} \geq p_{50} \quad \text{(Above median)} \tag{14}$$

$$\text{Sample 4:} \quad X_{ijt} \geq p_{75} \quad \text{(Top quartile)} \tag{15}$$

Table A7: Heterogeneity across different export values

	Export, USD			
	Full	p25	p50	p75
	(i)	(ii)	(iii)	(iv)
NATO	0.271***	0.321***	0.336***	0.370***
	(0.055)	(0.055)	(0.056)	(0.059)
PTA	0.105***	0.114***	0.113***	0.107***
	(0.031)	(0.031)	(0.031)	(0.032)
Defense	0.166***	0.143***	0.130***	0.109**
	(0.043)	(0.042)	(0.042)	(0.044)
EU	0.220***	0.208***	0.212***	0.224***
	(0.032)	(0.031)	(0.031)	(0.033)
Observations	1,613,088	652,977	435,342	217,659
Pseudo R^2	0.901	0.876	0.862	0.840
Reporter-Year FE fixed effects	✓	✓	✓	✓
Partner-Year FE fixed effects	✓	✓	✓	✓
Pair FE fixed effects	✓	✓	✓	✓

Heteroskedasticity-robust standard-errors clustered at reporter-partner level in parentheses
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

Table A7 reports the PPML estimates for these alternative samples and reveals a clear pattern in the size of the NATO coefficient across the trade-flow distribution. In the full sample of positive flows, the NATO coefficient is 0.271, which corresponds to an increase in bilateral exports of roughly 31 per cent for joint members. As we restrict attention to larger flows, the estimated effect strengthens: the coefficient rises to 0.321 (around 38 per cent) when restricting to flows above the 25th percentile, to 0.336 (around 40 per cent) for flows above the median, and to 0.370 (around 45 per cent) for the top quartile of trade relationships. This monotonic increase suggests that

NATO membership has particularly strong effects on established, high-volume trade links.

The fact that the estimated impact of NATO grows with trade size is consistent with an interpretation in which the alliance operates primarily at the intensive margin, by scaling up existing trade relationships rather than primarily generating numerous small new flows at the extensive margin. This pattern aligns with the institutional features of NATO: procurement coordination and large defence contracts, the harmonisation of technical and industrial standards, and enhanced protection for cross-border investment are mechanisms that are more likely to affect sizeable, ongoing exchanges than sporadic or marginal shipments. At the same time, the NATO coefficient remains positive and economically meaningful even in the full sample, indicating that smaller flows also benefit from alliance membership.

Overall, the results are robust across the distribution of trade flow sizes. PPML estimates indicate that NATO membership increases major bilateral trade flows by up to about 45 per cent, while still generating substantial gains when all positive flows are considered. The combined evidence points to NATO facilitating trade at both the extensive and intensive margins, with especially pronounced effects on large, established trading relationships.

9.7 D: Additional results for Russian war on Ukraine

Sample Restrictions We estimate models on several nested samples:

- **All to All:** Full sample of bilateral trade flows
- **OECD to All:** Reporter countries in OECD
- **All to NATO:** Partner countries in NATO
- **OECD to NATO:** Both restrictions combined

9.8 Baseline Effects

Table A8 presents baseline estimates of the NATO-war interaction effect across different sample restrictions, including only bilateral pair fixed effects.

The coefficient on `nato_war` measures the percentage change in trade for NATO pairs during the war period relative to: (a) NATO pairs pre-war, and (b) non-NATO pairs during the war. All specifications show positive point estimates, though magnitudes and precision vary across samples.

9.9 Country-Specific Accession Effects

Looking at the experience of the new NATO members, we did not find a significant increase in the trade of North Macedonia, Finland, and Sweden with the other NATO members. We examine the pooled effect across 3 countries and the separate effects for each. Table A9 decomposes the pooled NATO effect into country-specific estimates for North Macedonia (March 2020), Finland (April 2023), and Sweden (March 2024). The results are positive but not significant, confirming

Table A8: Baseline NATO-War Effects

	Export, USD			
	All to All	OECD to All	All to NATO	OECD to NATO
	(i)	(ii)	(iii)	(iv)
NATO × War	0.148***	0.148***	0.148***	0.148***
	(0.011)	(0.011)	(0.011)	(0.011)
Observations	2,520,541	936,295	352,205	116,536
Pseudo R^2	0.970	0.969	0.970	0.965
Pair FE fixed effects	✓	✓	✓	✓

Standard errors clustered at the reporter-partner level.
Trade data from trade monitors, Jan 2017-Aug 2025.
*Signif. Codes: ***: 0.01, **: 0.05, *: 0.1*

our previous findings that NATO membership requires developing value chain links and integrating infrastructure into NATO command and control to achieve a positive effect on trade.

Table A9: Country-Specific NATO Accession Effects

	Export, USD			
	Pooled	N. Macedonia	Finland	Sweden
	(i)	(ii)	(iii)	(iv)
NATO Member	0.027			
	(0.053)			
N. Macedonia		0.011		
		(0.073)		
Finland			0.058	
			(0.122)	
Sweden				0.007
				(0.040)
Observations	2,323,479	2,323,479	2,323,479	2,323,479
Pseudo R^2	0.988	0.988	0.988	0.988
Pair FE fixed effects	✓	✓	✓	✓
Reporter-Time FE fixed effects	✓	✓	✓	✓
Partner-Time FE fixed effects	✓	✓	✓	✓

Standard errors clustered at the reporter-partner level.
Signif. Codes: ***: 0.01, **: 0.05, *: 0.1
N. Macedonia: March 2020; Finland: April 2023; Sweden: March 2024.
Trade data from Trade Data Monitor, Jan 2017–Dec 2025.