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Lin Jones

Serge Shikher

Yoto V. Yotov

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Abstract

This paper examines the impact of various determinants of trade, including geopolitical risks, on global supply chains using a structural gravity model and the newly constructed *International Trade and Production Database by End Use* (ITPD-U), which disaggregates trade into intermediate, capital, and consumer goods. Results show that intermediate goods trade responds differently to standard trade determinants compared to capital and consumer goods: distance is the largest barrier, while regional agreements and currency unions have weaker effects. Geopolitical risks reduce trade overall, though its impact is notably smaller for intermediate goods, reflecting the "stickiness" of global supply chains. These results highlight the relatively high trade costs and structural inertia characterizing intermediate goods trade amid geopolitical uncertainty.

Lin Jones
Country and Regional Analysis Division
Office of Economics
U.S. International Trade Commission

Serge Shikher
Research Division
Office of Economics
U.S. International Trade Commission
gravity@usitc.gov

Yoto V. Yotov
Drexel University, CGPA, ifo, CESifo

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1 Introduction

Global supply chains (GSCs) have transformed international trade, enabling firms to optimize production across borders and integrate efficiently into global markets. However, geopolitical risks—such as potential economic sanctions, trade restrictions, blockades, and regional conflicts—pose significant threats to the stability of these interconnected networks. The prospect of such disruptions creates uncertainties that affect investment decisions and trade flows. Therefore, understanding the impact of geopolitical risks on GSCs is critical for policymakers and businesses seeking to mitigate vulnerabilities, safeguard economic stability, and reinforce national security.

One of the primary transmission channels through which geopolitical risks affect GSCs is trade in intermediate products. These goods comprise about 60 percent of global merchandise trade today, and serve as essential inputs in international production networks (WTO, 2023). With high frequency of cross-border movements, intermediate good trade is expected to be particularly susceptible to disruptions triggered by geopolitical shocks. Any disruption in intermediate goods trade flows can generate widespread ripple effects, propagating across global supply chains, and impacting countries, industries, businesses, and consumers worldwide.

To quantitatively assess the impact of geopolitical risks on trade flows and global supply chains, we use the workhorse empirical trade model—the gravity equation—and we apply the latest recommendations for gravity estimations from Larch et al. (2025a), as summarized in Section 5. One of the most important contributions of this paper, which enables us to focus on GSCs and intermediate goods, is the construction of a new database—the *International Trade and Production Database by End Use* (ITPD-U).[1] The ITPD-U distinguishes international and domestic trade across three categories of end use—intermediate, capital, and consumer goods—as follows:

[1] The database and its technical documentation (Jones et al., 2025) will be available online, on the USITC's Gravity Portal at gravity.usitc.gov.

- Intermediate goods are products used as inputs in the production of other goods and services. They include raw materials, components, and semi-finished products that require further processing before reaching the final consumer. Examples include steel used in car manufacturing, semiconductor chips for smartphones, and textiles for apparel production.

- Capital goods consist of physical assets used by businesses to produce goods and services. These goods are not directly consumed but serve as tools or infrastructure in production. Examples include machinery and equipment.

- Consumer goods are finished products intended for direct consumption by individuals or households. Examples include household appliances, food, and clothing. These goods require no further processing before reaching end users.

The newly constructed ITPD-U offers a unique opportunity to examine the potentially heterogeneous effects of standard trade determinants across end-use categories, and more specifically, to assess the impact of geopolitical risks on GSCs and intermediate goods trade. Additionally, it enables us to use a gravity model approach to study how the standard determinants of trade flows differently affect consumer, intermediate, and capital goods.

Our key findings can be summarized as follows: First, we find that intermediate goods trade responds differently to standard trade determinants and policy variables, compared to those observed in capital and consumer goods: Distance has the strongest effect on intermediate goods trade. As distance is a primary proxy and determinant for bilateral trade costs, this result suggests that bilateral trade costs for intermediate goods for a given pair of countries are significantly higher than those for the other categories. Meanwhile, contiguity—another geographic variable indicating shared borders—shows the smallest positive effect on intermediate goods trade. This may reflect the fact that intermediate goods often move within complex supply chains, where proximity alone does not guarantee trade integration. It also suggests that trade in intermediates depends more heavily on infrastructure, logistics, and production network linkages than simple geographic closeness.

EU membership has a strong positive effect on consumer goods trade, a modest effect on intermediate goods trade, and a statistically insignificant impact on capital goods trade. Participation in currency unions and regional trade agreements benefits consumer goods trade the most and intermediate goods trade the least. On the other hand, WTO accessions and sanctions have a disproportionately high effect on capital goods trade (positive and negative, respectively), while their impact on consumer and intermediate goods trade is more muted.

Second, we find that geopolitical risks reduce trade flows overall, though its negative effect is smaller on intermediate goods trade. We measure geopolitical risks using several different indices. The Fraser's Economic Freedom Index (EFI) and the World Bank's Worldwide Governance Indicator (WGI) are positively associated with trade, while the Political & Social Value Distance (PSVD) index, that we construct, has a negative effect, indicating that higher geopolitical risk is associated with lower trade volumes. Notably, the impact of these risk indicators is smaller for intermediate goods trade than for consumer goods, a finding that aligns with existing theories and empirical evidence on global supply chain "stickiness" (Grossman et al., 2024).

Finally, we test the popular Geopolitical Distance (GD) index that is based on the United Nation (UN) General Assembly voting data. However, we obtain counterintuitive results—its estimated impact on trade is positive and statistically significant across all goods categories in our sample. This result confirms concerns about the validity of using this variable to predict bilateral economic relationships and highlights the need for caution when employing the UN voting data as a proxy for geopolitical alignment (Broner et al., 2025).

The rest of this paper is structured as follows. Section 2 provides a literature review on the economic impact of geopolitical risks and the resistance of global supply chains to changes. Section 3 discusses the data used in this paper and their sources, with a particular focus on the ITPD-U and geopolitical risk measures. Section 4 highlights several global trade patterns by end use, informed by the newly constructed ITPD-U. Section 5 outlines the econometric methods employed in the analysis. Section 6 summarizes the estimation results, offering insights on the effects of standard trade determinants as well as geopolitical risks on global trade and supply chain dynamics. Finally, Section 7 concludes the paper by highlighting key findings and outlining directions for future research and methodological advancements.

2 Literature Review

While most studies of global supply chain risks focus on logistical disruptions (Federal Reserve Bank of New York, 2025; Arvis et al., 2024), recent geopolitical events—such as Russia's invasion of Ukraine and U.S.-China trade tension—are found to have had a growing impact on global supply chains (Fajgelbaum et al., 2023; Freund et al., 2024; Luo and Wang, 2025). As a result, there are growing interests in investigating the effect of geopolitical risks.

Geopolitical risks include adverse geopolitical events such as political instability, conflicts, sanctions, trade disputes, and policy shifts that affect economic performance, financial markets, and supply chains (S&P Global, 2025). Caldara and Iacoviello (2018) characterize geopolitical risks as both the threat and realization of such adverse geopolitical events.

Applying the Geopolitical Risk (GPR) Index—a news-based measure that they constructed,[2] Caldara and Iacoviello (2022) find that heightened geopolitical risk is associated with reduced investment and employment, increased disaster probability, and greater downside risks to the global economy. Notably, both the threat and actual occurrence of geopolitical events contribute to economic downturns.

Also using the GPR index, Gupta et al. (2019) demonstrate that elevated geopolitical

[2]The Geopolitical Risk (GPR) Index, developed by Caldara and Iacoviello (2022), measures geopolitical risk based on the relative frequency of keywords related to geopolitical tensions—such as "war," "terrorist threat," and "military conflict"—appearing in leading international newspapers. The global GPR Index is constructed using articles from major U.S. and U.K. publications including The New York Times, The Wall Street Journal, and The Financial Times, with monthly coverage beginning in 1985. Country-specific GPR indices are available for 44 countries, drawing on both international and selected local news sources. Full methodology and data are available at: https://www.matteoiacoviello.com/gpr.htm.

risks lead to declining trade volumes between countries, while Thakkar and Ayub (2022) note that the adverse effects of geopolitical uncertainty are more pronounced for foreign direct investment (FDI) than for trade. Most recently, Mulabdic and Yotov (2025) show that geopolitical risks lead to significant reduction of international trade by 30 to 40 percent, and that services and agriculture sectors are particularly vulnerable to these risks.

Economic policy uncertainty, driven by the threat of adverse geopolitical events such as sanctions or trade protectionism, is a key channel through which geopolitical risks affect the global economy. Using the Economic Policy Uncertainty (EPU) Index, also a news-based measure developed by Baker et al. (2016),[3] Constantinescu et al. (2019) find that economic policy uncertainty significantly hinders trade growth, while Kim and Lee (2024) show it discourages greenfield FDI inflows.

A related body of literature examines the effects of trade policy uncertainty (TPU)—a source of economic policy uncertainty—on aggregate trade flows. Synthesizing multiple measures developed in the literature, Handley and Limao (2017, 2022) analyze specific events that increase or reduce trade policy uncertainty, and investigate the variations in risk exposure and associated impacts across industries and countries. Their findings indicate that uncertainty alone about tariff or trade agreements even without realized policy changes reduces exports, investment, employment, and output. It amplifies trade cost and affects the global distribution of production and trade. Some industries, such as those with high fixed costs, long planning horizons, or reliance on global markets, are more sensitive to risk exposure and thus react more strongly to changes in uncertainty than others.

Helbig et al. (2021) conduct a comprehensive systematic review of 88 supply risk assessment methods, and identify political instability and regulatory uncertainty as top risk fac-

[3] The Economic Policy Uncertainty (EPU) Index, developed by Baker et al. (2016), quantifies policy-related economic uncertainty based on the frequency of specific keywords—such as "economic," "policy," and "uncertainty"—in major newspaper articles. The original U.S. index draws from ten leading U.S. newspapers, with data available monthly from 1985 onward. The EPU framework has since been extended to over 20 countries using local-language news sources. The index captures both domestic and global policy-related uncertainty and is widely used in empirical macroeconomic research. Methodological details and data access are available at: https://www.policyuncertainty.com.

tors affecting the supply of critical minerals—an upstream industry in global supply chains. These studies often utilize indices such as the Country Political Risk Index or the World Governance Index to measure political instability. In addition, they employ metrics such as the Policy Perception Index to gauge regulatory uncertainty arising from policy shifts and regulation changes. These risks are micro-level reflections of broader geopolitical trends affecting global trade and supply chain resilience.

Bosone and Stamato (2022) find that geopolitical distance—the degree of political alignment or divergence between trading partners, measured through UN General Assembly voting patterns—has increasingly acted as a trade friction, reducing trade volumes over time. The study provides evidence of friend-shoring, where countries prioritize trade with politically aligned partners.

While a rich body of literature examine the effects of geopolitical risk on the global economy, trade, foreign investment, and industries, relatively fewer studies explicitly explore its impact on global supply chains. However, some research investigates how global supply chains respond to negative shocks such as tariff changes, trade restrictions, or geopolitical instability.

Grossman et al. (2024) find that global supply chains are slow to adjust to negative shocks due to the stickiness of supply chain arrangements and customer-supplier relationships. Firms frequently are reluctance to switch suppliers due to high sunk costs, long-term contractual commitments, and customized production dependencies, which make rapid supplier replacement both impractical and costly.

Martin et al. (2023) note that trade relationship stickiness varies by product type. Firms dealing with products exhibiting high stickiness—such as customized or specialized inputs—are less likely to switch suppliers due to challenges such as identifying alternative sources, renegotiating long-term contracts, managing relationship-specific investments, and adjusting production integration. As a result, industries reliant on stickier inputs are more vulnerable to tariff changes, geopolitical risks, and supply chain shocks.

The existing literature on global supply chain stickiness highlights the importance of assessing the impact of geopolitical risks on global supply chains through trade in intermediate goods. However, there is a limited body of economic research that analyzes trade policy through the lens of end-use classifications—such as intermediate, capital and consumer goods. Among the few, Goldberg and Pavcnik (2016) note that the positive relationship between trade liberalization and economic growth is primarily driven by tariff reductions on intermediate inputs and capital goods, rather than consumer goods. More recently, Amiti et al. (2020) show that tariffs on intermediate goods can lead to significant cost pass-through to domestic producers, while consumer goods tariffs more directly affect retail prices. This work reveals that trade policy impacts could be highly heterogeneous across these end use categories, underscoring the importance of disaggregating trade data by end-use to fully understand the transmission mechanisms and welfare implications of trade policy.

Building on prior studies, we hypothesize that intermediate goods—such as raw materials and components used in production—responds differently to geopolitical uncertainties compared to final goods, including capital and consumer products. However, the extent of this impact likely vary across industries, depending on the stickiness of their production and input sourcing arrangements, which affect firms' ability and willingness to adjust supply chains in response to external disruptions.

3 Data and Sources

To perform the econometric analysis of the impact of geopolitical risks on global supply chains and intermediate goods trade, we use the following data: (i) trade data by end use; (ii) data on geopolitical risk indicators; and (iii) data on other gravity and policy variables. We describe each of the three data sets along with the corresponding sources below.

3.1 International Trade and Production Database by End Use (ITPD-U)

Recognizing that the impact of geopolitical risk on global supply chains primarily occurs via trade in intermediate goods, we constructed the *International Trade and Production Database by End Use* (ITPD-U), a novel trade dataset that disaggregates domestic and bilateral merchandise trade into three end-use categories: intermediate goods, capital goods, and consumer goods (Jones et al., 2025).

The ITPD-U builds upon the *International Trade and Production Database for Estimation* (ITPD-E), a database originally developed by Borchert et al. (2021). The third release of the ITPD-E covers 264 countries, 36-year period from 1986 to 2022,[4] and 170 industries in all broad sectors of the economy, including 28 industries in agriculture, 7 in mining and energy, 120 in manufacturing, and 17 in services. (Larch et al., 2025b).[5] The ITPD-U has the same coverage as ITPD-E in terms of years and countries. It only covers the 153 goods industries out of 170 industries in ITPD-E. ITPD-U expands the goods sections of the ITPD-E by three end-use categories.

To construct the ITPD-U, we first disaggregate bilateral merchandise trade data from UN Comtrade into three end-use categories using the *End Use Concordance* (Jones et al., forthcoming), described in the paragraphs below. Then we aggregate trade data by end use and map it to align with the industry classification used in the ITPD-E.

UN Comtrade classifies merchandise trade data at the Harmonized System (HS) 6-digit level. Although the HS is a standard classification system for traded goods, it does not provide information on how these goods are used—whether they serve as intermediate inputs in production processes, function as capital assets that support production without becoming part of the final output, or are intended for use by final consumer. Therefore, we rely on the *End Use Concordance* to assign each of traded goods at the HS 6-digit level (HS-6) to one

[4] The year coverage of 1986-2022 for agriculture, 1988-2022 for manufacturing, mining, and energy, and 2000-2022 for services

[5] Both ITPD-U and ITPD-E are available on USITC's Gravity Portal at gravity.usitc.gov.

of the four end-use categories: capital goods (CAP), consumer goods (CONS), intermediate goods (INT), and mixed-use goods (MIXED), based on its primary economic function.

Before doing so, we first conduct a comprehensive review and update on the *End Use Concordance*, a dataset originally produced for the construction of the Asia-Pacific Economic Cooperation (APEC) Trade-in-value-added (TiVA) database (Jones et al., 2019). Consistent with the UN Broad Economic Categories (BEC) framework, the *End Use Concordance* incorporates input data from various sources, including the Organisation for Economic Co-operation and Development (OECD), the United Nation Statistics Division (UNSD), the World bank, and the World Input-Output Database (WIOD). The first version of the *End Use Concordance* was incorporated into the UN BEC rev. 5 (2019).[6] This paper uses the 2024 revision.

For many traded goods, the end use is unique and can be clearly assigned to a specific category. For instance, 100 percent of traded goods under HS 220410—sparkling wine—are classified as consumer goods, as this group of goods is primarily intended for consumer consumption. In contrast, certain goods serve multiple functions with both industrial and consumer applications. Accordingly, these vehicles are classified as mixed-use goods and split across multiple end use categories according to estimated shares. These estimated shares are derived from industry sources, such as industry reports, expert assessments, and data from trade associations.

For example, traded goods under HS 870380—vehicles with only electric motor for propulsion (EVs)—can be either used by firms as capital goods to support production operations, or driven by individuals or households as consumer goods. Accordingly, EVs are classified as mixed-use goods. Based on available industry data such as the Vehicle Inventory and Use Survey (VIUS), it is estimated that approximately 87.5 percent of EVs are used for consumer purposes, while 12.5 percent are used as capital goods in commercial fleets (Table 1).[7]

[6] UNSD, "BEC 5 Correlations (2019)," https://unstats.un.org/unsd/trade/classifications/BEC5Correlations.zip

[7] U.S. Census Bureau, "2021: ECNSVY Vehicle Inventory and Use Survey All Vehicles," https://data.census.gov/table/VIUSA2021.VIUS212A?d=ECNSVY+Vehicle+Inventory+and+Use+Survey+All+Vehicles

For more information on the methodology on estimating the splits, see Jones et al. (forthcoming). The *End Use Concordance* (revision 2024) includes over 400 such mixed-use goods, each assigned estimated shares across these three primary end-use categories. Nearly 99 percent of these mixed-use goods are assigned to two end-use categories. Only about 1 percent are assigned to three end-use categories, including those under special chapter 99 which does not describe specific products.

Table 1: Illustration of the USITC End Use Concordance

HS6	**Description**	**End Use**	**CAP**	**CONS**	**INT**
220410	Sparkling wine	CONS	0.00	1.00	0.00
281122	Silicon dioxide	INT	0.00	0.00	1.00
840110	Nuclear reactors	CAP	1.00	0.00	0.00
870380	Vehicles with electric motor for propulsion	MIXED	0.125	0.875	0.00

Source: USITC End Use Concordance (2024 revision).

Bilateral merchandise trade data from UN Comtrade is first disaggregated into three end-use categories using the *USITC End Use Concordance*. Trade value of mixed-use goods are distributed to respective end-use categories based on their estimated splits. These data are then mapped and aggregated to align with the industry classification used in the ITPD-E. To estimate domestic trade (or production) by end use, we apply the proportionality derived from total exports—under the assumption that a country's export product composition mirrors its domestic production (Saltarelli et al., 2020). This means that the division of domestic trade in country i, year t, industry k into the three end uses is done using the same proportions as country i, year t, industry k total exports. The resulting dataset, ITPD-U, is a novel contribution that provides harmonized information on both international trade and domestic production by end-use category. Further details on the ITPD-U construction methodology are provided in the technical appendix available on the USITC's Gravity Portal (Jones et al., 2025).

The ITPD-U offers several advantages for global supply chain analysis. First, the ITPD-U retains the expansive country, industry, and year coverage of the ITPD-E. Second, the ITPD-U includes both domestic and bilateral trade flows, which is crucial for mapping and identifying supply chain dependencies. Third, like the ITPD-E, the ITPD-U is constructed from raw data without relying on statistical modeling, making it well-suited for econometric estimations and empirical analysis.[8] Fourth, disaggregating trade flows by end use allows us to study global supply chains more effectively, as trade in intermediate goods tends to respond differently to various trade determinants than trade in other types of goods.

3.2 Geopolitical Risk Measures

We employ multiple indicators to capture different dimensions of geopolitical risks at both the national and bilateral levels. These include country-specific measures of economic and political risks, as well as bilateral geopolitical risks specific to trading partner pairs (Jones, forthcoming). While GPR and EPU indices are commonly used in the related literature, we opt not to use them in our analysis due to limited country coverage, high monthly volatility, and potential media bias.

To measure country-specific economic risks, we rely on the Economic Freedom Index (EFI), published annually by the Fraser Institute. This composite index is built on five core areas—each representing a distinct dimension of a country's economic conditions that are influenced by related policies (Gwartney et al., 2024b). We do estimations with both the overall EFI and its individual components:

- Size of government. It measures government consumption, transfers, subsidies, and the extent of state-owned enterprises. Countries with smaller government, lower marginal tax, and less state ownership of assets earn higher ratings in this component.

- Legal system and property rights. It assesses the rule of law, judicial independence, im-

[8]ITPD-E is constructed using four primary data sources, each covering distinct industry sectors: For agriculture, trade and production data come from the Food and Agriculture Organization of the United Nation (FAO) statistical database. For manufacturing and Mining and Energy, trade data are obtained from the UN Comtrade Database, while production data come from INDSTAT, maintained by the United Nations Industrial Development Organization (UNIDO). ITPD-E also includes services industries, which are not included in ITPD-U. See Borchert et al. (2021) and (Larch et al., 2025b) for further details on the construction and features of the ITPD-E.

partial courts, and protection of property rights. Strong legal institutions are essential for secure economic transactions.

- Sound money. It evaluates inflation levels, money growth, and freedom to own foreign currency. Stable monetary policy and low inflation are key to preserving purchasing power and economic predictability.

- Freedom to trade internationally. It captures tariffs, trade barriers, exchange rate controls, and capital market restrictions. Greater openness to international trade is associated with higher economic freedom.

- Regulation. It examines credit market regulations, labor market flexibility, and business regulations. Countries with fewer and less burdensome restrictions earn higher ratings in this component.

Each area is scored from 0 to 10, with higher scores indicating greater economic freedom. The resulting composite EFI has a similar score ranging from 1 and 10 (Gwartney et al., 2024a). A higher value indicates a more favorable economic environment, and thus, lower economic risks.[9]

To measure country-specific political risks, we use the World Bank's Worldwide Governance Indicators (WGI), which evaluate a country's institutional and governance quality based on six key dimensions: voice and accountability, control of corruption, government effectiveness, political stability and absence of violence or terrorism, rule of law, and regulatory quality (Kaufmann et al., 2010). The WGI database covers over 200 countries from 1996 to 2022. The scores ranging from -2.5 to 2.5 (World Bank, 2024). Higher values indicate stronger governance, and, consequently, lower political risk.[10]

To quantify bilateral geopolitical risks, we construct two measures—the Political and Social Value Distance (PSVD) and Geopolitical Distance (GD)—to assess the degree of

[9] Fraser Institute, "Economic Freedom," accessed February 24, 2025.
[10] World Bank, "Worldwide Governance Indicators," accessed February 24, 2025.

alignment or divergence between countries based on their democratic conditions or foreign policy stance. These measures serve as a quantitative proxy for geopolitical risks in bilateral trade relations. To construct GD and PSVD measures, we employ Euclidean distance between an array of country-specific measures, which calculates the degree of dissimilarity between countries based on their respective values.

The first measure, the PSVD, is derived from the Freedom in the World index (FIW), published annually by the Freedom House. This dataset provides a comprehensive assessment of democratic conditions across 210 countries and territories worldwide. The FIW index is composed of two main categories: Political Rights (scored out of 40) and Civil Liberties (scored out of 60). Political Rights includes three subcategories: the electoral process, political pluralism and participation, and the functioning of government. Civil Liberties is divided into four subcategories: freedom of expression and belief, associational and organizational rights, rule of law, and personal autonomy and individual rights. The FIW scores range from 0 to 100, with higher values indicating higher political freedom (Freedom House, 2024).[11] The PSVD is calculated based on the Euclidean distance between countries in both Political Rights and Civil Liberties scores (Jones, forthcoming).

The second measure, the GD, is derived from the United Nations General Assembly (UNGA) Voting Data, which contains ideal point estimates based on countries' voting patterns in UNGA sessions from 1946 to 2023. These ideal points range from 3.2 to -3.2, reflecting a country's foreign policy preferences and indicating its degree of alignment with the U.S.-led liberal order (Bailey et al., 2017).[12] The GD is calculated using the Euclidean distance between countries' ideal point estimates. The UN voting-based GD measure has been increasingly used in international economic literature for estimating the impact of political relations on trade(Airaudo et al., 2025; Freund et al., 2024; Bosone and Stamato, 2022). However, empirical findings have been mixed, as UN voting patterns reflect a range of strate-

[11] Freedom House, "Freedom in the World 2025: A Global Survey of Political Rights and Civil Liberties," accessed January 22, 2025.

[12] The ideal point estimates are estimated by sessions instead of calendar year in the dataset. This paper converts them into the yearly data by taking the average of three consecutive sessions for a given year.

gic, ideological, and contextual factors that vary with the nature of individual resolutions.

3.3 Other Gravity and Policy Variables

We employ several other gravity and policy variables from various sources. Specifically, we rely on the USITC's *Dynamic Gravity Dataset* (DGD) for data on the standard gravity variables, including bilateral distance, contiguous borders, common official language, and colonial relationships (Gurevich and Herman, 2018).[13] In addition, we use the DGD for data on membership in the European Union (EU) and the World Trade Organization (WTO). For data on regional trade agreements (RTAs), we use Mario Larch's *Regional Trade Agreements Database* (Egger and Larch, 2008).[14] Finally, data on sanctions are from the latest edition of the *Global Sanctions Database* (GSDB) (Felbermayr et al., 2020; Syropoulos et al., 2024).[15]

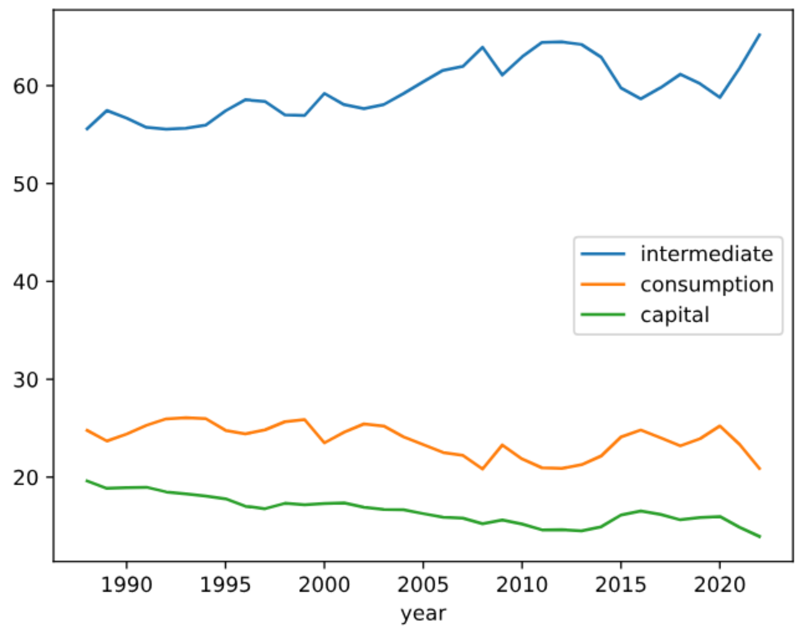
4 Global Trade by End Use

The newly developed ITPD-U database provides a novel lens that allows us to analyze international trade by three end-use categories. Intermediate goods constitute the largest share of global trade. On average, they represent approximately 60 percent of total merchandise trade across all years covered in the ITPD-U. This share increased gradually from 56 percent in 1988 to 64 percent in 2008. Following the global financial crisis, the share exhibited modest fluctuations, reaching 65 percent in 2022—the most recent year in the database (see Figure 1).

The share of capital goods in global trade declined steadily from 19.6 percent in 1988 to 14.5 percent in 2013. While it experienced a modest rebound between 2015 and 2020, the downward trend resumed thereafter, reaching 14 percent in 2022. In contrast, the share of consumer goods fluctuated between 21 percent and 26 percent over this period. On average,

[13] The dataset is available at https://www.usitc.gov/data/gravity/dgd.htm
[14] https://www.ewf.uni-bayreuth.de/en/research/RTA-data/index.html
[15] https://www.globalsanctionsdatabase.com/

Figure 1: International trade by end use, shares in total



Source: International Trade and Production Database by End Use (ITPD-U)

it was slightly higher during the 1990s compared to more recent years.

The end-use composition of exports and imports varies across countries. In the case of the United States, exports are predominantly composed of intermediate goods, whose share rose from just over 50 percent to more than two-thirds in recent decades. The share of capital goods in U.S. exports declined from around 25 percent to about 16 percent, while the share of consumer goods remained relatively stable at around 16 percent. The composition of U.S. imports exhibited little change between 1988 and 2022: intermediate goods accounted for about 50 percent, consumer goods for 31 percent, and capital goods for about 19 percent. The U.S. trade deficit is heavily concentrated in consumer goods, which made up 60 percent of the total deficit in 2022. Intermediate goods contributed 17 percent to the deficit in that year—a notable shift from the 1990s, when trade in intermediates was nearly balanced before turning into a deficit in 2000. Similarly, trade in capital goods was close to balanced throughout the 1990s but has since shifted into deficit, comprising 24 percent of the overall trade deficit in 2022.

Zooming in on China, we find that the share of intermediate goods in China's exports declined from 55% in 1988 to 30% in 1993 and then slowly increased to 48% in 2022. The share of consumption goods was increasing between 1988 and 1993, from 43% to 62%. After 1993 it went on a slow decline, falling to 31% in 2022. The share of capital goods steadily increased from 2% in 1988 to 21-23% in 2020-2022. The composition of China's imports has also changed over the years, but not as much as the composition of China's exports. The share of intermediate goods in imports has increased from around 70% in the late 1980s and early 1990s to 75-80% after 2005. The share of consumption goods was 5-10% from 1988 until 2013. In more recent years it grew to 10-13%. The share of capital goods was 20-30% from 1988 to 2004 and then declined to around 10% in 2022.

The ITPD-U also provides new insights into bilateral trade patterns. An example is the trade patterns between the United States and China, where the end-use composition of imports and exports differs substantially. The United States primarily exports intermediate goods to China, while it imports mostly consumer goods. In 2022, 73 percent of U.S. exports to China consisted of intermediate goods, followed by 15 percent in capital goods, and 12 percent in consumer goods. Over the years, the share of consumer goods in U.S. exports increased modestly, while the share of capital goods in U.S. exports declined.

On the other side, consumer goods led China's exports to the United States in 2022, accounting for 48 percent of the total, followed by 30 percent in intermediate goods and 22 percent in capital goods. Notably, the composition of China's exports to the United States has shifted in recent decades: the share of consumer goods has gradually declined, whereas intermediate and capital goods have gained more prominence.

These examples demonstrate that the ITPD-U enables us to gain useful insights into trade patterns based on different end uses. In the following section, we perform a systematic analysis of the determinants of international trade for these different types of goods using the ITPD-U.

5 Econometric Methods

We obtain our estimates using the ITPD-U covering for 264 countries from 1986 to 2022 with the workhorse model of trade — the gravity equation, and we apply the recent recommendations for gravity estimations of Larch et al. (2025a). Specifically, we estimate alternative specifications of the following econometric model:[16]

$$X^k_{ij,t} \; = \; \exp[RISK_{ij,t} \times \beta^k + POLICY_{ij,t} \times \alpha^k + GRAV_{ij} \times \gamma^k + GLOB^k_{ij,t} + \pi^k_{i,t} + \chi^k_{j,t}] \times \epsilon^k_{ij,t}. \quad (1)$$

$X^k_{ij,t}$ denotes nominal trade flows from exporter i to importer j in industry k at time t, i.e., the dependent variable includes directional trade (exports and imports) at the industry level at each point of time. Following Egger et al. (2022), we use data for consecutive years, instead of data with intervals as suggested by Cheng and Wall (2005). $X^k_{ij,t}$ includes both cross-border/international and domestic/internal trade flows, which is consistent with theory and has important implications for gravity estimations of the effects of various policies (Yotov, 2022). In fact, following Beverelli et al. (2024), the use of domestic trade flows is exactly what would enable us to identify the impact of country-specific risk on international trade relative to domestic sales in our econometric model.

Due to the separability of the theoretical gravity model (Anderson and van Wincoop, 2004; Costinot et al., 2012), equation (1) can be estimated at any level of aggregation, e.g., product, industry, sector, or aggregate. This is important for the current purposes, as it enables us to estimate the model by pooling (not aggregating) the data for individual industries within each of the three end-use goods categories in our data.[17]

Motivated by Santos Silva and Tenreyro (2006), we use the Poisson Pseudo Maximum Likelihood (PPML) as our preferred estimator. Due to its multiplicative form, the PPML estimator enables us to include and take advantage of the information contained in the zeros in our sample. In addition, and more importantly, the PPML estimator successfully

[16]Our econometric specification is consistent with a wide class of theoretical foundations, which, subject to parameter interpretation, lead to isomorphic gravity equations (Arkolakis et al., 2012).

[17]This also implies that, in principle, we could estimate the model separately, and consistent with theory, for each of the 170 industries from the ITPD-E.

handles heteroskedasticity in trade flows data, which, due to Jensen's inequality, renders the corresponding OLS estimates inconsistent. We estimate our model with the **ppmlhdfe** command of Correia et al. (2020), and, following the standard approach in the gravity literature (Egger and Tarlea, 2015; Pfaffermayr, 2022), we cluster the standard errors by country pair.

Turning to the covariates in our model, the most important term on the right-hand side of equation (1) is $RISK_{ij,t}$, which is a vector that includes our proxies for risk. As discussed earlier, we test with four alternative risk indices: (i) the country-specific economic risk measure—Economic Freedom Indexes ($EFI_{i,t}$) of the Fraser Institute;[18] (ii) the country-specific political risk measure—the World Bank's Worldwide Governance Indicators ($WGI_{i,t}$); (iii) the political and social value distance ($PSVD_{ij,t}$), which is derived from the Freedom in the World index by the Freedom House; and (iv) the bilateral geopolitical distance ($GD_{ij,t}$), which is derived from the United Nations General Assembly voting data.[19]

The vector $POLICY_{ij,t}$ in equation (1) includes the following time-varying bilateral policy variables: membership in Regional Trade Agreements ($RTA_{ij,t}$), membership in Customs Unions ($CU_{ij,t}$), membership in the European Union ($EU_{ij,t}$), membership in the World Trade Organization ($WTO_{ij,t}$), and complete trade sanctions ($SANCT_{ij,t}$).

The vector $GRAV_{ij}$ includes the four proxies for time-invariant trade frictions that are used most often in the gravity literature, including bilateral distance ($DIST_{ij}$), and indicators for common official language ($LANG_{ij}$), the presence of colonial relationships ($CLNY_{ij}$), and contiguous borders ($CNTG_{ij}$). Some recent econometric gravity models do not include time-invariant gravity variables, and instead rely on country-pair fixed effects. The reason for our choice is that we want to explore the heterogeneous impact of these widely-used gravity covariates across the three end-use goods categories in our data. In addition, the use of country-pair fixed effects would absorb most of the variation in our bilateral risk proxies,

[18]In the main analysis, we will employ the average EFI index. However, in robustness analysis that are reported in the appendix, we also obtain results for each of the five separate EFI categories.

[19]The sources and construction of these and all other variables in our econometric model are described in the data section.

which do vary over time but very slowly.

Equation (1) includes three sets of fixed effects. $GLOB_{ij,t}^{k}$ denotes a vector of time-varying border indicators, which take a value of one for international flows and are equal to zero for domestic sales for each year in our sample. The estimates on these dummy variables capture the impact of common (de-)globalization trends that have affected the international relative to the domestic trade, e.g., improvements in communication, transportation, global recessions, etc.[20] Thus, our risk variables would capture effects that are in addition to any common (de-)globalization trends among the countries in our sample.

Guided by theory, equation (1) also includes source-industry-time and destination-industry-time fixed effects ($\pi_{i,t}^{k}$ and $\chi_{j,t}^{k}$, respectively) to account for structural multilateral resistances terms (Anderson and van Wincoop, 2003) and for any country-time-specific determinants of trade on the source and the destination side. When the model is estimated with pooled data, the corresponding fixed effects remain at the source-industry-time and the destination-industry-time dimensions, respectively. Thus, regardless of the level of aggregation, the exporter and importer fixed effects account for and absorb all country-industry-time-specific characteristics that influence bilateral trade flows.

6 Estimation Results and Analysis

The objective of this section is twofold. First, we examine potential heterogeneity in how standard determinants of trade affect consumer, intermediate, and capital goods. Second, we assess and compare the impact of alternative geopolitical risk measures on trade for each end-use category of goods. Our main findings are presented in Table 2 to 5, which report estimates by end use obtained from specification (1). Table 2 and 3 report estimates for country-specific geopolitical risks, and Table 4 and 5 report estimates for bilateral geopolitical risks. Each panel has the same set of covariates, with the exception of geopolitical risk indicators (RISK),

[20]Bergstrand et al. (2015) demonstrate that the estimates of the effects of RTAs are biased if such globalization dummies are not included in the gravity model.

which vary across Table 2 through 5, as detailed below.

Table 2: Gravity Estimates Across Goods by End Use, EFI

	Cons.	Interm.	Cap.
DIST	-0.745	-0.885	-0.669
	(.032)****	(.026)****	(.032)****
CNTG	0.449	0.338	0.432
	(.058)****	(.051)****	(.062)****
CLNY	0.047	0.103	0.008
	(.081)	(.064)	(.076)
LANG	0.229	0.224	0.172
	(.044)****	(.041)****	(.048)***
EU	0.608	0.311	-0.087
	(.064)****	(.072)****	(.081)
CU	0.930	0.496	0.616
	(.112)****	(.09)****	(.137)****
RTA	0.269	0.241	0.260
	(.044)****	(.041)****	(.045)****
WTO	0.311	0.491	1.074
	(.109)**	(.079)****	(.125)****
SANCT	-1.452	-1.957	-2.167
	(.389)***	(.459)****	(.358)****
Risk-EFI	1.503	0.847	1.104
	(.063)****	(.051)****	(.09)****

Notes: This table reports gravity estimates that are obtained from equation (1) for each of the three categories of goods based on end use in our sample using the country-specific Economic Freedom Index (EFI). The dependent variable is trade in levels and the estimator is PPML. All estimates are obtained with exporter-industry-time, importer-industry-time, and border-industry fixed effects, whose estimates are omitted for brevity. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

Table 2 presents the estimates using Fraser's Economic Freedom Index (EFI)—serving as a proxy for a country's economic policy risk. As discussed in section 3 on data, the EFI is a composite measure, evaluating five dimensions of economic conditions in a country that are influenced by related economic policies. Panel A also includes the estimated effects of the standard gravity covariates across the three end-use categories of goods in our sample.

Several notable findings emerge from Table 2. First, the estimated coefficient on distance is negative and statistically significant across all three end-use categories, with a substantially stronger effect observed for intermediate goods. Because distance serves as a key proxy or determinant for bilateral trade costs, capturing frictions such as logistics expenses and transport infrastructure, this finding suggests that for a given pair of countries trade costs are notably higher for intermediate goods compared to consumer and capital goods. This may reflect their greater reliance on just-in-time delivery or more complex logistical coordination (Pisch, 2020). The heightened sensitivity of intermediate goods trade to distance also implies that firms may favor geographically proximate suppliers and prefer regional supply chain structures to reduce disruption and costs.

The results for the other geography-related variable, contiguity (CNTG)—whose positive effect is the smallest for intermediate goods—further supported this interpretation. The weaker positive effect of CNTG for intermediate goods suggests that being neighbors doesn't boost intermediate goods trade as much as it does for capital or consumer goods. This may reflect the fact that intermediate goods often move within complex supply chains, where proximity alone does not guarantee trade integration. It also suggests that trade in intermediates depends more heavily on infrastructure, logistics, and production network linkages than simple geographic closeness.

Consistent with gravity estimates employing PPML (Santos Silva and Tenreyro, 2006), we do not find statistically significant effect of colonial relationships (CLNY) on trade flows, regardless of the type of goods. In addition, the estimated impact of sharing a common official language is similar for intermediate and consumer goods, but notably smaller for capital goods.

Table 2 also reveals several interesting findings regarding the impact of policy variables. Most estimates associated with memberships of European Union (EU), customs unions (CU), and regional trade agreements (RTAs) are large, positive, and statistically significant. The EU effect for capital goods is the sole exception, which is small, negative, and statistically insignificant. Notably, across all three policy measures, the effects are consistently smallest for intermediate goods (excluding the EU-capital goods case). This suggests that, relative to other product categories, the standard forms of economic integration have been less effective at promoting trade in intermediate goods. That intermediate goods trade often stems from established, sticky production networks, and that supply chains may already be optimized within regions, are among the possible explanations for the relatively smaller marginal gains from joining EU, CU, or an RTA.

The estimated effects of WTO membership are also positive, large, and statistically significant across all three categories of goods. However, the impact is stronger for capital goods and intermediate goods, suggesting that WTO accessions have been most beneficial for capital goods trade. One possible explanation for this result is that our sample excludes the early years of the General Agreement on Tariffs and Trade (GATT). Therefore, the identified WTO effects primarily capture the influence of accessions by more heterogeneous countries after 1986—particularly those with diverse levels of development and comparative advantage.[21] These later entrants are more likely to be less developed and, as such, tend to experience larger gains from trade liberalization than high-income countries (Peng et al., 2015). The stronger WTO effects for capital goods may thus be driven by the demand from these newer members' accelerated industrialization and integration into global production networks, rather than by changes among long-standing liberalized economies.

Table 2 presents the estimated effects of sanctions that reveal two clear patterns. First, the coefficients are consistently large, negative, and statistically significant across all product categories, indicating that sanctions have been broadly effective in curtailing trade flows. Second, the trade-suppressing effects of sanctions are strongest for capital goods, followed by intermediate goods, and weakest for consumer goods. This result aligns with both economic intuition and policy dynamics. Sanctions frequently target strategic sectors like aerospace, defense, telecommunications, and industrial machinery—most of which fall under capital

[21] The General Agreement on Tariffs and Trade (GATT) was established in 1947 by 23 founding members—mostly high-income, industrialized economies with relatively similar legal systems, levels of development, and approaches to trade policy (e.g. the United States, the United Kingdom, Canada, Australia, and Western European countries). By contrast, accessions from the 1980s onward, especially under the WTO, brought in countries with much greater diversity in terms of development level, institutional quality, and trade orientations, including many emerging markets and former centrally planned economies.

goods. Since capital goods are often less substitutable in the short run, a sanctioned country may find it harder to replace them. Intermediate goods may offer slightly more flexibility via alternative sourcing, while consumer goods tend to be easiest to substitute or smuggle, especially through informal channels or third countries. In addition, sanctions often exclude some consumer goods for humanitarian reasons.

Finally, Table 2 shows that the coefficients for the Fraser's Economic Freedom Index (EFI)—our country-specific economic policy risk indicator—are sizable, positive, and statistically significant across the three product categories. The results are consistent with our expectation, given that higher EFI values reflect a more favorable economic policy environment with lower risk. Importantly, the estimated EFI effect for intermediate goods is significantly smaller than that for capital goods, and nearly half the magnitude of the effect observed for consumer goods. This comparatively lower sensitivity of intermediate goods trade to economic policy risk is consistent with existing theories and empirical evidence on global supply chain "stickiness" (Grossman et al., 2024). In particular, it reflects the tendency of firms to maintain stable sourcing relationships for intermediate inputs, even in the face of shifting policy environments or economic uncertainty. Such inertia in production networks may arise from high switching costs, technical compatibility requirements, or long-term supplier contracts, which collectively reduce the responsiveness of intermediate goods trade to macro-level risk factors.

The results are consistent when employing the individual components of the EFI, as described in the data section. The corresponding results are reported in Tables 6, 7, 8, 9, 10 of the Appendix.

Table 3 presents the estimation results using the World Bank's Worldwide Governance Index (WGI), serving as a proxy for a country's political risk. Our main findings and conclusions remain robust and consistent. The estimated effects are similarly strong and statistically significant, consistent with the findings in Table 2 as well as those of Beverelli et al. (2024). Notably, intermediate goods trade also exhibits the lowest sensitivity to political

Table 3: Gravity Estimates Across Goods by End Use, WGI

	Cons.	Interm.	Cap.
DIST	-0.774	-0.895	-0.686
	(0.033)****	(0.027)****	(0.034)****
CNTG	0.395	0.319	0.407
	(0.062)****	(0.052)****	(0.066)****
CLNY	0.039	0.086	-0.003
	(0.081)	(0.066)	(0.079)
LANG	0.296	0.257	0.233
	(0.048)****	(0.042)****	(0.052)****
EU	0.410	0.186	-0.227
	(0.081)****	(0.079)*	(0.096)*
CU	0.905	0.498	0.590
	(0.115)****	(0.093)****	(0.139)****
RTA	0.251	0.236	0.233
	(0.047)****	(0.041)****	(0.047)****
WTO	0.660	0.618	1.212
	(0.098)****	(0.073)****	(0.114)****
SANCT	-1.405	-1.839	-2.089
	(0.374)***	(0.403)****	(0.337)****
Risk-WGI	1.534	0.971	1.130
	(0.079)****	(0.070)****	(0.103)****

Notes: This table reports gravity estimates that are obtained from equation (1) for each of the three categories of goods based on end use in our sample using the country-specific Worldwide Governance Index (WGI). The dependent variable is trade in levels and the estimator is PPML. All estimates are obtained with exporter-industry-time, importer-industry-time, and border-industry fixed effects, whose estimates are omitted for brevity. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

risk, reinforcing the notion of global supply chain stickiness.

Table 4 reports the estimation results based on the Political & Social Value Distance (PSVD) index, one of two proxies for bilateral geopolitical risk employed in this paper. Several key findings from Panel A and B, such as the heterogeneous effects of geographic distance and contiguity, remain robust in Panel C. However, notable differences emerge, particularly in the magnitudes of effects for most policy variables across all product categories. This may reflect the PSVD's correlation with these policy variables.

PSVD coefficients are consistently negative and statistically significant across all prod-

Table 4: Gravity Estimates Across Goods by End Use, PSVD

	Cons.	Interm.	Cap.
DIST	-0.748	-0.859	-0.621
	(.043)****	(.03)****	(.038)****
CNTG	0.408	0.316	0.430
	(.07)****	(.068)****	(.082)****
CLNY	0.0830	0.090	0.051
	(.091)	(.076)	(.09)
LANG	0.295	0.294	0.269
	(.053)****	(.047)****	(.059)****
EU	0.761	0.491	0.082
	(.131)****	(.097)****	(.127)
CU	0.684	0.437	0.545
	(.131)****	(.095)****	(.15)***
RTA	0.180	0.165	0.197
	(.059)**	(.048)***	(.058)***
WTO	1.706	1.288	2.192
	(.11)****	(.08)****	(.116)****
SANCT	-2.216	-2.631	-2.822
	(.325)****	(.288)****	(.327)****
Risk-PSVD	-0.005	-0.004	-0.003
	(.002)**	(.001)**	(.002)*

Notes: This table reports gravity estimates that are obtained from equation (1) for each of the three categories of goods based on end use in our sample using the bilateral Political & Social Value Distance (PSVD) index. The dependent variable is trade in levels and the estimator is PPML. All estimates are obtained with exporter-industry-time, importer-industry-time, and border-industry fixed effects, whose estimates are omitted for brevity. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

uct categories, indicating a dampening effect of bilateral geopolitical risk on trade flows. However, this effect is smaller than that associated with country-specific risk measures such as the EFI and WGI, suggesting that bilateral geopolitical tensions exert a comparatively smaller influence on trade flows. Consistent with the estimates in Table 2 and 3 and the global supply chain "stickiness" hypothesis, the impact on intermediate goods trade is less significant than on consumer goods, implying that entrenched production relationships are more resilient to geopolitical divergence between trading partners.

Lastly, Table 5 shows the estimation results based on the Geopolitical Distance (GD)

Table 5: Gravity Estimates Across Goods by End Use, GD

	Cons.	Interm.	Cap.
DIST	-0.795	-0.893	-0.634
	(.044)****	(.031)****	(.037)****
CNTG	0.408	0.328	0.453
	(.071)****	(.067)****	(.078)****
CLNY	0.274	0.270	0.230
	(.087)**	(.077)***	(.093)*
LANG	0.277	0.291	0.246
	(.054)****	(.048)****	(.057)****
EU	0.859	0.532	0.187
	(.126)****	(.095)****	(.123)
CU	0.654	0.403	0.515
	(.127)****	(.092)****	(.149)***
RTA	0.350	0.265	0.343
	(.059)****	(.046)****	(.063)****
WTO	1.693	1.289	2.059
	(.106)****	(.074)****	(.105)****
SANCT	-2.195	-2.644	-2.738
	(.284)****	(.249)****	(.27)****
RISK-GD	0.187	0.096	0.185
	(.029)****	(.024)****	(.031)****

Notes: This table reports gravity estimates that are obtained from equation (1) for each of the three categories of goods based on end use in our sample using the bilateral Geopolitical Distance (GD) index. The dependent variable is trade in levels and the estimator is PPML. All estimates are obtained with exporter-industry-time, importer-industry-time, and border-industry fixed effects, whose estimates are omitted for brevity. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

index, a widely used bilateral geopolitical risk indicator based on UN General Assembly voting results. As in Table 2, 3, and 4, several key findings—such as the heterogeneous effects of distance and contiguity—remain robust and consistent. Meanwhile, the estimated magnitudes of effects for most policy variables differ markedly from those in Table 2 and 3, likely reflecting the similar correlation issue between the GD index and policy variables. However, the GD coefficients reveal a positive and statistically significant association with trade—a somewhat unexpected result that reinforce existing concerns about the validity of using the GD index, or the underlying UN voting results, as a reliable predictor of bilateral economic relations.

7 Conclusion

This paper provides a novel investigation into how standard trade determinants and geopolitical risk affect global supply chains, with a specific focus on intermediate goods trade. We construct the ITPD-U database—unprecedented in scope—covering domestic and international trade by end use for 153 industries across 265 countries over 35 years.

By leveraging this new database and applying the latest gravity modeling techniques, our findings reveal that intermediate goods, accounting for about 60 percent of global merchandise trade, respond differently to several standard trade determinants as well as geopolitical risk, compared to capital and consumer goods.

Distance—a key proxy or determinant for trade cost—has the largest dampening effect on intermediate goods trade, likely due to the logistical complexity and coordination demand of global supply chains. Contiguity offers a relatively small effect on intermediate goods trade, suggesting that sharing border alone offers limited additional benefit once supply chains are regionally optimized.

Economic integration measures such as EU, CU, or RTA memberships most benefit consumer goods trade, while their influence on intermediate goods trade is comparatively smaller. By contrast, WTO accession and sanctions have disproportionate large effects on capital goods trade. Together, these patterns point to important asymmetries in how different trade policies shape global commerce across product categories.

Geopolitical risk depresses trade across all product types, though its impact is significantly smaller for intermediate goods, underscoring the inertia as well as dependence of established sourcing relationships, which aligns with the concept of supply chain "stickiness." Our findings highlight that building resilient supply chains requires a deeper understanding of how firms respond to geopolitical uncertainty—not only through diversification, nearshoring, or friendshoring, but also through institutional frameworks that reduce switching costs and through building durable trust with sourcing sources.

This paper fills a longstanding gap in the gravity trade literature by revealing how standard trade determinants affect goods differently depending on their role in global production network. The ITPD-U database developed for this study enables these insights by offering granular trade flow data disaggregated by end use and incorporating domestic trade.

References

Airaudo, M., R. Cezar, R. C. Mano, A. M. Santacreu, P. Topalova, and J. Xu (2025): "Measuring Geopolitical Fragmentation: Implications for Trade, Financial Flows, and Economic Policy," International Finance Discussion Paper 1408, Board of Governors of the Federal Reserve System.

Amiti, M., S. J. Redding, and D. E. Weinstein (2020): "Who's Paying for the US Tariffs? A Longer-Term Perspective," *AEA Papers and Proceedings*, 110, 541–546.

Anderson, J. and E. van Wincoop (2003): "Gravity with Gravitas: A Solution to the Border Puzzle," *American Economic Review*, 93, 170–192.

——— (2004): "Trade Costs," *Journal of Economic Literature*, 42, 691–751.

Arkolakis, C., A. Costinot, and A. Rodriguez-Clare (2012): "New Trade Models, Same Old Gains?" *American Economic Review*, 102, 94–130.

Arvis, J.-F., C. Rastogi, J.-P. Rodrigue, and D. Ulybina (2024): "A Metric of Global Maritime Supply Chain Disruptions: The Global Supply Chain Stress Index (GSCSI)," Policy research working paper, World Bank Group.

Bailey, M., A. Strezhnev, and E. Voeten (2017): "Estimating dynamic state preferences from United Nations voting data," *Journal of Conflict Resolution*, 61, 430–456.

Baker, S. R., N. Bloom, and S. J. Davis (2016): "Measuring Economic Policy Uncertainty," *The Quarterly Journal of Economics*, 131, 1593–1636.

Bergstrand, J. H., M. Larch, and Y. V. Yotov (2015): "Economic Integration Agreements, Border Effects, and Distance Elasticities in the Gravity Equation," *European Economic Review*, 78, 307–327.

Beverelli, C., A. Keck, M. Larch, and Y. Yotov (2024): "Institutions, Trade, and Development: Identifying the Impact of Country-specific Characteristics on International Trade," *Oxford Economic Papers*, 76, 469–494.

Borchert, I., M. Larch, S. Shikher, and Y. V. Yotov (2021): "The International Trade and Production Database for Estimation (ITPD-E)," *International Economics*, 166, 140–166.

Bosone, C. and G. Stamato (2022): "Beyond Borders: How Geopolitics is Reshaping Trade," Working paper, European Central Bank.

Broner, F., A. Martin, J. Meyer, C. Trebesch, and J. Z. Wu (2025): "Hegemony and International Alignment," Working paper, the European Research Council Executive Agency.

Caldara, D. and M. Iacoviello (2018): "Measuring Geopolitical Risk," International finance discussion paper, Board of Governors of the Federal Reserve System.

——— (2022): "Measuring Geopolitical Risk," *American Economic Review*.

Cheng, I. and H. Wall (2005): "Controlling for Heterogeneity in Gravity Models of Trade and Integration," *Federal Reserve Bank of St. Louis Review*, 87, 49–63.

Constantinescu, I. C., A. Mattoo, and M. Ruta (2019): "Policy Uncertainty, Trade, and Global Value Chains: Some Facts, Many Questions," Policy research working paper, World Bank Group.

Correia, S., P. Guimaraes, and T. Zylkin (2020): "Fast Poisson estimation with high-dimensional fixed effects," *Stata Journal*, 20, 95–115.

Costinot, A., D. Donaldson, and I. Komunjer (2012): "What Goods Do Countries Trade? A Quantitative Exploration of Ricardo's Ideas," *Review of Economic Studies*, 79, 581–608.

Egger, P. and M. Larch (2008): "Interdependent Preferential Trade Agreement Memberships: An Empirical Analysis," *Journal of International Economics*, 76, 384–399.

Egger, P. H., M. Larch, and Y. V. Yotov (2022): "Gravity Estimations with Interval Data: Revisiting the Impact of Free Trade Agreements," *Economica*, 89, 44–61.

Egger, P. H. and F. Tarlea (2015): "Multi-way clustering estimation of standard errors in gravity models," *Economics Letters*, 134, 144–147.

Fajgelbaum, P., P. K. Goldberg, P. J. Kennedy, A. Khandelwal, and D. Taglioni (2023): "The US-China Trade War and Global Reallocations," NBER Working Paper Series 29562, National Bureau of Economic Research, revised.

Federal Reserve Bank of New York (2025): "Global Supply Chain Pressure Index," https://www.newyorkfed.org/research/policy/gscpi#/overview, accessed: 2025-05-19.

Felbermayr, G., A. Kirilakha, C. Syropoulos, E. Yalcin, and Y. V. Yotov (2020): "The Global Sanctions Data Base," *European Economic Review*, 129.

Freedom House (2024): "Freedom in the World 2024: The Global Expansion of Authoritarian Rule," https://freedomhouse.org/report/freedom-world, accessed: 2025-01-15.

Freund, C., A. Mattoo, A. Mulabdic, and M. Ruta (2024): "Is US trade policy reshaping global supply chains?" *Journal of International Economics*, 152, 104011.

Goldberg, P. K. and N. Pavcnik (2016): "The Effects of Trade Policy," NBER Working Paper 21957, National Bureau of Economic Research.

Grossman, G. M., E. Helpman, and S. J. Redding (2024): "When Tariffs Disrupt Global Supply Chains," *American Economic Review*, 114, 988–1029.

Gupta, R., G. Gozgor, H. Kaya, and E. Demir (2019): "Effects of geopolitical risks on trade flows: evidence from the gravity model," *Eurasian Economic Review*.

Gurevich, T. and P. Herman (2018): "The Dynamic Gravity Dataset: 1948-2016," USITC Working Paper 2018-02-A.

Gwartney, J., R. Lawson, and R. Murphy (2024a): "Economic Freedom Dataset," *Economic Freedom of the World: 2024 Annual Report*, accessed: 2025-02-12.

Gwartney, J., R. Lawson, R. Murphy, M. D. Mitchell, K. Grier, R. Grier, and D. J. Mitchell (2024b): "Economic Freedom of the World: 2024 Annual Report," annual report, Fraser Institute.

Handley, K. and N. Limao (2017): "Policy Uncertainty, Trade and Welfare: Theory and Evidence for China and the U.S." *American Economic Review*, 107, 2731–2783.

——— (2022): "Trade Policy Uncertainty," *Annual Review of Economics*, 14, 363–395.

Helbig, C., T. Thorenz, A. Tuma, and W. Schultmann (2021): "An Overview of Indicator Choice and Normalization in Raw Material Supply Risk Assessments," *Resources*, 10, 79.

Jones, L. (forthcoming): "Measuring Geopolitical Risk in Global Value Chains," *USITC Working Paper*.

Jones, L., E. Bethmann, and M. Demirkaya (forthcoming): "End Use Concordance," *USITC Working Paper*.

Jones, L., S. Shikher, and Y. Yotov (2025): "International Trade and Production Database by End Use (ITPD-U)," *USITC Working Paper 2025-12-B*.

Jones, L., Z. Wang, N. Ahmad, J. Yuan, Q. Chen, F. Wang, and J. Guo (2019): "Methodologies of Constructing the APEC TiVA Database for Better Understanding

Global Value Chains in the APEC Region," Technical report, APEC Committee on Trade and Investment.

Kaufmann, D., A. Kraay, and M. Mastruzzi (2010): "The Worldwide Governance Indicators: Methodology and Analytical Issues," working paper, World Bank.

Kim, D. and S. Lee (2024): "Multinational Investment Activity under Policy Uncertainty in Host and Competing Countries," Electronic journal, SSRN.

Larch, M., S. Shikher, and Y. Yotov (2025a): "Estimating Gravity Equations: Theory Implications, Econometric Developments, and Practical Recommendations," *Review of International Economics*, 33, 1066–1092.

Larch, M., S. Shikher, and Y. V. Yotov (2025b): "The International Trade and Production Database for Estimation - Release 3 (ITPD-E-R03)," *USITC Working Paper 2025–06–A*.

Luo, C. and N. Wang (2025): "U.S.-China trade frictions and supply chain reconstruction: Perspective from indirect links," *Journal of International Money and Finance*, 151, 103256.

Martin, J., I. Mejean, and M. Parenti (2023): "Relationship Stickiness, International Trade, and Economic Uncertainty," *The Review of Economics and Statistics*, 1–45.

Mulabdic, A. and Y. Yotov (2025): "Geopolitical Risks and Trade," Tech. Rep. Manuscript, World Bank.

Peng, S.-K., R. Riezman, and P. Wang (2015): "Intermediate Goods Trade, Technology Choice and Productivity," Tech. Rep. 5637, CESifo Working Paper Series, available at SSRN: https://ssrn.com/abstract=2717413 or http://dx.doi.org/10.2139/ssrn.2717413.

Pfaffermayr, M. (2022): "Cross-section Gravity Models, PPML Estimation and the Bias Correction of the Two-way Cluster-robust Standard Error," *unpublished manuscript.*

Pisch, F. (2020): "Managing Global Production: Theory and Evidence from Just-in-Time Supply Chains," Discussion Paper dp1689, Centre for Economic Performance, London School of Economics.

Saltarelli, F., V. Cimini, A. Tacchella, A. Zaccaria, and M. Cristelli (2020): "Is Export a Probe for Domestic Production?" *Frontiers in Physics*, 8, 180.

Santos Silva, J. and S. Tenreyro (2006): "The Log of Gravity," *Review of Economics and Statistics*, 88, 641–658.

S&P Global (2025): "Top Geopolitical Risks of 2025," https://www.spglobal.com/en/research-insights/market-insights/geopolitical-risk, accessed: 2025-05-19.

Syropoulos, C., G. Felbermayr, A. Kirilakha, E. Yalcin, and Y. V. Yotov (2024): "The global sanctions data base–Release 3: COVID-19, Russia, and multilateral sanctions," *Review of International Economics*, 32, 12–48.

Thakkar, N. J. and K. A. Ayub (2022): "Geopolitical Risk and Globalization," *Journal of Applied Business and Economics*.

World Bank (2024): "Worldwide Governance Indicators, 2024 Update," https://www.worldbank.org/en/publication/worldwide-governance-indicators, accessed: 2025-06-16.

WTO (2023): "World Trade Statistical Review 2023," Report, Center for Global Policy Analysis, LeBow College of Business, Drexel University.

Yotov, Y. V. (2022): "On the role of domestic trade flows for estimating the gravity model of trade," *Contemporary Economic Policy*.

Appendix

Table 6: Gravity Estimates Across Goods by End Use, EFI 1—Size of Government

	Cons.	Interm.	Cap.
DIST	-0.750	-0.859	-0.619
	(.041)****	(.029)****	(.034)****
CNTG	0.439	0.354	0.482
	(.068)****	(.065)****	(.077)****
CLNY	0.117	0.127	0.105
	(.084)	(.073)	(.079)
LANG	0.272	0.259	0.166
	(.052)****	(.047)****	(.057)**
EU	0.859	0.605	0.255
	(.102)****	(.083)****	(.097)**
CU	0.655	0.444	0.536
	(.132)****	(.097)****	(.175)**
RTA	0.201	0.171	0.219
	(.055)***	(.045)***	(.054)****
WTO	1.559	1.119	1.803
	(.102)****	(.075)****	(.109)****
SANCT	-1.541	-1.953	-2.134
	(.388)****	(.45)****	(.339)****
EFI_1	0.175	0.217	0.471
	(.075)*	(.049)****	(.092)****

Notes: This table reports gravity estimates that are obtained from equation (1). The results replicate those from Table 2 but with the EFI 1—Size of Government. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

Table 7: Gravity Estimates Across Goods by End Use, EFI 2—Legal System and Property Rights

	Cons.	Interm.	Cap.
DIST	-0.750	-0.879	-0.673
	(.033)****	(.026)****	(.033)****
CNTG	0.406	0.325	0.400
	(.062)****	(.053)****	(.065)****
CLNY	0.0290	0.0820	-0.00700
	(.081)	(.065)	(.078)
LANG	0.301	0.266	0.237
	(.047)****	(.042)****	(.05)****
EU	0.472	0.230	-0.188
	(.077)****	(.076)**	(.09)*
CU	0.910	0.515	0.618
	(.114)****	(.092)****	(.138)****
RTA	0.283	0.256	0.261
	(.047)****	(.042)****	(.046)****
WTO	0.637	0.602	1.198
	(.098)****	(.075)****	(.114)****
SANCT	-1.381	-1.831	-2.118
	(.39)***	(.416)****	(.347)****
EFI_2	0.808	0.521	0.652
	(.04)****	(.036)****	(.052)****

Notes: This table reports gravity estimates that are obtained from equation (1). The results replicate those from Table 2 but with the EFI 2—Legal System and Property Rights. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

Table 8: Gravity Estimates Across Goods by End Use, EFI 3—Sound Money

	Cons.	Interm.	Cap.
DIST	-0.761	-0.875	-0.654
	(.036)****	(.027)****	(.034)****
CNTG	0.448	0.360	0.460
	(.065)****	(.056)****	(.068)****
CLNY	0.0390	0.0770	0.00900
	(.086)	(.067)	(.081)
LANG	0.285	0.274	0.235
	(.049)****	(.043)****	(.053)****
EU	0.470	0.260	-0.133
	(.103)****	(.084)**	(.107)
CU	0.828	0.489	0.625
	(.118)****	(.091)****	(.141)****
RTA	0.261	0.234	0.249
	(.05)****	(.042)****	(.051)****
WTO	0.806	0.693	1.261
	(.102)****	(.072)****	(.113)****
SANCT	-1.515	-1.885	-2.130
	(.393)***	(.421)****	(.35)****
EFI_3	1.006	0.627	0.810
	(.059)****	(.041)****	(.072)****

Notes: This table reports gravity estimates that are obtained from equation (1). The results replicate those from Table 2 but with the EFI 3—Sound Money. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

Table 9: Gravity Estimates Across Goods by End Use, EFI 4—Freedom to Trade Internationally

	Cons.	Interm.	Cap.
DIST	-0.807	-0.897	-0.696
	(.037)****	(.027)****	(.035)****
CNTG	0.409	0.338	0.428
	(.064)****	(.054)****	(.068)****
CLNY	-0.0220	0.0410	-0.0370
	(.086)	(.067)	(.084)
LANG	0.310	0.280	0.247
	(.051)****	(.044)****	(.056)****
EU	0.178	0.0880	-0.354
	(.104)	(.084)	(.11)**
CU	0.612	0.334	0.374
	(.124)****	(.097)***	(.143)**
RTA	0.230	0.217	0.233
	(.049)****	(.041)****	(.048)****
WTO	0.275	0.378	0.989
	(.117)*	(.085)****	(.136)****
SANCT	-1.493	-1.913	-2.128
	(.399)***	(.476)****	(.34)****
EFI_4	1.311	0.763	0.917
	(.072)****	(.056)****	(.086)****

Notes: This table reports gravity estimates that are obtained from equation (1). The results replicate those from Table 2 but with the EFI 4—Freedom to Trade Internationally. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.

Table 10: Gravity Estimates Across Goods by End Use, EFI 5—Regulation

	Cons.	Interm.	Cap.
DIST	-0.724	-0.871	-0.641
	(.031)****	(.026)****	(.03)****
CNTG	0.448	0.331	0.438
	(.058)****	(.052)****	(.063)****
CLNY	0.0530	0.106	0.00600
	(.078)	(.064)	(.075)
LANG	0.212	0.217	0.164
	(.045)****	(.041)****	(.048)***
EU	0.781	0.431	0.0470
	(.064)****	(.072)****	(.079)
CU	0.958	0.528	0.665
	(.107)****	(.088)****	(.132)****
RTA	0.277	0.240	0.276
	(.043)****	(.041)****	(.044)****
WTO	0.685	0.650	1.244
	(.093)****	(.074)****	(.111)****
SANCT	-1.493	-1.896	-2.208
	(.376)****	(.418)****	(.352)****
EFI_5	1.020	0.592	0.781
	(.042)****	(.037)****	(.059)****

Notes: This table reports gravity estimates that are obtained from equation (1). The results replicate those from Table 2 but with the EFI 5–Regulation. ** $p < 0.10$, *** $p < .05$, **** $p < .01$. See text for further details.