Foreign Ships in U.S. Waters*

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Abstract

Who services U.S. imports, and how does this reliance on foreign-built and foreign-operated vessels balance potential risks to trade resilience with the efficiency benefits they provide? This paper studies the extent to which U.S. international trade depends on foreign-built and foreign-operated maritime vessels. Using detailed shipment-level import data matched with vessel characteristics, we document substantial reliance on foreign ships, especially among smaller and recently built container vessels. To interpret these findings, we develop a two-country model featuring strategic investments in shipping infrastructure under geopolitical risk. Our analysis highlights potential underinvestment in domestic shipping capacity arising from decentralized decision-making and uncertainty about future geopolitical conditions.

*Contact: simon.fuchs@atl.frb.org, fernando.leibovici@stls.frb.org, and wfwong@uoregon.edu. KC Pringle provided excellent research assistance. The views expressed herein are those of the individual authors and do not necessarily reflect official positions of the Federal Reserve Bank of St. Louis, the Federal Reserve Bank of Atlanta, the Federal Reserve System, or the Board of Governors. All errors are our own.

1 Introduction

Global maritime shipping facilitates over 80% of world trade by volume, knitting together production and consumption across continents (UNCTAD, 2024). For much of the 20th century, the United States maintained both a leading shipbuilding industry and a substantial U.S.-flag merchant fleet, assets viewed as integral to economic growth and national defense (Mahan, 1890; United States Congress, 1936). In recent decades, however, U.S. shipyard output has fallen dramatically and the U.S.-flag fleet has dwindled to below 1% of global capacity (Barwick, Kalouptsidi and Zahur, 2024; Bureau of Transportation Statistics, 2022).

Concurrently, foreign nations——particularly in East Asia—have expanded their shipbuilding capabilities through industrial policy and strategic investment, resulting in a global shipping system heavily reliant on foreign-built and foreign-operated ships. While this reliance raises important questions about trade resilience and national security, foreign fleets also bring benefits such as increased capacity, specialized expertise, and cost efficiencies that support global commerce. Against this backdrop, this paper addresses the question: *Who services U.S. imports, and how does this reliance on foreign-built and foreign-operated vessels balance potential risks to trade resilience with the efficiency benefits they provide?*

To address this question, we link shipment-level U.S. import microdata with a comprehensive vessel registry that includes information on shipbuilder, capacity, build year, and operator. This integrated dataset allows us to examine both where the ships servicing U.S. imports are built and who operates them. We quantify the extent to which different countries contribute to U.S. import shipping capacity by measuring the share of volume, expressed in twenty-foot equivalent units (TEU), transported on vessels built in each country. Furthermore, we examine how this reliance varies systematically by vessel characteristics, including size and vintage, as well as by the operator and its nationality.

We establish two stylized facts. First, U.S. imports rely heavily on vessels built in East Asia, with South Korea, China, and Japan dominating across ship sizes and vintages. While China has rapidly expanded its presence in newer and smaller vessels, South Korea and Japan continue to lead in larger and mid-aged segments. Second, most Chinese-built ships serving U.S. trade are operated by non-Chinese firms, reflecting the global integration of Chinese shipbuilding into international shipping networks. This highlights an important distinction between the origin of a vessel's construction and the nationality of its operator, an interesting dimension that is critical for assessing trade resilience and strategic exposure.

To provide a conceptual framework for interpreting these empirical findings, we develop a theoretical model that explicitly incorporates both economic and geopolitical considerations driving investment in shipping infrastructure. In particular, we aim to understand the sources

of potential underinvestment in domestic shipping capacity, the economic consequences of reliance on foreign-operated vessels, and the strategic incentives for policy intervention under geopolitical risk. Our model features two countries investing independently in complementary shipping infrastructure—ports and shipping fleets—in the presence of uncertainty about future geopolitical conflicts. By comparing equilibrium outcomes across different institutional settings (competitive markets, global coordination, and independent national planners), we characterize the inefficiencies arising from decentralized decision-making and highlight how strategic considerations shape national investment incentives. This theoretical analysis clarifies the trade-offs policymakers face between leveraging foreign capacity for short-term economic efficiency and investing in domestic shipping assets to enhance long-term trade resilience and national security.

Finally, we quantify the welfare implications of a recent U.S. trade policy proposal to impose differentiated port surcharges aimed at reducing reliance on maritime vessels connected to China (USTR, 2025). Under this policy, container ships either built in Chinese shipyards or operated by Chinese firms face targeted fees upon entry into U.S. ports. Vessels operated by Chinese entities incur significantly higher charges compared to non-Chinese operators of Chinese-built ships, creating distinct cost incentives. Using a standard first-order welfare approximation, we estimate the economic burden borne by U.S. importers and consumers due to these surcharges. Our analysis highlights key trade-offs policymakers must navigate when deploying targeted port charges to address strategic concerns about foreign maritime dependence.

2 Historical Background

To provide context for today's reliance on foreign vessels, we briefly review the historical evolution of global shipbuilding. We document the United States' maritime strength during and after World War II, its subsequent decline due to competitive pressures, and the strategic rise of East Asian shipbuilders—particularly China, South Korea, and Japan.

Maritime Power and National Security Historically, great powers have viewed commercial shipping as foundational to naval capability. For example, Mahan (1890) stressed that a strong merchant marine underpins military mobility by supplying logistics and transport in wartime. In World War II, U.S. shipyards produced over 2,700 Liberty ships, ensuring supply lines to multiple theaters and exemplifying the use of civilian shipbuilding for strategic sealift. The Merchant Marine Act of 1936 and subsequent Maritime Security Programs formalized the integration of commercial shipping into national defense by requiring that

a portion of U.S. commerce be transported on U.S.-flag vessels, owned and operated by U.S. citizens, and readily available for government requisition in times of emergency (United States Congress, 1936).

Decline of U.S. Shipbuilding Postwar dominance gave way to decline as globalization and cost pressures led shipping companies to register vessels under "flags of convenience". U.S. shipyards, facing high labor and regulatory costs, saw output fall from dozens of large commercial hulls annually in the 1970s to fewer than five in the 2010s. The resulting contraction left the U.S.-flag fleet below 1% of global capacity by 2020, creating reliance on foreign-built and foreign-flag vessels for nearly all peacetime commercial trade and wartime sealift needs (Bureau of Transportation Statistics, 2022; Barwick, Kalouptsidi and Zahur, 2024).

Strategic Rise of East Asian Shipbuilding and Fleet Following World War II, Japan launched ambitious national programs to rebuild and expand its shipbuilding industry, setting a global benchmark in maritime manufacturing. In subsequent decades, South Korea surpassed this lead through an even more intensive, government-driven campaign of heavy industrialization, transforming itself into a dominant force in global ship production. Beginning in the early 2000s, China executed expansive industrial policies—backed by over $90 billion in subsidies from 2006 to 2013—to build up shipyard capacity through low-interest financing, tax incentives, land grants, and export credits. This campaign elevated China's market share in new ship orders from under 15% in 2000 to over 50% by 2010, displacing Japan and South Korea as leaders in commercial shipbuilding. Chinese yards now launch over 1,200 vessels annually, spanning container ships, bulk carriers, and tankers, while U.S. yards produce only a handful (Alliance for American Manufacturing, 2025). For a comprehensive overview of the evolution of global shipbuilding, see (Barwick, Kalouptsidi and Zahur, 2024).

3 Data

Our analysis relies on two primary data sources, which we link together at the vessel level. The first is U.S. import shipment microdata from Panjiva, commonly referred to as bills of lading, which capture entry transactions at U.S. ports. These records include detailed information such as commodity codes, shipment weights and values, and vessel identifiers. The second source is Clarksons' *Shipping Intelligence Network*, a commercial vessel registry that provides granular characteristics of each ship, including builder country, year of construction,

twenty-foot equivalent unit capacity (TEU) for container vessels, and the operating firm's country of ownership. In order to understand the U.S. trade reliance on foreign ships, we will focus on two dimensions: where these ships are built and who operates them.

We quantify reliance by calculating the total volume of U.S. imports, measured in TEUs, that is transported on vessels built in each shipbuilder country. We then express this as a share of the overall import volume, yielding the proportion of U.S. containerized imports carried on ships constructed by each builder country. For vessel operators, we follow a similar approach: we aggregate the total TEUs imported into the U.S. based on the country of ownership of the operating firm and compute the share of total import volume for each country. Both measures allows us to shed light on the ships and operators of ships that responsible for U.S. trade.

To explore heterogeneity in reliance, we disaggregate the results along two key dimensions, vessel size and shipbuilding vintage. We classify vessel size into five categories of container capacity: fewer than 3,000 TEUs; 3,000 to 7,999 TEUs; 8,000 to 11,999 TEUs; 12,000 to 16,999 TEUs; and 17,000 TEUs or more. For shipbuilding vintages, we group year of construction into four cohorts: pre-2005; 2005–2014; 2015–2019; and 2020 onward.

Global Fleet Composition by Builder Country To situate U.S. import reliance within the broader maritime landscape, Figure 1 illustrates the distribution of container shipping capacity across the world's seven largest shipbuilding nations. The figure compares each country's share of global TEU capacity (dark purple bars) with its share of TEU capacity among vessels that called at U.S. ports (light beige bars). South Korea is the dominant shipbuilder globally accounting for approximately 25-–30% of global container capacity. China ranks second, contributing around 20% of global capacity. Japan, Taiwan, and Germany follow, each contributing between 5–10% of total global capacity.

When focusing specifically on the U.S.-servicing fleet, the overall ranking of builder countries remains consistent, with South Korea retaining its position as the leading shipbuilder. However, there is a modest shift in relative shares: South Korea's share of the fleet serving U.S. trade declines slightly, while China's share increases by approximately five percentage points. This suggests a somewhat greater reliance on Chinese-built vessels in the subset of ships directly supporting U.S. maritime trade, even as South Korea continues to dominate overall.

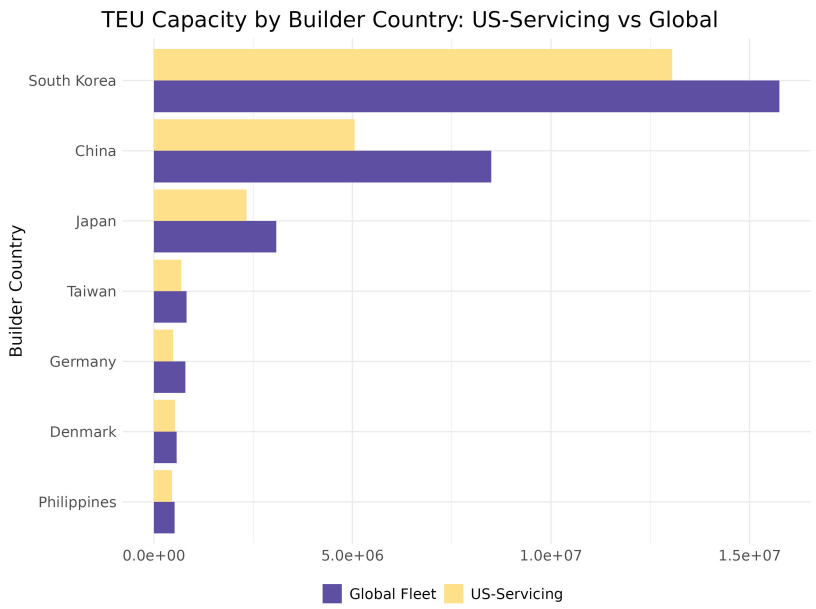


Figure 1: Top Five Builder Countries: Global vs. U.S.-Servicing Fleet

Note: Bars display aggregated TEU capacity by builder country for the entire global fleet and for vessels calling at U.S. ports. For China specifically, we define shipbuilders and operators as Chinese if their respective builder or ownership country is located in mainland China, Hong Kong SAR, or Macau. Source: Panjiva, Clarksons, and authors' calculations.

4 Stylized Facts: Who services U.S. imports?

In this section, we shed light on who services U.S. import trade by highlighting three stylized facts from the data. We present two complementary analyses of the container fleet serving U.S. import volume: first by vessel size, then by build vintage of these vessels. Additionally, we distinguish between where these vessels are built and who operates them.

Vessel Size Figure 2a plots the share of total container-equivalent volume (TEU) transported into U.S. ports on ships of different size classes. Vessels are grouped into five categories by TEU capacity : feeder ships under 3,000 TEU, small mainline ships (3,000–7,999 TEU), mid-sizers (8,000–11,999 TEU), large mainline ships (12,000–16,999 TEU), and ultra-large vessels (17,000 TEU and above). Each bar stacks the proportion of U.S. import TEUs delivered by builder country.

Across all ship size categories (rightmost column), the vessels serving U.S. imports are primarily built in East Asian countries—particularly South Korea, China, and Japan. In the feeder segment (under 3,000 TEU, leftmost column), Chinese-built ships account for approximately 35% of total capacity, reflecting China's rapid penetration into regional-service vessels. At the other extreme, ultra-large vessels (17,000 TEU+, second column from the

right) remain dominated by South Korean and Japanese yards, with Chinese-built ships accounting for only about 15%. Intermediate ship size classes exhibit a tapering Chinese presence, consistent with the enduring strength of established East Asian builders in these categories.

Build Vintage Figure 2b breaks U.S. import TEU volume into four age cohorts based on build year: pre-2005 ("Old"), 2005–2014 ("Mid"), 2015–2019 ("New"), and 2020+ ("Latest"). Within each cohort, bars stack the share of capacity by builder country.

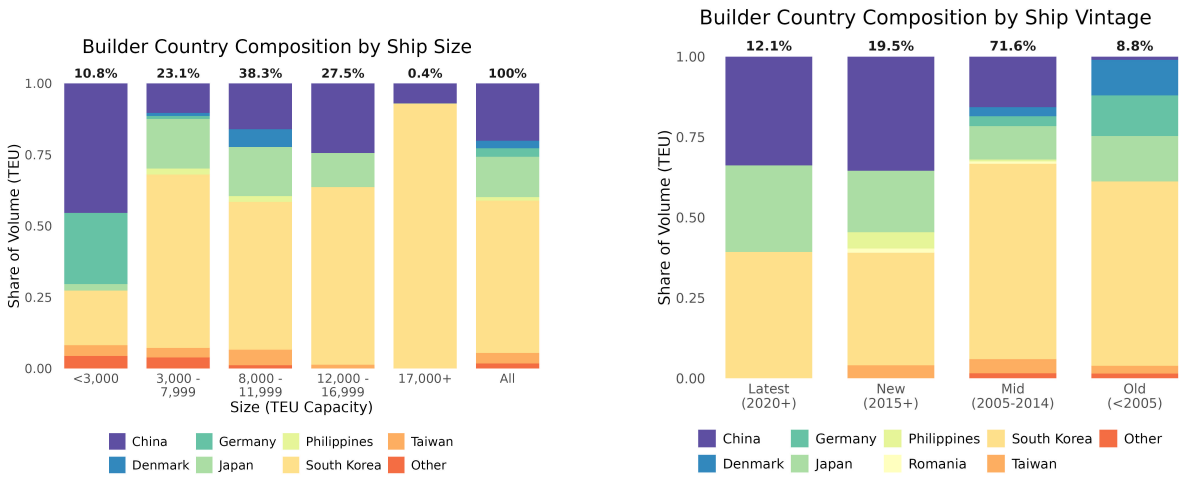
The oldest vessels (pre-2005) feature the most diverse builder composition, including contributions from European countries like Germany and Denmark on top of the East Asian countries, though they represent a relatively small share of total capacity. Chinese-built tonnage for the oldest vessels is negligible (below 5%), reflecting China's limited capacity at that time. The mid-vintage vessels (2005–2014), which make up the bulk of current capacity at 71.6%, sees that the Chinese share rise to roughly 20%, marking early stages of state support in shipbuilding, although the majority is still built in South Korea and Japan, underscoring the historical strength of these countries in global shipbuilding. Vessels built between 2015 and 2019 show Chinese builders responsible for just under 40% of capacity, on par with South Korea. In the most recent cohort (2020+), Chinese yards account for over 45% of TEU capacity, underscoring that nearly half of all new container tonnage entering U.S. trade routes is of Chinese origin and reflecting their growing prominence in recent years.

Both these empirical patterns lead us to summarize following stylized fact:

Stylized Fact 1. *U.S. imports are predominantly serviced by vessels built in East Asian shipyards, across both vessel size and vintage. China has rapidly expanded its share in smaller and newer vessels, while South Korea and Japan maintain a stronghold in larger and mid-aged ships.*

Vessel Operators We now examine which countries and shipping lines operate these vessels. While Stylized Fact 1 demonstrated the structural prevalence of Chinese-built tonnage in U.S. import flows, the operational control of those ships—-whether by Chinese carriers or by international third-party operators—-shapes the day-to-day exposure and governance of critical maritime routes.

Figure 3a displays the distribution of TEU capacity by operator country, broken down by whether the ships were built in China or elsewhere. Among Chinese-built ships, a majority share is operated by non-Chinese firms, including companies from Denmark, France, Switzerland, and Taiwan (leftmost column). Chinese operators account for only a minority share of Chinese-built vessels servicing U.S. ports. This suggests that Chinese shipyards are



(a) TEU Capacity by Size Category

(b) TEU Capacity by Build Vintage

Figure 2: Composition of Ships Servicing U.S. Imports by Size and Vintage

Figure 2a aggregates TEU capacity within discrete size bins (<3,000; 3,000–7,999; 8,000–11,999; 12,000–16,999; ≥17,000 TEUs). Figure 2b groups vessels by build vintage (pre-2005; 2005–2014; 2015–2019; 2020+), summing each builder country's share of capacity weighted by port-call frequency. Source: Panjiva, Clarksons, and authors' calculations.

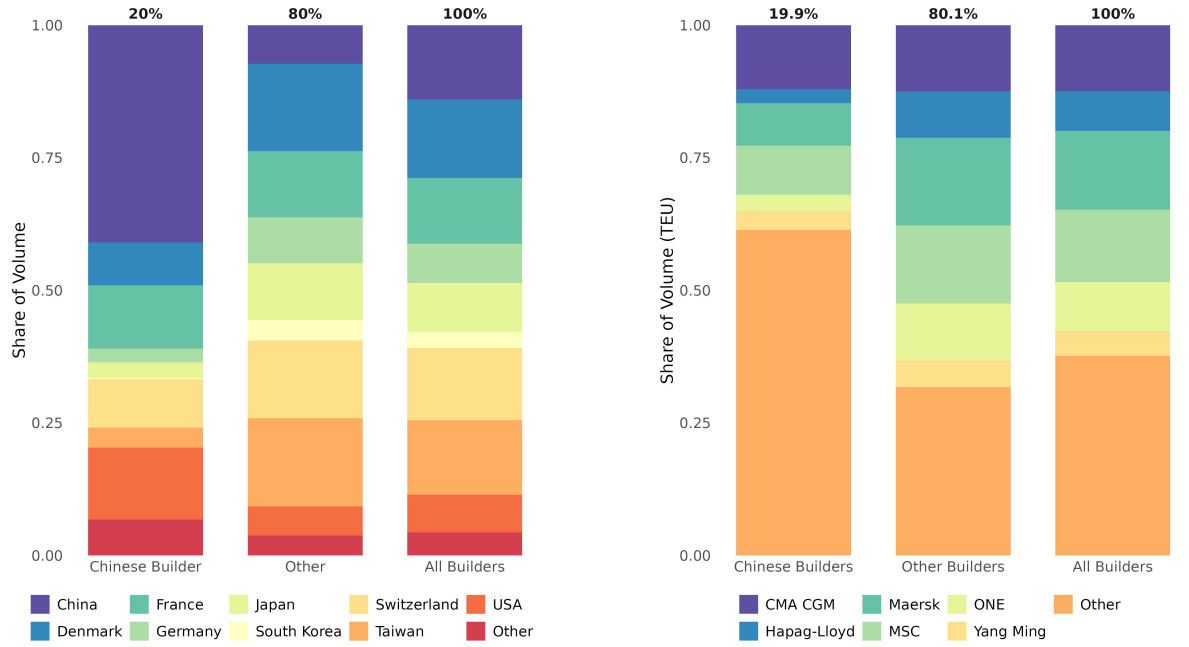
supplying a global clientele, not just domestic carriers. Chinese operators are more likely to operate Chinese-built ships than non-Chinese-built ones. In contrast, vessels built outside China are operated by a much more diverse set of countries (middle column).

Instead, Figure 3b highlights the specific shipping lines operating vessels in U.S. trade. Major global carriers such as MSC, Maersk, CMA CGM, Hapag-Lloyd, and ONE appear prominently across all builder categories. Even among Chinese-built vessels, these top-tier global shipping lines are major operators (leftmost column). This suggests that Chinese-built ships are well integrated into global shipping networks.

These patterns motivate the following stylized fact, which highlights the global integration of Chinese-built vessels into U.S. import logistics:

Stylized Fact 2. *Chinese-built ships serving U.S. imports are predominantly operated by non-Chinese firms and countries, including major global carriers. This reflects the integration of Chinese shipbuilding into international shipping networks, extending well beyond use by Chinese operators.*

The two stylized facts together reveal a nuanced picture of U.S. maritime logistics. First, U.S. imports are overwhelmingly carried on vessels built in East Asia, with China rapidly expanding its footprint in newer and smaller ships, while South Korea and Japan continue to dominate in larger and mid-aged segments. Second, despite the rise of Chinese shipbuilding, these vessels are predominantly operated by non-Chinese firms, including major



(a) Operator Country Distribution

(b) Operator Distribution

Figure 3: Operator Composition of Vessels Servicing U.S. Imports by Country and Shipping Lines

Figure 3a shows the nationality of firms operating vessels in U.S. trade, broken down by whether the ships were built in China, elsewhere, and overall. Figure 3b shows the breakdown of the specific shipping lines operating these ships. Source: Panjiva, Clarksons, and authors' calculations.

global carriers that are European. This decoupling of ship construction from ship operation underscores the global integration of Chinese-built vessels into international trade networks. This highlights an interesting distinction between the origin of a vessel's construction and the nationality of its operator when assessing trade resilience and strategic exposure.

These empirical patterns underscore the importance of distinguishing between the origin of vessel construction and the nationality of vessel operators when assessing trade resilience. They also highlight the globally distributed nature of shipping capacity and the potential vulnerabilities that arise from concentrated control. To explore these dynamics more formally, we now turn to a stylized two-country model in which each country invests in port infrastructure and shipping fleet capacity to support international trade. In this framework, trade depends on the simultaneous availability of port capacity in both countries and a shared global fleet—three strictly complementary inputs. We introduce geopolitical risk into this setting, allowing for the possibility that conflict may disrupt trade entirely, and examine how such risk shapes investment incentives and strategic exposure.

5 Model

We consider a two-country environment in which each country invests in port infrastructure and shipping fleet capacity to enable international trade. Trade requires the simultaneous availability of three inputs: port capacity in the exporting country, port capacity in the importing country, and a global shipping fleet. These inputs are strictly complementary: insufficient investment in any one component limits the volume of trade. Geopolitical relations between the two countries are subject to risk. With probability p, war breaks out in period 1, halting trade entirely.

We analyze the model under three institutional settings that differ in how decisions about capacity investments are made. In the decentralized competitive equilibrium, capacity is provided by privately owned firms that invest based on market prices. In the global planner setting, a central decision-maker coordinates all investment choices to maximize total welfare across countries. In the country-specific planner setting, each government chooses its own investments independently, taking the other country's actions as given and potentially valuing shipping infrastructure for both economic and strategic purposes.

This framework allows us to address three core questions. First, to what extent does the decentralized equilibrium feature underinvestment in shipping capacity? Second, how does geopolitical risk affect optimal and equilibrium investment decisions? Third, what are the incentives for unilateral policy interventions by a national planner, and can these policies mitigate the inefficiencies introduced by risk and decentralization?

5.1 Setup

We consider a world with two countries, indexed by $n \in \{A, B\}$, that engage in international trade. Investment decisions are made in period 0, while trade and geopolitical uncertainty materialize in period 1. The environment abstracts from consumption, production, and investment beyond trade-enabling infrastructure. Our focus is on the allocation and coordination of port and fleet capacity, and how institutional arrangements affect trade outcomes.

In period 1, geopolitical uncertainty resolves. With probability $1 - p$, the world remains at peace and international trade proceeds as described below. With probability p, war breaks out and trade is fully interrupted: no shipments occur, and infrastructure generates no commercial returns.

Fleet Providers. Each country has a domestic fleet provider that chooses shipping capacity $f_n \geq 0$ in period 0. Fleet capacity is a tradable input: ships based in one country may be used for shipments between either pair of countries. In period 1, each shipment—whether

from A to B or from B to A—requires one unit of fleet capacity. Letting Q_{AB} and Q_{BA} denote the volume of shipments from A to B and from B to A, respectively, the total number of shipments is $Q_{AB} + Q_{BA}$. Since fleet capacity is pooled globally, total fleet capacity must satisfy:

$$Q_{AB} + Q_{BA} \leq f_A + f_B.$$

Fleet providers face a country-specific quadratic investment cost of the form $\frac{1}{2}\mu_n f_n^2$, where $\mu_n > 0$ governs the marginal cost of expanding fleet capacity in country n. Providers are risk-neutral, operate under perfect competition, and take the per-unit shipping fee τ^f as given. They earn revenue only in the peaceful state. Each fleet provider solves:

$$\max_{f_n \geq 0} (1-p) \cdot \tau^f f_n - \frac{1}{2}\mu_n f_n^2.$$

Port Providers. Each country operates a local port authority that invests in port capacity $i_n \geq 0$ in period 0. Port capacity is non-tradable and is used whenever the country serves as an exporter or importer. In particular, country A's port is used for both exports to B (volume Q_{AB}) and imports from B (volume Q_{BA}). Port capacity in country n must be sufficient to handle all shipments involving that country, either as exporter or importer:

$$Q_{nm} + Q_{mn} \leq i_n.$$

Port providers face country-specific quadratic investment costs of the form $\frac{1}{2}\kappa_n i_n^2$, where $\kappa_n > 0$ governs the marginal cost of expanding port infrastructure in country n. Providers earn per-unit fees τ_n^p conditional on peace. Each port provider solves:

$$\max_{i_n \geq 0} (1-p) \cdot \tau_n^p (Q_{nm} + Q_{mn}) - \frac{1}{2}\kappa_n i_n^2,$$

where Q_{nm} denotes exports from country n to country m and Q_{mn} denotes imports into n from m.

Importers. In the peaceful state, households or firms in each country demand imported goods in period 1. Rather than modeling preferences, income, or domestic production explicitly, we impose a reduced-form inverse demand schedule. Specifically, the quantity of goods imported by country m from country n is given by:

$$Q_{nm} = a_m - b_m \tau_{nm}, \quad \text{with } a_m > 0,\ b_m > 0,$$

where τ_{nm} is the total per-unit cost of importing from n to m. This functional form captures that trade volumes decline with delivered trade costs, and serves as a tractable reduced-form representation of import demand. It abstracts from microfoundations such as income effects or substitution across sources, allowing us to focus on how shipping costs and infrastructure constrain equilibrium trade flows. Surplus from trade arises only in the peaceful state and is valued through the volume of imports.

Shipping Costs. Each shipment from country n to country m incurs shipping costs from three sources:

$$\tau_{nm} = \tau^f + \tau_n^p + \tau_m^p,$$

where τ^f is the payment to fleet providers, and τ_n^p and τ_m^p are the port fees charged by the exporting and importing countries, respectively. All components of τ_{nm} are modeled as specific (per-unit) fees rather than ad valorem rates.

Feasibility Constraints. The feasible volume of trade flows must respect both fleet and port capacity constraints:

$$Q_{AB} + Q_{BA} \leq f_A + f_B,$$

$$Q_{AB} + Q_{BA} \leq i_A, \quad Q_{AB} + Q_{BA} \leq i_B.$$

These constraints reflect the indivisibility and complementarity of shipping inputs. A shipment cannot occur unless there is available capacity at both the export and import ports, as well as a ship to carry the goods. Equivalently, the total volume of trade across both directions must satisfy:

$$Q_{AB} + Q_{BA} \leq \min\left\{f_A + f_B,\ i_A,\ i_B\right\},$$

highlighting that total trade is limited by the most restrictive input among global fleet and local port capacities.

Competitive Equilibrium. A competitive equilibrium consists of:

- Capacity choices $\{f_n, i_n\}_{n\in\{A,B\}}$ by fleet and port providers;
- Shipping prices τ^f, τ_A^p, τ_B^p;
- Trade flows Q_{AB} and Q_{BA};

such that:

1. Fleet and port providers choose capacities to maximize expected profits given prices;

2. Importers in each country demand imports according to their inverse demand schedules;

3. Trade flows satisfy the feasibility constraint:

$$Q_{AB} + Q_{BA} \leq \min\{f_A + f_B,\ i_A,\ i_B\}.$$

War Payoffs and Strategic Value. In the event of war, trade is fully interrupted and fleet and port providers earn no commercial revenue. However, countries may derive strategic value from their shipping infrastructure. Specifically, we assume that a strategic prize of size $W > 0$ is awarded to one of the two countries. The probability that country n wins the prize is determined by a Tullock contest function:

$$\Pr(n \text{ wins}) = \frac{s_n}{s_A + s_B}, \quad \text{where } s_n = f_n + \alpha i_n.$$

Here, s_n denotes the strategic capability of country n, defined as a weighted sum of its fleet and port capacity. The parameter $\alpha > 0$ governs the relative importance of port infrastructure in contest success. This formulation implies that infrastructure investments can be valuable even in the absence of trade, due to their contribution to strategic power in the event of geopolitical conflict.

Foreign Shipping Dependence. Given fleet capacities f_A and f_B, country n's dependence on foreign shipping capacity is defined as the share of its total trade volume that exceeds its domestic fleet capacity. For country A, this share is:

$$\frac{f_B}{Q_{AB} + Q_{BA}},$$

with an analogous expression for country B. This directly captures the fraction of a country's trade volume enabled by its trading partner's fleet.

5.2 Global Planner

We now describe the allocation problem faced by a benevolent global planner. The planner chooses infrastructure investments and trade flows to maximize expected global welfare, accounting for both the gains from trade in the peaceful state and the strategic value of infrastructure in the event of war. The planner internalizes the constraints governing trade feasibility and the role of infrastructure in determining war outcomes.

The planner values both trade in the peaceful state and strategic outcomes in the event of war. Imports yield welfare gains of $\varphi_n > 0$ per unit for country n. War halts trade but delivers a strategic prize of size $W > 0$ to one of the two countries. The probability that country n wins the prize is given by a Tullock contest:

$$\Pr(n \text{ wins}) = \frac{s_n}{s_A + s_B}, \quad \text{with } s_n = f_n + \alpha i_n,$$

where $\alpha > 0$ governs the strategic weight of port infrastructure relative to fleet.

The planner solves:

$$\begin{aligned}
\max_{\{f_n, i_n\}_n, \{Q_{nm}\}_{n \neq m}} \quad & (1-p) \cdot \sum_{n \neq m} \varphi_m Q_{nm} + p \cdot \sum_n \left(\frac{s_n}{\sum_k s_k} \right) W - \sum_n \left(\frac{1}{2} \mu_n f_n^2 + \frac{1}{2} \kappa_n i_n^2 \right) \\
\text{subject to} \quad & \sum_{n \neq m} Q_{nm} \leq \min \left\{ \sum_n f_n, \ \min_n i_n \right\}, \\
& Q_{nm} \geq 0 \quad \text{for all } n \neq m, \\
& f_n, i_n \geq 0 \quad \text{for all } n.
\end{aligned}$$

The planner coordinates investments across countries and infrastructure types, internalizing the complementarities across fleet and port capacity and the bottleneck nature of trade. In contrast to the decentralized equilibrium, the planner accounts not only for the expected value of trade, but also for the role of infrastructure in determining strategic outcomes under war. This formulation provides a benchmark for efficient investment under full global coordination.

5.3 Country-Specific Planners: Strategic Nash Equilibrium

We now consider a setting in which each country independently chooses its infrastructure investments to maximize its own expected welfare, taking the other country's choices as given. Each country values imports in the peaceful state and the prospect of winning a strategic prize in the event of war, where success depends on its own infrastructure capacity. Unlike the global planner, each country accounts only for its own objective and does not internalize the impact of its decisions on the other country's welfare.

Let Q_{mn} denote the volume of goods imported by country n from country m, with $m \neq n$.

Given the rival country's choices (f_m, i_m), country $n \in \{A, B\}$ solves:

$$\begin{aligned} \max_{f_n, i_n} \quad & (1-p) \cdot \varphi_n Q_{mn} + p \cdot \frac{s_n}{s_n + s_m} W - \frac{1}{2}\mu_n f_n^2 - \frac{1}{2}\kappa_n i_n^2 \\ \text{subject to} \quad & Q_{mn} \leq \min\left\{f_n + f_m,\ i_n,\ i_m\right\}, \\ & f_n, i_n \geq 0. \end{aligned}$$

Nash Equilibrium. A Nash equilibrium consists of investment choices $\{f_n^*, i_n^*\}_{n \in \{A,B\}}$ such that for each country n, the pair (f_n^*, i_n^*) solves the problem above given (f_m^*, i_m^*).

In equilibrium, each country balances the expected value of trade against the strategic return to infrastructure. Because each planner optimizes only over its own objective, the resulting allocation generally differs from both the decentralized equilibrium and the efficient outcome under a global planner.

5.4 Solution and Results

We now examine the equilibrium outcomes implied by the model under the three institutional environments introduced above. Our focus is twofold. First, we assess whether the decentralized competitive equilibrium leads to efficient investment and trade outcomes. Second, we evaluate the incentives of a country-specific planner to deviate from the decentralized allocation.

For expositional clarity, we specialize to the case of symmetric countries. Specifically, we assume that all structural parameters are identical across countries: the marginal benefit from imports ($\varphi_n = \varphi$), demand parameters ($a_n = a$, $b_n = b$), and investment cost parameters for fleet and port infrastructure ($\mu_n = \mu$, $\kappa_n = \kappa$). These assumptions allow us to derive closed-form solutions and isolate the core mechanisms that drive inefficiencies and strategic behavior across institutional regimes.

5.4.1 Competitive Equilibrium vs. Global Planner

Competitive Equilibrium. We begin by solving the decentralized competitive equilibrium under the symmetric case. Given that all parameters are identical across countries, the equilibrium allocation is also symmetric: $f_A = f_B = f$, $i_A = i_B = i$, and $Q_{AB} = Q_{BA} = Q$. Total trade volume is $2Q$. Since each shipment requires one unit of fleet capacity and uses one unit of port capacity in both the exporter and importer, the bottleneck constraint implies:

$$Q \leq \min\left\{f,\ \frac{i}{2}\right\}.$$

We first solve the problem of the fleet providers. Each provider chooses capacity to maximize expected profits, taking the fleet price τ^f as given. The optimality condition for country n is:

$$(1-p)\cdot\tau^f = \mu f.$$

Under symmetry, this condition holds for both providers. Total fleet capacity is $2f$, and since each unit of trade requires one unit of fleet, market clearing implies:

$$2Q = 2f \quad \Rightarrow \quad f = Q.$$

Substituting into the first-order condition yields:

$$\tau^f = \frac{\mu Q}{1-p}.$$

We now turn to the port providers. Under symmetry, each port is used for both exports and imports of volume Q, and must therefore process $2Q$ shipments. This implies that each provider must invest $i = 2Q$ to satisfy the feasibility constraint. Taking the port fee τ^p as given, each provider equates expected marginal revenue and marginal cost. The first-order condition implies:

$$(1-p)\cdot\tau^p = \kappa i = \kappa\cdot 2Q \quad \Rightarrow \quad \tau^p = \frac{2\kappa Q}{1-p}.$$

The total shipping cost per unit is:

$$\tau = \tau^f + \tau^p_A + \tau^p_B = \frac{\mu Q}{1-p} + 2\cdot\frac{\kappa Q}{1-p} = \frac{(\mu+2\kappa)Q}{1-p}.$$

Import demand is linear: $Q = a - b\tau$. Substituting in for τ gives:

$$Q = a - b\cdot\frac{(\mu+2\kappa)Q}{1-p} \quad \Rightarrow \quad Q\left(1+\frac{b(\mu+2\kappa)}{1-p}\right) = a.$$

Solving for Q yields the competitive equilibrium quantity:

$$Q^{CE} = \frac{a}{1+\frac{b(\mu+2\kappa)}{1-p}}.$$

Global Planner. The global planner chooses per-country fleet and port investments to maximize expected global welfare, internalizing both the bottleneck constraint and the value of infrastructure in trade and conflict. The planner values trade in the peaceful state and the strategic prize awarded in the event of war. Under symmetry, total trade volume is $2Q$,

with equal flows in each direction, and expected war payoffs sum to W.

The planner's problem is:

$$\max_{f,i,Q} (1-p)\cdot 2\varphi Q + p\cdot W - \mu f^2 - \kappa i^2 \quad \text{subject to} \quad Q \le \min\{f,\ \tfrac{i}{2}\}.$$

The constraint binds at the optimum, so the planner sets $f = Q$, $i = 2Q$. Substituting into the objective yields:

$$\max_{Q} (1-p)\cdot 2\varphi Q + p\cdot W - \mu Q^2 - \kappa(2Q)^2 = (1-p)\cdot 2\varphi Q + p\cdot W - \mu Q^2 - 4\kappa Q^2.$$

The first-order condition is:

$$(1-p)\cdot 2\varphi = 2(\mu + 4\kappa)Q \quad \Rightarrow \quad Q^{PL} = \frac{(1-p)\cdot\varphi}{\mu + 4\kappa}.$$

Comparison. We now compare the decentralized and planner allocations. To simplify the comparison and normalize units, we set $a = \varphi$ and $b = 1$. This ensures that the intercept of the linear import demand schedule matches the marginal benefit from trade in the planner's objective, and it allows us to express both outcomes in the same units.

Under these assumptions, the competitive equilibrium trade volume is:

$$Q^{CE} = \frac{\varphi}{1 + \frac{\mu+2\kappa}{1-p}} = \frac{(1-p)\cdot\varphi}{1-p+\mu+2\kappa},$$

while the planner allocation is:

$$Q^{PL} = \frac{(1-p)\cdot\varphi}{\mu + 4\kappa}.$$

Comparing the two expressions, we observe that $Q^{PL} > Q^{CE}$ if and only if:

$$2\kappa < 1 - p.$$

This condition provides clear intuition for why underinvestment arises in the decentralized equilibrium. The left-hand side, 2κ, represents the marginal cost of simultaneously expanding port infrastructure in both countries, reflecting the complementary nature of ports: each shipment necessarily requires port capacity at both origin and destination. The right-hand side, $1-p$, captures the expected benefit from trade infrastructure, discounted by the probability of geopolitical conflict halting trade entirely. Underinvestment thus emerges precisely when the expected benefits from enabling trade (high when geopolitical risk p is low) significantly outweigh the combined cost of port expansions (low κ). Importantly, the cost of fleet

investment (μ) does not influence this condition, as fleet capacity is globally pooled and thus avoids the duplication and coordination challenges inherent in port investments. The decentralized equilibrium underinvests specifically because port providers set prices independently, neglecting the aggregate effect of their pricing decisions on total trade volume.

Stepping back, these findings illustrate how decentralized market decisions combined with geopolitical risk can systematically depress investment in trade-enabling infrastructure. While our analysis is stylized, the underlying mechanism highlights a general issue: essential shipping infrastructure components—such as ports—are complementary and require coordinated investment decisions. Without coordination, independent pricing and investment decisions can cumulatively create substantial distortions, especially when geopolitical uncertainty makes future trade gains less secure. In practice, policymakers frequently intervene in global shipping markets through subsidies, public investments, or infrastructure coordination. Our results suggest these interventions can mitigate fundamental inefficiencies by internalizing complementarities and alleviating risk-induced underinvestment, potentially enhancing global trade volumes and stability in international commerce.

5.5 Discussion

Our theoretical framework highlights potential underinvestment and inefficiencies arising from decentralized infrastructure decisions under geopolitical uncertainty, providing a clear rationale for policy intervention. While the existing literature typically justifies such interventions on infant-industry grounds, our analysis emphasizes additional strategic considerations, including dual-use infrastructure in conflict scenarios and network externalities inherent in global shipping capacity.

Thus, the framework developed in this section establishes a benchmark for analyzing optimal infrastructure investment under geopolitical risk. Our next steps are to explicitly characterize the equilibrium with country-specific planners strategically investing in infrastructure, and to examine policies such as port fees and fleet subsidies that can decentralize these planner outcomes. Understanding these strategic interactions will allow us to quantify the specific inefficiencies arising from independent national decisions and identify targeted policies to mitigate them.

Moreover, we plan to extend the analysis to realistic asymmetric environments reflecting the United States' substantial reliance on foreign-built and foreign-operated vessels. Incorporating these asymmetries will be essential to precisely evaluate recent U.S. policy proposals that impose differentiated fees on Chinese-linked vessels, enabling us to provide direct quantitative assessments of their economic impact and strategic desirability.

6 Welfare Analysis of Fees on Chinese-linked Vessels

In this section, we use our two-country, three-input framework to quantify how much U.S. policymakers implicitly "pay" in consumer welfare when they impose Section 301 port-call surcharges on Chinese-linked vessels. While our theoretical model highlights how unilateral port-fee distortions undermine the essential complementarities of global shipping infrastructure, the following welfare exercise shows the magnitude of the burden U.S. consumers accept to signal geopolitical resolve.

In April 2025, the U.S. Trade Representative finalized a Section 301 rule that levies per-voyage port fees on container vessels with Chinese connections (USTR, 2025). Under these rules, any ship owned or operated by a Chinese entity pays an initial USD 50 per net ton (NT) of capacity, rising by USD 30/NT each year over a three-year phase-in (reaching USD 140/NT). Vessels built in mainland Chinese shipyards but operated by non-Chinese carriers incur USD 18/NT at the outset, increasing by USD 5/NT annually (up to USD 28/NT). Exemptions shield Jones Act and Great Lakes vessels as well as empty repositioning voyages, while ships constructed in U.S. yards receive rebates of up to USD 1 million per call. Taken together, these provisions function as a variable ad-valorem "tax" on Chinese-linked capacity that, at current rates, translates into an average surcharge of roughly 6 percent of landed cost per TEU.

Our baseline model identifies port capacity as the locus of a coordination failure: independent port authorities choose fees τ_n^p based on their private cost functions $\frac{1}{2}\,\kappa\, i_n^2$, neglecting the fact that every shipment requires capacity at both origin and destination. The first-best remedy in our framework is therefore a positive subsidy s_i on port investment, which lowers the effective marginal cost to $\frac{1}{2}\,(\kappa - s_i)\, i_n^2$. One can show that the subsidy

$$s_i^* \;=\; \frac{1-p}{2} \;-\; \kappa$$

exactly closes the gap between the competitive equilibrium trade volume Q^{CE} and the planner's optimum Q^{PL}. By contrast, Section 301 raises the average port margin by

$$\Delta\tau \;=\; s_{\mathrm{CN}}\,\Delta,$$

where $s_{\mathrm{CN}} = 0.35$ is the share of U.S. import TEUs on Chinese-linked ships and $\Delta = 6\%$ is the ad-valorem surcharge. In effect, the policy acts like a negative port subsidy of approximately 2.1 percent of landed cost, further depressing trade below the un-subsidized equilibrium.

To quantify the resulting welfare cost, we adopt a first-order equivalent-variation ap-

proximation familiar from tariff incidence analysis. Denote by $\bar{Q}$ annual container imports (TEUs), by P the pre-surcharge landed cost per TEU, and by ε the constant import-demand elasticity. The surcharge raises the import-price index by $\Delta \ln P \approx \varepsilon \times s_{\text{CN}}\, \Delta$, and the associated annual consumer-and-importer burden is

$$\text{EV} \;=\; \bar{Q} \times s_{\text{CN}} \times (\Delta\, P) \times \frac{\varepsilon}{\varepsilon + 1}.$$

Plugging in $\bar{Q} = 22$ million TEUs, $s_{\text{CN}} = 0.35$,

$$P = \$2{,}000$$

, $\varepsilon = 4$, and $\Delta = 0.06$ yields an EV of approximately \$739 million per year.

To see how this distortion compares with the model's efficient correction, suppose a war-break probability $p = 0.10$ and port-cost parameter $\kappa = 0.15$. The optimal port subsidy is

$$s_i^* = \frac{1-p}{2} - \kappa = \frac{0.90}{2} - 0.15 = 0.30 \quad (30\%).$$

Section 301's negative subsidy of 6 percent therefore amounts to only 20 percent of the efficient level. In other words, U.S. consumers bear a distortion equal to one-fifth of what would be required to correct the underlying port-coordination failure—and they pay nearly \$740 million annually—to advance a geopolitical signal.

This "revealed willingness to pay" exercise demonstrates how model insights translate into real-world policy trade-offs. Far from being a minor adjustment of port fees, Section 301 represents a deliberate welfare sacrifice—equivalent to a negative subsidy at one-fifth of the efficient magnitude—by U.S. policymakers in pursuit of strategic leverage in global shipping.

7 Conclusion and Policy Implications

Our detailed mapping of U.S. import flows onto vessel builder origins reveals that Chinese-built ships account for a significant and growing share of maritime capacity, especially among newer and smaller vessels. This structural dependence raises strategic considerations around supply chain resilience and national security. Policymakers weighing measures to diversify maritime sources or bolster domestic shipbuilding must consider the trade-offs between higher logistical costs and reduced vulnerability. Future research should examine the operational dimensions of this dependence, including port-access patterns and charter markets,

to inform policy design aimed at securing critical marine transport infrastructure.

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