Collective Decision-Making in Global Antitrust Enforcement: Evidence from Shipyard Mergers *

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Abstract

This paper examines how factors beyond market impact and strategic interaction among authorities shape antitrust decision-making in shipyard mergers. Modeling merger reviews as unanimous voting games, we rationalize two empirical patterns: authorities may become more lenient due to trade or political considerations, with many large ship-buying countries rubber-stamping the mergers. Structural estimation shows that removing non-market considerations or incentives to free-ride on other authorities leads to stricter enforcement. As the probability of obtaining unanimous approval falls by 0.64–1.04 percentage points, anti-competitive mergers become less likely to materialize, resulting in consumer welfare gains equivalent to 4.1–5.8% of annual global ship-sales revenue.

Keywords: antitrust policy, horizontal merger, Bayesian persuasion, shipbuilding, international institutional arrangement
JEL Codes: C11, F55, G34, L40, R41

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1 Introduction

Rising markups and growing market power have prompted a re-examination of competition policies (Berry, Gaynor, and Morton 2019; Shapiro 2020). While the empirical literature has examined specific antitrust rules, such as concentration thresholds (Nocke and Whinston 2022), exemptions from pre-merger notification (Wollmann 2020), and presumptions against high-risk mergers (Salop and Morton 2021), antitrust enforcement is still largely treated as a single country's effort guided solely by a certain market welfare standard. Breinlich, Nocke, and Schutz (2020) have considered the externalities that a country's merger policy might impose on its trading partners. Yet, countries are still assumed to set competition policies independently, with maximizing domestic consumer welfare being the sole objective.

Large business transactions, however, often require approval from multiple antitrust authorities (Cabral 2005), who may weigh factors beyond the transactions' market impact in practice ("non-market factors"). De Stefano and Rysman (2010) show how a country can use its merger policy as a trade tool by regulating the number of firms in its economy. Legal scholars likewise argue that an antitrust authority may weaponize competition policy to hinder transactions in rival countries (Zhang 2021). For instance, Intel scrapped its $5.4 billion plan to acquire an Israeli chipmaker in 2023 after prolonged review by the Chinese antitrust authority (Sen 2023; Wei and Fitch 2023).

In the context of shipyard mergers, this paper examines how non-market factors, such as trade and political considerations, and strategic interaction among jurisdictions influence an antitrust authority's decision-making process. We examine global antitrust authorities' decisions on shipyard mergers proposed between 2000 and 2024, linking them to a transaction-level dataset of global shipyards' commercial vessel order books. This allows us to observe each shipyard's output, market share, and prices across different buyer countries at the time of each merger announcement. Using demand estimates from a random coefficients logit model and assuming Cournot competition, we also simulate each merger's impact on HHI, prices, and consumer welfare in each buyer country. We then incorporate these observed and simulated market conditions, alongside a set of potentially salient non-market factors, to model how antitrust authorities decide each merger.

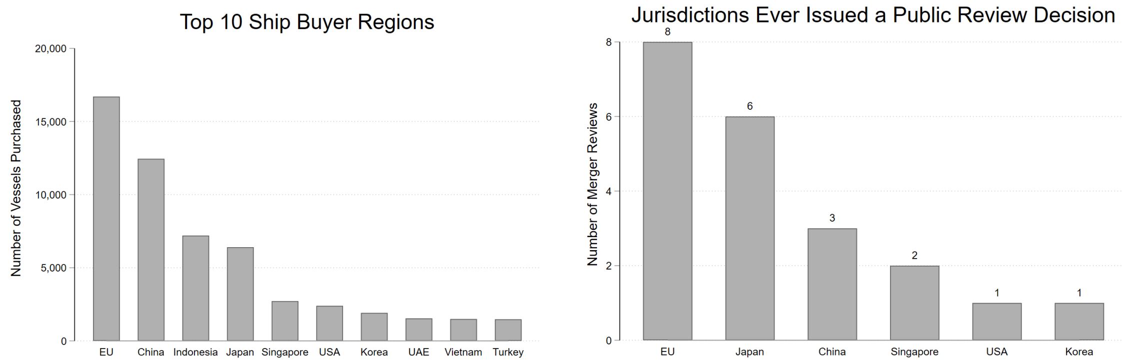
We situate our analysis in the shipbuilding industry for two reasons. First, a shipyard merger usually affects more than one buyer countries, necessitating approvals from multiple authorities. Since most ship buyers are shipping companies delivering goods internationally, they frequently purchase vessels from shipyards around the world.[1] As such, a shipyard merger often has cross-border implications. This is illustrated by the 2019 merger proposed by two Korean shipbuilding conglomerates, Hyundai Heavy Industries and Daewoo Shipbuilding. Although Singapore and China approved the deal within a year, the European Commission ("EC") ultimately rejected it three years later (European Commission 2022). Japan and Korea kept the case open until the parties voluntarily withdrew following the EC's decision.

Second, as a symbol of national "pride and machismo," shipyard mergers often carry political significance beyond profits (Barwick, Kalouptsidi, and Zahur 2024; Strath 1987). As many large shipyards have strong state connections, an antitrust authority may be deterred from conducting an extensive investigation if it faces tacit or explicit political or trade pressure from a shipyard's home country.[2] Notably, several major ship-buying countries have been consistently silent on shipyard mergers. In Figure 1a, Indonesia, the UAE, Vietnam, and Türkiye rank among the top ten buyers by number of vessels purchased between 2000 and 2024. However, none of these countries had conducted any public review of the shipyard mergers in our sample, as shown in Figure 1b. This paper examines whether this pattern may be explained by trade or political pressure and/or reliance on other large buyers for merger regulation.

We begin the analysis with a stylized model of antitrust decision-making and present descriptive evidence consistent with its predictions. We start with a single-agent model similar to Henry and Ottaviani (2019), in which an antitrust authority decides whether to approve or reject a proposed merger. The authority does not know the merger's true state, which can be either anti-competitive or

[1] The transaction costs of purchasing ships from foreign shipyards are small relative to manufacturing costs, unless ports charge additional fees based on a ship's place of origin.

[2] For example, in 2019, the Chinese government directed a merger between China State Shipbuilding Corporation and China Shipbuilding Industry Company, similar in scale to the Korean case. Against the backdrop of China's reform to consolidate state-owned enterprises and create "national champions" (Leutert 2016), the merger was completed within a year without public intervention from any foreign buyers. In terms of total vessels purchased from the two shipyards between 2000 and 2024, Greece, Singapore, Germany, Taiwan, and Norway are the top five buyers.



(a) Top Ship Buyers

(b) Ever Issued a Public Decision

Note: This figure presents the top ship-buying regions and the jurisdictions that have issued public review decisions on the shipyard mergers examined between 2000 and 2024. Panel (a) displays the top 10 ship-buying regions, ranked by the total number of vessels purchased by firms based in these regions during that period (source: Clarksons Research). Panel (b) shows the number of public merger review decisions issued by each jurisdiction for the 63 shipyard mergers in the data.

Figure 1: Top Buyer Economies and Jurisdictions that Have Issued a Public Decision

not anti-competitive. The payoff from approving a not-anti-competitive merger is normalized to zero, while rejecting a merger yields a constant payoff minus a rejection cost. The rejection cost stems from non-market factors such as whether the merging firms are foreign and the risk of retaliation by their home countries. Approving an anti-competitive merger yields a negative payoff, which depends on how much harm it does to consumer welfare. The authority approves the merger upon arrival of a good signal, providing persuasive evidence that the merger does not lessen competition. When no signal arrives, it may approve/reject the merger, or wait for the signal for another period. Signal arrival is modeled by a Poisson process, the arrival rate of depends on the merger's market characteristics. Like the classical optimal stopping problem studied by Wald (1945), the authority's optimal strategy involves two threshold beliefs: the authority approves the merger once its belief that the merger is not anti-competitive exceeds the upper threshold, and it rejects once the belief drops below the lower threshold.

The model's comparative statics show that rejection cost induced by non-market factors can offset the influence of market factors that would otherwise prompt stricter antitrust enforcement. Higher prices and greater market concentration post transaction reduce the authority's payoff from approving an anti-competitive merger and signal arrival rate, making approval less likely and rejection more likely. However, a larger rejection cost reduces the payoff from rejecting a merger, regardless of its true state. If rejection cost is sufficiently high, the authority may approve a merger it would have otherwise rejected in the absence of non-market factors. Consistently, our data reveals a strong positive correlation between adverse market effects and the level of scrutiny by the authority, measured by whether it issued a public review decision or review duration. Yet, scrutiny is also negatively associated with non-market factors such as whether the acquiring firm is a foreign entity with state ties.

Second, we extend the single-agent model to a unanimous voting game to account for the fact that shipyard mergers often require approval by multiple antitrust authorities. The merging shipyards identify a set of authorities from which clearance is required, and the deal may proceed only if it receives unanimous approval. Each authority's payoffs and the information process are public information. This game resembles the K-majority voting game studied in Chan et al. (2018), but it allows for asymmetric payoffs from approving an anti-competitive merger versus rejecting a not-anti-competitive one. Similar to Canen and Iaryczower (2024), we adapt the model to a discrete-time, finite-horizon setting to make it computationally more tractable. In this setting, we characterize an equilibrium in which the authority least tolerant of a mistaken approval acts as the pivotal voter.[3] The other authorities approve immediately, and none rejects the merger. This equilibrium aligns closely with the empirical decision pattern: on average, 25.7 jurisdictions were potentially affected by a shipyard merger, but only 1.5 authorities exerted meaningful effort before approval, as indicated by a public announcement of the review outcome. The remaining 24.2 authorities did not intervene, which we interpret as implicit approval. Additionally, among the 63 mergers in the data, only two were ultimately rejected, both by the EC.

Third, we quantify how non-market factors and the presence of other authorities influence an authority's decision by structurally estimating the unanimous voting game. We relax the assumptions that the payoffs and information process are public

[3]More precisely, the authority least tolerant of a mistaken approval is the one with the highest value of $|\frac{V_{LA}}{V_{HA}}|$, where V_{LA} is the authority-specific payoff from approving an anti-competitive merger, and V_{HA} is the payoff from approving a not-anti-competitive merger.

information. Instead, we allow each authority to hold a belief about the probability that the merger will eventually be rejected by another authority, denoted as P^e. In equilibrium, each authority's belief matches the expected probability that another authority will reject the merger. In line with the approach of assuming an antitrust authority's objective to be maximizing domestic consumer welfare (Breinlich, Nocke, and Schutz 2020), we parameterize the authority's payoffs from approving an anti-competitive merger by change of consumer welfare brought about by the merger. Rejection cost is similarly parameterized using non-market factors, including whether the acquiring firm is a foreign entity with state connections. On the other hand, the arrival rate of good merger signal is calibrated by market-based metrics, including the change of prices and HHI associated with the merger.[4]

The model estimates suggest that non-market factors and free-riding make an authority less stringent. A good signal is less likely to arise for a merger associated with larger increases in price and HHI. The authority sets higher approval thresholds when the deal would substantially harm consumer welfare, but it incurs a higher rejection cost when the transaction involves a foreign firm or a firm with state connections. For an average shipyard merger in the data, non-market factors reduce the perceived anti-competitive effect by 14.4% in the authority's decision process. Moreover, because there is a 5.2% chance that another authority will eventually reject the merger in equilibrium, each authority further discounts the potential adverse market consequences to 94.8% of their full extent.

Fourth, we consider two counterfactual scenarios: (1) no rejection cost, and (2) independent decision-making, in which each authority believes that no other authority will reject the merger. Both changes make an authority less likely to approve a merger by a given deadline, thus making unanimous approval harder to attain. Removing the rejection cost eliminates a factor that makes the authority more lenient, whereas independent decision-making removes the possibility of relying on another authority to block an anti-competitive merger. When the rejection cost is nonzero for all authorities, however, removing it for more authorities also increases the expectation that someone else may reject the merger, thereby introducing a countervailing mechanism that dampens the overall

[4]Another candidate variable is HHI before/after merger. However, following Nocke and Whinston (2022), which demonstrates that change of HHI is more informative about cost efficiencies and hence change of consumer welfare the merger brings about, we use change of HHI instead.

effect of removing the rejection cost.

As removing rejection cost or adopting independent decision-making makes unanimous approval less likely, consumers may benefit from authorities' heightened scrutiny of welfare-deteriorating mergers. When there is no rejection cost for any authority, the average probability that a merger will be approved unanimously within 19 months of its public announcement falls by 1.04 percentage points, resulting in an expected global consumer welfare gain of $5.96 billion per year.[5] When all authorities decide independently, the average probability of unanimous approval by the 19th month falls by 0.64 percentage points, translating into a $4.16 billion increase in expected consumer welfare. Overall, this tighter review process yields an expected consumer welfare gain of 4.1–5.8% of global ship-sales revenue per year, equivalent to about $102 billion.[6]

Given that shipbuilding is only one of many industries subject to antitrust oversight, understanding the mechanisms underlying antitrust decision-making has broad implications for the global economy.

1.1 Literature Review

This paper is related to three strands of literature, including retrospective merger reviews, Bayesian persuasion, and research on the shipbuilding industry.

Merger Review. First, this paper connects to the industrial-organization literature on retrospective merger reviews. The effect of mergers and acquisitions on various market outcomes have been studied extensively. In light of the recent push for stricter antitrust enforcement (Shapiro 2020), the legal doctrines governing merger review have received increased attention. Wollmann (2020, 2019) shows that lax antitrust enforcement induces more anti-competitive behavior and suggest that the pre-merger notification exemption for small mergers may be unwarranted in certain industries. Similarly, Bhattacharya, Illanes, and Stillerman (2022) estimate

[5] We use the 19th month after merger announcement as the cutoff because, by that point, the probability that the merger has received decisions from all jurisdictions involved has reached 99.5% under both the baseline scenario and the two counterfactuals. The merger is assumed to be rejected or voluntarily withdrawn if it has not received unanimous approval by the deadline.

[6] Calculated as a yearly average using ship transactions between 2000 and 2024 in our data. Source: Clarksons Research.

the price threshold above which US regulators are likely to challenge a merger, and Nocke and Whinston (2022) question the effectiveness of concentration-based thresholds used by regulators. While these studies focus on market-based metrics such as HHI, price, and consumer welfare, we show that antitrust enforcement may also take into account non-market factors.

More specifically, this paper relates to the literature on the cross-border externalities generated by merger policy. Countries can regulate mergers in order to control the number of firms in their economies (De Stefano and Rysman 2010; Horn and Levinsohn 2001). However, if firms export, approving a domestically welfare-improving merger may harm the firms' consumers abroad. Breinlich, Nocke, and Schutz (2020) study circumstances under which a country's merger policy, set for its domestic mergers, may be too stringent or too lenient from the standpoint of its trade partners. While Cabral (2005) considers a repeated veto game between two hypothetical authorities, there is sparse empirical research on how the merger policies of multiple authorities may interact. Extending this line of work, we examine how an antitrust authority endogenously responds to other authorities' decisions to approve or reject a merger at the individual merger level. We further quantify the implication of having such strategic interaction in terms of a merger's success rate and consumer welfare.

Bayesian Persuasion. Second, the framework in this paper is related to the extensive theoretical literature on Bayesian persuasion, specifically on approval decision-making. A typical Bayesian persuasion game involves a sender transmitting signals to a receiver, where the signals are functions of the true state of nature. The receiver updates their beliefs based on the signals and then chooses the optimal action (Kamenica and Gentzkow 2011).

In settings where the receiver sequentially receives a stochastic series of signals, Henry and Ottaviani (2014, 2019) study a sequential game between the company (sender) and the drug authority (receiver). Bardhi and Guo (2018) and Chan et al. (2018) consider cases where approval requires a K-member majority vote. Empirical works have applied the Bayesian persuasion framework to contexts such as information collection process, (Reshidi et al. 2021) and FDA drug approval (Canen and Iaryczower 2024). Our model is closest to Canen and Iaryczower (2024), as we consider the optimal stopping problem in a discrete-time finite horizon setting. However, we differ by focusing on a unanimous voting game with nonzero search cost, allowing agents to have private information and asymmetric payoffs for false positives and false negatives. The information process is also modeled as Poisson good news learning instead of a drift diffusion model.[7]

Shipbuilding. Third, this paper adds to the growing literature on the shipbuilding industry. Previous work has examined shipping companies' investment decisions (Greenwood and Hanson 2015; Jeon 2022; Kalouptsidi 2014). Kalouptsidi (2018) and Barwick, Kalouptsidi, and Zahur (2019) develop methods to detect subsidies and other industrial policies and evaluate their welfare implications in China's shipbuilding sector. This paper focuses on how mergers and acquisitions affect competition and welfare in the shipbuilding industry.

The remaining parts of this paper are organized as follows: Section 2 describes the institutional background of the shipbuilding industry, the merger control scheme, and the data we employ. In Section 3, we use a theoretical model to decompose the market and non-market factors affecting an authority's decision process, accounting for strategic interactions with other authorities. We further provide descriptive evidence from global shipyard mergers that aligns with our theoretical predictions. Section 4 extends the theoretical model to an empirical framework, outlines the estimation procedure, and presents the model estimates. Section 5 conducts counterfactual analysis that removes the influence of non-market factors and strategic interaction with other authorities from an individual authority's decision-making process. Section 6 concludes the paper.

[7] The Poisson learning framework is flexible and has been applied to settings such as attention allocation to media (Che and Mierendorff 2019) and corporate investment (Nikandrova and Pancs 2018). As Che and Mierendorff (2019) argue, Poisson learning is especially "useful to model the discovery of individual pieces of information that are very informative." In the antitrust investigation setting, such information can be interpreted as a pivotal piece of evidence that resolves the regulator's doubt about whether the merger is anti-competitive.

2 Institutional Background and Data

2.1 Institutional Background

2.1.1 Shipbuilding Industry

Shipyards today produce highly specialized commercial vessels tailored to transporting specific types of goods. This paper focuses on commercial vessels in general, including bulkers (for grain and ore), general cargo ships, containerships (for containers), gas carriers (for volatile liquids), offshore vessels (e.g., those used for oil rigging), specialized goods carriers (e.g., reefers for perishable goods requiring refrigeration and roll-on/roll-off for automobiles), passenger carriers (ferries and yachts), tankers (for stable chemicals), and other commercial vessels falling into a residual category. Beyond the broad categories, shipyards can also manufacture more niche vessels by installing specialized equipment or adjusting vessel size and capacity. The sub-categories within the main vessel categories are hereafter referred to as "ship types".[8]

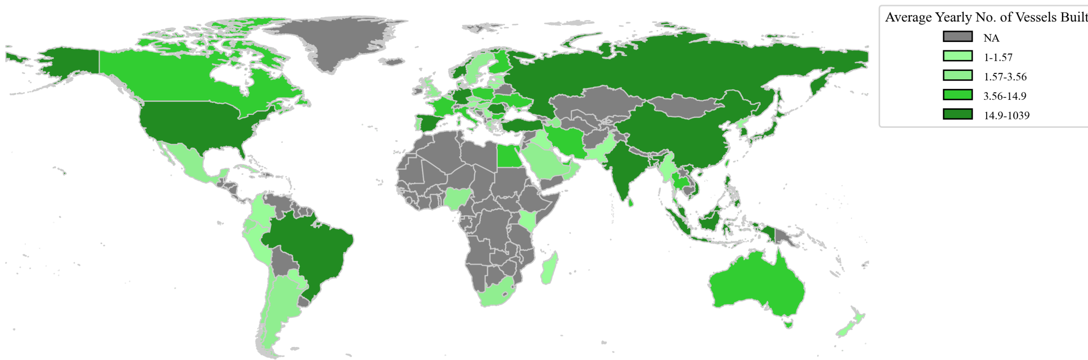
Shipyards active today are concentrated in East Asia, while buyer shipping companies are more dispersed across the globe. Although there are thousands of shipyards worldwide, most vessels are currently built by shipyards in China, Korea, and Japan. Large shipyards usually have multiple subsidiary dockyards, and we denote the family of firms as a shipbuilding group. Figure 2a shows the global distribution of the average number of vessels built per year from 2000 to 2024. In contrast, ship buyers are more geographically dispersed.[9] The average number of vessels bought per year internationally is shown in Figure 2b, which reveals a less concentrated distribution that tends to correlate with the size of the economy.

2.1.2 Scheme of Merger Regulation

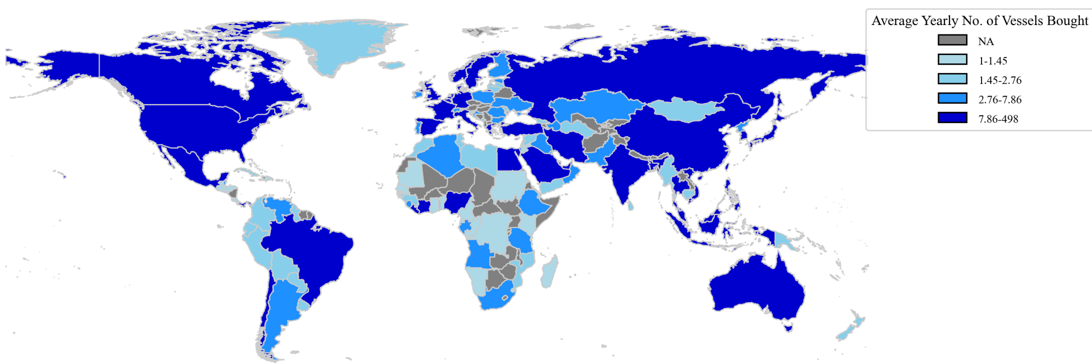
Types of M&A. We consider three types of horizontal M&A deals in this paper: (1) the merger or acquisition of an entire shipbuilding group by another group,

[8] For example, transporting liquefied natural gas (LNG) requires refrigeration equipment, as LNG must be stored at low temperatures. Liquefied petroleum gas (LPG), on the other hand, requires high pressure to remain in liquid form, making a compressor essential.

[9] Most ship buyers are shipping companies that purchase vessels to transport goods, although some bank subsidiaries also acquire vessels for leasing and investment purposes.



(a) Annual Number of Vessels to Build



(b) Annual Number of Vessels Ordered

Note: This figure shows the annual number of commercial vessels built or purchased by each country from 2000 to 2024. Panel (a) presents the average number of new vessel orders received by each country per year, representing shipbuilding activity. Panel (b) presents the average number of new vessel orders placed by each country per year. Source: Clarksons Research.

Figure 2: Global Distribution of Revenue and Expenditure on Commercial Vessels

(2) the merger or acquisition of a subsidiary of a shipbuilding group (typically a dockyard) by another group, and (3) joint ventures between two shipbuilding groups. We broadly refer to all three types of transactions as "mergers." Joint ventures fall within the scope of merger regulation because they often result in the parent companies exercising joint control over the new entity and may facilitate coordination between the parent companies (European Commission 1998).

Objective of Merger Review. Competition law, which encompasses merger regulation, is widely enforced around the world, with its central objective being to promote market competition. As of 2023, 203 countries have enacted competition legislations (UNCTAD 2024). The core responsibility of antitrust regulators is typically to promote competition, which in practice often translates into protecting consumer welfare (Wilson 2019). For example, it is the duty of the EC to ensure that "competition in the internal market is not distorted" by transactions such as mergers and acquisition, a litmus test of which is the merger's "potential harm to consumers" (Council of the European Union 2004).[10]

Some younger jurisdictions may specify that antitrust enforcement should also account for broader public interest. Nevertheless, there remains a common understanding that the purpose of competition law is "to control or eliminate [economic activities], which limit access to markets or otherwise unduly *restrict competition*, adversely affecting domestic or international trade or economic development" (UNCTAD 2007). Therefore, the influence of non-market factors on antitrust decisions *should* be tangential at most.

Merger Review Notification. As a general principle, the merging firms should notify an antitrust authority if the merger is likely to create market power in a market within the authority's jurisdiction. The transaction will be prohibited if it "substantially increases the ability to exercise market power" (UNCTAD 2007).[11]

Although the exact definition of "creating market power" differs across jurisdictions, market power can be deemed to arise even if the merging firms are not physically based in the jurisdiction. For example, the EC requires notification if the merging firms' joint global turnover exceeds €5,000 million and each party's EU-wide turnover exceeds €250 million (European Commission 2024b). Failure to notify can result in a fine of up to 10% of the firms' annual global revenue (European Commission 2024a). Such far-reaching legislation is not limited to

[10]Similarly, promoting competition and innovation and protecting consumer welfare are key tenets of many major antitrust authorities (Federal Trade Commission 2024b; Japan Fair Trade Commission 2023; Korean National Assembly 2016).

[11]While the U.S. Federal Trade Commission (FTC) has a Pre-Merger Notification Program and requires notification if the transaction value exceeds certain thresholds (Federal Trade Commission 2024a), it does not have the legal authority to directly block the merger. Instead, the FTC or the Department of Justice has to seek an injunction from the court or negotiate a settlement with the merging parties in order to intervene (Federal Trade Commission 2024b).

developed economies. For instance, the Indonesia Competition Commission also requires notification if the merging firms' combined asset value exceeds 2.5 trillion Rupiahs or if the annual turnover exceeds 5 trillion Rupiahs (Baskara 2011). While each country's legal requirement varies, it suffices to say that a successful merger generally requires approval from all the jurisdictions in which the merging parties have a substantial business presence.[12]

Merger Review Timeline. An antitrust authority typically completes a merger review within one month, though there may be slight differences across jurisdictions. For example, the EC has 25 working days to complete an initial review (Phase I review), during which approximately 90% of merger applications are unconditionally approved (European Commission 2013). However, if the Commission identifies potential competition concerns, it may initiate a Phase II review, which can last between 90 and 125 working days. If the merging parties fail to provide information requested by the EC, a "stop-the-clock" mechanism is triggered, pausing the review process until the EC is satisfied with the submission (European Commission 2013). Internationally, the default duration for a Phase I review ranges from 20 to 40 days, with a few exceptions extending up to 60 days, such as in Algeria and Venezuela (UNCTAD 2007).

Disclosure of Merger Review Outcome. Aiming for transparent law enforcement, antitrust authorities typically disclose their merger review decisions publicly. However, a review decision may remain private if the jurisdiction follows a voluntary notification scheme: firms are not required to notify, but the authority may investigate if the merger crosses certain regulatory thresholds.[13] Risk-averse firms may engage in private consultations with the authority before formal notification. If the firms eventually decide not to notify and no government intervention follows, no public merger review decision may be released. Since the merger is publicly announced and the authority is still consulted, we interpret this as an implicit

[12]As observed by Breinlich, Nocke, and Schutz (2020), many countries may not choose to exercise their rights to prohibit a transaction in practice despite the merging firms' substantial business presence. However, we are establishing countries' *de jure* rights to regulate the mergers in this section, and why many of them choose not to exercise such rights is precisely the question we seek to answer.

[13]Such a scheme is adopted in countries such as Singapore and the United Kingdom (Competition and Consumer Commission of Singapore 2025; Competition and Markets Authority 2025).

approval of the transaction. In terms of review duration, if there is no evidence of public intervention by the authority with respect to a deal, we infer that it has been approved after private consultation or informal review. We note the approval as occurring within a month since the merger announcement, reflecting the default timeline for closing a simple case that raises no competition concerns.

2.2 Data

2.2.1 Vessel Transaction

The vessel transaction data comes from Clarksons Research, a shipping intelligence company that tracks global shipyard production. It includes commercial vessel construction contracts awarded to individual shipyards from 2000 to 2024, recorded at the individual contract level. For each order, the dataset records the buying party, the builder shipyard, the ship's size in compensated gross tonnage (CGT), whether the vessel is equipped with alternative fuel technology, an electric engine, or a scrubber, the construction duration, and the order date.[14]

While the data itself does not include contract prices, we follow the approach in Barwick, Kalouptsidi, and Zahur (2019) to impute prices based on vessel size and category-size-specific monthly vessel valuations. See Appendix C for the details. Additionally, the data identifies the shipbuilder at the dockyard level, which may be a subsidiary of a larger builder group (e.g., Hyundai Ulsan, as its name suggests, is part of the Hyundai Heavy Industries group). Since a builder group is likely to make joint decisions for all dockyards within the group, we conduct our analysis at the group level.[15]

Table 1 presents summary statistics after aggregating the individual transaction data to market-brand level. Given the high degree of specialization within each ship category, we define a market as ships sold to country c in year y that are

[14]Since vessel size is often measured in different units across categories (e.g., tonnage for bulkers and cubic meters for gas carriers), aggregating a shipyard's output across vessel types can be challenging. Following Barwick, Kalouptsidi, and Zahur (2019), we use CGT to measure output. CGT reflects the amount of work required to build a vessel, adjusted for its type.

[15]The dataset identifies each dockyard's current parent company, but it does not always reflect the dockyard's historical ownership. For dockyards that have undergone name changes, which may indicate a change in ownership, we check whether they previously belonged to another builder group based on name matching and manual verification using historical shareholding information obtained through online research.

of category k. A brand is defined by the building dockyard (at the subsidiary level), ship category, and ship type. In total, we use 27,709 market-brand pairs in our analysis, corresponding to 58,455 individual contracts, 1,433 builder groups across 1,758 dockyards, and 126 buyer countries. While the average HHI across markets is only 219, the most concentrated market has an HHI exceeding 1,800, which is considered "highly concentrated" under the U.S. DOJ's Horizontal Merger Guidelines (DOJ and FTC 1997).[16]

	count	mean	sd	min	max
Price (mil USD)	27709	33.56	60.34	0	1590.51
Size (CGT)	27709	12543.79	15370.85	524	202682
Time to Build (months)	27709	28.93	14.7	1	244
Alternative Fuel/ Electric Engine/ Scrubber Installed	27709	.21	.4	0	1
HHI	3462	219.12	374.93	.01	2500

Notes: This table reports summary statistics of vessel transactions from 2000 to 2024, after aggregating the transaction-level data to the market-brand level. A market is defined as a buyer country c that purchases vessels of category k in year y. A brand is defined by the combination of the subsidiary dockyard, ship category, and type. See Section 2.2 for more details on market and brand definitions. The Herfindahl–Hirschman Index (HHI) is calculated as $\sum_l^L s^2 l$, measured at the market level, where l indexes the brand in a given market, L is the total number of brands in the market, and s_l is the market share of brand l.

Table 1: Market Level Summary Statistics

2.2.2 Shipyard Mergers

Sample of Mergers. The main sample of horizontal shipyard mergers between 2000 and 2024 used is drawn from SDC (Securities Data Company) Platinum by Thomson Reuters, which provides global coverage of major M&A activities. We restrict the sample to M&A deals in which both the share acquirer and seller operate in the shipbuilding industry and have sold at least one vessel according to Clarkson Research's vessel transaction data. Deals in which the acquirer merely increases its shareholding in a subsidiary it has already owned are excluded.

[16]The highest HHI reported in Table 1 is higher than that in Barwick, Kalouptsidi, and Zahur (2019), as we define a market by ship buyer country-year-ship category, whereas Barwick, Kalouptsidi, and Zahur (2019) examines the global market for vessels supplied by Chinese, Japanese, and Korean shipyards without distinguishing between ship categories for HHI calculation.

Furthermore, since we find that only China, the EU, Japan, Korea, Singapore and the USA have issued public review decisions regarding mergers in the main sample, we identify additional shipyard mergers reviewed by antitrust authorities in these jurisdictions using their publicly disclosed decisions to construct the supplementary merger sample.[17] Details on how we identify the main and supplementary sets of mergers are provided in Appendix C.

Set of Relevant Antitrust Jurisdictions. We identify the jurisdictions potentially affected by each merger based on the merging firms' sales records in the vessel transaction data. Jurisdictions without antitrust legislation as of 2024 are excluded. We then identify jurisdictions where the merging firms would be required to file a notification. Instead of applying each jurisdiction's antitrust legislation to determine whether a notification is required, we approximate the legal threshold by limiting our analysis to jurisdictions that, on average, had purchased at least one vessel per year from the merging firms prior to the merger announcement. Among ship-buying countries, the 75th percentile country purchases 7.86 vessels per year, as shown in Figure 2b. Therefore, making one sale per year implies a market share of at least 12.7% for the merging firms in 75% of the ship-buying countries, making it likely that the merger would raise competition concerns in those markets.

To simplify the analysis, we treat any decision made by a European Union ("EU") member state as if it were made by the EC, and any decision made by the EC as if it were made by all the member states.[18] The national authority of an EU member state may issue an independent decision regarding a merger, even if the case does not fall within the EC's jurisdiction, and vice versa. However, a

[17] The Chinese State Administration for Market Regulation, the EC, and the Competition and Consumer Commission of Singapore maintain systematic records of their merger review decisions. The Japan Fair Trade Commission (JFTC) provides a complete record of mergers filed only from 2015 onward. Prior to 2015, it discloses only those mergers involving parties with combined assets exceeding 30 billion Yen. The U.S. Federal Trade Commission releases notifications when it terminates the merger review process early due to lack of competitive concerns. To the best of our knowledge, the Korea Fair Trade Commission does not maintain a systematic public record of merger decisions.

[18] For simplicity, we use the list of European Economic Area members as of 2024 to determine which national authorities are eligible to refer cases to the EC. Additionally, since the United Kingdom is no longer an EU member after 2020, we attribute a merger review decision to the United Kingdom only if its national authority issued an independent decision.

referral mechanism allows the EC and member state authorities to transfer cases between one another so that only one decision is ultimately required (European Commission 2013). We therefore treat any decision by the EC or an EU member state as a joint EU decision.

For each deal, we record the date the transaction was announced and whether each relevant jurisdiction issued a public merger review decision. If a public decision was issued, we also record the date of the decision and whether the merger proposal was approved, rejected, or withdrawn.[19] For cases where there is no evidence of intervention by a relevant authority, we classify the merger as having received implicit approval within one month, as discussed earlier in Section 2.1.2 about the disclosure of merger review outcome.

2.2.3 Mergers' Market Impact

In addition to the observed market conditions, we simulate each merger's market impact using a random utility model following Berry, Levinsohn, and Pakes (1995) and Nevo (2001). The utility of purchasing a vessel is specified as:

$$u_{klm} = a_k p_{lm} + X_{lm}\beta + \xi_l + \xi_m + \epsilon_{klm}, \tag{1}$$

where k indexes the buyer, l the brand, and m the market. A market m is defined by the buyer country, year, and the ship category. A brand l is identified by the producing firm (dockyard), ship category, and type. Product characteristics includes vessel price per CGT p_{lm} and other product characteristics X_{lm}, including time to build and whether the brand installs any carbon-reduction feature such as compatibility with alternative fuel, electric engine, and scrubber. The estimation results are shown in Table 2. Standard errors are clustered at the brand level. Estimation details are provided in Appendix B.

We then use the estimated demand to simulate each merger's market impact, assuming shipyards engage in Cournot competition.[20] To account for (dis)economies of scape and/or scope, we allow shipyards' average variable costs to change post

[19] The merger proposal was withdrawn in Korea and Japan only in the Hyundai–Daewoo case, where the EC had already rejected the proposal.

[20] We also take into account whether the merger was between two shipbuilding groups or an acquisition of a dockyard by another group, as we observe prices and output at individual dockyard level.

Variabless	Means	Standard Deviations
Prices (mil USD/CGT)	-0.00193^{***}	0.001
	(0.0001)	(0.0007)
Time to Build (months)	0.264^{***}	
	(0.0175)	
Alt. Fuel / Electric Engine / Scrubber	-3.25^{***}	
	(0.633)	
Brand FEs	Yes	
Market FEs	Yes	
Observations	27709	

Notes: This table reports the parameter estimates of the demand and supply model specified in Equation (1). Prices are measured in millions of USD per CGT, and time to build is measured in months. A market is defined as a buyer country c purchasing vessels of category k in year y. A brand is defined by the combination of the subsidiary dockyard, ship category, and type. See Section 2.2 for further details on market and brand definitions. Standard errors are clustered at the brand level. Significance levels: *(p< 0.10), **(p< 0.05), ***(p< 0.01).

Table 2: Parameter Estimates for Vessel Demand and Supply Model

merger.[21] For markets within each buyer country–year pair, we calculate the average changes in price and HHI by taking a market-size-weighted average. To capture the worst-case scenario, we then take the highest price and HHI increase observed across years for each country, excluding the years following the merger announcement. The calculation for the change in average consumer surplus follows a similar approach, except that we sum across all markets within each buyer country–year instead of taking a weighted average.

2.2.4 Other Data

We also track a set of non-market factors potentially salient to antitrust authorities' review decisions. Indicators of a jurisdiction's economic outlook are constructed using data from various sources. GDP of different jurisdictions is sourced from the International Monetary Fund. Countries' trade data comes from CEPII's International Trade Database (BACI), while Taiwan's trade data is obtained from the Observatory of Economic Complexity.

[21]See Appendix B for estimation details.

2.2.5 Summary Statistics

Table 3 presents summary statistics at the deal–buyer country level for the 63 M&A deals in the main sample. On average, only 6% of the deal–country pairs have released a public merger review decision. Each review takes an average of 2.11 months. Most decisions are approvals, while only 2% are rejections. The merging firms have an average market output of 23.72 thousand CGT and a market share of 3%. According to simulations from the random coefficients model, a merger in the main sample will increase the HHI by 3.97 and the average ship price by 0.1 million USD in the worst year for an average buyer country. Consumer surplus will decline, with a mean reduction of 11.1 billion USD in the worst year.

In terms of non-market factors, 89% of the deal–reviewing country pairs involve a merger proposed by a foreign acquiring firm. The acquiring firm's home country contributes 5% of the reviewing jurisdiction's annual trade value on average. The mean GDP ratio of the acquiring country to the reviewing country is approximately 23.6, indicating that the reviewing country is typically smaller. Additionally, 23% of the merging firms have state connections, meaning they are either state-owned enterprises or long-term suppliers of military equipment, which are ascertained by manual research.[22]

3 Theoretical Framework

We begin by presenting a two-period theoretical framework to conceptualize an antitrust authority's merger review process, with the generalized finite horizon model detailed in Appendix A. The model yields two key predictions. First, while a merger's market impact plays a crucial role in shaping the authority's review duration and final decision, non-market factors may result in more leniency. Second, when a merger requires approval from multiple authorities, the outcome is often determined by the strictest authority, and the others tend to rubber-stamp the transaction. We then present descriptive evidence from global shipyard mergers that aligns with these theoretical predictions.

[22]Bollinger Shipyards, for example, is classified as having a state connection because it has supplied military vessels to the U.S. Coast Guard and U.S. Navy for over thirty years. Source: https://www.bollingershipyards.com/what-we-build/government-military-vessels/.

	count	mean	sd	min	max
Public Review Decision	1619	0.06	0.24	0.00	1.00
Review Duration (Months)	1619	2.11	6.00	1.00	56.00
Issued Approval	1619	0.98	0.15	0.00	1.00
Issued Rejection	1619	0.02	0.15	0.00	1.00
Merging Firm Market Output (thousand CGT)	1619	23.71	94.58	0.00	1796.92
Merging Firm Market Share	1619	0.03	0.07	0.00	0.58
Change of HHI	1619	3.97	27.54	-0.95	420.79
Change of Average Ship Price (mil USD)	1619	0.10	0.36	-2.40	1.75
Change of Consumer Surplus (bil USD)	1619	-11.09	115.24	-453.19	1753.97
Foreign Firm	1619	0.89	0.31	0.00	1.00
% Trade with Merging Firms' Countries	1619	0.05	0.07	0.00	0.73
Acquiring Country to Decision Country GDP Ratio	1619	23.59	183.16	0.00	3604.95
Merging Firm State Connection	1619	0.23	0.42	0.00	1.00

Notes: This table reports summary statistics of the market and non-market conditions observed by antitrust authorities when deciding on each shipyard merger in the main sample. See Section 2.2.2 for the definition of the main sample of shipyard mergers. "Public Review Decision," "Review Duration (Months)," "Issued Approval," and "Issued Rejection" refer to authority i's decision regarding deal d in the sample. Review duration is measured as the time between the public announcement of merger d and the date authority i released its decision. If an authority did not issue a public decision on merger d, we assume it implicitly approved the merger within the first month after the public announcement. The merging firms' market output and market share are calculated as the average output and share within each ship category in a buyer country, weighted by market size (measured in total CGT sold). A simple average is then taken across the years from 2000 to the year the merger was announced. The change in average ship price in a year is calculated similarly, while price changes for a vessel brand in a given market are simulated following the steps described in Section 2.2.3. See Appendix B for further details. The highest price increase across the sample years is then taken for each deal–buyer country pair. The change in HHI and consumer welfare are also computed similarly, except that changes in consumer welfare are summed across ship categories within a buyer country–year rather than averaged. "Foreign Firm," "Trade with Merging Firms' Home Countries," "Acquiring Country to Decision Country GDP Ratio," and "Merging Firm State Connection" are defined relative to the acquiring party in the M&A deal. State connection is defined as the acquiring party being either state-owned or a long-term military equipment supplier.

Table 3: M&A Deal Level Summary Statistics

3.1 Non-Market Factors in Merger Review

We first examine the antitrust authority's decision process using a single-agent model, which allows us to decompose factors that determine the duration and outcome of the merger review process.

3.1.1 Single-Agent Model

An antitrust authority is to decide whether to approve or block a proposed merger. The merger is either anti-competitive, defined as the low state, or not anti-competitive, defined as the high state. The authority's payoff from approving the merger is u_H (u_L) in the high (low) state, where the low state payoff is strictly less than the high state payoff ($u_L < 0 < u_H$). When the authority blocks the merger, its payoff is $r_0 - C_{rej}$ regardless of the true state (Henry and Ottaviani 2019).[23] We interpret r_0 as the authority's payoff from maintaining the market's status quo, and C_{rej} captures rejection cost arising from non-market factors $(C_{rej} \geq 0)$. For example, if the merging parties are based in a country with close trade ties to the authority's country, or if blocking the merger benefits the domestic industry.

The authority's payoff matrix is summarized in Table 5, where the payoff of approving a high-state merger is assumed to be 0. Without loss of generality, we then normalize the payoff from rejection to 0, transforming the payoff of approving the merger to $C_{rej} - r_0$ in the high state and $C_{rej} + u_L - r_0$ in the low state, respectively.

Decision/State	High	Low
Approve	$u_H = 0$	$u_L < 0$
Reject	$r_0 - C_{rej}$	$r_0 - C_{rej}$

Authority's Payoff Matrix

Decision/State	High	Low
Approve	$V_{HA} = C_{rej} - r_0$	$V_{LA} = C_{rej} + u_L - r_0$
Reject	0	0

Payoff after Normalization

Notes: This table presents the payoff matrices for the antitrust authority before and after normalization, in which the payoff from rejecting the merger is normalized to zero.

Table 4: An Antitrust Authority's Payoff Matrix

To simplify the expressions, the payoff matrix can be rescaled as follows:

[23] By assuming that rejection yields the same payoff regardless of the true state, we follow Henry and Ottaviani (2019) and depart from Chan et al. (2018), which assumes that the "wrong" choices give 0 payoff. In our setting, this would imply that the authority receives the same payoff whether it approves an anti-competitive merger or rejects a non-anti-competitive merger, which seems implausible.

Decision/State	High	Low
Approve	1	$V = \frac{V_{LA}}{V_{HA}}$
Reject	0	0

Payoff after Normalization

Notes: This table presents the payoff matrices for the antitrust authority before and after normalization. The payoff from rejecting the merger is normalized to zero, and the payoff from approving the merger in the high state is rescaled to one.

Table 5: An Antitrust Authority's Payoff Matrix

Decision Process. The authority is to decide whether to approve or reject the merger within T periods. Time is discrete. If no decision has been made by the T-th month, the deal is effectively rejected. This reflects the fact that if the transaction fails to materialize before the deadline, the takeover offer will lapse.

The antitrust authority does not know the true state ω of the proposed merger before it is realized. It therefore makes its decision based on its belief about the merger's state. At the beginning of the review process, the authority holds a prior belief regarding the likelihood of the merger being anti-competitive, based on pre-existing information Ω_0.

In each period, if the merger's true state is high, positive signals about the merger arrive according to a Poisson process with an arrival rate of λ per period. Signal never arrives for an anti-competitive (low state) merger ($\lambda = 0$). We interpret a positive signal as a piece of convincing evidence indicating that the merger does not substantially lessen competition. When at least one signal arrives, the authority approves the merger with certainty. When no signal arrives, the authority updates its belief $Pr(\omega = H)$ according to Bayes' Law. The probability that at least one signal arrives in a given period is therefore

$$Pr_\lambda = 1 - \exp(-\lambda).$$

Denoting the last period as period *0*, the second-to-last period as period *1*, and so on, the authority's belief about the probability that the merger's true state is high by the end of period t, given that no signal arrives, is

$$P_t = \frac{\exp(-Pr_\lambda)P_{t+1}}{\exp(-Pr_\lambda)P_{t+1} + 1 - P_{t+1}}.$$

Optimal Stopping Thresholds. Consider T = 2 for intuition. At $t = 0$, which is the last period, the authority must decide whether to approve or reject the merger. If a signal arrives, it approves without ambiguity; if no signal arrives, it approves if and only if

$$P_0 + (1 - P_0)V \geq 0 \iff P_0 \geq -\frac{V}{1 - V}, \tag{2}$$

where $P_0 = \frac{\exp(-Pr_\lambda)P_1}{\exp(-Pr_\lambda)P_1 + 1 - P_1}$.

Now consider the second-to-last period, t = *1*. If a signal arrives, the merger is approved. If no signal arrives, the authority has three choices: (1) approve, (2) continue reviewing, or (3) reject. The solution is analogous to the optimal stopping rule studied in Wald (1945), where the authority's optimal strategy involves two threshold beliefs (a_t^*, A_t^*): in period t, it approves the merger once its belief that the merger is not anti-competitive exceeds the upper threshold A_t^*, and it rejects once the belief falls below the lower threshold a_t^*. The following three conditions can be derived:

Condition 1: The authority does not approve the merger if no signal arrives in period 0. Given P_1, if the authority would approve the merger even if no signal arrives in period 0, then waiting and subsequently approving/rejecting is strictly dominated by approving in period 1, as waiting incurs additional delay and review costs. Formally, this requires

$$\begin{aligned} P_0 < -\frac{V}{1 - V} \iff & \frac{\exp(-Pr_\lambda)P_1}{\exp(-Pr_\lambda)P_1 + 1 - P_1} < -\frac{V}{1 - V} \\ \iff & P_1 < -\frac{V}{\exp(-Pr_\lambda) - V}. \end{aligned} \tag{3}$$

Condition 2: The authority prefers waiting to approving the merger. Conditional on the authority rejecting the merger if no signal arrives in period 0, i.e., Equation (3), the expected value of waiting is $-c + \beta Pr_\lambda P_1$, where c denotes the per-period review cost, and β is the discount factor. Waiting is preferred to approving when

$$\begin{aligned} & -c+\beta Pr_\lambda P_1 > P_1(1)+(1-P_1)V = (1-V)P_1+V \\ \iff & P_1 < \frac{-V-c}{1-V-\beta Pr_\lambda}. \end{aligned} \tag{4}$$

Condition 3: The authority prefers waiting to rejecting the merger. Conditional on the authority rejecting the merger if no signal arrives in period 0 (i.e., Equation (3) holds), and since rejecting yields a payoff of 0, waiting is preferred to rejecting when

$$-c+\beta Pr_\lambda P_1 \geq 0 \iff \frac{c}{\beta Pr_\lambda} \leq P_1. \tag{5}$$

Proposition 1. *In a two-period setting, assuming $c \ll -V$, we have:*

1. *In the second-to-last period ($t=1$), if no signal arrives, the authority:*

$$\begin{cases} \textit{rejects the merger,} & \textit{if } P_1 < \dfrac{c}{\beta Pr_\lambda}, \\ \textit{waits until the next period,} & \textit{if } \dfrac{c}{\beta Pr_\lambda} \leq P_1 < \min\left\{\dfrac{-V}{\exp(-Pr_\lambda)-V}, \dfrac{-V-c}{1-V-\beta Pr_\lambda}\right\}, \\ \textit{approves the merger,} & \textit{if } P_1 \geq \min\left\{\dfrac{-V}{\exp(-Pr_\lambda)-V}, \dfrac{-V-c}{1-V-\beta Pr_\lambda}\right\}. \end{cases}$$

2. *In the last period ($t=0$), if no signal arrives, the authority:*

$$\begin{cases} \textit{approves the merger,} & \textit{if } P_0 \geq -\dfrac{V}{1-V}, \\ \textit{rejects the merger,} & \textit{if } P_0 < -\dfrac{V}{1-V}. \end{cases}$$

The proof is obtained by combining Equation (3), Equation (4), and Equation (5).

Comparative Statics. Whether the authority will wait until the last period when no signal arrives in $t=1$ depends on four factors: the per-unit review cost c, its patience β, the probability of signal arrival if the merger is in the high state Pr_λ, and the consequence of approving the merger V. When c increases, the rejection threshold strictly increases, and the approval threshold weakly decreases. The waiting region therefore narrows, making it more likely that a decision will be reached in the first period. Similarly, decreasing the discount factor β makes the authority less patient, rendering an early decision more likely.

When Pr_λ increases, the rejection threshold strictly decreases and the approval threshold strictly increases. Hence, the authority is more likely to wait until the last period. The intuition is that a higher Pr_λ means that if the merger is in the high state, the authority is more likely to receive a confirming signal by waiting, making the option of waiting for certainty more valuable.

When V decreases, both terms of the approval threshold strictly increase, making the authority less likely to approve the merger. Since $V = -\frac{V_{LA}}{V_{HA}}$ measures the disparity between low- and high-state outcomes, a lower V implies more severe consequences for making the wrong decision. The authority therefore requires greater confidence in the merger's true state. On the other hand, V does not affect the timing of rejection, as rejection yields zero payoff regardless of the true state.

Finite Horizon. We show that the intuition established by the two-period model continues to hold when extended to a multi-period finite horizon in Appendix A. The authority still applies a pair of approval and rejection thresholds to determine when to approve or reject the transaction. Similar to Canen and Iaryczower (2024), the key difference between the two-period model and the multi-period model is that when $t > 0$, the payoff from waiting depends not only on the expected payoffs of approving or rejecting in the next period, but also on the expected payoff of waiting for an additional period.

3.1.2 Decomposing Factors Affecting Antitrust Decisions

The comparative statics of the single-agent model show that both market factors and rejection cost shape an antitrust authority's decision-making process. When the authority expects the merger to result in higher prices and/or market concentration, u_L, and thus V_{LA}, decreases. The decrease in V_{LA} raises $-V$, which in turn raises the upper approval threshold A_t^*. Intuitively, the gravity of a mistaken approval would require the authority to have greater confidence before granting approval.[24]

[24]For instance, this could mean that the authority may initially require the merging firms to demonstrate that the merger does not lessen competition *on the balance of probabilities* (a 50% chance).

Additionally, assuming that the signal arrival rate is lower for mergers associated with larger price increases and/or greater market concentration, the authority is also less likely to receive a favorable signal for these mergers. This reflects the fact that it is harder for a merger with more adverse market consequences generate convincing evidence that addresses the authority's competition concerns.[25]

However, rejection cost can partially or even completely offset the effect of these market-based concerns. A higher C_{rej} increases the opportunity cost of rejecting the merger, thereby lowering V_{LA} and V regardless of the merger's true state. As a result, the authority may be more inclined to approve the merger, lowering the approval threshold A_t^*, even though it would have raised the approval threshold in the absence of rejection cost C_{rej}.

Empirical Evidence. The model's prediction is consistent with the observed decision patterns in global shipyard mergers. First, to test whether mergers that are more likely to be anti-competitive receive greater scrutiny, we estimate the following specification:

$$Y_{di} = X_{di}\beta + \epsilon_{di}, \tag{6}$$

where Y_{di} is a measure of antitrust authority i's effort spent on reviewing deal d. More specifically, Y_{di} is either a dummy variable indicating whether the authority issued a public merger review decision after deliberation, or the duration of the review. The term X_{di} is a vector of market factors, including the change in HHI, vessel price, and consumer surplus following the merger. The coefficient β captures the correlation between authority effort and market conditions. Note that we do not include the supplementary sample described in Section 2.2.2 in this reduced-form analysis, since those mergers, by construction, involve at least one authority issuing a public merger review decision.

Column 1 of Table 6 presents results where the dependent variable is whether

But given more adverse market consequences of approval, it may instead require the firms to prove their case *beyond a reasonable doubt*.

[25]This describes a distinct mechanism that also makes approval less likely. For instance, the authority may always require the merging parties to prove that the merger does not lessen competition *on the balance of probabilities*. But for a merger involving firms with more than 50% combined market share, it is harder to prove the case on the balance of probabilities than for a merger between firms with 5% combined market share.

the authority issued a public merger review decision. We find that antitrust authorities are more likely to formally review a larger merger, as measured by greater rise of market concentration (HHI). When we additionally control for country fixed effects (Column 2), thereby comparing decisions made within the same country, we find authorities to be also more likely to formally review deals associated with a larger fall of consumer surplus.

Column 3 of Table 6 reports results using review duration (in months) as the dependent variable. Similar to Column 1, we find that antitrust authorities tend to take longer to review mergers expected to cause a greater increase in HHI and average ship prices. When we further control for country fixed effects (Column 4), we find statistically significant positive correlation between review duration and change of HHI and average ship price.

	(1) Public Review Decision	(2) Public Review Decision	(3) Review Duration	(4) Review Duration
Change of HHI	0.0194*	0.0217**	0.641*	0.707**
	(0.0104)	(0.00981)	(0.355)	(0.348)
Change of Average Ship Price	-0.00790	-0.00866	-0.0663	0.609***
	(0.00598)	(0.00962)	(0.162)	(0.148)
Change of Consumer Surplus	-0.00624	-0.0130***	0.0997	0.238
	(0.00735)	(0.00189)	(0.280)	(0.222)
Country FEs	No	Yes	No	Yes
Obs	1619	1619	1619	1619
Dep. Var Mean	.059	.059	2.107	2.107
Dep. Var SD	.235	.235	6	6

Notes: This table reports the correlation between an antitrust authority's effort in merger review and a set of the merger's market characteristics, using Equation (6). Columns 1 and 2 regress whether an authority issued a public merger review decision on the simulated changes in HHI, average vessel price, and consumer surplus for merger d in buyer country i, as described in Section 2.2.3, with and without controlling for authority-country fixed effects. Columns 3 and 4 present similar regressions using the authority's merger review duration, measured in months, as the outcome variable. See Table 3 for variable definitions. Significance levels: *(p< 0.10), **(p< 0.05), ***(p< 0.01).

Table 6: Market Factors and Merger Decisions

Second, we examine whether the presence of non-market factors is associated with greater leniency in merger reviews by re-estimating Equation (6). In this specification, we replace the vector of market factors with a vector of non-market factors. These include whether the acquiring firm is a foreign entity, the percentage of trade with the acquiring firm's country, the GDP ratio of the acquiring country to the decision country, whether the acquiring firm has state connections, and whether a foreign acquiring firm with state connections is involved.

	(1) Public Review Decision	(2) Public Review Decision	(3) Public Review Decision	(4) Review Duration	(5) Review Duration	(6) Review Duration
Foreign Firm	-0.0151	0.0726*	0.0699*	0.0600	1.811*	1.796**
	(0.0462)	(0.0406)	(0.0411)	(0.888)	(0.933)	(0.836)
% Trade with Merging Firms' Countries	-0.0123***	-0.00398	-0.00383	-0.233***	-0.0326	0.000382
	(0.00361)	(0.00278)	(0.00282)	(0.0786)	(0.0596)	(0.0600)
Acquiring Country to Decision Country GDP Ratio	-0.00247**	0.00150*	0.00135*	-0.0391	0.0470**	0.0524**
	(0.00120)	(0.000769)	(0.000764)	(0.0239)	(0.0202)	(0.0226)
Merging Firm State Connection	0.534***	0.543***	0.542***	8.888***	8.964***	9.073***
	(0.0679)	(0.0618)	(0.0624)	(1.441)	(1.459)	(1.416)
Foreign * State Connection	-0.558***	-0.570***	-0.566***	-9.609***	-9.702***	-9.759***
	(0.0702)	(0.0648)	(0.0648)	(1.469)	(1.487)	(1.439)
Country FEs	No	Yes	Yes	No	Yes	Yes
Market Factors Controls	No	No	Yes	No	No	Yes
Obs	1619	1619	1619	1619	1619	1619
Dep. Var Mean	.059	.059	.059	.059	.059	.059
Dep. Var SD	.235	.235	.235	.235	.235	.235

Notes: This table reports the correlation between an antitrust authority's effort in merger review and a set of the merger's non-market characteristics, using Equation (6). Columns 1–3 estimate regressions of whether an authority issued a public merger review decision on the following variables: whether the acquiring party is a foreign firm, the share of trade with the acquiring party's home country in the year the merger was announced, the GDP ratio relative to the acquiring party's home country in that year, whether the acquiring party has state connections, and the interaction between the foreign-firm indicator and state connection. Columns 2 and 3 incrementally add decision-country fixed effects and the vector of market characteristics described in Equation (6) as controls. Columns 4–6 replicate the analysis using the authority's merger review duration, measured in months, as the outcome variable. See Table 3 for variable definitions. Significance levels: *(p< 0.10), **(p< 0.05), ***(p< 0.01).

Table 7: Non-Market Factors and Merger Decisions

Column 1 of Table 7 shows the correlation between public merger review decisions and non-market factors. A case is less likely to receive a public merger review decision when there is stronger trade connection with the acquiring firm's home country, when the acquiring firm's country is larger relative to the decision country as measured by GDP, and when it is a foreign firm with state connections.

Column 3 of Table 7 presents the results using review duration as the dependent variable. The findings are consistent with those in Column 1. Although including authority country fixed effects absorbs much of the variation in trade volume and GDP ratio, the relationship between the level of antitrust scrutiny and whether the acquiring firm is foreign with state connections remains strong, as shown in Columns 2 and 4 of Table 7. Furthermore, the magnitude and statistical significance of the coefficients change minimally when we additionally control for market factors discussed in Table 6, as seen in Columns 3 and 6 of Table 7.

3.2 Strategic Interaction between Antitrust Authorities

Since a merger requires approval from all the relevant antitrust authorities, we extend the single-agent model to account for potential strategic interaction between authorities by introducing a multi-agent unanimous voting model.

3.2.1 Unanimous Voting Game

In the unanimous voting game, a pair of firms exogenously decides to merge. Based on each jurisdiction's antitrust legislation and sales records, the firms identify the set of authorities to notify before carrying out the transaction. Once the notification process is initiated, if the merger is not anti-competitive, the firms send a public signal to each authority with an arrival rate of λ per period, which we model as a Poisson process. The authorities share a common prior P_T regarding the probability that the merger is not anti-competitive.

In a given period, based on the prior, the arrival (or absence) of a signal, and their beliefs about the actions of other authorities, each authority decides whether to approve, reject, or continue reviewing the merger. The game ends when either (1) all authorities grant approval or (2) any authority rejects the merger, at which point the payoffs are realized. For simplicity, all authorities are assumed to share the same per-period review cost c and discount factor β.

Assumptions. To solve the game, we make three simplifying assumptions, while relaxing the last two assumptions when estimating the structural model. First, this setting is a special case of the super-majority voting game extensively discussed by Chan et al. (2018). Accordingly, we follow the literature by focusing on the equilibrium in which each authority i's strategy is characterized by a pair of approval–rejection thresholds $\pi = (a_{it}, A_{it})$, which may vary over time. Second, we assume that each authority has complete information about the payoff matrices of all other authorities. As a result, each authority knows the optimal thresholds that the others would adopt if they were acting independently in a single-agent setting. Third, the merging firms send a public signal to all authorities, implying that when the public signal arrives, all authorities approve at the same time. Nevertheless, the assumptions appear non-critical, since the model's predictions align well with observed patterns in antitrust decisions.

Authority's Optimization Problem. The key difference between the multi-agent voting game and the single-agent model is that each authority is no longer solving an unconstrained optimization problem. Instead, the outcome is determined by the last approver or the first rejecter. Conditional on the strategy profile of the other authorities in period t,

$$\pi^t_{-i} = \big((a^t_1, A^t_1), (a^t_2, A^t_2), \ldots, (a^t_{i-1}, A^t_{i-1}), (a^t_{i+1}, A^t_{i+1}), \ldots, (a^t_N, A^t_N)\big),$$

authority i's decision affects the outcome in period t only when $a^t_i \in [a^t_{[N-1]}(\pi_{-i}), \infty)$ or $A^t_i \in [A^t_{[N-1]}(\pi_{-i}), \infty)$, where $a^t_{[N-1]} = \max(a^t_1, a^t_2, \ldots, a^t_{i-1}, a^t_{i+1}, \ldots, a^t_N)$, and similarly for $A^t_{[N-1]}$. Authority i solves the following constrained optimization problem:

$$\arg\max_{a,A} \; E[U_{it}(a, A) \,|\, \sigma_t, \pi^t_{-i}] \quad \text{s.t.} \quad (a, A) \in I^a(\pi^t_{-i}) \times I^A(\pi^t_{-i}), \tag{7}$$

where $I^a(\pi^t_{-i}) = [a^t_{[N-1]}, \infty)$ and $I^A(\pi^t_{-i}) = [A^t_{[N-1]}, \infty)$.

Equilibrium Analysis. Consider a merger that potentially affects N jurisdictions. The equilibrium is defined according to the standard Nash framework.

Definition 1. *Let $(a_{[N]}(\pi), A_{[N]}(\pi)) = (\hat{a}, \hat{A})$, where $\hat{a} = (a^T_{[N]}, a^{T-1}_{[N]}, ..., a^0_{[N]})$ and $\hat{A} = (A^T_{[N]}, A^{T-1}_{[N]}, ..., A^0_{[N]})$. A strategy profile π is a perfect Bayesian Nash equilibrium if, for any authority i holding an arbitrary belief P_t,*

$$E[U_{it}(\hat{a}, \hat{A} \mid P_t)] \geq E\big[U_{it}(a_{[N]}(\pi'_i, \pi_{-i}), A_{[N]}(\pi'_i, \pi_{-i}) \mid P_t)\big]$$

for all $\pi'_i \in \Pi_i$ and $t \in \{T, T-1, \ldots, 0\}$, where Π_i denotes authority i's strategy set.

Proposition 2. *Let there be N authorities in the unanimous voting game. Index the authorities such that $V_1 < V_2 < ... < V_N$. In a two-period setting, suppose $c << -V_N$;*

then there exists an equilibrium in which

1. *Authority 1 follows its single-agent optimal strategy. Specifically, in the first period, it approves the merger if a signal arrives. If no signal arrives, the authority:*

$$\begin{cases} \textit{rejects the merger,} & \textit{if } P_t < \dfrac{c}{\beta Pr_\lambda}, \\ \textit{waits until the next period,} & \textit{if } \dfrac{c}{\beta Pr_\lambda} \leq P_t < \min\left\{\dfrac{-V_1}{\exp(-Pr_\lambda) - V_1}, \dfrac{-V_1 - c}{1 - V_1 - \beta Pr_\lambda}\right\}, \\ \textit{approves the merger,} & \textit{if } P_t \geq \min\left\{\dfrac{-V_1}{\exp(-Pr_\lambda) - V_1}, \dfrac{-V_1 - c}{1 - V_1 - \beta Pr_\lambda}\right\}. \end{cases}$$

   In the last period, it approves the merger if a signal arrives. If no signal arrives, the authority

$$\begin{cases} \textit{approves the merger,} & \textit{if } P_0 \geq -\dfrac{V_1}{1 - V_1}, \\ \textit{rejects the merger,} & \textit{if } P_0 < -\dfrac{V_1}{1 - V_1}. \end{cases}$$

2. *The other authorities (authority 2 through N) approve the merger immediately in the first period.*

Proof: In the first period, note that both $\frac{-V_i}{\exp(-Pr_\lambda)-V_i}$ and $\frac{-V_i-c}{1-V_i-\beta Pr_\lambda}$ are decreasing in V_i. Although the waiting region $\left[\frac{c}{\beta Pr_\lambda}, \min\left\{\frac{-V_i}{\exp(-Pr_\lambda)-V_i}, \frac{-V_i-c}{1-V_i-\beta Pr_\lambda}\right\}\right)$ is non-stationary and changes over time, each authority's single-agent waiting region is nested. Authority 1 has the widest waiting region, followed by authority 2, 3, ..., N. All authorities share the same lower rejection threshold at $\frac{c}{\beta Pr_\lambda}$.

Suppose Authority 1 enforces its single-agent optimal thresholds:

$$\left(\frac{c}{\beta Pr_\lambda}, \min\left\{\frac{-V_1}{\exp(-Pr_\lambda) - V_1}, \frac{-V_1 - c}{1 - V_1 - \beta Pr_\lambda}\right\}\right).$$

For another authority i ($i > 1$), its optimal decision thresholds in the first period are nested within those of authority 1. Authority 1 approves, waits, and rejects in all cases where Authority i would also have approved, waited, or rejected. Given authority 1's strategy, immediate approval (i.e., deferring to authority 1's decision) yields authority i a payoff that is at least as good as immediate rejection (0 payoff), since $V_i > V_1$. Waiting would incur a review cost without changing the outcome. Therefore, authority i strictly prefers to approve the merger right away.

On the other hand, suppose all other authorities approve the merger immediately. Authority 1 is then effectively in a single-agent setting and will enforce its single-agent optimal thresholds $\left[\frac{c}{\beta Pr_\lambda}, \min\left\{\frac{-V_1}{\exp(-Pr_\lambda)-V_1}, \frac{-V_1-c}{1-V_1-\beta Pr_\lambda}\right\}\right)$. □

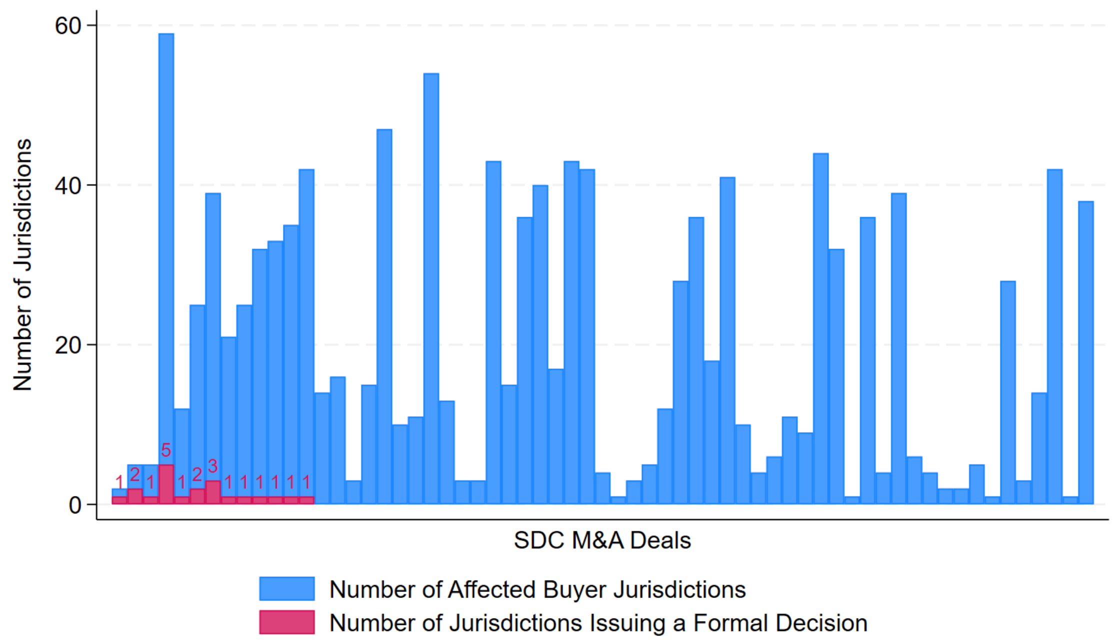
Finite Horizon. The two-period model equilibrium can also be extended to a multi-period unanimous voting game. In Appendix A, we show that when the arrival rate λ and the initial belief P_T are such that the upper approval threshold is monotonically decreasing in V_i, the authorities' waiting regions are again nested. As a result, authority 1, who is the strictest reviewer in the single-agent setting, will once again be the one reviewing the merger extensively, while the other authorities will approve the merger immediately.

3.2.2 Concentration of Merger Review Power

Despite its simplifying assumptions, the unanimous voting model captures a key empirical pattern: the vast majority of affected jurisdictions effectively rubber-stamp the merger, while only a few exert meaningful effort before deciding. In the main sample, an average of 25.7 jurisdictions are potentially affected by each shipyard merger. However, on average, only 1.5 authorities publicly announced that they undertook deliberation before making a decision. The remaining authorities did not interfere with the M&A process at all, which we interpret as implicitly approving within a month, as detailed in Section 2.2.

Figure 3 illustrates this pattern by breaking down the number of jurisdictions affected and the number of public decisions issued at the individual case level. While a large number of jurisdictions are typically affected by a merger, only one or two, and at most five, issued a public decision. In terms of review duration, the average is only 2.11 months. However, the distribution exhibits a long tail, with some reviews lasting up to 56 months, as shown in Table 3. This again suggests that while most reviews are likely perfunctory, a small number of authorities subject the mergers to substantive scrutiny.

Additionally, when review cost c is close to zero, the model rationalizes the observed reality that antitrust authorities rarely reject merger proposals. As c



Note: This figure shows the number of jurisdictions involved in each of the 63 shipyard mergers in the main sample, indicated by blue bars, and the number of jurisdictions that issued a public merger review decision for each deal, indicated by red bars. The numbers in red indicate the number of jurisdictions that issued a public decision for the given deal. See Section 2.2.2 for the definition of the main sample of shipyard mergers. A country is considered involved in a shipyard merger if the merging firms jointly sold at least one vessel to that country between 2000 and the year the merger was announced, based on Clarksons Research's vessel transaction records.

Figure 3: Number of Jurisdictions Affected and Issuing Decisions

goes to 0, the rejection threshold $\frac{c}{\beta Pr_\lambda}$ also goes to 0, meaning that the authority would reject the merger only when it believes that the probability of the merger being high state is minuscule. Indeed, among the 63 shipyard mergers in the main sample, only two were withdrawn due to antitrust enforcement by the EC. This suggests that, although the review cost is unlikely to be exactly zero in practice, it is minimal relative to the merger's overall impact that is considered by the authorities.[26]

[26] While the assumption that c is close to zero is not explicitly used in the two-period unanimous voting game, we will trigger this assumption when we derive the generalized finite horizon model in Appendix A.

4 Structural Analysis

4.1 Empirical Model of the Merger Review Process

In this section, we extend the theoretical model from Section 3 by relaxing several assumptions to structurally estimate an empirical model. Specifically, we allow each authority i to have private information about its payoff (V_{HA_i}, V_{LA_i}) and its information process.[27] To keep the model tractable, we assume that each authority i holds a belief P_i^e, which is the probability that the merger will be eventually rejected by another authority. In equilibrium, this belief is consistent with expectation, that is,

$$P_i^e = \frac{1}{D_i} \sum_{d=1}^{D_i} [1 - \Pi_{j \neq i}^{N_d} (1 - Pr_{dj}(\text{eventual rejection}))],$$

where $\Pr_{dj}(\text{eventual rejection})$ denotes authority i's ex ante believed probability that authority j will eventually reject merger d by terminal period T; N_d is the number of authorities involved in deal d; D_i is the number of deals authority i is involved. P_i^e is then the average probability of rejection by at least one authority other than authority i. Since we observe limited heterogeneity in the sample authorities' rejection probabilities, the authorities' equilibrium beliefs are likely to be similar. We therefore drop the subscript i and assume that the equilibrium belief P^e is the same across authorities, where $P^e = \frac{1}{N} \sum_{i=1}^{N} P_i^e$ and N is the number of authorities:

$$P^e = \frac{1}{N} \sum_{i=1}^{N} \frac{1}{D_i} \sum_{d=1}^{D_i} [1 - \Pi_{j \neq i}^{N_d} (1 - Pr_{dj}(\text{eventual rejection}))]. \tag{8}$$

The payoff matrix that incorporates P^e is shown in Table 8. Compared to the matrix in Section 3, the approval payoff for an anti-competitive merger is now a convex combination of u_L (the low-state market-related payoff) and r_0 (the market-related payoff when the merger fails). The term r_0 appears because, although the focal authority avoids the rejection cost C_{rej} by approving, another authority may still block the merger. After normalizing the rejection payoff, the low-state

[27] Merging firms still cannot choose which signal each authority receives; the signal remains determined by the merger's true state.

approval payoff becomes $V_{LA} = C_{rej} + (1 - P^e)(u_L - r_0)$.

Higher P^e and/or r_0 render the authority more lenient. As P^e increases, the authority anticipates a higher chance that another authority will reject the merger and discounts the loss u_L more heavily.[28] When $u_L < 0$, the bad-to-good-outcome ratio V increases with r_0, so the authority becomes more lenient as r_0 increases (Lemma A1).

Decision/State	High	Low
Approve	$P^e r_0$	$(1 - P^e)u_L + P^e r_0$
Reject	$r_0 - C_{rej}$	$r_0 - C_{rej}$

Authority's Payoff Matrix

Decision/State	High	Low
Approve	$V_{HA} = C_{rej} - (1 - P^e)r_0$	$V_{LA} = C_{rej} + (1 - P^e)(u_L - r_0)$
Reject	0	0

Payoff after Normalization

Notes: The table presents the antitrust authority's payoff matrices before and after normalization. In the normalized matrix, the payoff for rejecting the merger is normalized to zero.

Table 8: Authority Payoff Matrix Incorporating Others' Beliefs

Given the payoffs $\left(V_{HA}(P^e), V_{LA}(P^e)\right)$, each authority i solves its own single-agent optimization problem. In equilibrium, the belief is consistent with expectation, that is, the equilibirum P^e is a fixed point of the function defined by Equation (8).

4.2 Estimation

We combine the main and supplementary merger samples, as described in Section 2.2.2, to estimate the model primitives that best capture the authorities' empirical responses to each merger.[29]

[28] This prediction differs from the "contagious leniency" conjecture proposed by Cabral (2005), where in a two-authority veto game, if one authority becomes more lenient, the other authority also becomes more lenient. However, in our model, an exogenous decrease in P^e may lead an authority to be more stringent. This is because (1) we consider each merger as an independent game and (2) rejection is attached with a cost due to non-market factors. Given that a merger is anti-competitive, an authority would prefer someone else rejecting it to rejecting the deal itself.

[29] As we treat decision(s) made by EU member states as a joint decision, we aggregate market factors for EU by taking cross-country averages weighted by each country's market size.

Model Parametrization. Given the payoff matrix defined in Section 4.1, suppressing the subscript, an authority's bad-to-good-outcome ratio V $(-\frac{V_{LA}}{V_{HA}})$ can be written as

$$V = -\frac{V_{LA}}{V_{HA}} = -\frac{C_{rej} + (1 - P^e)(u_L - r_0)}{C_{rej} - (1 - P^e) r_0}. \tag{9}$$

We can then use V to back out the authority's approval and rejection thresholds in the finite multi-period model defined by Proposition A1:

$$\begin{cases} [\frac{c}{\beta Pr_\lambda}, \min\{-\frac{V}{\exp(-tPr_\lambda)-V}, \frac{\beta \mathcal{V}_{t-1}(P_{t-1})-V-c}{1-V-\beta Pr_\lambda(1-\mathcal{V}_{t-1}(P_{t-1}))}\}) \text{ when } t > 0. \\ \text{Approve, if } P_t \geq \frac{-V}{1-V}\text{; reject if } P_t < \frac{-V}{1-V} \text{ when } t = 0. \end{cases}$$

Among the terms used to form these thresholds, we parameterize the bad-to-good outcome ratio V and the good-signal arrival rate (λ and Pr_λ) using observed market and non-market conditions. The continuation value of waiting, $\mathcal{V}_{t-1}(P_{t-1})$, is then solved via backward induction, with the continuation value in period 1, $\mathcal{V}_1(P_1)$, given by the left-hand side of Equation (4): $(-c + \beta Pr_\lambda P_1)$.[30]

Market Impact of Mistaken Approval (u_L). Since antitrust enforcement often amounts to consumer protection in practice (Wilson 2019), we parameterize the authority's payoff from market-related factors using the change in consumer surplus (CS) following the merger. This follows the approach in Breinlich, Nocke, and Schutz (2020), which assumes that a country's objective is to maximize the utility of a representative domestic consumer. Since u_L reflects the market impact of a mistaken approval, we ensure that it is negative by defining it as the negative exponential of $\beta_1 \Delta CS_{di}$, where β_1 is a coefficient to be estimated.

$$u_{L_{di}} = -\exp(\beta_1 \Delta CS_{di}) + \epsilon_{1di}. \tag{10}$$

Rejection Cost (C_{rej}). As shown in As shown in Table 7, review effort is correlated with the acquirer's foreign status and state connections. We therefore specify the rejection cost as a function of the acquirer's foreign status, its government ties, and

[30] Since the authority can no longer choose to wait in period 0, the continuation value is $-\infty$.

their interaction:

$$C_{rej_{di}} = \gamma_1 \text{Foreign}_{di} + \gamma_2 \text{State Connection}_{di} + \gamma_3 \text{Foreign * State Connection}_{di} + \epsilon_{2di}. \tag{11}$$

Signal Arrival Process (λ). We parametrize the arrival rate using the price and HHI increase associated with a merger. As explained in Section 3.1.2, intuitively, the arrival rate of good signals captures the probability of the authority receiving a piece of pivotal evidence that addresses its competition concerns. When the merger is associated with a higher increase of price and/or HHI, which are key metrics an antitrust authority evaluates (Table 6), it becomes harder for the merging firms to produce such a piece of evidence, entailing a lower arrival rate. When the increase in price and/or HHI is large enough, the merger becomes anti-competitive and no signal will ever arrive ($\lambda = 0$).

To capture the fact that over 90% of approvals in our data occur within the first month, we include a dummy variable $\mathbf{1}\{\text{1st Month of Review}\}$ when calibrating the arrival rate. This high first-month approval rate may be explained by the two-phase structure of merger review, as many jurisdictions, such as the EU, aim to clear most applications during Phase 1, which lasts for one month (European Commission 2013). The constant δ_0 captures the baseline signal arrival rate, independent of observed merger characteristics. The arrival rate is specified as follows:[31]

$$\lambda_{di} = \delta_0 + \delta_1 \Delta Price_{di} + \delta_2 \Delta HHI_{di} + \delta_3 \mathbf{1}\{\text{1st Month of Review}\}_{di} + \epsilon_{3di}. \tag{12}$$

Given the arrival rate in the Poisson process, the probability of receiving at least one good signal in a given period, Pr_λ, is computed as $1 - \exp(-\lambda)$.

Prior Belief P_T. As we assume that antitrust authorities aim to maximize consumer welfare, we classify a merger as anti-competitive if BLP simulations indicate a decrease in consumer welfare. Using a probit model, we regress the dummy variable $\mathbf{1}\{\Delta CS_{di}\} \geq 0$ on a vector of observed market characteristics, including the merging parties' output and market share, changes in HHI and prices, and

[31]Note that when $\Delta Price_{di}$ and ΔHHI_{di} are sufficiently large, λ_{di} can be non-positive. We bound λ_{di} by 0 below, in which case good signal never arrives.

pre-merger market-wide consumer welfare, to predict the probability that the merger is anti-competitive. We then use the model's predicted probability as authority i's prior belief that merger d is not anti-competitive before launching an investigation.

In summary, we estimate five sets of model primitives for the approval process: $\theta = (\beta, \gamma, \delta, r_0, c)$, where β captures the merger's market impact, γ the cost of rejecting a merger, δ the signal arrival rate, r_0 the market-related payoff of rejecting the merger, and c the per-period review cost. The authority's belief that another authority will reject the merger P^e is solved as the fixed point given the set of parameters θ. The discount factor is assumed to be 0.992, corresponding to a 10% annual discount.

Identification. Given the data and a set of parameters θ, P^e is determined as the unique fixed point solving Equation (8) when Lemma A1 holds. To see this, note that V_{di} increases with P^e.[32] By Lemma A1, the approval thresholds decrease with P^e when the continuation value of waiting is not too large relative to the probability of signal arrival $Pr_{\lambda_{di}}$. As approval thresholds and hence probabilities rise, the chance of rejection by others, defined in Equation (8), falls with P^e. This monotonicity ensures that the fixed point defining the equilibrium belief P^e is unique. Therefore, each parameter set corresponds to a single fixed point P^e.

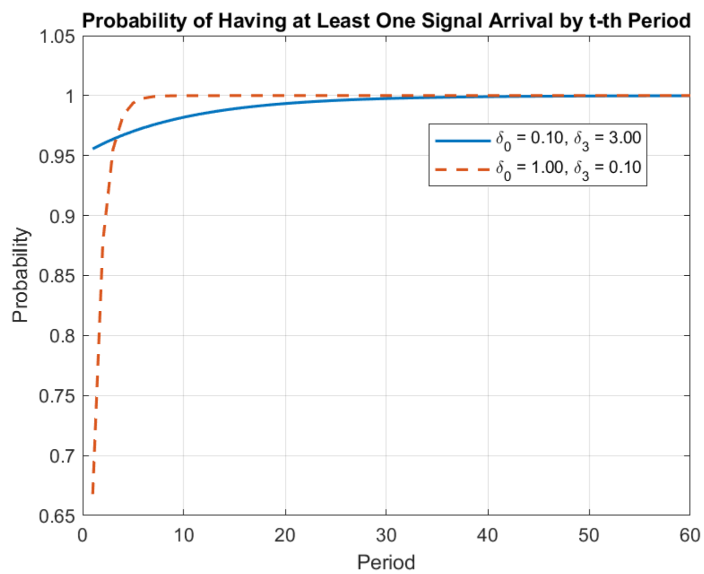
Once P^e is identified as a unique fixed point in the "inner loop," the parameters β, γ, and δ are identified from variation across mergers and jurisdictions, including changes in prices, HHI, and consumer welfare, the acquirer's foreign–state-connection status, and the time taken to review the deal. Given estimates of market impact (β), rejection cost (γ), and signal arrival rate (δ), the review cost c is identified from variation in decision time.

The rejection payoff r_0 is identified from observations where $C_{rej_{di}} = 0$, that is, country–deal pairs in which the acquiring firm is a domestic firm without state connections. In these cases, $V_{di} = -\frac{V_{LA_{di}}}{V_{HA_{di}}}$ simplifies to $\frac{u_{L_{di}}}{r_{0_{di}}} - 1$. Given $u_{L_{di}}$, these observations identify r_0.

For the arrival rate, δ_0 (constant) and δ_3 (coefficient on the first-month dummy) are separately identified because they affect the "slope" and "level" of the signal

[32]The intuition is that as the probability that another authority will eventually reject the merger increases, the difference between approving high- and low-state mergers becomes smaller.

arrival process, respectively. As shown by the blue line in Figure 4, when δ_0 is low and δ_3 is high, the probability of at least one signal arrival is already high in the first month, but the cumulative probability grows slowly thereafter, producing a gentle slope in the approval probability over time. On the other hand, as shown by the dotted orange line, when δ_0 is high and δ_3 is low, the first-month approval probability is low, but the cumulative probability rises rapidly toward 1, producing a steeper slope over time. Country–deal pairs concluding within the first month therefore identify δ_3, while those extending beyond the first month identify δ_0.



Note: This figure illustrates the antitrust authority's simulated decision-making process under two sets of arrival parameters, δ_0 and δ_3, which capture the constant and the coefficient on the first-month dummy, as specified in Equation (12). The solid blue line shows the cumulative probability when $\delta_0 = 0.1$ and $\delta_3 = 3$, while the dotted orange line shows the cumulative probability when $\delta_0 = 1$ and $\delta_3 = 0.1$.

Figure 4: Probability of Good Signal Arrival by the t-th Month

Maximum Likelihood. We estimate the model primitives θ by maximum likelihood, choosing the parameter values that maximize the probability of the observed merger outcomes. For merger d and authority i, the likelihood function is:

$$\arg\max_{\theta} L(X, Z, W, \theta) = \prod_{d=1}^{D} \prod_{i=1}^{N} \Pr(o_{di}, t_{di} | X_{di}, Z_{di}, W_{di}, \theta), \tag{13}$$

where o_{di} is authority i's decision on merger d; t_{di} is the time taken to reach the decision; X_{di} is the change of consumer welfare entering u_L; Z_{di} is the vector of non-market variables entering C_{rej}; W_{di} is the vector of market variables entering the signal arrival rate λ.

The probability of observing the merger-jurisdiction outcome, $\Pr(o_{di}, t_{di}|X_{di}, Z_{di}, W_{di}, \theta)$, for a given parameter set is computed using the following four-step procedure:[33]

1. Given (γ, δ), estimate $\hat{C}_{rej_{di}}$ and $\hat{\lambda}_{di}$ for all deal-country pairs according to Equation (11) and Equation (12).

2. Given $(\beta, \hat{C}_{rej_{di}}, \hat{\lambda}_{di})$ and an initial guess of P^e, iteratively evaluate Equation (10) and Equation (8) until P^e_n is a fixed point as per Equation (8), where n indexes the number of iterations. We thereby obtain $\hat{u}_{L_{di}}$ as well.

3. Given $\hat{\lambda}_{di}$, calculate the probability of signal arrival per period, $\hat{P}r_{\lambda_{di}}$, for each country-deal pair. The belief path $(\hat{P}^t_{di})^T_{t=0}$, in the absence of signal arrival, is calculated as
$$\hat{P}^t_{di} = \frac{\exp(-\hat{P}r_{\lambda_{di}})\hat{P}^{t+1}_{di}}{\exp(-\hat{P}r_{\lambda_{di}})\hat{P}^{t+1}_{di} + 1 - \hat{P}^{t+1}_{di}}$$

4. Compute the optimal threshold pair $(\hat{a}^*_{dit}, \hat{A}^*_{dit})$ as per Proposition A1, which varies across deal-country pairs and time.

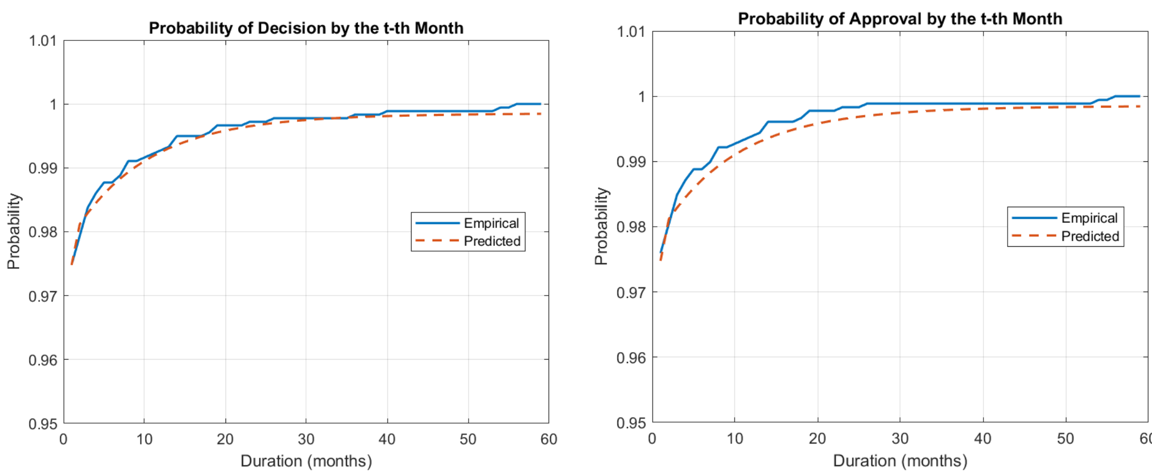
5. Compute approval and rejection probabilities in period k.

   The approval probability $\Pr(\text{approve}, k|X, Z, W, \theta)$ is:
$$\begin{cases} 1, & \text{if } \hat{P}^k_{di} \geq \hat{A}^*_{dik} \text{ and } k = T, \\ \Pi^T_{t=k+1}[\mathbf{1}\{\hat{a}^*_{dit} \leq \hat{P}^t_{di} < \hat{A}^*_{dit}\}(1 - \hat{P}r_{\lambda_{di}})], & \text{if } \hat{P}^k_{di} \geq \hat{A}^*_{dik} \text{ and } k < T, \\ \hat{P}r_{\lambda_{di}}, & \text{if } \hat{P}^k_{di} < \hat{A}^*_{dik} \text{ and } k = T, \\ \Pi^T_{t=k+1}[\mathbf{1}\{\hat{a}^*_{dit} \leq \hat{P}^t_{di} < \hat{A}^*_{dit}\}(1 - \hat{P}r_{\lambda_{di}})]\hat{P}r_{\lambda_{di}}, & \text{if } \hat{P}^k_{di} < \hat{A}^*_{dik} \text{ and } k < T. \end{cases}$$
   The rejection probability $\Pr(\text{rejection}, k|X, Z, W, \theta)$ is:
$$\begin{cases} \Pi^T_{t=k+1}[\mathbf{1}\{\hat{a}^*_{dit} \leq \hat{P}^t_{di} < \hat{A}^*_{dit}\}(1 - \hat{P}r_{\lambda_{di}})]\mathbf{1}\{\hat{P}^k_{di} < \hat{a}^*_{dik}\}(1 - \hat{P}r_{\lambda_{di}}), & \text{if } k < T, \\ \mathbf{1}\{\hat{P}^k_{di} < \hat{a}^*_{dik}\}(1 - \hat{P}r_{\lambda_{di}}), & \text{if } k = T. \end{cases}$$

[33] As the longest review duration in our sample is 56 months, we set $T = 60$ months for calibration.

4.3 Estimation Results

Figure 5 evaluates the model fit, showing that the predicted probabilities for time to decision and approval closely resemble the empirical probabilities.[34]



(a) Avg. Prob. of Reaching Decision by the t-th Month

(b) Avg. Prob. of Approval by the t-th Month

Note: This panel of figures assesses the model fit. Panel (a) plots the average empirical probability that an antitrust authority will reach a decision on the merger *by the t-th month* ($t = 1, 2, ..., 59$), shown as a solid blue line, alongside the model-predicted average probability, shown as a dashed orange line. Panel (b) shows the average empirical probability that an antitrust authority will approve the deal *by the t-th month, conditional on the merger eventually being approved*, shown as a solid blue line, with the corresponding model-predicted probability shown as a dashed orange line. The estimation uses mergers from both the main and supplementary samples. See Section 2.2.2 for the definitions of these samples of shipyard mergers.

Figure 5: Model Fit

Table 9 presents the parameter estimates, with standard errors calculated using the inverse information matrix. All continuous variables are scaled by their maximum absolute values to fall between –1 and 1. Consistent with the reduced-form evidence in Table 6, mergers that result in larger decreases in consumer welfare are associated with lower values of u_L. Mergers leading to larger increases in price and/or market concentration (HHI) have lower signal arrival

[34] The 60th month ($t = 0$) is omitted in the plots because it is the terminal period in the model, leading to a mechanical jump in the authority's probability of reaching a decision. No observed country-deal that took 60 months to complete merger review.

rates, reflecting the greater difficulty for merging parties to produce evidence that the merger would not substantially lessen competition. The first-month dummy on the arrival rate, δ_3, is large, helping explain the over 90% approval rate observed within that period. The term r_0 is negative, reflecting the business loss from blocking the merger relative to approving a not-anti-competitive deal. In addition, consistent with the model's assumption, the estimated per-period review cost c is close to zero and statistically insignificant.

Variable	Estimate	Variable	Estimate
β_1 (ΔCS)	-5.155***	γ_1 (Foreign)	0.097***
	(0.024)		(0.025)
r_0	-0.657***	γ_2 (State Connection)	0.029
	(0.025)		(0.048)
δ_0	0.116***	γ_3 (Foreign * State Connection)	0.192***
	(0.000)		(0.025)
δ_1 (ΔPrice)	-0.231***	P^e	0.052
	(0.015)		
δ_2 (ΔHHI)	-1.558***	c (Review Cost)	0.000
	(0.105)		(0.000)
δ_3 (1st Month of Review)	3.526***		
	(0.005)		
Obs	1792		

Notes: The table reports the parameter estimates obtained using the maximum likelihood estimation method described in Equation (13). Standard errors, shown in parentheses, are computed using the inverse information matrix. The estimation uses mergers from both the main and supplementary samples. See Section 2.2.2 for the definitions of these samples of shipyard mergers. Significance levels: *(p< 0.10), **(p< 0.05), ***(p< 0.01).

Table 9: Parameter Estimates

Non-market factors significantly affect antitrust decision-making. As shown in Columns 3 and 4 of Table 9, an authority faces a higher C_{rej} when the merger involves a foreign acquirer. While the coefficient on the state-connection dummy is small and imprecisely estimated, the authority is most reluctant to reject mergers involving foreign firms with state connections, defined as acquiring firms that are either state-owned or long-term military equipment suppliers.

Consider a hypothetical merger with sample-average characteristics: $\overline{\Delta CS} \approx -0.0082$, $\overline{Foreign} \approx 0.96$, $\overline{StateConnection} \approx 0.26$, and $\overline{Foreign * StateConnection} \approx 0.24$. This yields $\overline{u_L} \approx -1.04$ and $\overline{C_{rej}} \approx 0.15$. Even without factoring in the discount from the probability that another authority will reject the merger (P^e), the loss from approving such an anti-competitive merger amounts to only about 85.6% of its full adverse market impact.

Moreover, there is an expectation that another authority may eventually reject the merger, further reducing the weight placed on market outcomes in an individual authority's decision-making process. On average, each authority assigns a 5.2% probability that at least one other authority will ultimately reject the merger within 60 months. This expectation effectively discounts the adverse market consequences of approving an anti-competitive merger to 94.8% of their full impact. Accounting for free-riding incentives, the negative payoff from approving an average anti-competitive merger amounts to $1 - \frac{0.15}{1.04*0.948} \approx 84.8\%$ of its full adverse market impact.

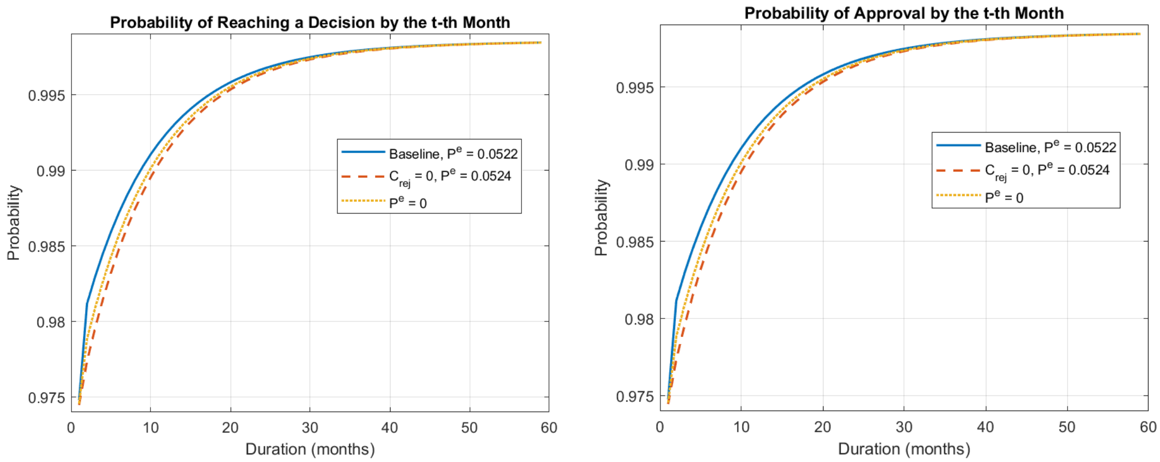
5 Counterfactual Analysis

We consider two counterfactual scenarios: (1) removing the influence of non-market factors, setting $C_{rej} = 0$ for all or a subset of jurisdictions; and (2) independent decision-making, setting $P^e = 0$ for all or a subset of jurisdictions. In both cases, jurisdictions find it harder, relative to the baseline, to reach consensus on approving a merger. This leads to a $4.16–5.96 billion annual increase in global consumer welfare, as anti-competitive mergers face more stringent regulatory scrutiny, with the largest gains occurring when rejection costs are eliminated across all jurisdictions.

5.1 Removing Influence of Non-Market Factors

5.1.1 Decision Pattern of an Individual Authority

Removing rejection cost makes an authority more stringent, as it becomes less likely to issue a quick approval. The dotted red and solid blue lines in Figure 6 plot the average probability that an individual authority will reach a decision and approve a case by month t when $C_{rej} = 0$ and in the baseline scenario, respectively. In both cases, the probability of deciding or approving by month t is never higher than in the baseline. The gap in the first month is minimal, driven by the dominant



(a) Cumulative Prob. of Reaching Decision by the t-th Month

(b) Cumulative Prob. of Approval by the t-th Month

Note: This panel of figures plots the average probability that an authority will reach a decision and approve a merger by the t-th month ($t = 1, 2, ..., 59$). The three lines represent: (1) the baseline, where both rejection cost and P^e remain at the status quo; (2) C_{rej} is set to zero and P^e adjusts to the new equilibrium; and (3) P^e is set to zero while C_{rej} remains at the status quo. The analysis uses mergers from both the main and supplementary samples. See Section 2.2.2 for the definitions of these samples of shipyard mergers.

Figure 6: Cumulative Probability of Deciding/Approving a Merger by the t-th Month

effect of the first-month-of-review dummy, but it becomes more visible from the second month onward. For example, the probability of approval by the 10th month falls from 99.1% in the baseline to just under 99% when $C_{rej} = 0$. Although the absolute difference is small, unanimous approval across multiple authorities means that even small reductions at the individual level can substantially lower the success rate of a merger with international spillovers.

Additionally, as authorities become more stringent when rejection cost vanishes, they also update their belief about the probability that another authority will reject the deal. As shown in Figure 6, the equilibrium belief P^e rises from 5.22% to 5.24% when C_{rej} becomes zero, reflecting the expectation that no rejection cost makes authorities stricter across the board.[35]

[35] Recall that the bad-to-good-outcome ratio is $-\frac{C_{rej}+(1-P^e)(u_L-r_0)}{C_{rej}-(1-P^e)r_0}$. When $C_{rej} = 0$ for all authorities, P^e cancels out and does not affect V. The counterfactuals when $C_{rej} = 0$ and when $C_{rej} = 0$

Change of Average Success Probability Relative to Baseline (%)			
Cutoff Month	**1**	**11**	**19**
$C_{rej} = 0$, All	-0.331	-2.397	-1.040
$C_{rej} = 0$, Authorities Ever Decided	-0.074	-0.347	-0.145
$C_{rej} = 0$, Authorities Never Decided	-0.258	-2.087	-0.901
$C_{rej} = 0$, Authorities Never Decided, Random Subgroup	-0.305	-2.197	-0.949

Notes: This table reports the change in the average probability that a merger will receive unanimous approval from all jurisdictions involved by the 1st, 11th, and 19th months, relative to the baseline (status quo) scenario. Mergers not approved by the respective deadlines are assumed to be either rejected or voluntarily withdrawn. "$C_{rej} = 0$, All" simulates the case where the rejection costs for all jurisdictions are set to zero; "$C_{rej} = 0$, Authorities Ever Decided" simulates the case where rejection costs are set to zero only for jurisdictions that have ever issued a decision; "$C_{rej} = 0$, Authorities Never Decided" simulates the case where rejection costs are set to zero only for jurisdictions that have never issued a decision; and "$C_{rej} = 0$, Authorities Never Decided, Random Subgroup" simulates the case where rejection costs are set to zero for nine randomly selected never-decided jurisdictions. Nine jurisdictions are drawn at random 500 times, and the reported numbers represent the sample average. The probability of unanimous approval by the t-th month is calculated as $\Pi^{N_d} i = 1 Prdi(\text{approve}, t)$, where d indexes the deal and i indexes the authority. N_d denotes the total number of authorities involved in deal d.

Table 10: Effect of Removing Non-Market Factors on Merger Success Probability Relative to the Baseline Scenario

5.1.2 Chance of Reaching Unanimous Consensus

When a merger affects some jurisdictions more adversely than others, removing the influence of non-market factors makes it more difficult for authorities to reach a consensus on whether the merger should be approved. Table 10 reports changes in the average probability that a merger receives unanimous approval by month

and $P^e = 0$ are thus equivalent. Intuitively, if there is no rejection cost, the authority's payoff from approving the merger depends solely on its market impact, which is always scaled by the probability that the merger will not pass due to rejection by another authority, regardless of the merger's true state.

1 (the default Phase 1 review period in most jurisdictions), as well as by months 11 and 19, by which time the probability of the case receiving a decision from all jurisdictions has reached 99% and 99.5%, respectively.[36] Mergers not approved by these deadlines are treated as rejected or voluntarily withdrawn, a de facto rejection. Relative to the baseline scenario, setting $C_{rej} = 0$ for all jurisdictions lowers the probability of obtaining unanimous approval by the 19th month by 1.04 percentage points.

Furthermore, removing rejection cost has heterogeneous impacts across authorities. As shown in rows 4 and 5 of Table 10, setting C_{rej} to zero for jurisdictions that have ever issued a public merger review decision in the sample ("ever-decided jurisdictions") reduces the probability of unanimous approval by the 19th month by 0.145 percentage points.[37] The probability drops by 0.901 percentage points when C_{rej} is set to zero for jurisdictions that have never issued a public merger review decision ("never-decided jurisdictions"). Because merging shipyards are often based in ever-decided jurisdictions (e.g., China, Japan, and Korea), the cost of rejecting a foreign merger does not apply to some of them. By comparison, never-decided jurisdictions primarily handle foreign cases, so their rejection cost is large relative to u_L, resulting in a more pronounced decline in the likelihood of unanimous approval.

While there are more never-decided jurisdictions than ever-decided jurisdictions, row 6 of Table 10 shows that the difference is not simply a mechanical result of removing rejection costs for more authorities. In fact, when we remove rejection costs for nine randomly selected never-decided jurisdictions, the expected drop in approval probability is 0.949 percentage points, slightly larger than the drop from setting C_{rej} to zero for all never-decided jurisdictions. This occurs because, although removing rejection cost makes an authority more concerned about a merger's potential adverse market impact, it also increases the expected probability that another jurisdiction will reject the merger (P^e). When more jurisdictions have zero rejection cost, the incentive to free-ride becomes stronger, tempering the overall effect. However, when C_{rej} is zero for all jurisdictions, P^e drops out of the

[36]For a given merger involving N_d jurisdictions, the probability of obtaining unanimous approval by the t-th month is calculated as $Pr_d(\text{Unanimous Approval}|t) = \Pi_{i=1}^{N_d} Pr_{di}(\text{Approval}|t)$.

[37]Since both the main and supplementary samples are used for the counterfactual simulation, there are nine jurisdictions that have issued at least one public merger review decision: Britain, China, the EU, Japan, Korea, Singapore, Türkiye, the USA, and Vietnam.

bad-to-good-outcome ratio V, and the impact of $C_{rej} = 0$ once again dominates.

Change of Average Success Probability Relative to Baseline (%)			
Cutoff Month	**1**	**11**	**19**
$P^e = 0$, All	-0.271	-1.503	-0.644
$P^e = 0$, Authorities Ever Decided	-0.074	-0.278	-0.117
$P^e = 0$, Authorities Never Decided	-0.198	-1.245	-0.531
$P^e = 0$, Authorities Never Decided, Random Subgroup	-0.019	-0.137	-0.057

Notes: This table reports the change in the average probability that a merger will receive unanimous approval from all jurisdictions involved by the 1st, 11th, and 19th months, relative to the baseline (status quo) scenario. Mergers not approved by the respective deadlines are assumed to be either rejected or voluntarily withdrawn. "$P^e = 0$, All" simulates the case where P^e for all jurisdictions is set to zero; "$P^e = 0$, Authorities Ever Decided" simulates the case where P^e for jurisdictions that have ever issued a decision is set to zero; "$P^e = 0$, Authorities Never Decided" simulates the case where P^e for jurisdictions that have never issued a decision is set to zero; and "$P^e = 0$, Authorities Never Decided, Random Subgroup" simulates the case where P^e is set to zero for nine randomly selected never-decided jurisdictions. Nine jurisdictions are drawn at random 500 times, and the reported numbers represent the sample average. The probability of unanimous approval by the t-th month is calculated as $\Pi^{N_d} i = 1 Prdi(\text{approve}, t)$, where d indexes the deal and i indexes the authority. N_d denotes the total number of authorities involved in deal d.

Table 11: Effect of Removing Free-Riding Incentives on Merger Success Probability Relative to the Baseline Scenario

5.2 Independent Decision-Making

5.2.1 Decision Pattern of an Individual Authority

Similar to the removal of rejection cost, enforcing independent decision-making by setting $P^e = 0$ also makes an authority less likely to issue a quick approval. When there is no possibility of relying on others to block an undesirable merger, the authority fully absorbs the market impact of approving an anti-competitive deal. The effect on an individual authority's likelihood of deciding or approving is illustrated by comparing the yellow and blue lines in Figure 6. However, the impact of setting $P^e = 0$ is smaller than that of setting $C_{rej} = 0$, because the baseline P^e is only 5.22%; on average, authorities are not heavily reliant on others to reject a shipyard merger.

5.2.2 Chance of Reaching Unanimous Consensus

Removing the possibility of relying on others to reject a merger also makes unanimous approval less likely. As shown in Table 11, setting P^e to zero for all authorities reduces the average probability of obtaining unanimous approval by the 19th month by 0.64 percentage points. Unlike the removal of rejection cost, which can be offset by stronger free-riding incentives, the probability of unanimous approval declines monotonically as more authorities engage in independent decision-making. Consequently, the largest drop occurs when $P^e = 0$ for all jurisdictions, as shown in Table 11. When P^e is altered for only a subset of jurisdictions, the largest decline is observed when it is set to zero for all the never-decided jurisdictions, followed by all the ever-decided jurisdictions, and then for nine random never-decided jurisdictions.

Ensuring independent decision-making among the ever-decided jurisdictions has a greater effect than doing so for the never-decided, conditional on changing P^e for the same number of jurisdictions. Since the issuance of a public merger review decision is correlated with the merger's market impact, the ever-decided jurisdictions tend to be those whose markets are more affected by mergers (i.e., u_L is large relative to C_{rej} in magnitude). Removing the discount on u_L created by free-riding incentives therefore matters more for the ever-decided. Table 11 shows that the probability of unanimous approval by the 19th month falls by 0.12 percentage points when $P^e = 0$ for all ever-decided jurisdictions, compared to a 0.057-percentage-point drop when it is set to zero for nine random never-decided jurisdictions.

5.3 Welfare Implications

As unanimous approval becomes less likely in the absence of rejection cost, and given limited merger-induced cost efficiencies, consumers are likely to benefit from stricter antitrust scrutiny of anti-competitive mergers. To assess how changes in the merger review process influence consumer welfare, we calculate the expected change in global consumer welfare due to a given merger as follows:

$$E(\Delta CS_d|t) = Pr_d(\text{Unanimous Approval}|t)\sum_{i=1}^{N_d}\Delta CS_{di}, \text{ where} \tag{14}$$
$$Pr_d(\text{Unanimous Approval}|t) = \Pi_{i=1}^{N_d} Pr_{di}(\text{Approval}|t),$$

where d indexes the transaction and i indexes the authority or the buyer country it oversees. t is the cutoff deadline, after which any undecided merger is treated as rejected. N_d denotes the number of authorities involved in deal d. The term $Pr_d(\text{Unanimous Approval}|t)$ is the probability that deal d receives approval from all N_d authorities by month t, calculated as the product of each authority's probability of approval by month t, $Pr_{di}(\text{Approval}|t)$. If the merger does not occur, we assume $\Delta CS = 0$ for all authorities.

Panel A of Table 12 reports the annual consumer welfare gains from mergers when rejection cost is set to zero for all or a subset of jurisdictions. Using month 19 as the cutoff, the largest welfare gain occurs when $C_{rej} = 0$ for all authorities, amounting to \$5.96 billion per year. Given that annual global ship-sales revenue is \$102 billion, this represents 5.8% of global sales. Because the drop in the probability of unanimous approval is driven primarily by the never-decided jurisdictions rather than the ever-decided, setting $C_{rej} = 0$ for nine randomly chosen never-decided jurisdictions yields the second-largest welfare gain of \$5.46 billion. The smallest gain, \$0.96 billion, arises when $C_{rej} = 0$ only for the ever-decided jurisdictions.

Panel B of Table 12 reports the annual consumer welfare gains when all or a subset of jurisdictions adopt independent decision-making. Since the probability of unanimous approval declines monotonically with the number of jurisdictions acting independently, and ΔCS_{di} is negative on average, the largest welfare gain occurs when no authority free-rides on others. In this case, annual global consumer welfare increases by \$4.16 billion, equivalent to 4.1% of global ship-sales revenue. When $P^e = 0$ is applied to the same number of authorities, the welfare gain is greater when the ever-decided jurisdictions act independently rather than the never-decided. This difference amounts to \$0.034 billion in annual consumer welfare.

Panel A. Removing Influence of Non-Market Factors			
Cutoff Month	**1**	**11**	**19**
$C_{rej} = 0$, All	1.281	13.401	5.963
$C_{rej} = 0$, Authorities Ever Decided	0.214	2.279	0.961
$C_{rej} = 0$, Authorities Never Decided	1.080	11.406	5.053
$C_{rej} = 0$, Authorities Never Decided, Random Subgroup	1.173	12.324	5.456
Panel B. Independent Decision-Making			
Cutoff Month	**1**	**11**	**19**
$P^e = 0$, All	0.846	9.531	4.159
$P^e = 0$, Authorities Ever Decided	0.214	1.683	0.719
$P^e = 0$, Authorities Never Decided	0.640	7.997	3.467
$P^e = 0$, Authorities Never Decided, Random Subgroup	0.061	0.891	0.375

Notes: This table reports the gain in the average global consumer surplus following a merger, relative to the baseline (status quo) scenario. Mergers not approved by the respective deadlines (months 1, 11, and 19) are assumed to be either rejected or voluntarily withdrawn. "$C_{rej}/P^e = 0$, All" simulates the case where C_{rej}/P^e for all jurisdictions is set to zero; "$C_{rej}/P^e = 0$, Authorities Ever Decided" simulates the case where C_{rej}/P^e for jurisdictions that have ever issued a decision is set to zero; "$C_{rej}/P^e = 0$, Authorities Never Decided" simulates the case where C_{rej}/P^e for jurisdictions that have never issued a decision is set to zero; and "$C_{rej}/P^e = 0$, Authorities Never Decided, Random Subgroup" simulates the case where C_{rej}/P^e is set to zero for nine randomly selected never-decided jurisdictions. Nine jurisdictions are drawn at random 500 times, and the reported numbers represent the sample average. The expected change in consumer welfare resulting from a merger is calculated as described in Equation (14).

Table 12: Welfare Implication of Removing Non-Market Factors and Independent Decision-Making Relative to the Baseline Scenario

6 Conclusion

In the context of shipyard mergers, this paper assesses how non-market factors and the interaction with other authorities affect an individual antitrust authority's decision process. We first present a stylized model that rationalizes two empirical patterns: (1) authorities are more stringent with mergers that are more likely to be anti-competitive, but trade and political considerations may temper that stringency; and (2) a merger often affects multiple buyer countries, but most of these countries rubber-stamp the transaction, leaving only a few to undertake detailed reviews before granting approval. Structural estimation of the model shows that, absent non-market considerations or reliance on other authorities, an antitrust authority would focus more heavily on the merger's market impact and adopt a more stringent approach. Since anti-competitive mergers are less likely to receive unanimous approval, this would result in an annual gain in global consumer welfare equivalent to 4.1–5.8% of global ship sales revenue.

This paper adds to the ongoing debate over reform of antitrust enforcement. If the goal of antitrust is still to promote market efficiency, then the reform requires not only changes to the written rules but also institutional safeguards that shield decision-makers from irrelevant considerations and pressures. Moreover, no country is an island. Joint merger review that revises the current veto structure may better shield decision-makers from non-market influences and reduce free-riding incentives. Designing such a collaborative mechanism could yield substantial welfare improvement for consumers globally.

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Online Appendix

The appendix is intended for online publication.

A Finite Horizon Model

Consider a T-period model, where $0 < T < \infty$. In period t ($t > 0$), if a signal arrives, the authority approves. If no signal arrives, it must decide whether to approve, wait, or reject. As in the two-period model, the central question remains whether the authority chooses to wait for another period. However, when $t > 1$, the authority's continuation value also depends on its decision in the following period, *t - 1*. In the event that no signal arrives in period $t-1$ either, the continuation value depends on whether it will approve, wait, or reject in that future period.

A.1 Single-Agent Model

In period t, when no signal arrives, the authority will choose to wait if the following three conditions are satisfied: (1) The belief P_t is not so high that the authority would approve regardless of whether a signal arrives in the next period; (2) it prefers waiting over rejecting in period t; and (3) it prefers waiting over approving in period t.

Condition 1: Authority Will Not Approve Even If No Signal Arrives Next Period. By induction, it can be shown that the authority will not blindly approve a merger in the next period *t-1*, regardless of whether a signal arrives, when the current period belief P_t is such that ($t > 0$)

$$P_t < \frac{-V}{\exp(-tPr_\lambda) - V}. \tag{A1}$$

Note that the threshold increases with t; the more time the authority has before the terminal period (t = 0), the more confidence it demands in the merger's true state before granting approval. When the signal arrival rate varies across periods, Equation (A1) generalizes to

$$P_t < \frac{-V}{\exp(-\sum_{i=0}^{t-1} Pr_\lambda^i) - V},$$

for $1 \leq t \leq T - 1$.

Continuation Value of Waiting. When $t > 0$, the expected value of waiting also depends on whether the authority will choose to wait for another period if no signal arrives in the next period either. When Equation (A1) is satisfied, we know that the authority will not want to approve if no signal arrives next period. The authority then faces a choice between waiting and rejecting. Denote the continuation value as

$$\mathcal{V}_t(P_t) = \max\{\mathcal{V}_t(P_t, \text{wait}), \mathcal{V}_t(P_t, \text{reject})\},$$

for $P_t < \frac{-V}{\exp(-tPr_\lambda)-V}$, where $\mathcal{V}_t(P_t, \text{wait})$ and $\mathcal{V}_t(P_t, \text{reject})$ denote the expected payoffs from waiting and rejecting, respectively, if no signal arrives in the next period. By induction, it can be shown that when there is still no signal in the next period (period *t–1*), the authority prefers waiting for another period over rejecting if the following condition is satisfied.[38]

$$P_t \geq \frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda) + c}. \tag{A2}$$

When $\frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda)+c} \leq P_t < \frac{-V}{\exp(-tPr_\lambda)-V}$, the authority may still choose to wait if no signal arrives in period *t–1*.[39] The expected value of waiting is

[38]When the arrival rate varies over time, the generalized condition in period *t–1* is $P_t \geq \frac{c}{(\beta Pr_\lambda - c)\exp(-\sum^{t-1} i{=}1 Pr^i \lambda)+c}$.

[39]It holds that $\frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda)+c} < \frac{-V}{\exp(-tPr_\lambda)-V}$, when $c << V$.

then as follows.[40]

$$\begin{aligned}\mathcal{V}_t(P_t, \text{wait}) &= -c + \beta[Pr_\lambda P_t(1) + (1 - Pr_\lambda)P_t\mathcal{V}_{t-1}(P_{t-1}) + (1 - P_t)\mathcal{V}_{t-1}(P_{t-1})] \\ &= -c + \beta[Pr_\lambda P_t + \mathcal{V}_{t-1}(P_{t-1})(1 - Pr_\lambda P_t)] \qquad \text{(A3)} \\ &= -c + \beta[Pr_\lambda P_t + \mathcal{V}_{t-1}(P_{t-1}, \text{wait})(1 - Pr_\lambda P_t)], \\ &\left(\text{ if } \frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda) + c} \leq P_t < \frac{-V}{\exp(-tPr_\lambda) - V}\right).\end{aligned}$$

As seen in Equation (A3), the term $\mathcal{V}_t(P_t, \text{wait})$ consists of three components: the per-period review cost, the (discounted) expected payoff if a signal arrives in the next period, and the (discounted) expected continuation value of waiting an additional period if no signal arrives.

When $P_t < \frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda)+c}$, the authority will choose to reject the merger if no signal arrives in the next period ($t - 1$). The expected payoff of waiting in period t is then

$$\mathcal{V}_t(P_t, \text{reject}) = -c + \beta Pr_\lambda P_t,$$

which consists of the per-period review cost and the (discounted) expected payoff if a signal arrives in the next period. If no signal arrives, the authority receives a payoff of 0, as it chooses to reject the merger.

With the continuation value of waiting established, we return below to the discussion of when Conditions 2 and 3 are satisfied.

Condition 2: Authority Prefers Waiting to Rejecting. When $P_t < \frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda)+c}$, we have $\mathcal{V}_t(P_t) = \mathcal{V}_t(P_t, \text{reject})$. The authority prefers waiting over rejecting in this period when the following condition is satisfied.[41]

$$-c + \beta Pr_\lambda P_t \geq 0 \iff P_t \geq \frac{c}{\beta Pr_\lambda}.$$

When $\frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda)+c} \leq P_t < \frac{-V}{\exp(-tPr_\lambda - V)}$, we have $\mathcal{V}_t(P_t) = \mathcal{V}_t(P_t, \text{wait})$. The authority prefers to wait rather than reject in this period if the following con-

[40] In the case where the arrival rate varies across periods, the continuation value of waiting is given by $\mathcal{V}_t(P_t, \text{wait}) = -c + \beta[Pr_\lambda^{t-1} P_t + \mathcal{V}_{t-1}(Pr_\lambda^{t-1})(1 - \lambda_{t-1}P_t)]$.

[41] Since $\exp(-(t-1)Pr_\lambda) \in (0, 1)$ and c is small, it follows that $\frac{c}{(\beta Pr_\lambda - c)\exp(-(t-1)Pr_\lambda)+c} > \frac{c}{\beta Pr_\lambda}$.

dition holds.[42]

$$-c+\beta[Pr_\lambda P_t+\mathcal{V}_{t-1}(P_{t-1})(1-Pr_\lambda P_t)]\geq 0 \iff P_t\geq \frac{c-\beta\mathcal{V}_{t-1}(P_{t-1})}{\beta Pr_\lambda(1-\mathcal{V}_{t-1}(P_{t-1}))}.$$

Since $\mathcal{V}_{t-1}(P_{t-1})\geq \mathcal{V}_{t-1}(P_{t-1},\text{reject})=-c+\beta Pr_\lambda P_{t-1}$, it follows that

$$\frac{c-\beta\mathcal{V}_{t-1}(P_{t-1})}{\beta Pr_\lambda\left(1-\mathcal{V}_{t-1}(P_{t-1})\right)}\leq\frac{c-\beta\mathcal{V}_{t-1}(P_{t-1},\text{reject})}{\beta Pr_\lambda\left(1-\mathcal{V}_{t-1}(P_{t-1})\right)}=\frac{(1-\beta)c-\beta^2Pr_\lambda P_{t-1}}{\beta Pr_\lambda\left(1-\mathcal{V}_{t-1}(P_{t-1})\right)}.$$

When c is sufficiently close to 0, the expression $\frac{c-\beta\mathcal{V}_{t-1}(P_{t-1})}{\beta Pr_\lambda(1-\mathcal{V}_{t-1}(P_{t-1}))}$, is always non-positive. Therefore, Condition 2 is automatically satisfied when $\frac{c}{(\beta Pr_\lambda-c)\exp(-(t-1)Pr_\lambda)+c}\leq P_t<\frac{-V}{\exp(-tPr_\lambda-V)}$. As such, the authority prefers waiting over rejection in this range of P_t if:

$$P_t\geq\frac{c}{\beta Pr_\lambda}. \tag{A4}$$

Condition 3: Authority Prefers Waiting to Approving. When $P_t<\frac{c}{(\beta Pr_\lambda-c)\exp(-(t-1)Pr_\lambda)+c}$, we have $\mathcal{V}_t(P_t)=\mathcal{V}_t(P_t,\text{reject})$. The authority prefers waiting over approving in this period when:

$$-c+\beta Pr_\lambda P_t\geq P_t(1)+(1-P_t)V \iff P_t\leq\frac{-c-V}{1-V-\beta Pr_\lambda}.$$

When $c\approx 0$, we have

$$\frac{-c-V}{1-V-\beta Pr_\lambda}\approx\frac{-V}{1-V-\beta Pr_\lambda}=\frac{1}{1+\frac{\beta Pr_\lambda-1}{V}},$$

which is continuously decreasing and bounded between 0 and 1 for $V\in(-\infty,0]$.[43] On the other hand, $\frac{c}{(\beta Pr_\lambda-c)\exp(-(t-1)Pr_\lambda)+c}\approx 0$. Condition 3 is therefore automatically satisfied when $P_t<\frac{c}{(\beta Pr_\lambda-c)\exp(-(t-1)Pr_\lambda)+c}$.

When $\frac{c}{\beta Pr_\lambda}\leq P_t<\frac{c}{(\beta Pr_\lambda-c)\exp(-(t-1)Pr_\lambda)+c}$, we have $\mathcal{V}_t(P_t)=\mathcal{V}_t(P_t,\text{wait})$. The

[42] Note that since the maximum payoff is normalized to 1, $\mathcal{V}_t(P_t)$ is bounded between -c and 1.

[43] To see this, note that $V\in(-\infty,0]$ and consider the limits as V to $-\infty$ and 0, respectively.

authority prefers waiting over approving in this period when

$$\mathcal{V}_t(P_t, \text{wait}) > P_t(1) + (1 - P_t)V \iff$$
$$P_t < \frac{\beta\mathcal{V}_{t-1}(P_{t-1}) - V - c}{1 - V - \beta Pr_\lambda(1 - \mathcal{V}_{t-1}(P_{t-1}))}. \tag{A5}$$

Proposition A1. *In a T-period setting ($T < \infty$), assuming $c << -V$ as $c \to 0$, the authority's decision rule is as follows:*

1. *In period t ($t > 0$), if no signal arrives, the authority:*

$$\begin{cases} \textit{rejects the merger,} & \textit{if } P_t < \frac{c}{\beta Pr_\lambda}, \\ \textit{waits until the next period,} & \textit{if } \frac{c}{\beta Pr_\lambda} \leq P_t < \min\left\{-\frac{V}{\exp(-tPr_\lambda) - V}, \frac{\beta\mathcal{V}_{t-1}(P_{t-1}) - V - c}{1 - V - \beta Pr_\lambda(1 - \mathcal{V}_{t-1}(P_{t-1}))}\right\}, \\ \textit{approves the merger,} & \textit{if } P_t \geq \min\left\{-\frac{V}{\exp(-tPr_\lambda) - V}, \frac{\beta\mathcal{V}_{t-1}(P_{t-1}) - V - c}{1 - V - \beta Pr_\lambda(1 - \mathcal{V}_{t-1}(P_{t-1}))}\right\}. \end{cases}$$

2. *In the final period ($t = 0$), if no signal arrives, the authority:*

$$\begin{cases} \textit{rejects the merger,} & \textit{if } P_0 < -\frac{V}{1 - V}, \\ \textit{approves the merger,} & \textit{if } P_0 \geq -\frac{V}{1 - V}. \end{cases}$$

The proof follows from Equation (A1), Equation (A4), and Equation (A5).

Lemma A1. *When $\mathcal{V}_{t-1}(P_{t-1}) \leq \frac{1+c-\beta Pr_\lambda}{\beta(1-Pr_\lambda)}$ and $P_t < -\frac{V}{\exp(-tPr_\lambda)-V}$, the authority's upper approval threshold in period t decreases with V.*

Proof: The upper threshold is the minimum of two terms:

$$-\frac{V}{\exp(-tPr_\lambda) - V} \quad \text{and} \quad \frac{\beta\mathcal{V}_{t-1}(P_{t-1}) - V - c}{1 - V - \beta Pr_\lambda(1 - \mathcal{V}_{t-1}(P_{t-1}))}.$$

The first term, $-\frac{V}{\exp(-tPr_\lambda)-V}$, is decreasing in V. For the second term, we differentiate $\frac{\beta\mathcal{V}_{t-1}(P_{t-1})-V-c}{1-V-\beta Pr_\lambda(1-\mathcal{V}_{t-1}(P_{t-1})}$ with respect to V.[44] The derivative is:

$$\frac{-1 - c + \beta\left[\mathcal{V}_{t-1}(P_{t-1})(1 - Pr_\lambda) + Pr_\lambda\right]}{(1 - V - \beta Pr_\lambda(1 - \mathcal{V}_{t-1}(P_{t-1})))^2},$$

which is non-positive when $\mathcal{V}_{t-1}(P_{t-1}) \leq \frac{1+c-\beta Pr_\lambda}{\beta(1-Pr_\lambda)}$. Since both components of the upper threshold are decreasing in V, the upper threshold is decreasing in V. □

[44] Note that V does not affect $\mathcal{V}_{t-1}(P_{t-1})$, conditional on $P_t < -\frac{V}{\exp(-tPr_\lambda)-V}$.

A.2 Unanimous Voting Game

We now extend the two-period model described in Section 3.2 to a T-period unanimous voting game, where $T < \infty$.

Proposition A2. *Let there be N authorities in the unanimous voting game. Index the authorities such that* $V_1 < V_2 < ... < V_N$. *In a finite T-period setting, suppose (1)* $c << -V_N$ *as* $c \to 0$, *(2)* $P_t < -\frac{V_i}{\exp(-tPr_\lambda - V_i)}$ *for* $i =, 1, 2, ..., N$ *and* $t = 1, 2, ..., T$, *and (3)* $\mathcal{V}_{t-1}(P_{t-1}) \leq \frac{1+c-\beta Pr_\lambda}{\beta(1-Pr_\lambda)}$ *for t = 1, 2, ..., T,*[45] *then there exists an equilibrium where*

1. *Authority 1 enforces its single-agent optimal strategy. That is, in period t (*$t < 0$*), it approves the merger when a signal arrives. When no signal arrives, it:*

$$\begin{cases} \textit{rejects the merger,} & \textit{if } P_t < \dfrac{c}{\beta Pr_\lambda}, \\ \textit{approves the merger,} & \textit{if } P_t \geq \min\left\{\dfrac{-V_1}{\exp(-tPr_\lambda) - V_1}, \dfrac{\beta\mathcal{V}_{t-1}(P_{t-1}) - V_1 - c}{1 - V_1 - \beta Pr_\lambda(1 - \mathcal{V}_{t-1}(P_{t-1}))}\right\}, \\ \textit{waits until the next period,} & \textit{if } \dfrac{c}{\beta Pr_\lambda} \leq P_t < \min\left\{\dfrac{-V_1}{\exp(-tPr_\lambda) - V_1}, \dfrac{\beta\mathcal{V}_{t-1}(P_{t-1}) - V_1 - c}{1 - V_1 - \beta Pr_\lambda(1 - \mathcal{V}_{t-1}(P_{t-1}))}\right\}. \end{cases}$$

2. *In the last period (period 0), authority 1 approves the merger if* $P_t \geq \frac{-V_1}{1-V_1}$*; it rejects the merger otherwise.*

3. *The other authorities (authority 2 to N) approve the merger immediately in the first period.*

Proof: By Lemma A1, each authority's upper approval threshold in period t decreases with V_i. Their rejection lower thresholds coincide at $\frac{c}{\beta Pr_\lambda}$. Therefore, as in the two-period model, the authorities' waiting regions are nested every period, with authority 1's waiting region being the widest. The remainder of the argument follows from Proposition 2. □

[45]Note that the continuation value of waiting does not vary across authorities, so the subscript indexing for authority is omitted

B Merger Simulation

B.1 Estimation Procedure for the Random Coefficients Logit Model

As explained in Section 2.2.3, we assume that the utility from purchasing each CGT unit of a vessel is given by:

$$u_{klm} = a_k p_{lm} + X_{lm}\beta_k + \xi_l + \xi_m + \epsilon_{klm},$$

where k indexes the buyer, l the brand, and m the market. A market m is defined by the buyer's country, year, and ship category. A brand l is identified by the producing firm (dockyard) along with the ship's category and type. Product characteristics X_{lm} include the time to build (in months) and whether the brand installs carbon-reduction equipment, such as compatibility with alternative fuels, electric engines, or scrubbers.

Assuming that ϵ_{klm} follows an i.i.d. extreme value distribution, the probability that buyer k in market m chooses brand l is given by (Nevo 2000):

$$s_{lm} = \int \frac{\exp(a_k p_{lm} + X_{lm}\beta_k + \xi_l + \xi_m + \xi_{lm})}{\sum_{q=1}^{L} \exp(a_k p_{qm} + X_{qm}\beta_k + \xi_q + \xi_m + \xi_{qm})} dF(\alpha_k, \beta_k),$$

where L is the total number of brands offered in the market. If the distribution of buyers' taste parameters α_k and β_k in the population is known, the market share of product l in market m is:

$$s_{lm} = \int s_{klm} dF(\alpha_k, \beta_k).$$

Since the distribution of the taste parameters is unobserved, it must be simulated. Following Nevo (2000), we express the taste parameters $\begin{bmatrix}\alpha_k & \beta_k\end{bmatrix}'$ as the sum of the mean taste parameters $\begin{bmatrix}\alpha & \beta\end{bmatrix}'$ and the interaction between the variance–covariance matrix Σ and the unobserved individual attribute v_k, i.e., Σv_k.[46] We assume v_k follows a standard multivariate normal distribution. Given these assumptions, a sufficiently large number (ns) of random draws from the distribution

[46] As the dataset contains no observed buyer characteristics, we do not interact product attributes with buyer demographics.

of v_k can be used to approximate the market share s_{lm} by:

$$\hat{s}_{lm} = \frac{1}{ns} \sum_{k=1}^{ns} \frac{\exp(a_k p_{lm} + X_{lm}\beta_k + \xi_l + \xi_m + \xi_{lm})}{\sum_{q=1}^{L} \exp(a_k p_{qm} + X_{qm}\beta_k + \xi_q + \xi_m + \xi_{qm})}.$$

In order to estimate the set of parameters $\theta = (\theta_1, \theta_2) = \left(\begin{pmatrix}\alpha & \beta\end{pmatrix}', \Sigma\right)$, we search for the θ that minimizes the Euclidean distance between the vector of predicted market shares $\left(\hat{s}_{1m}, \ldots, \hat{s}_{Qm}\right)' = \hat{S}(\theta, p_m, x_m)'$ and the vector of observed market shares S_m in market m. Because this involves a non-linear search over parameters, we follow the approach of Berry, Levinsohn, and Pakes (1995). Let the mean utility from purchasing brand l in market m be $\delta_{lm} = \alpha p_{lm} + x_{lm}\beta + \xi_l + \xi_m$, which does not depend on individual idiosyncratic tastes. BLP's contraction mapping algorithm then computes a sequence of vectors $\delta_m^n = \left(\delta_{1m}, \ldots, \delta_{Qm}\right)$ for each market, where

$$\delta_m^n = ln(S_m) - ln(\hat{S}_m(p_m, x_m, \delta_m^{n-1}, \theta_2)).$$

The true mean utility δ_m is approximated by δ_m^H, where $\|\delta_m^H - \delta_m^{H-1}\|$ is less than a specified tolerance.

Given the approximated value of δ_m, and following Nevo (2000), we calculate the difference between δ_{lm} and $\alpha p_{lm} + x_{lm}\beta + \xi_l + \xi_m$ for each brand l, denoted as ω_{lm}. Since the unobserved buyer characteristics (v_k, ϵ_k) are numerically integrated out when computing market shares, the remaining component of the error term ω_{lm} is ξ_{lm}, the brand's market-specific deviation from its mean yearly utility. By assumption, ξ_{lm} is independent of supply shocks that solely affect the shipyards' costs and, arguably, the characteristics of vessel l's competing products. Under this assumption, the moment conditions can be written as

$$E[Z\omega(\theta\}] = E[Z\xi] = 0, \tag{A6}$$

where Z is a Q by M matrix of instruments assumed to be orthogonal to the error term $\omega(\theta)$; Q denotes the maximum number of brands sold in a market and M the total number of markets. Equation (A6) thus provides the basis for constructing a Generalized Method of Moments (GMM) estimator for $\theta = (\theta_1, \theta_2)$, following

Nevo (2000).

$$\hat{\theta} = \arg\min_{\theta} \omega(\theta)' Z \Phi^{-1} Z' \omega(\theta),$$

where Φ is a consistent estimator of $E[Z'\omega(\theta)\omega(\theta)'Z]$. Based on these estimates, the expected welfare of an individual buyer k can be expressed as

$$E(CS_k) = \frac{1}{\alpha_k} \ln(\sum_{l=1}^{L} \exp(\alpha_k p_{lm} + X_{lm}\beta_k + \xi_l + \xi_m + \xi_{lm})) + C,$$

where C is an unknown constant that cancels out when comparing consumer surplus before and after the merger. Suppose the taste parameters (α_k, β_k) are simulated for K types of ship buyers in the market; the average buyer's consumer surplus is

$$\sum_{k=1}^{K} w_k E(CS_k),$$

where w_k is the integration weight assigned to type k ship buyers.

B.2 Demand-side Instruments

We use two sets of instruments to construct the demand-side moments. The first set consists of the standard BLP instruments: the exogenous product characteristics of the vessel brand (time to build, installation of carbon-reduction equipment, and vessel capacity) and the sum of each of these characteristics for other brands sold by the same firm in the same market. The second set contains cost shifters, including the exchange rate of the shipyard country's currency relative to the USD (affecting the cost of importing raw materials), the average manufacturing-sector wage in the shipbuilder's country (in purchasing power parity), steel prices in China, Korea, and Japan, and global carbon prices. Since exchange rate, wage, and steel price data are unavailable for some countries in certain years, we also include indicators for whether each of these variables is missing for a given country-year as controls in the estimation.

B.3 Supply-Side Model

We assume that shipyards engage in Cournot competition. Suppose firm i located in market m sells J_i brands of vessels in that market. Suppressing the subscript for the market, it solves the following profit maximization problem:

$$\max_{Q_{J_i}} \Pi(Q_m) = \sum_{j \in \mathcal{J}_i} [p_j(Q_m) - c_j(Q_{J_i})]q_j,$$

where Q_m is the vector of output quantities of all vessel brands offered in market m (measured in CGT), Q_{J_i} is the output vector of brands offered by firm i, and $\mathcal{J}i$ denotes the set of brands owned by firm i. Here, p_j, c_j, and q_j denote the price, average variable cost, and output quantity of brand j, respectively. Taking the derivative of the profit function with respect to q_j yields the first-order condition:

$$\sum_{j \in \mathcal{J}_i} (\frac{\partial p_j}{\partial q_j} - \frac{\partial c_j}{\partial q_j})q_j + p_j - c_j = 0.$$

More generally, for all J brands offered in market m, the necessary condition for a Cournot competition equilibrium is given by:

$$-(\begin{bmatrix} \frac{\partial p_1}{\partial q_1} & \frac{\partial p_2}{\partial q_1} & . & . & . & \frac{\partial p_J}{\partial q_1} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ \frac{\partial p_1}{\partial q_J} & \frac{\partial p_2}{\partial q_J} & . & . & . & \frac{\partial p_J}{\partial q_J} \end{bmatrix} - \begin{bmatrix} \frac{\partial c_1}{\partial q_1} & \frac{\partial c_2}{\partial q_1} & . & . & . & \frac{\partial c_J}{\partial q_1} \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ . & . & . & . & . & . \\ \frac{\partial c_1}{\partial q_J} & \frac{\partial c_2}{\partial q_J} & . & . & . & \frac{\partial c_J}{\partial q_J} \end{bmatrix}) \bigodot \Omega_m \begin{bmatrix} q_1 \\ . \\ . \\ . \\ q_J \end{bmatrix} = \begin{bmatrix} p_1 - c_1 \\ . \\ . \\ . \\ p_J - c_J \end{bmatrix},$$

Where Ω_m is the ownership matrix for market m, such that $\Omega_{ij} = 1$ if brands i and j are owned by the same firm, and 0 otherwise. More compactly, for market m, the equilibrium condition can be written as

$$P_m = C_m - [((Q'_{p_m})^{-1} - C'_{q_m}) \bigodot \Omega_m]Q_m, \tag{A7}$$

where P_m, C_m, and Q_m are the vectors of prices, average variable costs, and output for all brands offered in market m. Q'_{p_m} is the Jacobian matrix obtained by differentiating Q_m with respect to each element of P_m, and C'_{qm} is the Jacobian matrix obtained by differentiating C_m with respect to each element of Q_m.

When a shipyard experiences economies of scale and/or scope, both C_m and C'_{q_m} are unknown. The vector of average variable costs is recovered as a fixed point that solves Equation (A7). More specifically, C_m is solved iteratively by

1. Start with an initial guess of $C'_{q_m} = 0$, and recover C_m as $P_m + [((Q'_{p_m})^{-1} - C'_{q_m}) \odot \Omega_m]Q_m$.
2. Given Q_m and C_m, update C'_{q_m} using an IV-GMM framework.
3. Repeat Step 1 using the updated C'_{q_m}.
4. Continue iterating Steps 1–3 until, in iteration n, $||C^n_m - C^{n-1}_m|| < \epsilon$, where ϵ is the specified tolerance level.

To ensure convergence, we dampen the updated C_m with a coefficient $\rho = 0.03$, updating it as $C^n_m = \rho C^n_m + (1-\rho)C^{n-1}_m$.

B.4 Solving Post-Merger Cournot Equilibrium

When a merger occurs, the ownership matrix defined in Equation (A7) is updated from Ω_m to Ω'_m. The post-merger equilibrium is then computed through the following iterative procedure:

1. Using the updated ownership matrix Ω'_m, update the price vector from P_m to P'_m using Equation (A7), keeping all other terms on the right-hand side fixed, except for Ω'_m.
2. Using P'_m, update the inverse Jacobian matrix $(Q'_{p_m})^{-1}$.[47] Use the updated inverse Jacobian matrix to recalculate market shares and, consequently, the output vector Q'_m. Holding C'_{q_m} fixed, update C_m to C'_m.
3. Apply Equation (A7) to update P'_m to P''_m.
4. Continue iterating Steps 1–3 until, in iteration n, $||P^n_m - P^{n-1}_m|| < \epsilon$, where ϵ is the specified tolerance level.

[47]Since the demand is estimated using a random coefficients logit model, updating the Jacobian matrix requires integration over consumer characteristics. This is approximated using a 5-node Gaussian–Hermite quadrature.

B.5 Estimating Economies of Scale and Scope

To recover the Jacobian matrix with respect to average variable cost C'_{q_m}, we iteratively regress the recovered cost vector C_m on the firm's output of brand j and the output of other brands produced by the same firm within the same market. More specifically,

$$c_{mij} = \beta_0 + \beta_1 q_{mij} + \beta_2 q_{mi-j} + \gamma X_{mij} + \alpha_t + \delta_i + \epsilon_{mij}, \tag{A8}$$

where c_{mij} is the average variable cost of brand j vessels sold by shipyard i in market m, q_{mij} is the output of brand j vessel in market m, and q_{mi-j} is the total output of all other brands of vessels sold by shipyard i in market m, defined as $q_{mi-j} = \sum_{k \in \mathcal{J}_i, k \neq j} q_{mik}$.[48] X_{mij} is a vector of vessel characteristics, including capacity, the presence of alternative fuel or electric engines, scrubbers, and construction time. We additionally include year fixed effects α_t and shipyard fixed effects δ_i. The coefficients of interest are β_1 and β_2, which capture economies of scale and economies of scope, respectively, within the market–shipyard pair.

An OLS regression of Equation (A8) is likely to yield biased estimates of β_1 and β_2 due to omitted variable bias and reverse causality. To address this, we instrument q_{mij} and q_{mi-j} using demand shifters. The instruments are (1) the total quantity of category k vessels sold globally in the previous year (where category k is the one to which brand i belongs) minus the quantity of brand i vessels sold globally in the same year and (2) for shipyard i in year t, the quantity of vessels sold to countries that have never purchased from shipyard i at any point in the sample period. Both instruments are designed to capture shifts in global demand for vessels, either generally or within specific ship categories, that plausibly affect a shipyard's variable costs only through changes in its output. Table A1 reports the estimates from OLS and IV-GMM specifications.

[48] The analysis is conducted at the shipbuilding group level, so i indexes shipbuilding groups rather than subsidiary shipyards.

	(1) Average Variable Cost (USD)	(2) Average Variable Cost (USD)
Output (CGT)	-0.0453***	0.0436
	(0.000303)	(0.0271)
Other Brands Output (CGT)	0.0218***	-0.0216*
	(0.000160)	(0.0114)
Capacity (CGT)	-0.00673**	-0.193***
	(0.00294)	(0.0555)
Alt. Fuel / Electric Engine / Scrubber	-930.3***	-1469.4***
	(81.65)	(317.0)
Time to Build (Months)	3.325**	2.845
	(1.343)	(2.487)
Year and Shipyard FEs	Yes	Yes
F-statistic		10.92
Obs	33782	33782
Method	OLS	IV

Notes: This table reports the estimates from Equation (A8). The average variable cost is measured in USD per CGT, and the time to build is measured in months. A market is defined as a buyer country c purchasing vessels of category k in year y. A shipyard is defined at the shipbuilding group level. The first column presents the estimates obtained using OLS, while the second column presents the estimates obtained using the IV generalized method of moments. See Section 2.2 for further details on market definition. Standard errors are clustered at brand level. Significance levels: *($p < 0.10$), **($p < 0.05$), ***($p < 0.01$).

Table A1: Economies of Scale and Scope Estimates

C Data Appendix

C.1 Imputation of Vessel Prices

The vessel transaction data from Clarksons Research does not contain the price of each individual ship order. Instead, the database provides time series data of ship broker's price estimates given a ship's category, type, and capacity at monthly frequency. We follow Barwick, Kalouptsidi, and Zahur (2019) to impute the price of each ship order using the following steps:

1. Divide the ship order book data according to vessel categories, namely, bulkers, general cargo carriers, combined carriers, containerships, cruises, ferries, LNG carriers, LPG carriers, multipurpose carriers, offshore vessels, pure car carriers, reefers, ro, and tankers. Note that we use more granular ship categories for the purpose of price imputation as compared to the categories used for market definition, even though the ships may be used to carry similar goods (e.g., pure car carriers and roll-on/roll-offs), in order to estimate the prices more accurately.

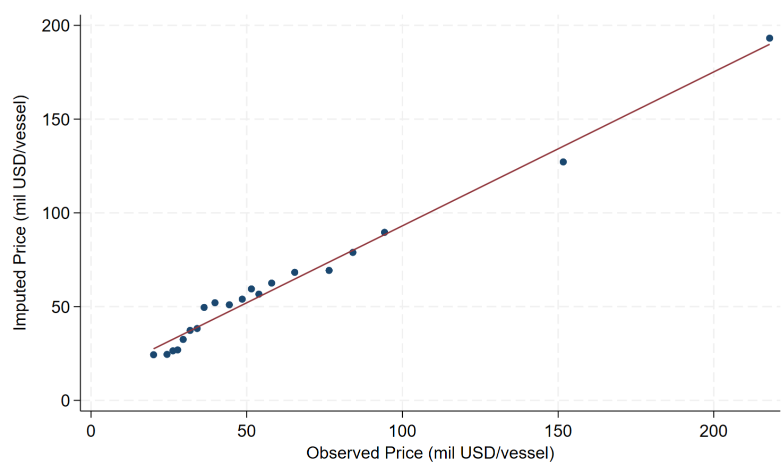
2. We have the time series price data for each of the vessel category listed above. Within each category, we also have more refined time series data according to ship capacity. For instance, within the LPG carrier category, we have time series data for LPG vessels with capacity between 23,000-25,000m^3, around 40,000 m^3, around 60,000m^3, and 88,000-91,000m^3.

3. As there are gaps in the time series data, we fill in the in-between missings by a weighted moving average of the prices two months before and after.

4. For each ship order, we assign the per vessel price according to its ship category and the nearest capacity range, conditional on the month the order was made. In a few instances, the capacity of the vessel sold exceeds the range of capacity available for the given ship category. We still assign the price from the highest capacity range available in the time series to the order (e.g., the price of a 10,000m^3 LPG carrier sold in March 2015 will be assigned the price of a 88,000-91,000m^3 LPG carrier estimated as of March 2015).

5. The time series data does not provide price estimates for ferries measured in monetary value. Only a price index is available. We therefore use the price series for general commercial vessels for the imputation exercise while matching the vessel capacity to the nearest category.

To validate the accuracy of the imputed price, we match the sales data from Clarksons Research to a subsample of transactions for which price is observed. The subsample comes from another shipping intelligence company VesselsValue Veson Nautical. We do not use the subsample for the main analysis as the data is available only for a few vessel categories. Nevertheless, by matching on vessel name, category and year of construction, we find a correlation of 0.904 between the imputed price and the observed price within the subsample. Figure A1 plots the imputed price against the observed price for 3,126 vessels we are able to match.



Note: This figure presents a bin-scatter plot of imputed prices against observed prices for 3,126 vessels matched by ship name, category, and year of construction. The plot is based on 20 bins. Sources: Clarksons Research and VesselValue Veson Nautical.

Figure A1: Imputed Vessel Price versus Observed Price

C.2 Merger Review Data

C.2.1 SDC Mergers (Main Sample)

We filter the SDC Platinum merger database by the following steps to identify horizontal shipyard mergers proposed between 2000 and 2024:

1. For both the acquirer and seller of shares, their brief business description should contain at least one of the three keywords: "ship", "vessel" and "marine".

2. We further restrict the dataset to mergers where both parties are in industries that may engage in shipbuilding. The list of industries include transportation & infrastructure, oil & gas, machinery, building/construction & engineering, other industrials, and automobiles & components.

3. We discard mergers that are only rumored.

4. For the remaining mergers, we feed the acquirer's and seller's detailed description into ChatGPT to verify both of them engage in ship construction or repairing services.

5. After dropping observations that do not concern horizontal shipyard mergers, we fuzzy match the acquirer's and buyer's names to the list of firm names that appear in the vessel transaction data. We keep the mergers where both parties' names appear in the dataset, suggesting that we observe at least one sale by each party.

6. We finally exclude deals where a parent company merely increases its shareholding in a subsidiary.

C.2.2 Merger Reviews Released by Antitrust Authorities (Supplementary Sample)

We obtain public merger review decisions released by China, the EU, Japan, Singapore, and the US from the sources listed below.

Chinese State Administration for Market Regulation (SAMR). The SAMR periodically releases the list of mergers it has approved conditionally or unconditionally, the mergers approved subject to remedies, as well as prohibition decisions. The SAMR's decisions until 2018 can be found at http://fldj.mofcom.gov.cn/article/zcfb/?. Decisions after 2018 are released at https://www.samr.gov.cn/fldys/ajgs/jyaj/index.html and https://www.samr.gov.cn/fldes/tzgg/ftj/index.html.

Competition and Consumer Commission of Singapore (CCCS). The CCCS keeps a public register containing all merger review decisions it has made at https://www.cccs.gov.sg/case-register/public-register/mergers-and-acquisitions/.

European Commission (EC). The EC keeps a well-maintained public register containing its merger review decisions at https://competition-cases.ec.europa.eu/search?caseInstrument=M&sortField=caseLastDecisionDate&sortOrder=DESC. For the purpose of this paper, we restrict our analysis to mergers whose economic activities are classified as manufacture of electric equipment (C27), manufacture of engines and turbines (C28), building of ships and boats (C30), or repair and maintenance of ships and boats (C33).

Federal Trade Commission (FTC). The U.S. Federal Trade Commission releases notifications when it terminates the merger review process early due to lack of competitive concerns before the typical 30-day waiting period. The list of early termination notices can be found at https://www.ftc.gov/legal-library/browse/early-termination-notices.

Japan Fair Trade Commission (JFTC). The JFTC releases a complete record of merger notifications received from 2012 onward in its annual report. Before 2012, it discloses merger notifications from parties with combined assets exceeding 30 billion Yen. The annual reports can be found at https://www.jftc.go.jp/soshiki/nenpou/index.html (1989-2023). The list of merger notifications from 2017 to 2024 is also compiled at https://www.jftc.go.jp/dk/kiketsu/toukeishiryo/ichiran.html.

Except for decisions by the EC, which already has a classification by economic activity, we filter the decisions made by the other authorities by identifying mergers that concern the shipbuilding industry via manual research of firm background. We then link the merging firm names to the vessel transaction data to construct the supplementary sample of mergers.