Shipwrecked by Rents

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September 15, 2020

Abstract

The trade route between Manila and Mexico was a monopoly of the Spanish Crown for more than 250 years. The Manila Galleons were "the richest ships in all the oceans", but much of the wealth sank at sea and remain undiscovered. We introduce a newly constructed dataset of all of the ships that travelled this route. We show formally how monopoly rents that allowed widespread bribe-taking would have led to overloading and late ship departure, thereby increasing the probability of shipwreck. Empirically, we demonstrate not only that these late and overloaded ships were more likely to experience shipwrecks or to return to port, but that such effect is stronger for galleons carrying more valuable, higher-rent, cargo. This sheds new light on the costs of rent-seeking in European colonial empires.

JEL Codes: N00, N13, K00

Keywords: Corruption, Rent-seeking, Bribery, Shipwrecks

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1 Introduction

In 2011 underwater archaeologists discovered the remains of the *San Jose*, a galleon sunk near Lubang Island on July 3rd 1694. It was one of 788 galleons that traversed the route between Manila and Acapulco between 1565 and 1815, as part of the Manila Galleon trade — the longest, most profitable, and most celebrated colonial era trading route. The *San Jose* carried a huge amount of silks and spices, over 197,000 works of Chinese and Japanese porcelain, 47 chests full of objects of worked gold, and hundreds of other chests containing precious stones and objects, the total value of which was recorded as 7,694,742 pesos or more than $500 million in today's money.[1] The *San Jose* was far from the only galleon to sink over the almost 250 year long course of the Manila Galleon trade; 99 ships or 12.6% of all galleons were shipwrecked (either sunk or so heavily damaged by storms that they could not make the voyage). In contrast, only 3.5% of the ships of the Dutch East India Company sank while traveling between the Netherlands and Asia during the same period (1595-1795).[2]

Why did the *San Jose* and so many other Manila galleons experience shipwrecks? While the *proximate* cause could sometimes be a storm, two other factors are important for understanding the *deeper* reason for its ill-fate and for the fate of the other ships that either sank or were returned to port severely damaged. The Manila Galleon trade was highly regulated. The number, size, and weight of the ships was specified by law. But the *San Jose* was overloaded. It had a cargo of more than 12,000 *piezas*, three times the prescribed legal limit. This answer begs a deeper question: Why was the galleon overloaded?

The Manila Galleon trade was the most lucrative single voyage in the early modern world—"the richest ships in all the oceans" (Schurz, 1939, 1). The entire economy of Spain's Philippine colony rested on the galleon trade—on the profits realized from the sale of Asian goods in Acapulco and from the silver stipend sent back on the returning ships. The best available estimates suggest that total GDP in the Spanish empire in 1700 was approximatively $13.016 billion (1990$) (Arroyo Abad and van Zanden, 2016). The value of the *San Jose*'s cargo was equal to almost 2% of the GDP of the entire Spanish empire.[3] Given the scale of the losses involved, why did captains risk overloading their ships? Answering this question provides new insights into the extent and costs of rent-seeking.

We propose an institutional explanation for why galleons leaving Manila were often late and overloaded. We formally show how high monopoly rents and regulations restricting cargo could have induced massive bribe-taking which led to overloading and delayed departures, thereby increasing the probability of shipwreck. We test the predictions of our model using a unique new dataset of the

[1]See *ORRV Team Discovers Two Shipwrecks in the Philippines* (2011).

[2]See Bruijn et al. (1987). Kelly, Gráda and Solar (2019) report that around 5% of ships sailing between Britain and North America in the mid-18th century did not succeed in making the voyage.

[3]Specifically, the value of the cargo was approximately $252 million in 1990$. We calculate our estimates of GDP for the Spanish empire by adding up the separate estimates Arroyo Abad and van Zanden (2016) provide for Spain, Mexico, and Peru and our own back of the envelope estimate of Philippine GDP based on Maddison (2003).

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universe of ships that made the journey between the Philippines and Mexico between 1565 and 1815.

In the corruption literature, there have been differing views on whether bribes impose an additional cost in the form of queues and delays or whether to the contrary, bribery “greases the wheels”. For instance, Myrdal (1968, 952) observed that in corrupt countries “often delay is deliberately contrived so as to obtain some kind of illicit gratification”. On the other hand, much-cited theoretical work by Lui (1985) that explores the relationship between queuing and bribery demonstrates that bribery is a form of price discrimination. Queuing can therefore be efficient if the size of the bribe is linked to the opportunity cost of the briber.[4]

Note, however, that in Lui (1985), customers pay a bribe in exchange for being provided a service that is essentially inexhaustible. Thus, while each bribe is an efficient ‘price’ that reflects each customer’s costs of queuing, there are no external effects since the service is not rationed. In contrast, when customers bid for a regulated good or service, bribes do not only reflect the valuation of the customer, but can induce the server to over-provide the service and delay the completion of his task. This can have deleterious effects, such as disasters and shipwrecks, in the particular case of loading valuable ship cargo.[5]

In our model, traders in Manila who want to sell merchandise in Acapulco bribe galleon officials in exchange for cargo space. Such space is limited, and legally mandated, precisely in order to prevent overloading. In addition, there is a deadline imposed, on or before which the galleon has to depart, in order to avoid perilous waters during the monsoon season. In equilibrium, galleon officials are able to extract maximum bribes — with many merchants vying for an allocation of the total space in the galleon, officials are able to pit them against each other and bid the bribe up to the cargo’s value. In addition, when the cargo value is very high, officials are induced to accept more cargo even beyond the legal limit and to delay departure past the deadline to load more cargo. That is, they would be willing to accept a larger probability of shipwreck for as long as the marginal value of each cargo is greater than the increase in probability of shipwreck. With more valuable cargo, merchants are indeed more able to compensate officials with the expected cost of shipwreck.

The model is thus an application of the lobbying framework in Grossman and Helpman (1994, 2001), and the common agency models of Bernheim and Whinston (1986a,b), and Dixit et al. (1997) which have heretofore been largely applied to policy selection and special interest politics. Bribery is efficient for both cargo loader and merchant in that the merchant’s offer precisely takes into account the cargo loader’s marginal expected cost from shipwreck. It is, however, socially inefficient to the extent that the cargo loader does not take into account costs to other stakeholders, e.g. lives of crew members and

[4]See discussion in Bardhan (1997, 1323).

[5]There are many disasters that have been linked to corruption. For instance, Ambraseys and Bilham (2011) show that 83% of deaths from building collapse due to earthquakes in the last 30 years occurred in corrupt countries. Nellemann and INTERPOL, eds (2012) estimate that 50-90% of the wood from developing countries are from illegal logging. See Fisman and Golden (2017) for a survey.

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passengers, costs of shipbuilding and repairs, lost revenues to the Crown, nor the distortions from the monopoly trade.

Using data on the universe of Manila galleons that sailed between Manila and Acapulco between 1565-1815, we first demonstrate a robust relationship between sailing past the deadline from Manila and the probability of shipwreck. We then test the hypothesis that large rents induced more overloading and late departures which led to shipwrecks. Specifically, we show that voyages made immediately after a failed voyage – whose cargo were likely priced higher to make up for the lost cargo, and which departed late, were more likely to be shipwrecked. The probability of shipwreck was even higher for lower-tonnage ships which, given the same deadline, would have been easier to overload than higher-tonnage ships. We exploit other institutional changes within the period, e.g. periods during which oversight was higher, and periods of relatively higher or lower monopolistic pressures, to corroborate our main findings.

The paper thus makes several contributions to the literature. First, by examining the relationship between rent-seeking, overloaded ships, and failed voyages, we contribute to the literature on the costs of rent-seeking and corruption; for surveys see Aidt (2003), Rose-Ackerman and Palifka (2016), Rose-Ackerman (2011), Rose-Ackerman and Søreide (2011), Olken and Pande (2012) and Fisman and Golden (2017).[6] Though a sizable empirical literature sought to build on the insights of Tullock (1967), Krueger (1974), and Murphy, Shleifer and Vishny (1993); Shleifer and Vishny (1993, 1998) attempts to measure the true costs of rent-seeking remain a major challenge and one that has never been fully answered. Indeed a survey of the empirical literature on rent-seeking concludes that "its measurement is very problematic" (Del Rosal, 2011, 300). One reason for this is that much rent-seeking is *hidden* from view. For instance, it often takes the form of "in-kind" transfers (Mixon, Laband and Ekelund, 1994). Another factor is that the efficiency costs of corruption can exceed the amount stolen (Tullock, 1967; Shleifer and Vishny, 1993). Recent papers on the cost of corruption using microlevel data and causal identification thus focus on specific contexts such as the benefits of public office and political connections in Indonesia (Fisman, 2001), India (Fisman et al., 2014), and China (Chen and Kung, 2018); leakages from public projects in Indonesia Olken (2006, 2007), in Uganda (Reinikka and Svensson, 2004), in India (Niehaus and Sukhtankar, 2013), and the Philippines (Desierto, 2020); the relationship between corruption and culture (Fisman and Miguel, 2007); and extortion along trucking routes in Indonesia (Olken and Barron, 2009). In a similar view, our findings are specific to the Manila Galleon trade, but have more general insights that are highly relevant across other historical settings, as discussed below.

As a second contribution, our paper suggests that the costs of rent-seeking in the premodern economy was high and that premodern institutions were often a source of inefficiency (see North, 1981, 1990; North et al., 2009; Ekelund and Tollison, 1981; Root, 1994; Koyama, 2010; Ogilvie, 2007, 2019). The insight that colonial trading regimes were a rich source of rents to insiders but imposed high costs on

[6]As discussed by Aidt (2016) the literatures on rent-seeking and corruption have proceeded largely on parallel tracks, though substantively they overlap considerably. Here we view them as referring to essentially the same underlying phenomenon.

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society at large is an old one. It predates Adam Smith's (1776) critique of mercantilism. In modern context, Krueger (1974) applied Tullock's (1967) concept of rent-seeking to study inefficient trading regimes in developing and middle-income countries.[7] Ekelund and Tollison (1981, 1997) applied these insights to the mercantilist and colonial regimes of early modern England, France, and Spain.[8] Root (1991) discussed how the costs of corruption and rent-seeking common in early modern Europe hinged critically on the type of corruption. Recent research has studied the long-run consequences of office selling in the Spanish empire (Guardado, 2018). More generally, from a macro-perspective, the long-run costs of colonial regimes has been the subject of a large empirical literature since Acemoglu et al. (2001). Nevertheless, there have been few empirical studies about how colonial trading regimes functioned.[9]

The paper provides the first empirical study of the Manila Galleon trade, a long-lasting and economically important part of Spain colonial empire. The seminal historical study of the Manila Galleon trade is Schurz (1939) and subsequent scholarship relies heavily on his original archival work (e.g Legarda, 1967, 2017; Giraldez, 2015). Among economic historians, the focus on much of the recent literature has been on the silver flows between the Philippines and Mexico and how this contributed or abated inflation in Europe (Bauzon, 1981; TePaske, 1983; Flynn and Giráldez, 1995; Loyola, 2019; Alvarez, 2012; Abad and Palma, 2020). This is the first empirical examination of rent-seeking in the Manila Galleon trade.

A third contribution is to the economic history literature on Spain's colonial empire (Marichal, 2007; Grafe and Irigoin, 2006; Irigoin and Grafe, 2008; Grafe and Irigoin, 2012; Hough and Grier, 2015). As discussed in detail by Abad and Palma (2020), this empire was largely based around the extraction of precious metals, particularly silver. Legal trade was characterized by: being limited to a small number of ports; the periodic sailing of heavily guarded fleets; and the collusion of merchant guilds in Seville, Mexico City and Lima, which controlled the trade routes.[10] These stringent regulations produced widespread smuggling in the Americas. The immediate and long-run consequences of both legal and illegal trade are examined by Alvarez-Villa and Guardado (2020). The only permissible trade with the Philippines was the Acapulco-Manila trade route traversed by the Manila Galleons. The extent of rent-seeking originated out of this trading scheme has been emphasized by many historians (Brading, 1971; Walker, 1979; Garner and Stefanou, 1993). Bjork (1998, 50) notes that the "longevity of the Manila trade in the face of opposing Spanish interests attests to the significance and success of Mexican

[7]Within the United States, there is also evidence that the costs of corruption vary with the degree of regulation (Johnson, LaFountain and Yamarik, 2011; Johnson, Ruger, Sorens and Yamarik, 2014).

[8]See Root (1994) for an application of this analysis to ancien regime France.

[9]Within the economic history literature, Rei (2011, 2013, 2018) considers and contrast the organization of the Portuguese and Dutch merchant empires. But she does not consider the Spanish colonial empire or the Manila galleons trade.

[10]This trading scheme operated until 1776, when reforms were introduced to liberalize commerce, allowing alternative ports and elites across the Empire to participate in the imperial trade (Fisher, 1982). For the Philippines, the reforms led to the creation in 1785 of a Filipino mercantile company (Real Compañia de Filipinas) that was eventually permitted to trade with regions beyond that of Acapulco, though these reforms did not come into actual effect until the 1790s (Schurz, 1939, 57-60).

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as well as Chinese interests in maintaining it". The traditional historiography view these institutions as being both extremely costly, and highly profitable, for those involved. A more recent, revisionist literature, however, finds that the returns generated by these restrictions were not abnormally high. Baskes (2005), for instance, contends that "many of the business practices and trade institutions of the early modern Spanish empire that have been identified as the predatory creations of monopoly merchants need to be understood instead as adaptations to risk, attempts to reduce the tremendous uncertainty that characterized long-distance trade" (Baskes, 2005, 27).

Moreover, while a older literature associated Spain's colonial regime with its absolutist political institutions at home (e.g. North, 1990, 102-103), more recent research paints a more nuanced picture (see Grafe, 2012). It demonstrates that Spanish political institutions were not uniquely absolutist or unconstrained in the 16th and early 17th centuries (Henriques and Palma, 2019). Furthermore, all European powers relied on monopolies and struggled with agency problems. This does not mean that Spanish colonial institutions were no better or worse than that of other European powers, but it *does* mean that what is required to investigate their impact is a detailed, empirical, investigation that pays attention to local institutional details; and this is what we aim to provide in this paper.

Finally, we contribute to a growing literature examining more broadly the institutions and organization in the Age of Sail. Leeson (2007, 2008) analyzes the different incentives facing pirate captains compared to merchant captains from the perspective of principle-agent theory. His focus is on the internal organization of pirate vessels. Grafe (2011) studies the Spanish shipbuilding industry, emphasizing that its relative decline in the 17th and 18th century was caused by demand factors across the Spanish Empire. Exploiting novel data on shipwrecks in the Spanish empire, Brzezinski, Chen, Palma and Ward (2019) exploit maritime disasters as exogenous shocks to the money supply and assess its real effects in the European economy. There is also a small but growing literature on the British navy. Allen (2002, 2011); Benjamin and Thornberg (2007) examine the institutions that led to the success of the British navy. Voth and Xu (2019) study patronage institutions within the British navy. These papers demonstrate that much can be learned about how institutions function from studying this important era in global history.

The structure of the remainder of the paper is as follows. Section 2 provides a brief overview of the historical and institutional background to the galleon trade. Section 3 introduces our data and establishes a robust positive relationship between a late departure and a failed voyage. To examine why ship captains routinely left Manila late despite the additional risks this imposed, we develop a model in Section 4, by which we demonstrate how rents produced incentives to overload the galleon and depart late, which increased the probability of failed voyages. In Section 5 we present several tests of this model. Section 6 concludes.

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2 The Institutional Setting

Our focus is on the period between 1565 and 1815, the era of the Manila Galleon trade. In this section we outline the salient historical details required to understand the incentives facing merchants, ship commanders, and governors during the period of the Manila Galleon trade.

Our main source for the institutional details of the Manila Galleon trade is Schurz (1939). This is a unique source as it is the product of 27 years of archival research in the early 20th century and many of these original archives are no longer accessible. In particular, Schurz had access to the log books of the Manila galleons which have subsequently been lost (see Burt, 1990).[11] For this reason, subsequent books and articles on the Manila Galleon trade remain reliant on Schurz (1939).

2.1 Historical Background

A major motivation for Spanish colonial exploration and conquest was access to the products of Asia, especially the manufactured goods, including textiles and porcelain of China and Japan. The conquest of Cebu in 1565 and occupation of Manila in 1571 were motivated by this demand for Asian products. While the Philippines did not provide the spices or gold that the initial Spanish conquerors hoped for, it did enable the Spanish to establish a trade route between Asia and their American colonies.

For the majority of the period of our study, Spain's colony in the Philippines could only legally trade with Acapulco, an excellent natural harbor of no other economic or political significance (Schurz, 1917, 18).

The trade proceeded as follows. In May, merchants from China, but also from other parts of Asia, would arrive in Manila in small ships laden with silks, textiles, lacquer wear, china, and jewelry. At this time, the Manila merchants would either purchase these goods using credit or with the proceeds from the Acapulco galleon (if it had arrived). Following this trade fair, the preparations would begin to load the galleon that would depart from Manila to Acapulco. Once the galleon was loaded, it would depart, ideally in time to miss the rougher waters that were associated with the change of seasons in late July.

The journey from Manila to Acapulco could take between 5 and 7 months but on occasion it took as long as 8 months. It followed the Kuroshio current.[12] The ships would arrive in Acapulco between December and January in time for trade fairs that ended by February. The return journey from Acapulco to Manila was shorter: on average 4 months. It followed the north equatorial current that flows east-to-west between about 10 degree latitude and 20 degree latitude north. We depict the voyage in Figure 1.

[11]The search for the lost log books is described by Burt (1990) who concludes "that almost all of the original log books have been lost to the ravages of time. In all probability, most of the original log books for eastbound voyages that may have been written, were stored in Manila where the heat, humidity, insects, and possibly wartime activities have destroyed them".

[12]The Kuroshio current starts on the east coast of Taiwan before going northeast past Japan where it joins the North Pacific Current.

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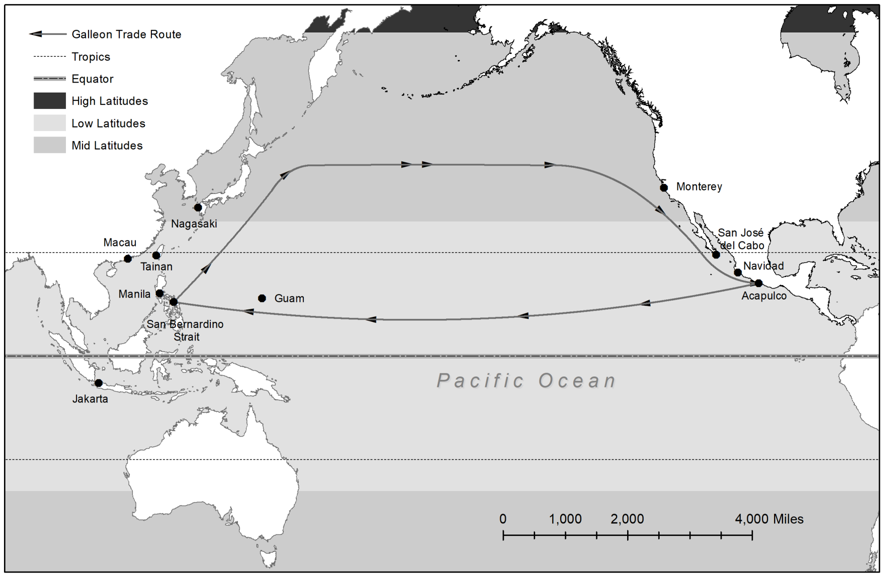

Figure 1: The Route of the Manila Galleons

2.2 The Cargo and the Boleta

On the Manila-Acapulco trip, the cargo comprised manufactured goods, largely from China, but also from Japan, and other parts of East Asia. Chinese textiles, particularly silks, were greatly valued both in Mexico and in Europe. Chinese porcelain were better quality than anything produced in Europe and highly demanded. These goods were taken to Manila by numerous Chinese merchants, predominately operating from Canton and Macao. On the Acapulco-Manila trade, the main produce was silver, though in addition to it, American goods such as cochineal, seeds, sweet potato, tobacco, chocolate, and fruits accompanied Spanish products like swords, olive oil and wine (Meijia, 2019).

The Manila Galleons were among the largest ships on the oceans. This was partly for economic reasons: "[a] vessel of seven hundred tons was much more cost-effective than one of three hundred; the larger ship, with a crew of eighty or ninety, would demand stores of foodstuffs and other supplies that would only occupy 10 percent of its capacity: the necessity for fifty or sixty men on the smaller vessel would need 13 to 15 percent of the storage space" (Giraldez, 2015, 123). Nonetheless, despite their huge carrying capacity, "[c]argo space on the Acapulco galleon was one of the most eagerly sought-after commodities in Manila" (McCarthy, 1993, 168).

This was due to the monopolistic and highly regulated nature of the trade. The galleons were owned by the crown and the cost of their construction was borne by the royal treasury. The galleon trade was intended to generate profits to encourage the settlement of Spanish merchants in Manila and to support the costs of the Spanish colony in the Philippines. But the volume of goods taken from Manila to Mexico was supposed to be limited due to lobbying by the influential merchants of Seville

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who wished to monopolize Mexican markets for textiles (Yuste, 2007b). Consequently, both the number of ships and the size of the cargo were limited by law. From 1593 onwards, due to successful lobbying by Seville's merchant guild, only two ships per year were officially allowed to cross the Pacific. Their size was limited to 300 tonnes. The value of the outgoing cargo from Manila was limited to 250,000 pesos. The value of the goods from Mexico was limited to 500,000 pesos. Direct transit between Spain and the Philippines was prohibited until 1765.

The limit on the value goods leaving Manila was enforced as follows. First, cargo space on the outgoing galleon was assigned by the Distribution Board (*junta de repartimiento*).[13] Second, to calculate how many goods could be transported upon the galleon, the ship's hold was measured and the volume of space divided into equal shares (bale or *fardo*). Each bale was divided into four packages or *piezas*—average size 2.5 feet in length, 2 feet in width, 10 inches in depth. The cargo space divided into 4,000 shares each corresponding to a *pieza*. A *boleta* was a ticket corresponding to one *pieza*. Based on official values, one *boleta* should have been worth 125 pesos ($500,000 \div 4000$).

Historians are unanimous in their assessment that this highly regulated and monopolistic system generated opportunities for percolation, rent-seeking and corruption. For instance, Mccarthy notes that "'[b]y nature this system became subject to abuse by imperious governors and a horde of speculators" and full of "abuse and privilege" (McCarthy, 1993, 169)

2.3 Overloading

The official number of *piezas* was chosen not because it corresponded to the carrying capacity of the ships involved, but because lobbying interests in Spanish wished to limit the importation of Asian goods. Therefore, the limit on the number of legal cargo, i.e. *pieza* with *boleta*, was typically exceeded. The actual number of *pieza* carried by ships appears to have varied considerably: some ships were said to regularly contain 6-7,000; the *San Jose*, however sank with 12,000 *piezas* onboard. However, if a ship captain went too far beyond the official limit, he risked the safety of his ship. This problem was well-known to contemporaries such that additional restrictions were imposed on the volume of total cargo based on the physical capacity, or tonnage, of the ship. In 1604 the problem became so latent that King Phillip III decreed that:

> "Galleons should not be overloaded and they must be reinforced as necessary. Because of overloading, many ships in the Philippines trade route have been lost, costing lives and funds. It is better to prevent and we mandate that ship tonnage limits be observed... we extremely caution against the overloading of ships, as it increases the risk of being lost due to mishaps. We recommend for ships to be in conditions to withstand sea torments and enemies." (*Recopilacion de leyes de los reinos de las indias*, 1841, 125-126)

[13]This board included the Governor, the senior judge of the *Audiencia*, the fiscal (attorney-general), two members of the City Council, and the Archbishop. In 1768 this was changed to a *consulado* composed of merchants.

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Yet, more than a century later after such law was decreed, the problem still persisted. King Ferdinand VI observed in 1752 that passages and crew had been "innocent victims of the barbarous greed of those who wish to use all of the space on the ship for their cargo" (quoted in Schurz, 1939, 257). As Schulz puts it:

> "Every cubic inch of space available in the hold was crammed with merchandise' ... Bales and chests were piled in the cabins and passage-ways and along the decks. They were stowed in the compartments reserved for necessary stores and supplies and in the power-magazine itself, while a flotilla of rafts, laden with water-tight bales, was sometimes dragged after the galleon, to be hoisted on the deck was the sea was high" (Schurz, 1939, 184).

Similarly, Mccarthy notes that as the cargo was so tightly packed, with the most valuably and vulnerable satins and silks wrapped inside cheap fabrics, "[c]lose inspection was thus quite impracticable and violations of the 250,000 peso *permiso* routinely went unpunished" (McCarthy, 1993, 176).

2.4 The Departure

In addition to being overloaded, galleons were often late. The optimal departure from the port of Cavite was in June. The date of departure was critical because the galleons had to clear the Philippine isles before the start of the baguio season, between July and October (Giraldez, 2015, 126). Departing in June also assured the most favorable winds.[14] The chances of running into bad weather increased dramatically after mid-July. Schurz (1939, 352) writes that "A galleon that left Manila after the middle of July was practically certain of running into rough weather within the next three months of her voyage".

Attempts to ensure a timely departure were all unsuccessful. By royal edicts passed in 1618, and then reiterated in 1620 and 1624, the ship was required to leave Manila by June 30th. A law of 1773 modified this expected departure date to early July. Despite this, departures remained routinely late.

2.5 Shipwrecks and Returned Ships

Our measure of a failed voyage is either a shipwreck or a ship returned to port. Shipwrecks were not uncommon occurrences for ships on the Manila-Acapulco route. Galleons often returned to port when facing the possibility of being wrecked. These returns to port were known as *arribadas* and as Giradez outlines, they were considered to be almost as disastrous as a shipwreck itself:

> "The return of galleon to the Philippines was a human and economic catastrophe. Usually, the vessel was greatly damaged, and many onboard died. Storms tangled the galleon's masts and rigging; heavy seas broke the rudder and opened up leaks, ruining the cargo. In

[14]Specifically the winds "pushed the galleon from Cavite to the Strait of San Bernardino–the *Embocadero* in colonial times—where the expected monsoon would propel it northward" (Giraldez, 2015, 126).

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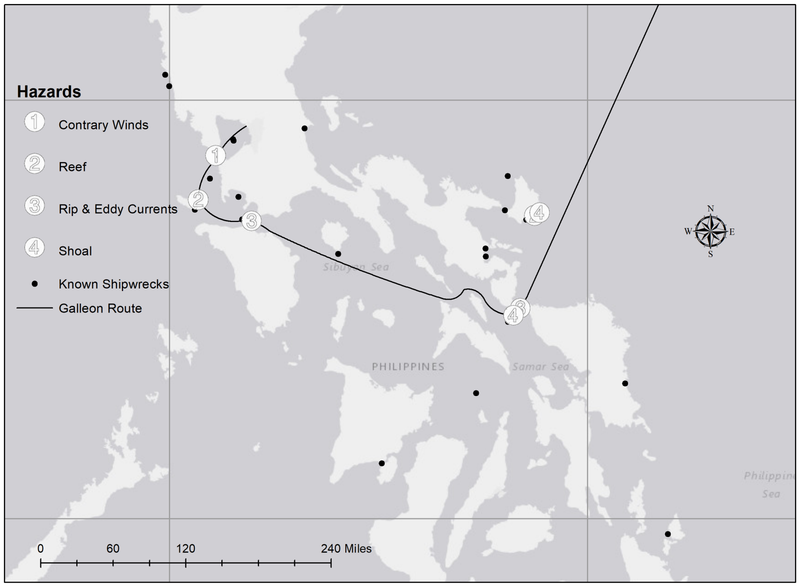

Figure 2: The main hazards on departing Manila & locations of known shipwrecks(Bennett, 2010).

> emergencies, bales and other merchandise were thrown overboard to lighten up the ship. Finally an arribada was nearly as damaging as a shipwreck. Even if the bales of silk could be kept undamaged until the following year, a double landing was not permitted or sometimes, for lack of space, not possible" (Giraldez, 2015, 130-131).[15]

Of the 410 individual voyages between the Philippines and Acapulco, 20% were either shipwrecked or returned to port. Of the 378 individual voyages between Acapulco and the Philippines 4.5% were either shipwrecked or returned to port.

The route taken by the Manila Galleons was a dangerous one. The main danger for a galleon was in the vicinity of the Philippine isles along the "winding channel that connected Manila to the Embocadero" where "Squalls and currents tossed the galleon on a course that was full of sandbanks, rocks, and low-level islands with days of fog presenting additional perils to navigation" (Giraldez, 2015, 126-7). In particular, there was a reef close to Lubang Island and rips and eddies between Mindoro and Maricaban (Figure 2). Once past this, there was a zone of storms and variable winds that posed a further danger, often obligating ships to return to port.

This review suggests that rent-seeking may have been responsible for ships being overloaded and departing late. But thus far no quantitative evidence has ever been marshaled to investigate this

[15]Similarly, Schurz (1939, 261) notes that usually "the cargo had greatly deteriorated or was totally ruined if much water had entered the hold. It was also customary to throw overboard part of the merchandise in order to lighten the ship".

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question. In the next section, we introduce a new dataset of voyages, ships, storms, and underlying weather conditions for the eastern and western Pacific. We first establish that there is indeed a robust empirical relationship between late departures and failed voyages. Then in Section 4 we formalize the hypothesized relationship between rent-seeking, overloading, and late departures. This model generates several additional predictions that we test in Section 3.

3 The Relationship Between Late Departures and Failed Voyages

3.1 Data

We combine several novel datasets which provide us with detailed information about every voyage made between the Philippines and Mexico from 1564 and 1815.

We have information from Manila Galleon Listing (Cruikshank, 2013) on every voyages made during the era of the Manila galleon trade. We supplement this data with information from the Spanish website, La América española and from Three Decks, a prominent web resource for researching naval history during the Age of Sail.[16]

From these sources, we construct a unique ship-level panel database for the entire period 1564-1815. This provides us the universe of ships that sailed between Manila and Acapulco during the era of the Manila Galleons. For each ship, we have information on the date of departure and arrival in either Manila or Acapulco. We are also able to collect information on the year when the ship first made its first transpacific voyage and hence estimate the age of the ship and the number of previous voyages a ship had made.

Our main explanatory variable of interest is whether a ship departed late. We construct this by checking whether a ship sailed after July 15, as this period coincides with the start of the worst part of the monsoon season. We also use the day in the year that the ship set sail as an alternative (continuous) measure of lateness. We also have information on the difference in days between the departure of the ship and the arrival—to the departing port—of the previous ship. This allows us to exclude the elements of a late departure that were due to exogenous events and to focus on that component of a late departure that was most likely to be caused by rent-seeking.

To capture the threat of storms or bad weather that may have affected a voyage we use several sources: (i) data on presence of typhoons from Garcia-Herrera et al. (2007) and supplemented by Warren (2012); (ii) whether or not a storm is mentioned in the ship logs collated by Cruikshank (2013). Another important determinant of the length and success of any voyage was the climates of the Pacific. We make use of recent work that has reconstructed temperature data in Western and Eastern Pacific from Garcia et al. (2001). We also have data on other threats mentioned in Cruikshank (2013) including pirates, buccaneers, and the English, French, or Dutch. We use Wikipedia to construct measures of

[16] These sources are in turn compiled from a host of other sources that we list, contrast, and discuss in Appendix B.

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conflicts involving the Spanish empire—conflicts with England, the Dutch Republic, other Southeast Asian societies, and within the Philippines.

We use Chaunu (1960) to construct a rich set of variables that measure the buoyancy of trade with China, Japan, and other parts of Asia. Specifically, we construct variables that capture the number of ships sailing from China each year and the number of all ships arriving in Manila (from all parts of Asia) and the assessed tax value of the contents of these ships.

One possible confounder mentioned in the historical literature is the competence or experience of the captain. For example, Schurz (1939, 257) writes: "[t]he incompetence of officers and seamen played its part, too, in the disasters of the line. Pilots were sometimes ignorant of the very essential of their craft and all to little acquainted with the difficult course which the galleons had to follow". The reason for this was that was a shortage of high quality seamen. Compared to service in the Atlantic, the voyage between Manila and Acapulco was more dangerous and arduous. Additionally, a successful voyage could make a captain so rich that it "removed the stimulus of further service" (Schurz, 1939, 205).

To proxy for the competency of captains we construct a novel dataset of ship captains. We first check for the identity of the captain, and then we look for qualitative descriptions of their level of expertise in Schurz (1939), and other sources (see Appendix B). Additionally, we check if the respective captain made more than one trip across the Pacific, hence proving that he was experienced. In our robustness analysis, we also include proxies for other factors that could have influenced the selection of the captain including the identity of the governor of the Philippines at the time, the identity of the viceroy, and the identity of the king of Spain.

The resulting dataset thus has a panel structure. Note, however, that because trade between Manila and Acapulco was restricted to one voyage in each direction per year, we cannot include year fixed effects in our analysis.

In Appendix Figure 4 we plot the raw data for both trips from Manila to Acapulco and from Acapulco to Manila. Two stylized facts are evident from the Appendix Figure 4. First, it confirms that the voyage from Manila to Acapulco was more dangerous than that from Acapulco to Manila. Second, it suggests that there are no visible time trends in the data. We confirm stationarity and the absent of unit roots in Appendix D.6.

3.2 The Relationship Between Late Departures and Failed Voyages

In Figure 3 we use a binscatter plot to illustrate a positive bivariate relationship between a late departure and the probability of a failed voyage. To exploit within ship variation, we estimate a series of regressions based on the following fixed effects specification:

$$\text{Failed Voyage}_{i,v,\tau} = \alpha + \beta_1 \text{Late}_{i,v,\tau} + \gamma \mathbf{X}_{i,v,\tau} + \Lambda_i + \Gamma_\tau + \epsilon_{i,v} \tag{1}$$

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where Failed Voyage$_{i,v,\tau}$ refers to a ship i wrecked or returned to port in voyage v and time period τ. Λ_i are ship fixed effects.[17] Γ_τ refers to either century or fifty-year time fixed effects that we employ in some specifications. The coefficient of interest is β_1. All standard errors are clustered at the ship level. All specifications include ship fixed effects.

The vector $\mathbf{X}_{i,v}$ includes controls for typhoons, the average temperature in the Western and the Eastern Pacific, storms, the age of the ship, and whether the captain was experienced.

Table 1 reports our main results using a linear probability model.[18] We first report, in column 1, the bivariate relationship between a late departure and whether a ship was wrecked or returned to port. Next, we include controls for the presence of typhoons (column 2) and then control for the climate (column 3). We view column 3 as our benchmark specification. Appendix Figure 7 depicts this regression visually. The coefficient of interest remains comparable across specifications and remains similarly robust when we sequentially include controls for storms (as recorded by the logs of the ships), the age of the ship, and the experience of the captain (column 5). Across specifications, the only control variable besides Late$_{i,v}$ that also predicts failed voyages is the presence of a storm. We report results using a Logit regression in Appendix Table 14. These are consistent with what we obtain using a linear probability model and we prefer the latter for ease of interpretation. We also report other specifications in the Empirical Appendix including those using departure date as our explanatory variable (Appendix Table 12) and using an inverse probability weighting model (Appendix Table 13 and Appendix Figure 5).

In contrast, when we examine the trip from Acapulco to Manila we find no such relationship between a late departure and a ship wreck or returned ship (Table 2). This is an important finding as it suggests that there was something specific to the situation in Manila that was responsible for the relationship between late departures and failed voyages. Recall that it is the Manila-Acapulco leg that carried the merchandise, while the Acapulco-Manila trip mostly carried silver as payment.

3.3 Ruling Out Alternative Explanations

The relationship between a late departure and a failed voyage is suggestive. But this relationship could be generated by innocuous reasons. Schurz (1939, 252) lists several possible explanations: (i) "[t]he necessity for awaiting the return of the Acapulco galleon, with the proceeds of the previous years' sale"; (ii) the possible threat of pirates or Dutch, English, or French ships; and (iii) delays or issues with the arrival of Chinese ships in Manila. Governor Basco y Vargas reported this as the reason for late departure in 1783 (Schurz, 1939, 251).[19] We now proceed to consider the evidence for these alternative

[17]Since each ship sails in a different a year, the ship fixed effect is also, in a sense, a time fixed effect.

[18]To account for the possibility that voyages are serially correlated, in Appendix D.6 we perform several formal exercises to rule out the presence of time trends, unit roots, and serial autocorrelation in our variables of interest.

[19]As summarized by McCarthy (1993, 169): "Logistically, it was a challenge to dispatch the galleons on schedule. Goods arriving from China had to purchased and allocated among the Spaniards. This process was complicated by the occasional lateness or non-arrival of the sampans (small Chinese boats)".

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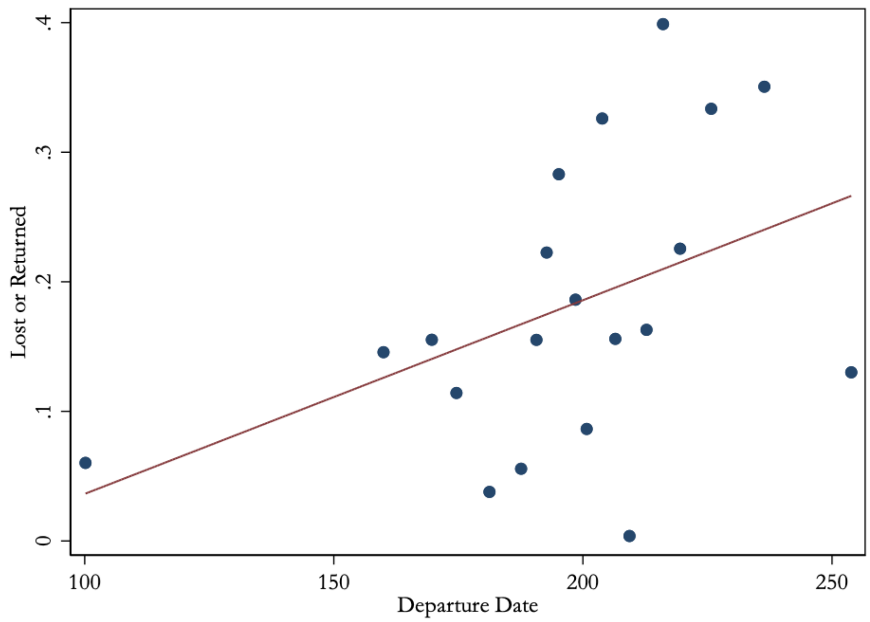

Figure 3: A binscatter plot of the relationship between departure date and a failed voyage. Controls include the presence of a storm, pirate threats, typhoons, temperature in the Eastern and Western Pacific and captain experience.

explanations.

(i) Late arrivals. To account for the late arrival of the Acapulco galleon we construct a measure based on information in Cruikshank (2013) and other sources.[20] We estimate:

$$\text{Failed Voyage}_{i,v} = \alpha + \beta_1 \text{Late}_{i,v} + \beta_2 \text{Arrival Date}_u + \gamma \mathbf{X}_{i,v} + \Lambda_i + \epsilon_{i,v} \tag{2}$$

We report results using a linear probability model. All specifications include ship fixed effects. Contrary to expectations, the coefficient on arrival date is negative and precisely estimated. This suggests that Schurz's hypothesis for delay was incorrect. Nonetheless, in all specifications, our measure of late remains large, positive, and precisely estimated (Table 3).

(ii). Pirates. Pirates and privateers (particularly English and Dutch privateers) frequently targeted the Manila Galleons which were seen as the greatest prize on the ocean (see Gerhard, 1960; Lane, 2016). On several occasions, Manila galleons were captured by English raiders. The presence of pirates or the ships of rival naval powers is mentioned by Cruikshank (2013). While this is not an ideal measure, it gives us some ability to control for years when the Manila Galleon was threatened by other ships including pirates, privateers or the vessels of an enemy power. We also use information on whether

[20] One can think of the arrival date as providing a source of exogenous variation in the departure date. Here our interest. is in the endogenous component of variation so we do not pursue an instrumental variable strategy

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Table 1: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.164**	0.165**	0.191**	0.197***	0.205***	0.205***
	(0.0639)	(0.0634)	(0.0758)	(0.0674)	(0.0671)	(0.0679)
Typhoon		0.0521	0.0587	0.0203	0.0135	0.0152
		(0.0683)	(0.0765)	(0.0694)	(0.0669)	(0.0692)
Western Pacific Temperature			-0.100	-0.000459	0.0253	0.0268
			(0.199)	(0.192)	(0.213)	(0.215)
Eastern Pacific Temperature			-0.0802	-0.0722	-0.0721	-0.0712
			(0.0815)	(0.0706)	(0.0687)	(0.0695)
Storm				0.285***	0.281***	0.281***
				(0.0942)	(0.0944)	(0.0947)
Years passed since first voyage					0.00578	0.00572
					(0.00755)	(0.00754)
Experienced Captain						-0.0121
						(0.0581)
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	364	363	250	250	250	250
Adjusted R^2	0.027	0.028	0.040	0.111	0.111	0.108

This table establishes a positive relationship between late departures from Manila and failed voyages. The number of observations shrinks in columns (3)-(6) because temperature data is only available from 1617 onwards. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Spain was at war, specifically if there was a battle or conflict with England and Netherlands as Spain was at war frequently during the 16th, 17th, and 18th centuries.

In Table 4 we first introduce controls for the presence of pirates and privateers (column 1). Next we control for Southeast Asian conflicts (column 2). Third, we control for conflicts with England (column 3) as English captains frequently targeted, and on occasion, captured Manila galleons. Fourth, we control for the conflict with the Dutch Republic—Spain's perennial enemy during the 16th and 17th centuries. Finally we control for both conflicts within the Philippines (column 5) and the all conflicts (column 6). Only the later is positively related with failed voyages.

(ii). The trade with China and Asia. In Table 5 we use data collected from Chaunu (1960) to control for the trade with Chinese and other merchants who brought their goods from China and elsewhere across East Asia to sell in Manila. Specifically, we include variables that capture the total number of ships arriving (columns 1-2) and the number of ships from China (column 3-4). Finally, we include information on the assessed tax value of the goods either from China (column 5) or in total (column 6).

As this data is not available for the entire period of analysis, our number of observations shrinks accordingly. Nonetheless, in all specifications, the coefficient on late remains positive and of comparable magnitude. It is worth noting that the number of ships is generally negatively associated with the probability of a failed voyage.

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We also provide a more direct test of Schurz's argument in Appendix Table 18 where we investigate whether the date of the arriving ships, the threat of pirate or of war can explain late departures, or the number of value of ships from China or Asia can explain whether the Manila ship departed late. We only find weak support these alternative explanations: only conflicts with England and total conflicts have any positive association with late departures.

Due to the sheer distance from Spain, McCarthy (1993) likened the discretionary power of the governor of the Philippines to that of a king. This discretionary power is relevant as governors may have varied in their attitude towards graft and corruption. One of the most important areas of discretion was the governors right to choose the commander of the galleon. Schurz describes this as the "richest gift" within their power. The commander earned a salary of 400 pesos but expected to make many times this from his share of the sale of the cargo as well as from a commission of four percent on the registered cargo and other commissions and bribes (which in total was estimated as totaling between 50-100,000 pesos but could be as high as 200,000). In our baseline analysis (Table 1) we control directly for captain experience. Nonetheless, there may still be concern that more corrupt governments might also choose less competent captains.

To address this concern we exploit variation in the type of governor. Due to the vast distances involved and the slow speed of communications, when a governor died, or was replaced, months or longer could go by before his replacement arrived. Specifically, we distinguish whether the governor was officially appointed, an interim governor, or if the royal audiencia governed instead, as interim governors may have had an incentive to permit more corrupt practices (as they time horizon was shorter). In Appendix Table 20 we find no differences by the type of governor; across specifications the coefficient on late remains unchanged.

We also find no support for the argument that ship size was responsible for shipwrecks at least on the Manila–Acapulco route.[21] Appendix Table 21 establishes that there is no relationship between the size of the ship and the probability of a shipwreck.

Taken together this analysis suggests that the remaining variation in departure time *not explained* by either external threats or the late arrival of the Acapulco ship has significant predictive power in explaining the failure of a voyage. In other words, the evidence suggests that the tardiness caused in loading the ships played an important role in explaining late departures, and failed voyages. Why, then, would captains sail late and risk shipwrecks?

In fact, there is evidence that captains knew that by sailing late they risked shipwrecks. As contemporaries were not unaware of the risks posed by the Embocadero route, there were numerous proposals to change the route. Schurz (1939, 224) observes that "the route up the west coast of Luzon should have been much safer and quicker than that by the Embocadero" and would have reduced the risk of shipwreck or an arribada. It is puzzling then why this alternative route was only considered and

[21] Rei (2011, 128) makes this argument in comparing Portuguese and Dutch ships during the 16th and 17th centuries.

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Table 2: Acapulco to Manila: No Relationship Between Late Departure and a Failed Voyage

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Departure Date	0.000416	0.000417	0.000631	0.000754	0.000789	0.000785
	(0.000328)	(0.000330)	(0.000548)	(0.000589)	(0.000603)	(0.000625)
Typhoon		0.134	0.170	0.178	0.177	0.179
		(0.0886)	(0.109)	(0.110)	(0.112)	(0.113)
Western Pacific Temperature			-0.239^{*}	-0.269^{**}	-0.243^{*}	-0.250^{*}
			(0.131)	(0.132)	(0.127)	(0.131)
Eastern Pacific Temperature			-0.0315	-0.0379	-0.0350	-0.0357
			(0.0493)	(0.0458)	(0.0461)	(0.0453)
Storm				-0.0643	-0.0679	-0.0661
				(0.0791)	(0.0827)	(0.0804)
Years passed since first voyage					0.00423	0.00419
					(0.00379)	(0.00377)
Experienced Captain						0.0369
						(0.0689)
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	310	310	198	198	196	196
Adjusted R^2	0.007	0.029	0.064	0.070	0.073	0.073

This table demonstrates that there is no relationship between late departures from Acapulco and failed voyages. The controls are the same as in Table 1. The number of observations shrinks in columns (3)-(6) because temperature data is only available from 1617 onwards. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

not seriously implemented until the late 18th century. The only reason given for why this route was rejected by merchants in Manila is that it would have necessitated a significantly earlier departure.[22]

In the next section we provide a formal model that shows how rent-seeking by local officials could have resulted in both overloaded ships and late departures.

4 A Model of Ship Cargo Loading and Departures

We now formally link late departures and overloading of the galleons to rent-seeking. The model is a variant of the lobbying framework in Grossman and Helpman (1994, 2001) and its origins in Bernheim and Whinston (1986a,b) and Dixit et al. (1997) in which principals offer a 'menu' of bribes to a common agent in exchange for a share or an allocation of, e.g., total public spending. In our context, merchants bid for a share in the galleon's total cargo space, but the result is qualitatively similar - by pitting the merchants against each other, the cargo-loader is able to bid up the bribes up to the value of the cargo.

Consider a large number N of merchants who are of two kinds — holders of legal boleta of finite size N_1, and those who do not have such legal rights to have their cargo loaded, of much larger size $N_2 > N_1$. Thus, $N = N_1 + N_2$. For convenience, let each merchant have one cargo with price V, and assume that it takes one time period to load a cargo. Thus, t also denotes the total number of cargoes

[22]Schurz (1939, 226) writes: "The successful navigation of the passage largely depended on the galleon's clearing from Manila earlier than was customary".

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Table 3: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage Controlling for Arrival Date

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.171**	0.168**	0.182**	0.188***	0.196***	0.196***
	(0.0744)	(0.0736)	(0.0774)	(0.0665)	(0.0667)	(0.0671)
Arrival Date	-0.000729***	-0.000673***	-0.000813***	-0.000787***	-0.000787***	-0.000787***
	(0.000240)	(0.000237)	(0.000275)	(0.000271)	(0.000268)	(0.000273)
Typhoon		0.0596	0.0533	0.0159	0.00911	0.00905
		(0.0696)	(0.0725)	(0.0653)	(0.0639)	(0.0661)
Western Pacific Temperature			-0.00802	0.0866	0.112	0.112
			(0.212)	(0.204)	(0.224)	(0.225)
Eastern Pacific Temperature			-0.0939	-0.0856	-0.0855	-0.0855
			(0.0824)	(0.0724)	(0.0699)	(0.0712)
Storm				0.279***	0.275***	0.275***
				(0.0905)	(0.0906)	(0.0908)
Years passed since first voyage					0.00573	0.00573
					(0.00652)	(0.00653)
Experienced Captain						0.000398
						(0.0598)
FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	273	272	250	250	250	250
Adjusted R^2	0.082	0.077	0.085	0.154	0.154	0.151

This table shows that the relationship between a late departure from Manila and a failed voyage is unaffected by including the date of arrival of the previous ship. The controls are the same as in Table 1. The number of observations shrinks in columns (3)-(5) because temperature data is only available from 1617 onwards. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

that could have been loaded as of t.

The cargo-loader faces three restrictions: (1) to load only legal cargo; (2) not to load beyond the ship's capacity; (3) and to sail by the deadline so as to avoid the monsoon season. Going against these restrictions entails costs. Let $\bar{N}$ denote the ship's cargo limit, and $\bar{t}$ the sailing deadline, where $\bar{N}$ could be greater or less than $\bar{t}$. The server incurs cost k_1 for each illegal cargo, k_2 for each cargo beyond the ship's capacity $\bar{N}$, and k_3 for each cargo loaded beyond the deadline $\bar{t}$.[23] In addition, since restrictions (2) and (3) are put in place in order to ensure the safe arrival of the ship in Acapulco, the probability ρ that the galleon sinks increases with k_2 and k_3. In particular, letting $\bar{\rho}$ denote some exogenous probability of shipwreck, we assume that the probability of shipwreck increases (at a decreasing rate) beyond $\bar{\rho}$ for every cargo that exceeds the ship's limit $\bar{N}$, and loaded past the sailing deadline $\bar{t}$.

To make this explicit, let $\mathbb{1}_2$ be an indicator variable equal to 1 whenever k_2 is incurred, and $\mathbb{1}_3$ an indicator variable equal to 1 whenever k_3 is incurred. Define $T_2^S \equiv \sum_{t=1}^{S} t\mathbb{1}_2$, $S < N$, as the number of cargo loaded as of period S that are above the limit $\bar{N}$, and $T_3^S \equiv \sum_{t=1}^{S} t\mathbb{1}_3$ the number of cargo loaded as of S after the deadline $\bar{t}$. Then the probability of shipwreck when sailing at period S is given by

[23] Since t also indexes the number of cargoes that could have been loaded as of t, deadline $\bar{t}$ can be cast as a type of cargo limit, distinct from the physical limit $\bar{N}$. With the same departure deadline imposed for all galleons leaving Manila, a higher (lower) tonnage ship would be more likely to face $\bar{N} > \bar{t}$ ($\bar{N} < \bar{t}$).

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Table 4: Manila to Acapulco: Late Departure and a Failed Voyage Controlling for Pirates and War

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.188***	0.187***	0.183**	0.181***	0.188***	0.169**
	(0.0668)	(0.0671)	(0.0706)	(0.0660)	(0.0645)	(0.0644)
Arrival Date	-0.00079***	-0.00082***	-0.0008***	-0.00079***	-0.00085***	-0.00082***
	(0.00027)	(0.00029)	(0.00028)	(0.00027)	(0.00029)	(0.000272)
Storm	0.279***	0.269***	0.276***	0.283***	0.281***	0.268***
	(0.0906)	(0.0902)	(0.0895)	(0.0918)	(0.0888)	(0.0879)
Typhoon	0.0156	0.0285	0.0127	0.00468	0.0236	0.00746
	(0.0658)	(0.0630)	(0.0648)	(0.0666)	(0.0632)	(0.0652)
Western Pacific Temperature	0.0889	0.110	0.0805	0.0647	0.0585	0.0585
	(0.206)	(0.203)	(0.209)	(0.209)	(0.213)	(0.206)
Eastern Pacific Temperature	-0.0862	-0.0755	-0.0874	-0.0951	-0.0861	-0.0911
	(0.0723)	(0.0713)	(0.0730)	(0.0730)	(0.0709)	(0.0727)
Pirates	-0.0168					
	(0.0933)					
Conflicts Southeast Asia		0.0697				
		(0.0674)				
Conflicts with England			0.0254			
			(0.0764)			
Conflicts with Dutch				0.131		
				(0.0946)		
Conflicts in the Philippines					0.126	
					(0.0790)	
Total Conflicts						0.109*
						(0.0638)
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	250	250	250	250	250	250
Adjusted R^2	0.151	0.155	0.151	0.159	0.160	0.166

This table shows that the relationship between late departure from Manila and a failed voyage is unaffected by controlling for pirates and other war-related threats. The other control variables are the same as in Table 1. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

$\rho^S = \bar{\rho} + \omega(T_2^S, T_3^S)$, where $\omega(0,0) = 0$ and ω are increasing at a decreasing rate both in $\mathbb{1}_2$ and in $\mathbb{1}_3$. Thus, e.g., $\omega(1,0) > \omega(0,0)$ and $\omega(2,0) - \omega(1,0) < \omega(1,0) - \omega(0,0)$. Similarly, $\omega(0,1) > \omega(0,0)$ and $\omega(0,2) - \omega(0,1) < \omega(0,1) - \omega(0,0)$.[24] Note that if $\bar{N} < \bar{t}$, then $\omega(1,0)$ is the smallest (non-zero) value that ω can take since $\bar{N}$ would be surpassed first before $\bar{t}$. Analogously, if $\bar{N} > \bar{t}$, then $\omega(0,1)$ is the smallest (non-zero) value that ω can take. We put the following lower bounds on these values: $\omega(1,0) > \frac{1-\bar{\rho}}{1+\bar{N}}$ and $\omega(0,1) > \frac{1-\bar{\rho}}{1+\bar{t}}$.[25]

Let the players be the incumbent official I (i.e. the captain, possibly in connivance with the governor and other officials) who decides which cargoes to load and the departure date of the galleon, and the

[24] We are agnostic as to the relative effect of loading beyond $\bar{N}$ or beyond $\bar{t}$ - e.g., $\omega(1,0)$ can be less than, greater than, or equal to $\omega(0,1)$. One possible justification for $\omega(0,1) > \omega(1,0)$ is to account for any temporal cost of playing the game, which would increase the likelihood of departure delay, without necessarily adding to the total number of loaded cargo.

[25] Thus, the smaller the limits $\bar{N}$ and $\bar{t}$ are, the larger the effect of the first cargo that is above the limit. This implies, for instance, that a low tonnage ship would be worse at handling an extra cargo than a high tonnage ship—that one extra cargo would increase the probability of shipwreck of the low tonnage ship much more than it would the high tonnage one.

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Table 5: Manila to Acapulco: Late Departure and a Failed Voyage Controlling Ships from China

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.135*	0.184***	0.135*	0.186***	0.166**	0.164**
	(0.0768)	(0.0677)	(0.0761)	(0.0652)	(0.0762)	(0.0763)
Arrival Date	-0.0006**	-0.0007**	-0.0006**	-0.0007**	-0.0007***	-0.0007***
	(0.00027)	(0.00027)	(0.00027)	(0.00027)	(0.00022)	(0.00022)
Storm	0.279**	0.282***	0.254**	0.286***	0.289***	0.285***
	(0.116)	(0.0890)	(0.114)	(0.0873)	(0.105)	(0.106)
Typhoon	0.0555	0.0151	0.0540	0.00948	0.00061	-0.000018
	(0.0783)	(0.0594)	(0.0805)	(0.0622)	(0.0733)	(0.0732)
Western Pacific Temperature	0.342	0.209	0.385*	0.216	0.0272	0.0203
	(0.216)	(0.194)	(0.209)	(0.192)	(0.259)	(0.251)
Eastern Pacific Temperature	-0.0646	-0.0740	-0.0578	-0.0652	-0.105	-0.109
	(0.111)	(0.0767)	(0.112)	(0.0774)	(0.0800)	(0.0813)
Total N. of Ships	-0.00722					
	(0.00449)					
> Mean N. Ships		-0.143**				
		(0.0612)				
Chinese Ships			-0.00698			
			(0.00514)			
> Mean N. Chinese Ships				-0.146**		
				(0.0588)		
Tax Value Chinese Ships					-0.000005	
					(0.000005)	
Tax Value Total						-0.000004
						(0.000003)
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	174	250	172	250	197	197
Adjusted R^2	0.141	0.175	0.127	0.174	0.144	0.147

This table shows that the relationship between late departure from Manila and a failed voyage is unaffected by controlling for various measures of the trade with China. The other control variables are the same as in Table 1. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

set $N = N_1 + N_2$ of merchants.

Game G is played, in which the following occurs at each time period $t = 1, 2, \ldots, N$:

1. A merchant, randomly drawn from N, arrives at port, and offers incumbent I bribe b in exchange for loading her cargo, which I accepts or rejects.

2. Incumbent I chooses to set sail ($\psi = 1$) or not ($\psi = 0$). If $\psi = 1$, the game ends.

That the decision to set sail is distinct from the decision to load cargo allows us to capture the possibility that the incumbent rejects a bribe and waits for another merchant who can pay a higher bribe, and to which the incumbent would prefer to allocate space in the galleon. Thus, a merchant at t pays a bribe that at least matches the incumbent's reservation utility at t, which reflects the incumbent's expected bribe offer from another merchant at $t + 1$. We elaborate on this mechanism by constructing

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an equilibrium in which the incumbent sets sail at some time period $T < N$, and accepts bribes and loads cargo at each period $t \leq T$, while each merchant at $t \leq T$ pays positive bribe amounts.

4.1 *The Decision to Set Sail*

We proceed by backward induction. For the incumbent I to choose $\psi_T = 1$ at time T, it must be that the expected payoff from setting sail at T is at least as large as that from not sailing. The expected payoff from sailing is what I gets to keep should the voyage successfully reach its destination – the sum of all the bribe payments I has accepted as of T. The expected payoff from sailing at T is, thus, $a \equiv (1-\rho_T)(\sum_{t=1}^{T}(b_t - k_1\mathbb{1}_{\mathbb{1}} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)$, where $\mathbb{1}_{\mathbb{1}}$ is an indicator variable equal to 1 whenever an illegal cargo is loaded, $\mathbb{1}_2$ and $\mathbb{1}_3$ are as previously defined, and $\rho_T = \bar{T} + \omega(T_2^T, T_3^T)$ is the probability of shipwreck as of T.[26] On the other hand, if the incumbent chooses to wait, i.e. $\psi_T = 0$, she expects to obtain bribe payment $\bar{b}_{T+1}$ in exchange for loading the cargo of the $(T+1)$th merchant, with the probability of shipwreck $\rho_{T+1} = \bar{\rho} + \omega(T_2^{T+1}, T_3^{T+1})$. Thus, the expected payoff from not sailing at T is $b \equiv (1-\rho_{T+1})(\sum_{t=1}^{T}(b_t - k_1\mathbb{1}_{\mathbb{1}} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3) + (\bar{b}_{T+1} - k_1\mathbb{1}_{\mathbb{1}} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)$.

The incumbent sets sail at T if $a \geq b$ which, re-arranging and letting bind with equality, gives the incumbent's expected payoff (at $T+1$) upon sailing at T: $\bar{b}_{T+1} = \frac{(\rho_{T+1}-\rho_T)(\sum_{t=1}^{T}(b_t - k_1\mathbb{1}_{\mathbb{1}} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)}{1-\rho_{T+1}} + k_1\mathbb{1}_{\mathbb{1}} + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$.

Notice then that at T, the incumbent can only calculate her expected payoff at $T+1$ because she can only form an expectation about the type of merchant who would arrive at $T+1$. Denote as $b_{T+1,1} = \frac{(\rho_{T+1}-\rho_T)(\sum_{t=1}^{T}(b_t - k_1\mathbb{1}_{\mathbb{1}} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)}{1-\rho_{T+1}} + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ the bribe payment if the $(T+1)$th merchant is a legal one (i.e. from set N_1), and $b_{T+1,2} = \frac{(\rho_{T+1}-\rho_T)(\sum_{t=1}^{T}(b_t - k_1\mathbb{1}_{\mathbb{1}} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)}{1-\rho_{T+1}} + k_1 + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ if illegal (i.e. from set N_2). Denoting the probability that a legal merchant arrives in period $T+1$ as μ_{T+1}, then another expression for the expected value of b_{T+1} is $\bar{b}_{T+1} = \mu_{T+1}b_{T+1,1} + (1-\mu_{T+1})b_{T+1,2}$, or[27]

$$\bar{b}_{T+1} = b_{T+1,1} + (1-\mu_{T+1})k_1. \tag{3}$$

This is the minimum amount of bribe that the incumbent would want from the $(T+1)$th merchant — below this, the incumbent would not be willing to wait and would thus prefer to sail. In turn, if the incumbent expects to earn this from the $(T+1)$th merchant, the Tth merchant would have to match this in order to get the $(T+1)$th merchant's cargo space. That is, the expected bribe at $T+1$ is the incumbent's reservation utility that a merchant who comes at period T has to match in order to induce the incumbent to load her cargo, rather than wait for the $(T+1)$th merchant's cargo.

[26] For ease of notation, we exclude subscript t from $\mathbb{1}_{\mathbb{1}}$, $\mathbb{1}_2$ and $\mathbb{1}_3$, but it should be obvious that these are time-varying.

[27] The probability μ_{T+1} can be obtained by letting $t = T+1$ and applying the following formula derived in the Appendix: $\mu_t = \sum_{x=1}^{t} a_{t-x}(\frac{N_1-t+x}{N_1+N_2-t+1})$, where each term in the summation is the joint probability of drawing a legal merchant in all $(t-x)$ periods, with $\frac{N_1-t+x}{N_1+N_2-t+1}$ the probability that a legal merchant is drawn in the $(t-x)$th period, and a_{t-x} the joint probability that a legal merchant is drawn in the periods prior to the $(t-x)$th period.

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4.2 Bribe Payments

Moving backward in the game, i.e. given $b_{T+1,1}$, μ_{T+1}, one can then solve for the bribe payment that the incumbent would demand at T. If the Tth merchant is a boleta-holder, then for the incumbent to accept her bribe, she should offer an amount $b_{T,1} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3 \geq \bar{U}_T$, where $\bar{U}_T \equiv \mu_{T+1}b_{T+1,1} + (1-\mu_{T+1})b_{T+1,2} = b_{T+1,1} + (1-\mu_{T+1})k_1$ is the reservation utility that the incumbent demands to be satisfied by a merchant arriving at T. If the Tth merchant is illegal however, then the incumbent would want bribe payment $b_{T,2} - k_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3 \geq \bar{U}_T$.

Letting these conditions bind with equality such that $b_{T,1} = \bar{U}_T + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ and $b_{T,2} = \bar{U}_T + k_1 + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ and writing out the expression for $\bar{U}_T$ in each, give the following:

$$F_{T,1} = b_{T,1} - \Big[(1-\mu_{T+1})\Big(\sum_{t=1}^{T-1}(b_t - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3) + (b_{T,1} - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)\Big)\Big(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}}\Big)\Big)$$
$$+\mu_{T+1}\Big(\sum_{t=1}^{T-1}(b_t - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3) + (b_{T,1} - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)\Big)\Big(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}}\Big)\Big] - k_2\mathbb{1}_2 - k_3\mathbb{1}_3 = 0\ ; \tag{4}$$

and:

$$F_{T,2} = b_{T,2} - \Big[(1-\mu_{T+1})\Big(\sum_{t=1}^{T-1}(b_t - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3) + (b_{T,2} - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)\Big)\Big(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}}\Big)\Big)$$
$$+\mu_{T+1}\Big(\sum_{t=1}^{T-1}(b_t - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3) + (b_{T,2} - k_1\mathbb{1}_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3)\Big)\Big(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}}\Big)\Big] - k_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3 = 0 \tag{5}$$

Equations (4) and (5) thus solve for $b_{T,1}$ and $b_{T,2}$, respectively. In fact, one can also go backward iteratively by lagging the time subscripts in (4) and (5) to solve for $b_{t,1}$ and $b_{t,2}$ for each t.[28] Note that because illegal merchants have to compensate the incumbent for incurring cost k_1, $b_{t,2} > b_{t,1}$.

However, while the incumbent would ideally want to receive bribe $b_{t,1}$ or $b_{t,2}$ at t, any merchant can only afford to pay bribes up to the price V of the cargo. Thus, the actual bribe that a legal and illegal merchant arriving at t pay are, respectively:

$$\bar{b}_{t,1} = \min(b_{t,1}, V) \tag{6}$$
$$\bar{b}_{t,2} = \min(b_{t,2}, V) \tag{7}$$

4.3 Equilibrium

Before providing the equilibrium of game G, the following result is useful.

[28]Given $b_{T,1}, b_{T,2}$, the incumbent's reservation utility at $T-1$ is $\bar{U}_{T-1} = \mu_T b_{T,1} + (1-\mu_T)b_{T,2}$ and, thus, $b_{T-1,1} = \bar{U}_{T-1} + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ and $b_{T-1,2} = \bar{U}_{T-1} + k_1 + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ which, when expanded, give equations (4) and (5), with subscript T replaced by $T-1$ and subscript $T+1$ replaced by T.

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Lemma 1. *Both $b_{t,1}$ and $b_{t,2}$ are increasing in t.*

All proofs are in Appendix C.

Since $b_{t,1}$ and $b_{t,2}$ keep increasing in t, there will be a time period $T+1$ at which $\bar{b}_{T+1}$, the minimum amount of expected bribe that the incumbent will require in order to wait for the $(T+1)$th merchant, will be greater than V. The following equilibrium is thus obtained.

Proposition 1. *In equilibrium, the bribe amount paid to the incumbent at each time period t is given by $(\bar{b}_1 = V, \bar{b}_2 = V, \ldots, \bar{b}_T = V)$, the incumbent's decision to sail at each t is given by $(\psi_1 = 0, \psi_2 = 0, \ldots, \psi_T = 1)$, and the departure time T is such that $\bar{b}_{T+1} > V$.*

In other words, each merchant that arrives before the galleon departs, whether legal or illegal, pays the maximum bribe V.[29] With a large number of merchants vying for limited space in the galleon, the captain is able to pit them against each other, thereby extracting all the surplus and earning V from each merchant. The captain sets sail when the amount of bribe that would compensate her for the probability of shipwreck becomes unaffordable — higher than V, for any merchant that comes in the next period.

The next two results formally establish that the higher the price V of the cargo, the more likely is the galleon overloaded and late and, hence, the more likely it is to be shipwrecked.

Proposition 2. *The higher the price V of each cargo, the more likely that the galleon departs late and is overloaded. Specifically, there exist threshold values $V_1 < V_2 < V_3$ such that:*

1. *if $V < V_1$, the galleon departs before the deadline $\bar{t}$, carrying total cargo below the limit $\bar{N}$.*
2. *if $V_1 \leq V < V_2$, the galleon departs before the deadline $\bar{t}$, carrying total cargo at the limit $\bar{N}$ if $\bar{N} < \bar{t}$; otherwise, if $\bar{N} > \bar{t}$, it departs on the deadline, carrying total cargo below the limit.*
3. *if $V_2 \leq V < V_3$, the galleon departs at or before the deadline $\bar{t}$, carrying total cargo beyond the limit $\bar{N}$ if $\bar{N} < \bar{t}$; otherwise, if $\bar{N} > \bar{t}$, it departs after the deadline, carrying cargo below or at the limit.*
4. *if $V_3 \leq V$, the galleon sails after the deadline $\bar{t}$, carrying total cargo above the limit $\bar{N}$.*

Since the captain always earns a bribe for each cargo loaded, she would want to keep loading cargo for as long as the merchant can pay the bribe – that is, for as long as the merchant can afford to compensate the captain for the marginal expected loss from a shipwreck. After some point, the

[29] The captain does not discriminate between legal and illegal merchants because the captain bears the cost k_1 of loading illegal cargo. Since all merchants can then pay the full price V, the captain is able to extract this from any merchant. There is no evidence that holders of legal boletas complained about extortionary bribes to officials in Manila—in fact, often, higher officials were implicated in the corruption scheme. Officials in Acapulco inspected the merchandise and ascertained whether illegal cargo were loaded, for which the captain would be liable.

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probability of shipwreck and, thus, the expected marginal loss, would be too high for any merchant to compensate. For very large V, however, this point is reached more slowly precisely because the merchant is able to pay a higher bribe V and compensate for a larger expected marginal loss from shipwreck. Hence, the captain is able to load more cargo, surpassing both the physical limit of the ship and the deadline.

This, then, increases the probability of shipwreck. That is:

Corollary 1. *The higher the price V of each cargo, the higher the probability of shipwreck.*

5 Testing the Model

The model not only predicts that late-sailing and overloaded ships have a higher probability of shipwreck, but reveals that the incumbent intentionally sails late and overloads the ship in order to keep capturing bribes. It is precisely because each cargo beyond the deadline and the cargo limit of the ship increases the chance of shipwreck that the incumbent can keep extracting bribes. The only constraint to such rent-seeking is the price of the cargo, as merchants cannot pay bribes beyond this maximum amount. Thus, when each cargo can be sold at a very high price in Acapulco, the incumbent can keep accepting cargo in Manila in exchange for bribes, thereby overloading the ship and delaying departure, and greatly risking shipwreck.

We can thus test two auxiliary predictions. First, we show that ships that are both overloaded and sail late are more likely to be shipwrecked than those that are late but not overloaded by comparing low and high-tonnage ships. Given the same departure time, the former are more likely to be overloaded than the latter.

Second, since late-sailing and overloading are more likely when the value of the cargo is very high, one would expect the probability of shipwreck to be higher in this case. The value of the cargo was especially high in the year *following* a failed voyage. From the historical literature, we know that a failed voyage was an economic disaster for the merchants and citizens of Manila (.e.g. McCarthy, 1993, 182). Thus the model predicts that in the year following a failed voyage (or if there was no voyage for some other reason), the relationship between late and the voyage failing will be strong as later ships will be especially overloaded.

To test the first of these predictions, we split the sample into ships with estimated high and estimate low tonnage based on whether they are above or below the mean tonnage of all ships in our sample. Importantly, the resulting two samples we obtain are balanced on other characteristics: low and high tonnage ships were no more likely to experience shipwrecks or returned voyages (see Appendix Figure 6). Next in Table 6 we look at how tonnage affects the relationship between late and failed voyages. Consistent with our theoretical predictions, we find a much larger coefficient on late for the low tonnage sample compared to the high tonnage sample (columns 1-2). This difference remains robust when we control for storms, typhoons, and temperature (columns 3-4) and for arrival date (columns 5-6). This

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difference shrinks a little in size when we include more covariates, but remains large and statistically significant overall.[30]

Recall that the second additional prediction we obtain from the model is that that higher value of V should induce more overloading and hence be associated with a higher probability of failure. We conduct several tests of this prediction.

First, we create a variable that records whether the previous year's voyage either had a shipwreck or was forced to return to port. We expect the effect of late to be greater for the former in comparison to the latter. The results in Table 7 confirm this prediction. Columns (1)-(2) report the contrast using only ship fixed effects. In columns (3-6) we successively introduce more controls. The difference in the magnitude of the respective coefficients declines somewhat, but it remains economically meaningful and statistically significant.

Second, in Table 8 we examine how the relationship between late departures and a failed voyage varied during periods when we expect V to have been either higher or lower. In columns (1)-(2) we contrast the period after 1640—when the number of ships that could travel between Manila and Acapulco was reduced to one—with that before 1640. Theoretically, this restriction should increase V and hence be associated with more overloading. The much larger coefficient we find for the post 1640 period is consistent with this.

Third, Schurz (1939) describes several periods when the galleon trade experienced greater oversight. The only way the crown could attempt to limit corruption was through an extraordinary inspection known as a *visita*. The *visitador* was directly responsible to the king and hence could overrule local officials. The most famous *visitador* was Pedro de Quiroga y Moya who was sent to investigate corruption and bribe-taking in the port of Manila (1635-1640) (Schurz, 1939, 187-188).[31] Another period where there was comparatively more oversight of the loading of the gallons was during the governorship of Campo y Coiso and Valdes who assigned two independent overseers to monitor the loading of the ships (Schurz, 1939, 181). This policy was suspended because of opposition from the merchants of Manila. It is highly noteworthy, therefore, and consistent with our model that in these years we find no relationship between late departures and failed voyages (Table 8, col. 4).

Next, we focus on the late 18th century, a period when Spanish colonial institutions began to be reformed. Specifically, in 1769, a new commercial code was established, which created the *consulado*, a corporation of merchants with control over the galleon trade. There is nothing in these reforms, however, to suggest that they would have reduced the value of V. In fact, they may have consolidated the power of existing mercantile elites in Manila. In Table (Table 8, cols. (5)-(6)) we find that if anything the relationship between late and shipwrecks strengthened after this reform. The same is true for another

[30]We confirm this formally using a version of the Hausman test as implemented by the Stata `suest` command. In all specifications, the null that the two coefficients are statistically indistinguishable is rejected with a p-value of 0.000.

[31]Schurz (1939, 188) notes that following the end of Quiroga's inspection period "commerce gradually resumed the comparative serenity and laxity that had prevailed before the incorruptible Quiroga's harsh irruption into its sphere".

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much lauded reform, the creation of the Royal Philippine Company in 1785. The purpose of the Royal Philippine Company was to develop direct trade between the Philippines and Spain. However, Schurz (1939, 57) notes that in practice little was done: "the passive opposition of the Manila merchants to this radical innovation in their field of business was largely to defeat the purpose of the change and to delay the full fruition of its possibilities to a later time". The same applies to attempts to open up Manila to the ships of other countries. Even when foreign ships were allowed into Manila bay, they were prohibited from trading outside Asia. It was only in 1795 that trade was fully liberalized. Our model predicts that this liberalization, when fully implemented, should have reduced the value of V and weakened the relationship between late departures and shipwrecks. And indeed this is what we find in Table 8, column (8). Not only does the estimate on late become imprecisely measured as one would expect due to the shortage of observations, the coefficient falls in size to approximately zero.

Together these results provide additional evidence that is consistent with the mechanism outlined in our model. Ships in the Manila Galleon trade were more likely to be shipwrecked or returned to port because they were late and overloaded; in short, they were shipwrecked by rents.

Table 6: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage by Tonnage

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.272***	0.0601	0.302***	0.142	0.306***	0.120
	(0.0823)	(0.0913)	(0.106)	(0.0862)	(0.106)	(0.0826)
Storm			0.196*	0.343**	0.183	0.352**
			(0.108)	(0.168)	(0.112)	(0.156)
Western Pacific Temperature			0.187	-0.288	0.247	-0.172
			(0.208)	(0.313)	(0.258)	(0.271)
Typhoon			0.0461	0.0235	0.0325	0.0316
			(0.105)	(0.0971)	(0.101)	(0.0864)
Eastern Pacific Temperature			-0.113	-0.0449	-0.120	-0.0735
			(0.0954)	(0.117)	(0.0987)	(0.120)
Arrival Date					-0.000584*	-0.00102**
					(0.000298)	(0.000497)
Tonnage	Low	High	Low	High	Low	High
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	214	150	121	129	121	129
Adjusted R^2	0.069	-0.002	0.147	0.082	0.166	0.151

This paper establishes that the relationship between late departure and a failed voyage is strongest for ships with low tonnage. The control variables are the same as in Table 1 The number of observations shrinks in columns (3)-(8) because temperature data is only available from 1617 onwards. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusion

The Manila Galleon trade was the longest and most valuable trade route in the preindustrial world. It linked together Spain's global empire for more than two and a half centuries. The profits associated

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Table 7: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage by Previous Failed Voyage

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.347***	0.138	0.456*	0.246***	0.350*	0.253***
	(0.111)	(0.0885)	(0.228)	(0.0832)	(0.207)	(0.0840)
Storm			0.350**	0.324**	0.399**	0.320**
			(0.168)	(0.126)	(0.156)	(0.128)
Typhoon			-0.148	-0.0302	-0.216	-0.0358
			(0.206)	(0.0686)	(0.248)	(0.0669)
Western Pacific Temperature			1.278	0.106	2.013*	0.123
			(1.083)	(0.275)	(1.123)	(0.309)
Eastern Pacific Temperature			-0.224	-0.108	-0.288	-0.111
			(0.307)	(0.0823)	(0.287)	(0.0798)
Years passed since first voyage					0.00587	0.00516
					(0.0103)	(0.00985)
Experienced Captain					0.323	-0.00445
					(0.203)	(0.0804)
Previous Voyage Failed	Yes	No	Yes	No	Yes	No
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	115	249	54	196	54	196
Adjusted R^2	0.134	0.017	0.442	0.122	0.515	0.116

This table establishes that the relationship between late departure and a failed voyage is strongest for ships that followed after the failure of a previous voyage. The controls are the same as in Table 1. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

with this trade were legendary; but so were the dangers.

This paper is the first quantitative study of the Manila Galleon trade. It introduces a unique new dataset containing the universe of ships that sailed between Manila and Acapulco between 1565 and 1815 and a host of climatic, geographic and geopolitical control variables. It establishes a link between rent-seeking and failed voyages—either shipwrecks or ships forced to return to port—in the Manila Galleon trade. We find that ships that left late were approximately 20% more likely to either be shipwrecked or returned to port. There is no relationship between late departures and failed voyages in trips from Acapulco to Manila.

This relationship holds when control for the presence of storms, typhoons, and the temperature of the Western and Eastern Pacific. It also remains strong when we account for the experience of captains, and the age of the ship. We further show that its magnitude does not change when we account for alternative explanations given by historians, including the date at which the ship coming from Mexico arrived, the presence of pirates and foreign enemies, and the number and value of the ships and cargo coming from China or the rest of Asia.

To understand both why ships were late departing Manila and why late departures were associated with failed voyages we build a formal model of bribe-taking. This model generates new insights into the costs of corruption. Specifically, we show that the captain has an incentive to deliberately sail later in order to extract the largest possible bribe payments.

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Table 8: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage by Time Period

	(1)	(2)	(3)	(4)
	After 1640	Before 1640	Normal Levels Oversight	Heightened Oversight
Late	0.193**	0.0505	0.272***	-0.00730
	(0.0830)	(0.0875)	(0.0824)	(0.0754)
Typhoon	Yes	Yes	Yes	Yes
Western Pacific Temperature	Yes	Yes	Yes	Yes
Eastern Pacific Temperature	Yes	Yes	Yes	Yes
Ship FE	Yes	Yes	Yes	Yes
Observations	205	45	221	29
Adjusted R^2	0.032	0.327	0.061	0.664
	(5)	(6)	(7)	(8)
	Before Consulado	After Consulado	After Royal Philippine Company	After Liberalization
Late	0.162*	0.301***	0.329**	-0.00295
	(0.0922)	(0.0610)	(0.119)	(0.436)
Typhoon	Yes	Yes	Yes	Yes
Western Pacific Temperature	Yes	Yes	Yes	Yes
Eastern Pacific Temperature	Yes	Yes	Yes	Yes
Ship FE	Yes	Yes	Yes	Yes
Observations	191	59	37	24
Adjusted R^2	0.057	0.087	0.024	0.218

This table reports the relationship between late and a failed voyage by subperiod. Specifically, in columns (1)-(2) we contrast the period after the number of ships was restricted with that before. We find that the coefficient increases in size considerably after that date (1640). In columns (3)-(4), we contrast the periods that are recorded as experiencing much greater oversight in order to reduce corruption. We find no relationship between a late departure and a failed voyage for those years. In columns (5)-(8) we examine the period of reforms in the late 18th century. We find that the introduction of the Consulado was associated with a stronger relationship late departures and failed voyages. Similarly the introduction of the Royal Philippine company did not weaken this relationship (column (7)). In contrast, we do find that after trade in Manila was liberalized (allowing any ship to trade there) the relationship between late departures and failed voyages disappears. In all columns, the control variables are the same as in Table 1. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

To further test the model, we derive two additional predictions. First, theoretically we expect smaller ships to be more likely to be more severely overloaded when they sailed late. Second, we expect the incentive to overload and to be greater when the value of the cargo is higher.

Empirically we indeed find that the relationship between late and a failed voyage is greatest for ships with below the mean tonnage. We also find that it is stronger for ships that followed on a previously failed voyage and during periods when we expect the value of the cargo to be higher—i.e. during the era when the number of ships that could travel between Manila and Acapulco was restricted to one. We find no such relationship during periods whether there was stricter oversight on the trade in Manila or in the period after trade in Manila was fully liberalized and opened to ships of other nations. Taken together, these additional tests provide further evidence that rent-seeking and corruption were important factors in explaining the high failure rate of voyages in the Manila Galleon trade.

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Not only is ours the first quantitative study of the Manila Galleon trade, to the best of our knowledge it is the first empirical study of corruption and shipwrecks. From a historical perspective, it highlights a previously ignored cost of the colonial trading regime in the Spanish empire. Our evidence undercuts the recent revisionist historiography that downplays these costs. It suggests that similar costs might have been relevant in other colonial trading regimes including the British, Dutch and French.

While this historical setting is unique, the lessons from rent-seeking in the Manila Galleon trade are generalizable. First, it shows how individually rational rent-seeking behavior had potentially disastrous social consequences. Second, the mechanisms responsible for shipwrecks in the Galleon trade are likely operative in other settings—at least 180 airline accidents in the last 70 years have been directly caused by overloading and in some cases these crashes have been associated with rent-seeking behavior by baggage loaders.

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Online Appendices (For Web Publication Only)

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A Historical Appendix

A.1 Additional background information

The Manila Galleon was the main link connecting the Philippines with the rest of the Spanish Empire. This specific trade route lasted more than 250 years, from the late 16th century up to the early 19th century. It was highly profitable but also dangerous.

Manila and Acapulco were the endpoints of the voyage. Figure 1 depicts the typical route followed by the Galleon from Acapulco to Manila, and from Manila back to Acapulco. Manila was, since its conquest by Miguel de Legazpi in 1565, the center of the Spanish presence in Asia. The Philippines became a General Captaincy of the Spanish Empire which officially was subordinated to the larger Viceroyalty of New Spain—whose capital was Mexico City. Its importance was derived from its strategical geographic location, giving access to all Southeast Asia (Bernabeu, 1992; Blair and Robertson, eds, 1904). In America, Acapulco was a minor town of no importance at the southwestern coast of New Spain. Its hot and humid weather along with its bad agricultural prospects made it a bad location for any year-long continuous settlement (e.g. not even pre-hispanic indigenous populations considered it a desirable place to settle). Acapulco's main asset was its large and spacious bay. After considering some alternatives [32], Acapulco was chosen as the default Spanish port in the Pacific.[33]. However, the Galleon didn't radically alter Acapulco urban prospects. For most of the year it remained a fishing village, and it only transformed into a vibrant spot of trade for the few weeks when the Manila Galleon and the rich Mexico City's merchants arrived to trade (Schurz, 1939).

A.2 The regulatory system

The transpacific commercial system of which the Galleon trade was a part of, was governed by the similar legal institutions that regulated the Atlantic trade—which had arisen in the early 16th century (Walker, 1979; Fisher, 1992). It had three important characteristics: *(i)* a regime of unique privileged ports; *(ii)* a fleet system with periodic scheduled voyages, *(iii)* and an arrangement based on trade privileges upheld by Merchant Guilds.

A.3 Chronology of the Manila Galleon trade

Table 9 provides a chronology of the Manila Galleon trade throughout its 250 year history. The Spanish settlement in the Philippines began in 1565. During the initial period (until 1593), trade occurred without any formal regulation. The period from the 1580s to the 1640s was one of high profits and rapid growth. And it was not only Mexicans that participated, but Peruvians too—Trade between Acapulco in New Spain and El Callao in Peru expanded in these decades (Borah, 1954; Bonalian, 2010). This growth of trade, however, caused a rift in the political economy of the Empire by threatening the interests of the Spaniard merchants, who saw themselves at a disadvantage because they had to compete with Asian merchandises for the share of silver produced in the Americas (Yuste, 2007b). Hence, the Spaniards increasingly lobbied for greater restrictions on the transpacific trade routes. Some of them went so far as to push for the abandonment of the Philippines as a colony. In 1593, strict regulations began to be imposed. Specifically, the number of ships that could travel between Manila and Acapulco was restricted to two. The value of the outgoing cargo from Manila was limited to 250,000 pesos. The

[32] Notably the port of Puerto Navidad, located in the westerner parts of Mexico, north of Acapulco

[33] Complementing that of Veracruz for the Caribbean and Atlantic

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value of the goods from Mexico was limited to 500,000 pesos. The restrictions were reiterated on several occasions but frequently violated.

After 1640, the Crown came to act as arbitrator of the disputes between the Spanish and American merchants, and set additional limits and regulations to the transpacific trade, giving it its famous characteristics: only one ship was allowed per voyage; the ship had to be limited in its tonnage size; and it had to sail once per year at a definite time. The South Sea trade, that united Peru and New Spain, was legally abolished: Peruvian merchants were forbidden to participate. Bonalian (2010, 55) states that the Pacific "suffered the most abusive . . . restrictive and prohibitionist legislation" of any maritime space in the Spanish Empire. Nonetheless, the local American elites restructured[34] around the new constraints and trade in the pacific boomed during the period (Bonalian, 2010; Yuste, 1984, 2007a).

The fleet system continued unmodified up until the late 18th century. During the Seven Years' War in the 1760s, Manila and Havana—arguably they most important Spanish ports in Asia and America respectively—were captured by the British, entirely disrupting the Spanish commercial endeavors. After the war ended, Spanish legislators pushed for reforms with he aim of reinforcing the commercial security of the Empire. These policies are known as the "Bourbon Reforms" and were aimed at decentralizing trade and empowering the Crown *vis a vis* local actors. (Arteaga, 2020) Complementary to these reforms, Mercantile Companies were created in the model of those the British and Dutch have had for centuries by then. One of those companies was the Royal Philippine Company, formed in 1785. But as we discuss in the text, these reforms were largely thwarted by domestic interest groups in Manila. Official direct commerce between the Islands and Spain began to occur for the very first time (Diaz-Trachuelo, 1989). The last galleon sailed in 1815 as Latin American wars of independence raged in America.

[34]Contraband became rampant, and as a famous Spaniard saying goes "Obedezco pero no cumplo," laws were technically obeyed but tacitly not complied.

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Table 9: Timeline of Major Events in the Course of the Manila Galleon Trade

Year	Event
1565	First Spanish settlement in Cebu island
1571	Foundation of the city of Manila by Miguel López de Legazpi
1574	Chinese pirate Limahong attacks Manila but fails to conquer it
1580	Portugal joins the Spanish Empire. Trade between Manila and Macau ensues
1587	English privateer Thomas Cavendish capture the *Santa Ana* close to Baja California
1593	Trade route is legally restricted to two ships per year and Peru is forbidden to engage in it
1596	The *San Felipe* shipwrecks in Shikoku, Japan. Its cargo is seized by the local *Daimyo*
1600	The *San Diego* sinks in Manila bay after a confrontation with the Dutch
1603	Sangley Rebellion in Manila is quelled. Thousands of Chinese-Filipinos are massacred
1604	King Phillip III issues a decree where he instructs ships to not be overloaded
1624	Spanish missionaries and officials are expelled from Japan
1626	Spain establishes a trading post in Keelung, Taiwan
1640	Portugal & its colonies secede from the Spanish Empire
1640	Trade route is restricted to one ship per year
1642	The Dutch settle in Tainan, Taiwan and expel all the Spanish garrisons from the island
1644	The Chinese Ming dynasty falls and Asian trade becomes erratic
1644	Governor of Philippines is indicted of negligence after the shipwreck of *Concepción*
1646	*Battle of La Naval de Manila* occurs where the Dutch failed to conquer the city
1662	Koxinga, Chinese pirate & ruler of Taiwan, raids the Philippines and threats to invade
1694	Shipwreck of the *San José* near Lubang Island
1709	English capture the *Encarnación*
1743	English capture the *Covadonga*
1762	English capture the *Santísima Trinidad*
1762	English capture Manila as part of the Seven Year's War
1769	New Commercial Code introduced
1785	The Royal Company of Philippines is created
1795	Trade in Manila is liberalized
1815	Last galleon sails & its cargo is confiscated by Mexican secessionists in Acapulco

B Data Appendix

Available upon request.

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C Theoretical Appendix

C.1 Proofs of the Main Results

C.1.1 Proof of Lemma

Since $b_{t,1} = \bar{U}_t + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ and $b_{t,2} = \bar{U}_t + k_1 k_2\mathbb{1}_2 + k_3\mathbb{1}_3$, it suffices to show $\bar{U}_t$ is increasing in t, since k_2 and k_3, once incurred, are incurred until T. In turn, $\bar{U}_t \equiv \mu_{t+1}b_{t+1,1} + (1-\mu_{t+1})b_{t+1,2} = b_{t+1,1} + (1-\mu_{t+1})k_1$ is increasing in t since $b_{t+1,1}$ is increasing in t and, with finite legal boleta holders N_1, $(1-\mu_t)$ is increasing in t.

C.1.2 Proof of Proposition 1

We first show that $\bar{b}_{T,1} = \bar{b}_{T,2} = V$. From equations (4) and (5), the largest bribe that the incumbent can get is V. Thus, by Lemma C.1.1 and equation (3), the incumbent sets sail when $\bar{b}_{T+1} \equiv \bar{U}_T > V$. This implies that $b_{T,1} - k_2\mathbb{1}_2 - k_3\mathbb{1}_3 > V$ and $b_{T,2} - k_1 - k_2\mathbb{1}_2 - k_3\mathbb{1}_3 > V$ or, $b_{T,1} > V + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ and $b_{T,2} > V + k_1 + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$. By (4) and (5), this confirms that $\bar{b}_{T,1} = \bar{b}_{T,2} = V$. In turn, $\bar{b}_T \equiv \bar{U}_{T-1} = V$, which implies $b_{T-1,1} = V + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$ and $b_{T-1,2} = V + k_1 + k_2\mathbb{1}_2 + k_3\mathbb{1}_3$. By (4) and (5), $\bar{b}_{T-1,1} = \bar{b}_{T-1,2} = V$. Iteratively applying this, one gets $\bar{b}_{t,1} = \bar{b}_{t,2} = V \ \forall t = 1, 2, ..., T$.

C.1.3 Proof of Proposition 2

By Proposition 1, the galleon departs when $\bar{b}_{T+1} > V$ or, using (3), when $b_{T+1,1} + (1-\mu_{T+1})k_1 > V$. Plugging in the expression for $b_{T+1,1}$, noting that in equilibrium, $b_t = V$, and rearranging, the above inequality can be written as

$$\Big(\frac{\rho_{T+1} - \rho_T}{1 - \rho_{T+1} - (\rho_{T+1} - \rho_T)T}\Big)[-\sum_{t=1}^{T}(k_1\mathbb{1}_1 + k_2\mathbb{1}_2 + k_3\mathbb{1}_3)] + \Big(\frac{1 - \rho_{T+1}}{1 - \rho_{T+1} - (\rho_{T+1} - \rho_T)T}\Big)(1-\mu_{T+1})k_1 > V. \tag{8}$$

Thus, if one can construct values $V_1 < V_2 < V_3$ that the LHS of (8) can take, then we know that when, say, $V < V_1$, then the galleon departs in conditions under which V_1 is constructed. Similarly, if $V_1 \leq V < V_2$, then the galleon departs in conditions under which V_2 is constructed, and so on.

Thus, we first construct values of the LHS of (8) by assuming some levels of cargo, and show that these values are increasing in departure time T or, equivalently, the total amount of cargo loaded by the departure date.

First, note that when the total cargo as of T is $T < \bar{N}, \bar{t}$, then if a cargo were to be loaded at $T+1$, the total cargo at $T+1$ would still not exceed $\bar{N}$ or $\bar{t}$ – at most, $T+1$ could be equal to $\min(\bar{N}, \bar{t})$. This implies that the probability of shipwreck if the galleon were to sail at $T+1$ would be no different that if it were to sail at T. That is, $\rho_{T+1} = \rho_T = \bar{\rho}$. The LHS of (8) thus becomes

$$V_{T<\bar{N},\bar{t}} \equiv (1-\mu_{T+1})k_1.$$

Now if $T \geq \bar{N}, \bar{t}$, then at least one limit ($\bar{N}$, $\bar{t}$, or both) would be surpassed by $T+1$. Hence, in this case, $\rho_{T+1} > \rho_T$. Moreover, the total average cost incurred as of T from loading illegal cargo would be $k_1\mu_T T$. Meanwhile, the total costs incurred as of T from loading cargo above the limit $\bar{N}$ would be $k_2(T - \bar{N})$ if $T > \bar{N}$, and 0 otherwise. Lastly, the total costs incurred as of T from loading cargo after the deadline $\bar{t}$ would be $k_3(T - \bar{t})$ if $T > \bar{t}$, and 0 otherwise.

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Thus, if the galleon were to depart at any time $T \geq \bar{N}, \bar{t}$, the LHS of (8) can be expressed as

$$V_{T\geq \bar{N},\bar{t}} \equiv \Big(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}-(\rho_{T+1}-\rho_T)T}\Big)[-k_1\mu_T T - k_2(T-\bar{N})\mathbb{1}_{\mathbb{N}} - k_3(T-\bar{t})\mathbb{1}_{\mathbb{t}}] + \Big(\frac{1-\rho_{T+1}}{1-\rho_{T+1}-(\rho_{T+1}-\rho_T)T}\Big)(1-\mu_{T+1})k_1,$$

where $\mathbb{1}_{\mathbb{N}}$ is an indicator variable equal to 1 if $T > \bar{N}$, and $\mathbb{1}_{\mathbb{t}}$ an indicator variable equal to 1 if $T > \bar{t}$.

Therefore, to prove Proposition 2, I first show that $V_{T<\bar{N},\bar{t}}$ is less than the minimum value that $V_{T\geq\bar{N},\bar{t}}$ can take, and that $V_{T\geq\bar{N},\bar{t}}$ is increasing in T. That is, I show that:

(a) $V_{T<\bar{N},\bar{t}} < V_{T=\min(\bar{N},\bar{t})}$

(b) $V_{T\geq\bar{N},\bar{t}}$ is increasing in T,

where $V_{T=\min(\bar{N},\bar{t})}$ is the value of the LHS of (8) if $T=\min(\bar{N},\bar{t})$. When these hold, then one can define the following: $V_1 \equiv V_{T<\bar{N},\bar{t}}$, $V_2 \equiv V_{T=\min(\bar{N},\bar{t})}$, and $V_3 \equiv V_{\bar{t}\geq T>\bar{N}}$ if $\min(\bar{N},\bar{t})=\bar{N}$ or, if $\min(\bar{N},\bar{t})=\bar{t}$, $V_3 \equiv V_{\bar{N}\geq T>\bar{t}}$, where $V_{\bar{t}\geq T>\bar{N}}$ is the value of the LHS of (8) when $\bar{t}\geq T>\bar{N}$, and $V_{\bar{N}\geq T>\bar{t}}$ the value of the LHS of (8) when $\bar{N}\geq T>\bar{t}$. Since $V_1<V_2<V_3$, then if $V<V_1$, then the galleon sails in conditions under which V_1 is constructed, i.e. $T<\bar{N},\bar{t}$. If $V_1\leq V<V_2$, then the galleon sails when $T=\min(\bar{N},\bar{t})$. If $V_2\geq V<V_3$, the galleon sails when $\bar{t}\geq T>\bar{N}$ if $\min(\bar{N},\bar{t})=\bar{N}$; otherwise, if $\min(\bar{N},\bar{t})=\bar{t}$, it sails when $\bar{N}\geq T>\bar{t}$. Finally, when $V_3<V$, it cannot sail when $\bar{N}\geq T>\bar{t}$ or $\bar{t}\geq T>\bar{N}$ for, in this case, $V_3>V$. Since $V_{T\geq\bar{N},\bar{t}}$ is increasing in T, it must then be that T is larger than $\max(\bar{N},\bar{t})$.

Thus, I first prove (a). In this case, $V_{T=\min(\bar{N},\bar{t})}$ is constructed by letting $T=\bar{N}$ and $T-\bar{t}<0$ of $\min(\bar{N},\bar{t})=\bar{N}$, or letting $T=\bar{t}$ and $T-\bar{N}<0$ of $\min(\bar{N},\bar{t})=\bar{t}$. In either case, neither cost k_2 nor k_3 is incurred. Thus, $V_{T<\bar{N},\bar{t}} < V_{T=min(\bar{N},\bar{t})}$ can be written as

$$(1-\mu_{T+1})k_1 < \Big(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}-(\rho_{T+1}-\rho_T)T}\Big)(-k_1\mu_T T) + \Big(\frac{1-\rho_{T+1}}{1-\rho_{T+1}-(\rho_{T+1}-\rho_T)T}\Big)(1-\mu_{T+1})k_1$$

or, simplifying, $\frac{\mu_T}{1-\mu_{T+1}} < T$. This is indeed true since $\frac{\mu_T}{1-\mu_{T+1}} < 1$ while T cannot be less than 1. (It is evident that $\mu_{T+1} < 1-\mu_T$ since, with finite number of legal merchants, the probability that a legal merchant arrives at port decreases over time and, hence, $\mu_{T+1}<\mu_T$. Since the latter is true for any value of μ_T, even approximately equal to zero, then it is true for very high values of $(1-\mu_T)$, i.e. close to one.)

We then prove (b). Consider the case when $\bar{t}\geq T>\bar{N}$ ($\min(\bar{N},\bar{t})=\bar{N}$). Cost $k_2(T-\bar{N})$ is incurred, but k_3 is not. Hence,

$$V_{\bar{t}\geq T>\bar{N}} = a(-k_1\mu_T T - k_2(T-\bar{N})) + a(1-\mu_{T+1})k_1,$$

where $a \equiv \Big(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}-(\rho_{T+1}-\rho_T)T}\Big)\big|_{\bar{t}\geq T>\bar{N}} = \omega(1,0)$. Now if T were exactly equal to $\bar{N}$, then $(\rho_{T+1}-\rho_T)\bar{N} = \omega(1,0)\bar{N}$, and $(1-\rho_{T+1}) = 1-\bar{\rho}-\omega(1,0)$. Thus, $1-\rho_{T+1}-(\rho_{T+1}-\rho_{\bar{N}})\bar{N} = 1-\bar{\rho}-\omega(1,0)-\omega(1,0)\bar{N}$, which, by our assumption on $\omega(1,0)$, is less than zero. Thus, if the denominator of a is less than zero at $\bar{N}$, then it is less than zero at all $T\geq\min(\bar{N},\bar{t})$, for both ρ_{T+1} and T would be increasing. Thus, $a<0$, which in turn requires that $-k_1\mu_T T - k_2(T-\bar{N}) + (1-\mu_{T+1})k_1 < 0$. Now since

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$(1-\mu_{T+1})k_1$ increases with T, then if $V_{\bar{t}\geq T>\bar{N}}$ increases with T, it must be that $k_1\mu_T T + k_2(T-\bar{N})$ increases with T, which is indeed the case.

An analogous reasoning establishes that when $\bar{N} \geq T > \bar{t}$ (i.e. $\min(\bar{N},\bar{t}) = \bar{t}$), then $V_{\bar{N}\geq T>\bar{t}}$ increases with T.

To complete the analysis, one can also show that T keeps increasing the LHS of (8), that is, when both $\bar{t}$ and $\bar{N}$ are surpassed. In this case,

$$V_{T>\bar{N},\bar{t}} = b(-k_1\mu_T T - k_2(T-\bar{N}) - k_3(T-\bar{t})) + b(1-\mu_{T+1})k_1,$$

where $b \equiv \left(\frac{\rho_{T+1}-\rho_T}{1-\rho_{T+1}-(\rho_{T+1}-\rho_T)T}\right)|_{T>\bar{N},\bar{t}}$. Since $b<0$, then $-k_1\mu_T T - k_2(T-\bar{N}) - k_3(T-\bar{t}) + (1-\mu_{T+1})k_1 < 0$ and since $(1-\mu_{T+1})k_1$ increases with T, then $k_1\mu_T T + k_2(T-\bar{N}) + k_3(T-\bar{t})$ increases with T, which is indeed the case.

C.1.4 Proof of Corollary 1

The proof is immediate. From Proposition 2, higher V makes it more likely that there are cargo loaded that are above limits $\bar{N}$ and $\bar{t}$, and from its proof, T increases with V. Hence, the probability of shipwreck at departure, $\rho^T = \bar{\rho} + \omega(T_2^T, T_3^T)$ is larger with higher V since $T_2^T = (T-\bar{N})$ and $T_3^T = (T-\bar{t})$ would be larger.

C.2 Probability μ_t of Drawing a Legal Boleta Holder

With N_1 the total number of merchants with legal boleta, and very large N_2 without boleta, the probability μ_t of drawing a merchant with legal boleta in the first period is $\mu_1 = \frac{N_1}{N_1+N_2}$. At $t=2$, if a legal merchant was drawn in period 1, the probability of drawing another legal merchant is $\frac{N_1-1}{N_1+N_2-1}$; otherwise, if an illegal merchant was drawn in period 1, then $\frac{N_1}{N_1+N_2-1}$. Thus, the probability of drawing a legal merchant in $t=2$ is $\mu_2 = \frac{N_1}{N_1+N_2}\left(\frac{N_1-1}{N_1+N_2-1}\right) + \left(1-\frac{N_1}{N_1+N_2}\right)\left(\frac{N_1}{N_1+N_2-1}\right) = \mu_1\left(\frac{N_1-1}{N_1+N_2-1}\right) + (1-\mu_1)\left(\frac{N_1}{N_1+N_2-1}\right)$. Similarly, the probability of drawing a legal merchant in $t=3$ is $\mu_3 = \mu_1\mu_2\left(\frac{N_1-2}{N_1+N_2-2}\right) + \mu_1(1-\mu_2)\left(\frac{N_1-1}{N_1+N_2-2}\right) + (1-\mu_1)(1-\mu_2)\left(\frac{N_1}{N_1+N_2-2}\right)$.

Thus, for any period t, the probability of drawing a legal merchant can be expressed as:

$$\mu_t = \sum_{x=1}^{t} a_{t-x}\Big(\frac{N_1-t+x}{N_1+N_2-t+1}\Big),$$

where each term is the joint probability of drawing a legal merchant in the $(t-x)$ periods, with $\left(\frac{N_1-t+x}{N_1+N_2-t+1}\right)$ the probability that a legal merchant is drawn in the $(t-x)$th period, and a_{t-x} the joint probability that a legal merchant is drawn in the periods prior to the $(t-x)$th period. (For instance, in period 3, the joint probability that legal merchants were drawn in all prior two periods is $a_2 = \mu_1\mu_2$; in just the first period, $a_1 = \mu_1(1-\mu_2)$; in no period prior to 3, $a_0 = (1-\mu_1)(1-\mu_2)$.)

Notice that μ decreases with t, e.g. $\mu_3 < \mu_2$. This is intuitive – with small N_1 and very large N_2, the probability of drawing a legal merchant from a decreasing remaining pool of legal merchants decreases over time.

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Table 10: Summary Statistics for Manila to Acapulco

	Mean	Standard Deviation	Min	Max
Lost or Returned	.2	.4004887	0	1
Late	.5631868	.4966741	0	1
Storm	.1902439	.392973	0	1
Pirates or Buccaneers	.0585366	.2350421	0	1
Typhoon	.2200489	.4147867	0	1
Temperature in Western Pacific	-.2602797	.1191281	-.65	.02
Temperature in in Eastern Pacific	.1049201	.4346396	-1.32	1.24
Age of Ship	3.928218	4.281334	0	20
Experienced Captain	.0536585	.2256179	0	1
Interim Governor	.1	.3003665	0	1
Audiencia Governor	.0512195	.2207145	0	1

Table 11: Summary Statistics for Acapulco to Manila

	Mean	Standard Deviation	Min	Max
Lost or Returned	.0449735	.2075207	0	1
Late	.0870968	.2824327	0	1
Storm	.0899471	.2864851	0	1
Pirates or Buccaneers	.0583554	.2347258	0	1
Typhoon	.0634921	.2441691	0	1
Temperature in Western Pacific	-.2678226	.1220212	-.65	.02
Temperature in in Eastern Pacific	.0872826	.4330218	-1.32	1.24
Age of Ship	4.435262	4.423452	0	21
Experienced Captain	.047619	.2132411	0	1

D Empirical Appendix

In this appendix we report several further robustness checks that are discussed but not included in the main paper.

D.1 Summary Statistics

Tables 10 and 11 provide summary statistics for the journey between Manila and Acapulco and Acapulco and Manila, respectively.

D.2 Alternative Specifications

In Table 12 we employ departure date as an alternative explanatory variable. We obtain the same results as with late. The advantage of departure date as an explanatory variable is that it provides a continuous measure of how late a ship was to depart.

In the main text we report the results of a linear probability model for ease of interpretation. Table 14 replicates the structure of Table 1 in the main text, but reports the coefficients and log odds from a logit specification.

An alternative approach is to relax the ship effects, and employ an inverse-probability weighting estimator. The advantage of this approach is that it allows us to include ship-specific covariates such as tonnage and ship type. As shown in Table 13 the average treatment effect associated with late is positive and precisely estimated in all specifications.

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Table 12: Manila to Acapulco: The Relationship Between Departure Date and a Failed Voyage

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Departure Date	0.00318***	0.00313***	0.00319***	0.00329***	0.00336***	0.00335***
	(0.000990)	(0.000979)	(0.00109)	(0.00113)	(0.00112)	(0.00113)
Typhoon		0.0354	0.0486	0.00977	0.00462	0.00529
		(0.0677)	(0.0751)	(0.0703)	(0.0691)	(0.0712)
Western Pacific Temperature			-0.0263	0.0758	0.0967	0.0972
			(0.195)	(0.188)	(0.206)	(0.209)
Eastern Pacific Temperature			-0.0759	-0.0678	-0.0675	-0.0672
			(0.0815)	(0.0706)	(0.0694)	(0.0704)
Storm				0.285***	0.282***	0.282***
				(0.0952)	(0.0953)	(0.0956)
Years passed since first voyage					0.00441	0.00438
					(0.00735)	(0.00733)
Experienced Captain						-0.00439
						(0.0604)
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	364	363	250	250	250	250
Adjusted R^2	0.032	0.031	0.040	0.111	0.110	0.106

The number of observations shrinks in columns (3)-(6) because temperature data is only available from 1617 onwards. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 13: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage: Treatment Effects

	Shipwrecked or Returned to Port				
	(1)	(2)	(3)	(4)	(5)
ATE Late	0.118***	0.156***	0.138***	0.139***	0.139***
	(0.0301)	(0.0363)	(0.0345)	(0.0345)	(0.0345)
Typhoon		0.697***	0.720***	0.720***	0.733***
		(0.263)	(0.272)	(0.271)	(0.276)
Western Pacific Temperature		-1.458	-1.296	-1.288	-1.340
		(0.900)	(0.943)	(0.947)	(0.967)
Eastern Pacific Temperature		0.181	0.222	0.220	0.230
		(0.259)	(0.263)	(0.263)	(0.266)
Storm			0.299	0.301	0.300
			(0.286)	(0.287)	(0.288)
Years passed since first voyage			-0.0465**	-0.0465**	-0.0472**
			(0.0226)	(0.0226)	(0.0226)
Experienced Captain			-0.151	-0.154	-0.160
			(0.280)	(0.281)	(0.281)
Tonnage Estimate				0.0000222	0.00000929
				(0.000237)	(0.000242)
Galleon Dummy					0.0535
					(0.214)
Observations	674	448	446	446	446

The number of observations shrinks in columns (2)-(5) because temperature data is only available from 1617 onwards. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Figure 4: Lost and Returned Ships

(a) Manila to Acapulco (b) Acapulco to Manila

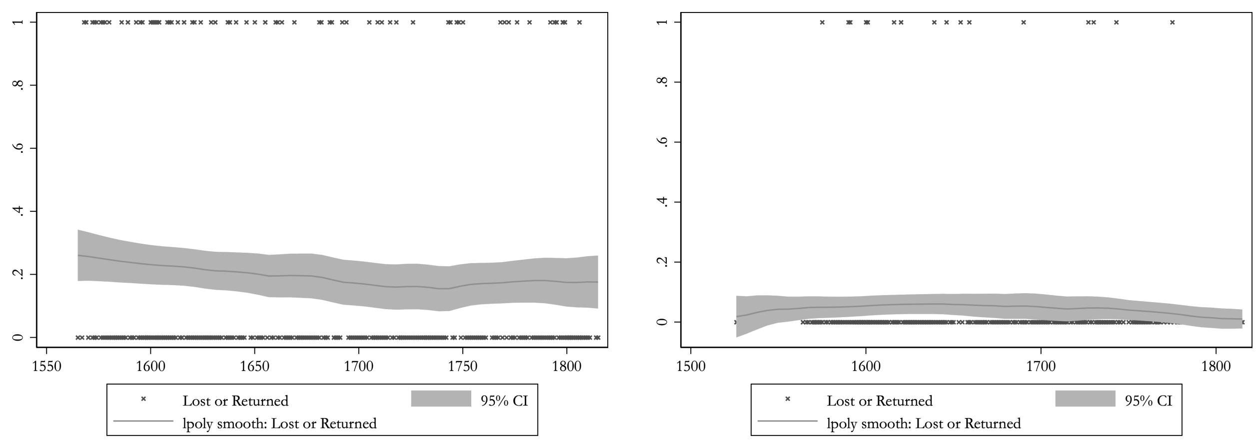

Table 14: Manila to Acapulco: The Relationship Between Departure Date and a Failed Voyage: Logit

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	1.417**	1.443**	2.276**	2.517**	2.743***	2.742***
	(0.597)	(0.589)	(1.127)	(1.034)	(1.040)	(1.034)
(Odds Ratio)	1.417**	1.443**	2.276**	2.517**	2.743***	2.742***
	(0.597)	(0.589)	(1.127)	(1.034)	(1.040)	(1.034)
Typhoon		0.425	0.362	-0.126	-0.193	-0.192
		(0.487)	(0.675)	(0.709)	(0.680)	(0.691)
Western Pacific Temperature			-1.078	-0.152	0.00665	0.00776
			(2.285)	(2.283)	(2.553)	(2.558)
Eastern Pacific Temperature			-0.814	-0.902	-0.961	-0.961
			(0.873)	(0.834)	(0.837)	(0.835)
Storm				2.523***	2.428**	2.427**
				(0.911)	(0.947)	(0.973)
Years passed since first voyage					0.0843	0.0842
					(0.0853)	(0.0863)
Experienced Captain						-0.0149
						(0.659)
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes
Observations	185	183	127	127	127	127
Pseudo R^2	0.125	0.129	0.165	0.255	0.264	0.264

The number of observations shrinks in columns (3)-(6) because temperature data is only available from 1617 onwards. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

D.3 Different Measures of Lateness

In Tables 15, 16, and D.3 we report the results of our baseline specification using several different measures of lateness. Specifically, in our main analysis we define vessels as late if they leave Manila after July 15th. In Table 15 we extend the definition of late forwards to July 19th and obtain very similar results as in the baseline specification.

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Table 15: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage: Different Measures of Late 1

	Shipwrecked or Returned to Port				
	(1)	(2)	(3)	(4)	(5)
	+ 1 Day	+ 2 Days	+ 3 Days	+ 4 Days	+ 5 Days
Late	0.153***	0.153***	0.144**	0.145**	0.135**
	(0.0583)	(0.0583)	(0.0598)	(0.0619)	(0.0584)
Storm	0.266***	0.266***	0.263***	0.262***	0.262**
	(0.0997)	(0.0997)	(0.0991)	(0.0994)	(0.100)
Typhoon	0.00117	0.00117	0.00225	-0.000882	-0.00607
	(0.0699)	(0.0699)	(0.0701)	(0.0707)	(0.0715)
Western Pacific Temperature	0.250	0.250	0.226	0.226	0.211
	(0.197)	(0.197)	(0.204)	(0.201)	(0.204)
Eastern Pacific Temperature	-0.0390	-0.0390	-0.0392	-0.0366	-0.0241
	(0.0660)	(0.0660)	(0.0662)	(0.0656)	(0.0650)
Years passed since first voyage	0.00456	0.00456	0.00404	0.00386	0.00437
	(0.00695)	(0.00695)	(0.00724)	(0.00739)	(0.00744)
Experienced Captain	-0.00841	-0.00841	0.00165	0.00154	-0.00222
	(0.0547)	(0.0547)	(0.0585)	(0.0586)	(0.0586)
Ship FE	Yes	Yes	Yes	Yes	Yes
Observations	284	284	284	284	284
Adjusted R^2	0.073	0.073	0.069	0.069	0.066

Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 16 extends the definition of late backwards to July 10th. Table 16 compares the coefficient on late when we define late as July 1 or July 30. Consistent with our expectations, we find that the coefficient on late becomes larger as one uses a later definition of what counts as a late departure.

D.4 Period Fixed Effects

In Table 19 we implement various period fixed effects. First in columns 1-2, we break the period of study into 50 year periods corresponding to 1550-1600; 1600-1650; 1650-1700; 1700-1750; 1750-1800; and 1800-1850. Next, in columns 3-4, we use century fixed effects. Third, in columns 5-6 we construct fixed effects corresponding to periods described by historians as being periods of expansion or decline. Specifically we use an indicator variable to distinguish: before 1640; 1640-1680; 1680-1760; and after 1760.

D.5 Governor and Viceroy

In Table 20 we introduce several institutional controls. As the Philippines was many thousands of kilometers away from Spain, there were frequent periods in which the governor appointed by the king was not yet resident. During those periods, interim governors were appointed. During other periods the Philippines was governed by its Royal Audiencia. We control for these periods in columns 1-2 and find that they had no effect on our variable of interest. Next we control for the identity of the Viceroy of New Spain (column 3). Finally, in column (4) we control for the identity of the King of Spain. This does not effect our variable of interest though it seems like in later periods, there were more failed voyages that are otherwise unexplained by our covariates.

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Table 16: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage: Different Measures of Late 2

	Shipwrecked or Returned to Port				
	(1)	(2)	(3)	(4)	(5)
	- 1 Day	- 2 Days	- 3 Days	- 4 Days	- 5 Days
Late	0.204***	0.194***	0.169**	0.167**	0.170**
	(0.0695)	(0.0707)	(0.0800)	(0.0828)	(0.0841)
Storm	0.268***	0.268***	0.264***	0.264***	0.265***
	(0.0962)	(0.0962)	(0.0970)	(0.0971)	(0.0971)
Typhoon	0.00355	0.00728	0.0116	0.0121	0.00771
	(0.0674)	(0.0667)	(0.0684)	(0.0685)	(0.0687)
Western Pacific Temperature	0.193	0.213	0.199	0.181	0.179
	(0.195)	(0.194)	(0.198)	(0.199)	(0.198)
Eastern Pacific Temperature	-0.0227	-0.0268	-0.0281	-0.0302	-0.0311
	(0.0632)	(0.0642)	(0.0644)	(0.0647)	(0.0651)
Years passed since first voyage	0.00625	0.00634	0.00622	0.00587	0.00609
	(0.00710)	(0.00716)	(0.00735)	(0.00748)	(0.00744)
Experienced Captain	-0.00108	-0.00222	0.00362	0.00670	0.00934
	(0.0545)	(0.0544)	(0.0564)	(0.0575)	(0.0578)
Ship FE	Yes	Yes	Yes	Yes	Yes
Observations	284	284	284	284	284
Adjusted R^2	0.087	0.083	0.072	0.070	0.070

Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 17: Manila to Acapulco: The Relationship Between Departure Date and a Failed Voyage: Different Measures of Late 3

	Shipwrecked or Returned to Port			
	(1)	(2)	(3)	(4)
	- 10 Day	- 15 Days	+10 Days	+ 15 Days
Late	0.184**	0.153*	0.197***	0.232***
	(0.0921)	(0.0876)	(0.0525)	(0.0555)
Storm	0.265***	0.258***	0.247**	0.254**
	(0.0942)	(0.0953)	(0.102)	(0.100)
Typhoon	0.00634	0.0162	-0.0158	-0.0127
	(0.0686)	(0.0690)	(0.0707)	(0.0698)
Western Pacific Temperature	0.140	0.136	0.265	0.253
	(0.194)	(0.198)	(0.205)	(0.207)
Eastern Pacific Temperature	-0.0383	-0.0324	-0.0241	0.00475
	(0.0654)	(0.0657)	(0.0648)	(0.0649)
Years passed since first voyage	0.00434	0.00444	0.00423	0.00489
	(0.00730)	(0.00736)	(0.00702)	(0.00669)
Experienced Captain	0.000178	-0.00849	0.00540	0.00408
	(0.0567)	(0.0571)	(0.0576)	(0.0579)
Ship FE	Yes	Yes	Yes	Yes
Observations	284	284	284	284
Adjusted R^2	0.073	0.064	0.092	0.106

Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Table 18: Explanations for Late Departures from Manila

	Late							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Storm	-0.0272	-0.0251	-0.0251	-0.0490	-0.0220	-0.0418	0.0185	0.0267
	(0.0973)	(0.0976)	(0.0955)	(0.0947)	(0.0985)	(0.0957)	(0.118)	(0.110)
Typhoon	0.101	0.104	0.102	0.0776	0.0918	0.0875	0.0518	
	(0.0792)	(0.0796)	(0.0803)	(0.0811)	(0.0839)	(0.0848)	(0.105)	
Western Pacific Temperature	-0.0835	-0.119	-0.106	-0.154	-0.125	-0.148	-0.0716	-0.0421
	(0.377)	(0.364)	(0.358)	(0.373)	(0.365)	(0.373)	(0.425)	(0.398)
Eastern Pacific Temperature	0.0473	0.0540	0.0500	0.0383	0.0418	0.0419	0.0556	0.0550
	(0.0754)	(0.0758)	(0.0769)	(0.0770)	(0.0729)	(0.0722)	(0.0872)	(0.0801)
Arrival Date	-0.000191							
	(0.000405)							
Pirates		0.101						
		(0.0889)						
Conflicts in Southeast Asia			-0.00457					
			(0.0581)					
Conflicts with England				0.179*				
				(0.105)				
Conflicts with Dutch					0.119			
					(0.0747)			
Total Conflicts						0.160*		
						(0.0852)		
Tax Value Chinese Ships							-0.00000701	
							(0.00000959)	
Tax Value Total								-0.00000517
								(0.00000554)
Ship FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	250	250	250	250	250	250	197	198
Adjusted R^2	-0.006	-0.005	-0.008	0.023	-0.002	0.020	-0.013	-0.009

Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

D.6 Panel Unit Root Tests

In our main analysis we employ a panel with a long T. It is natural in such a setting to be concerned about non-stationarity. As we note in the main text, we take confidence from Figure 4 which suggests that our main variables of interest are stationary. Nevertheless in this subsection, we subject this claim to more formal testing.

Specifically, as we have an unbalanced panel with gaps, the most appropriate panel unit root test is the the Fisher-type test proposed by Choi (2001). This test combines the p-values from unit root tests in each cross-section to test for unit roots in the panel. Table 22 reportsthe results of these tests. In all specifications we reject the presence of a unit root.

D.7 Serial Autocorrelation

Our knowledge of the historical setting does not lead us to anticipate serial autocorrelation. In this section, we test for the presence of serial autocorrelation more formally. Specifically, we report the results of Wooldridge's test for autocorrelation in panel data, the Arellano-Bond and the Cumby-Huizinga tests for autocorrelation. The former is implemented with the `xtserial command`, the Arellano-Bond test with the `abar` command; and the latter with the `actest` command.

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Table 19: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage: Different Fixed Effects

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.190***	0.185***	0.181**	0.178**	0.186***	0.177***
	(0.0700)	(0.0689)	(0.0692)	(0.0679)	(0.0648)	(0.0636)
Arrival Date	-0.000787***	-0.000697**		-0.000681**		-0.000796***
		(0.000294)		(0.000277)		
Storm	0.267***	0.268***	0.258***	0.260***	0.288***	0.282***
	(0.0963)	(0.0941)	(0.0935)	(0.0915)	(0.0935)	(0.0896)
Typhoon	0.0331	0.0299	0.0275	0.0230	0.0310	0.0275
	(0.0703)	(0.0672)	(0.0686)	(0.0659)	(0.0707)	(0.0659)
Western Pacific Temp.	0.0480	0.0967	0.0257	0.0915	0.0404	0.127
	(0.230)	(0.234)	(0.197)	(0.203)	(0.200)	(0.210)
Eastern Pacific Temp.	-0.0296	-0.0451	-0.0744	-0.0837	-0.0770	-0.0912
	(0.0724)	(0.0736)	(0.0737)	(0.0745)	(0.0742)	(0.0759)
Ship FE	50-year	50-year	100-year	100-year	Period	Period
Observations	240	240	250	250	249	249
Adjusted R^2	0.155	0.185	0.133	0.162	0.113	0.157
Time Period FE	Yes	Yes	Yes	Yes	Yes	Yes

Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 20: Manila to Acapulco: Late Departure and a Failed Voyage Controlling for Governor, Viceroy, and King

	Shipwrecked or Returned to Port			
	(1)	(2)	(3)	(4)
Late	0.195***	0.196***	0.197***	0.195***
	(0.0680)	(0.0670)	(0.0678)	(0.0664)
Arrival Date	-0.000791***	-0.000782***	-0.000797***	-0.000776***
	(0.000273)	(0.000277)	(0.000264)	(0.000257)
Storm	0.274***	0.286***	0.275***	0.264***
	(0.0920)	(0.0909)	(0.0911)	(0.0935)
Typhoon	0.00752	0.0149	0.00976	0.0102
	(0.0652)	(0.0668)	(0.0666)	(0.0673)
Western Pacific Temperature	0.114	0.0473	0.116	0.118
	(0.226)	(0.250)	(0.230)	(0.226)
Eastern Pacific Temperature	-0.0865	-0.0845	-0.0849	-0.120
	(0.0716)	(0.0710)	(0.0710)	(0.0763)
Years Since First Voyage	0.00632	0.00557	0.00199	-0.000318
	(0.00710)	(0.00668)	(0.00864)	(0.00668)
Experienced Captain	0.000262	0.00356	-0.000560	-0.00315
	(0.0599)	(0.0614)	(0.0593)	(0.0598)
Interim Governor	-0.0238			
	(0.0887)			
Audiencia Governor		0.135		
		(0.156)		
ID Viceroy of New Spain			0.0155	
			(0.0309)	
ID King of Spain				0.201**
				(0.0881)
Ship FE	Yes	Yes	Yes	Yes
Observations	250	250	250	250
Adjusted R^2	0.147	0.154	0.148	0.163

Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

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Table 21: Manila to Acapulco: The Relationship Between Late Departure and a Failed Voyage: Controlling for Tonnage

	Shipwrecked or Returned to Port					
	(1)	(2)	(3)	(4)	(5)	(6)
Late	0.140***	0.133***	0.135***	0.141***	0.134***	0.136***
	(0.049)	(0.047)	(0.047)	(0.049)	(0.046)	(0.047)
Typhoon	0.0662	0.0735	0.0712	0.0637	0.0719	0.0693
	(0.061)	(0.063)	(0.064)	(0.062)	(0.063)	(0.065)
Western Pacific Temperature	0.180	0.176	0.159	0.191	0.186	0.169
	(0.18)	(0.19)	(0.19)	(0.18)	(0.18)	(0.19)
Eastern Pacific Temperature	-0.0346	-0.0357	-0.0374	-0.0388	-0.0371	-0.0391
	(0.062)	(0.063)	(0.065)	(0.061)	(0.062)	(0.063)
Storm	0.297***	0.300***	0.297***	0.299***	0.300***	0.298***
	(0.083)	(0.083)	(0.083)	(0.083)	(0.082)	(0.083)
Tonnage		0.0000193	0.0000178			
		(0.000055)	(0.000054)			
Tonnage > Mean				0.0204	0.0201	0.0203
				(0.047)	(0.045)	(0.045)
Years passed since first voyage		-0.00620	-0.00628		-0.00617	-0.00624
		(0.0063)	(0.0063)		(0.0063)	(0.0063)
Experienced Captain			0.0266			0.0277
			(0.059)			(0.060)
Observations	250	250	250	250	250	250

This table establishes a positive relationship between late departures from Manila and failed voyages controlling for tonnage. Note that we cannot use ship fixed effects in this specification. Robust standard errors are clustered at the ship level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Table 22: Panel Unit Root Tests

Manila to Acapulco			
Variable	Test Statistics	P-value	Panels
Lost or Returned	107.8557	0.000	7
Late	47.4213	0.000	6
Storm	01.4696	0.000	7
Pirates or Buccaneers	89.4256	0.000	7
Typhoon	99.6638	0.000	7
Temperature in Western Pacific	43.6458	0.000	7
Temperature in in Eastern Pacific	78.4319	0.000	7

Acapulco to Manila			
Variable	Test Statistics	P-value	Panel
Lost or Returned	107.8557	0.000	7
Late	47.4213	0.000	6
Storm	01.4696	0.000	7
Pirates or Buccaneers	89.4256	0.000	7
Typhoon	99.6638	0.000	7
Temperature in Western Pacific	43.6458	0.000	7
Temperature in in Eastern Pacific	78.4319	0.000	7

This Table reports the test statistics from a fisher-type panel unit root test for our dependent and explanatory variables and the main control variables. All tests reject the presence of a unit root.

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D.8 Additional Figures

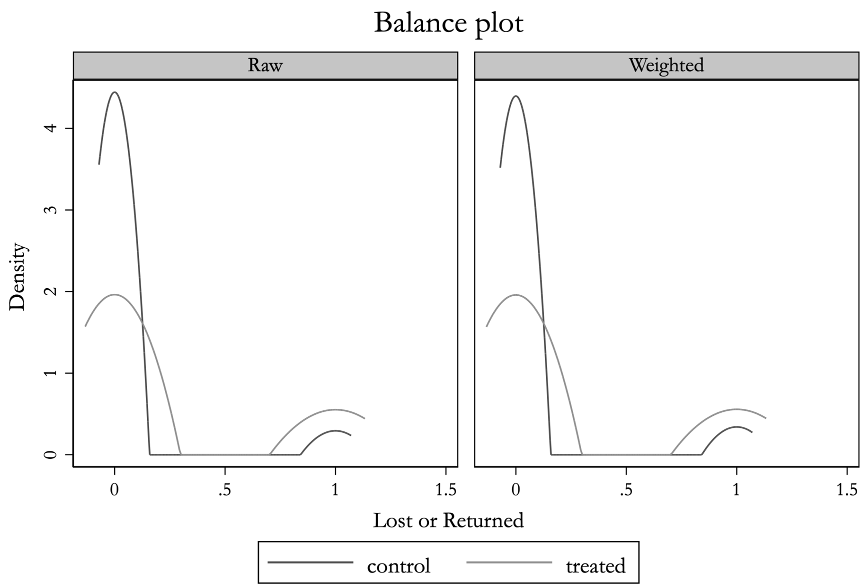

Figure 5: A deny plot depicting the inverse probability weighted estimates of being late compared to on time for Manila to Mexico.

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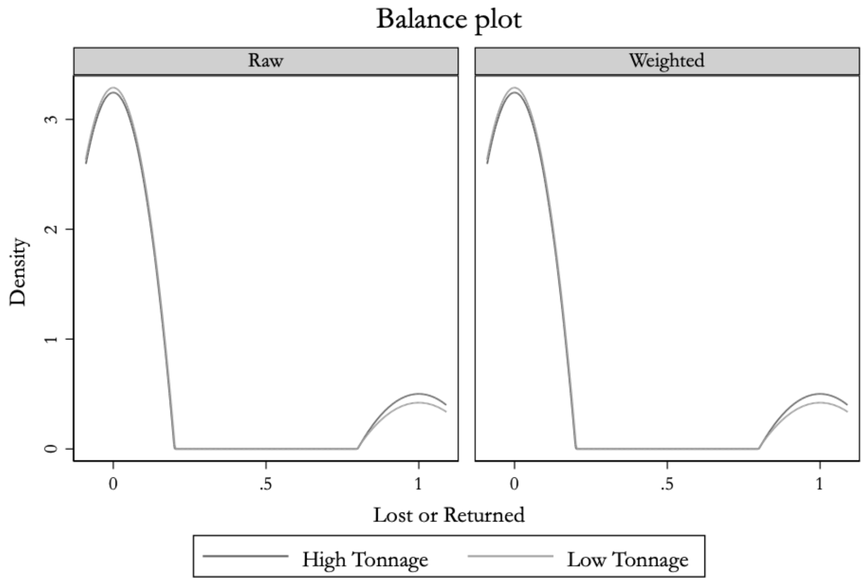

Figure 6: A density plot show that high tonnage and low tonnage ship were equally likely to be shipwrecked or returned to port.

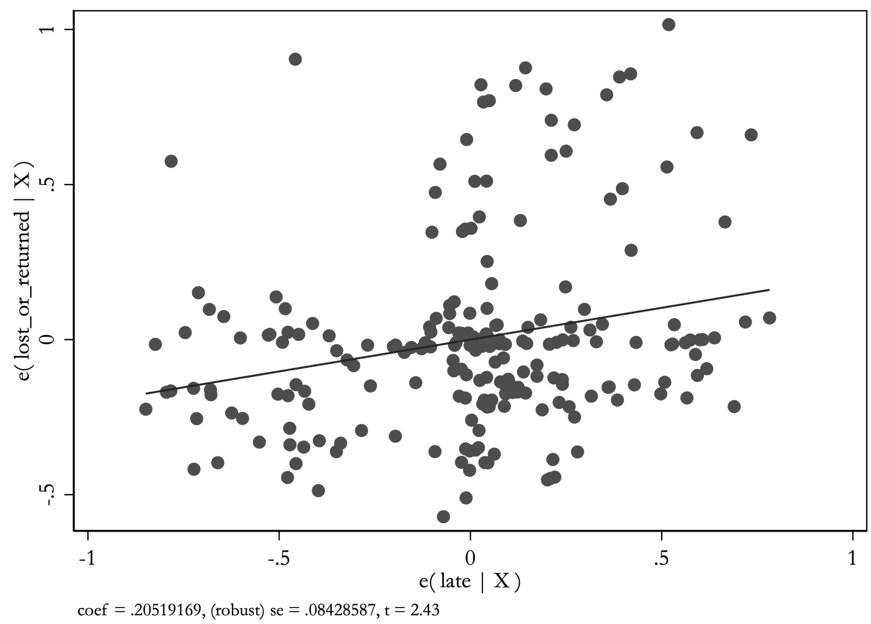

Figure 7: Average variable plot of our main specification (Table 1, col. 3)

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