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ABSTRACT: We use data from the natural experiment of the American offshore whaling industry to examine the causal effect of racial diversity on team performance. Teams consist of the crew operating onboard whaling vessels, and performance is measured by the value of the output captured during the voyage. Our identification strategy rests on the special characteristics of whaling voyages and exploits the richness of the data by including several fixed effects that address omitted factors. The results show that racial diversity's effect on performance is U-shaped. The nonlinear effect was transmitted negatively by conflicts and positively by creativity among the whalemen. Crews adapted to diversity over time, as the effect shifted from being strongly negative in short-term voyages to negligible in the medium-term and then to positive in long term voyages.

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1. Introduction

A fundamental recruitment objective commonly adopted by the U.S. government, educational institutions, and multinational corporations is to promote racial diversity in the workforce. This widespread objective is based on the belief that it is both the right thing to do and good for business performance. Despite its popularity, however, the empirical evidence supporting the positive effects on performance has been scant and inconclusive. Previous studies have been hampered by the difficulties of finding appropriate data and context for a systematic analysis and identifying the causal effect of racial diversity[1]. Given the tradeoff between the benefit and the cost of diversity, it is not obvious whether organizations promoting racial diversity would also perform better. With the increasing globalization and racial integration of labor markets, a central question in the economics and management literature is how the tradeoff between the benefit and the cost of diversity influences teamwork and team performance.

Economists have long recognized the externalities that stem from workplace diversity. In team production, greater diversity can have a positive impact by facilitating innovation, creativity, and knowledge spillover (Lazear, 1999a; Haas, 2010) especially when the task performed requires superior abilities (Hamilton et al., 2003). On the other hand, negative impacts can arise if language barriers lead

[1] For recent examples of the extensive interdisciplinary literature and different perspectives on the relationship between racial diversity and performance, see Banks and Whatley (2022), Bayer, et al. (2020), Ely and Thomas (2020), Herring (2009), Richard (2000), and Smulowitz, et al. (2019).

to communication problems (Marx et al., 2021) or higher diversity is associated with intergroup distrust or taste-based discrimination, which can lead to conflict and lack of coordination (Hjort, 2014).

The purpose of this paper is to study the causal effect of racial diversity on team performance at the firm level. To do this, we exploit data from the natural experiment of the American offshore whaling industry. In this context, teams consist of the crew operating aboard whaling vessels and performance is measured by the value of the output captured during the voyage. We examine how racial diversity was mediated negatively through conflicts and positively through creativity, which are the transmission channels responsible for the nonlinear shape of the estimated relationship. In addition, we examine the crew's adaptation to diversity over time by studying diversity's effect on performance across voyages of different duration.

The American whaling industry offers unique advantages in identifying the causal effect of racial diversity on team performance. Basic operations during voyage, especially in hunting and processing whales, required extensive teamwork and heterogeneous skills. Many of the usual endogeneity concerns raised by the selection of racial composition or choice of inputs do not apply in the context of the whaling industry. Each voyage was an independent operation, an ad-hoc economic enterprise that dissolved after the distribution of all proceeds upon returning to home port. Important managerial decisions were made by an agent before the beginning of the voyage. This included decisions regarding the destination, physical capital (e.g., vessel size and rigging, equipment, and provisions), and most importantly the crew. The racial composition of the crew was plausibly exogenous because members were recruited before the voyage, either indiscriminately in times of labor shortage, or specifically for the suitability of their skills and aptitude to sustain long periods at sea in times of labor surplus. Historical accounts of the crew recruitment process include no indication that agents systematically referred to race in hiring decisions or that they were actively seeking a certain level of diversity for a

higher moral, social, or economic objective (Creighton, 1995: Chapter 3; Gilje, 2004: 15-24; Hohman, 1928: Chapter 6; Nordhoff, 1856: Chapter 1). As with other inputs, the crew could not be changed in response to shocks to performance.

The importance and basic characteristics of the whaling industry support the external validity of our results. From colonial settlements into the twentieth century, whaling was an important industry in America. It ranked fifth in value among U.S. industries in mid-nineteenth century, thanks to the process of industrialization and urbanization that raised the demand for oil used for lubrication and illumination and for baleen used in the production of various consumer products. Each voyage was a complex profit-making enterprise (Davis, et al., 2007: chapter 7). Operations on the vessel required a significant amount of teamwork and cooperation by the crew, which consisted of a combination of high and low skill workers with well identified roles and ranks. Like modern firms, teams had organizational structures with vertical and horizontal division of labor. Most important, crews were multiracial and highly diverse, more typical of modern firms in the twenty first century than representative of contemporaneous industries.

To conduct our empirical analysis, we draw on a large number of data sources. Crew lists include the name, age, and residence of each voyage's whalemen, which can be used to identify them in other records. We combine the data available from the archival records of the whaling industry with information from the U.S. Federal Census enumeration schedules, the Seamen's Protection Certificate Database, and various sources on the names of native Americans employed in the whaling industry to determine the race of each crew member. Crew lists additionally include a visual description (skin complexion, hair and eye color) of the whalemen, recorded for identification at customs, which can also be used as proxy for race in our analysis. By determining the fractions of members in various racial categories, we calculate the standard index of fractionalization for each voyage as a measure of

diversity. Finally, the records provide detailed data regarding the performance of each voyage, including vessel characteristics (e.g., rig and size), the port and dates of departure and arrival, and output in terms of oil and whale bones obtained during the voyage, which we use to estimate the effect of racial diversity on total revenue.

Even though endogeneity concerns are minimal in the case of whaling crews, we cannot completely rule out the possibility of an endogenous relationship between racial diversity and team performance due to such things as selection effects in crew recruitment by the agents or in self-sorting to ports by the workers. To overcome these challenges, we exploit the richness of the data by including in the analysis several fixed effects that address omitted factors. We include an agent fixed effect to control for unobservable agent preferences for a specific racial composition of the crew. Similarly, to account for the possibility that levels of skill and prior whaling experience might be correlated with race, we include height as a proxy for skill, and experience among the crew. In the same vein, we include a fixed effect for the port of departure to control for systematic differences in labor supply due to race-based sorting of whalemen into specific port areas. We additionally include a fixed effect for the captain for two reasons. First, we cannot entirely exclude that he had some influence on the choice of crew members. Second, captains played a critical role in the success of the voyage through their skill in hunting whales and managing the crew, especially in handling the consequences of racial diversity. Including a captain fixed effect allows us to control for systematic differences between captains. Finally, we use information regarding the country of origin of crew members to generate an index of ethnic diversity to control for the potentially confounding effect of ethnicity on revenue.

This analysis offers three major novel results. First, thanks to our identification strategy we are the first to present robust estimates of the effect of racial diversity on team performance at the firm level. Furthermore, we provide evidence that the causal effect of racial diversity on team performance was U-

shaped. We find that while an initial increase in diversity induces a sharp decline in the value of output, higher levels of racial heterogeneity yield substantial gains.[2] This relationship is precisely estimated and robust across different specifications.

To assess the validity of our identification strategy and causal interpretation of results, we run several tests of robustness to alternative specifications. First, we test the consistency of the estimated nonlinear U-shaped relationship to alternative measures of racial diversity. When we replace the index of fractionalization by the share of black whalemen or use the Shannon index of entropy as a measure, our main results do not change qualitatively. In addition, we adopt an instrumental variable strategy by predicting racial diversity from the potential labor supply in areas surrounding whaling ports and separately run a falsification test by using a measure of diversity based on the initial letter of crew members. Both tests provide strong support for the causal interpretation of our results. Second, we discuss the robustness of the estimated results to alternative specification of the regression model. Importantly, the U-shaped relationship between racial diversity and performance remains qualitatively the same. Finally, we investigate whether this relationship is specific to our chosen measure of performance (voyage revenue), or it applies to other metrics. For this test, we repeat our main analysis by using total factor productivity of the whaling voyage as a measure of performance. The results reassuringly show that the estimated relationship is basically identical.

[2] For reviews of the economics literature, see Alesina and La Ferrara (2005), Alesina et al. (2016), and Ozgen (2021). See also Harrison and Klein (2007) for a review of the relevant management literature. Previous studies provide useful evidence for conceptualizing the performance effects of racial diversity at the team level. Taken together, three general possibilities emerge regarding the net effects of diversity. First, the net effect could be positive at all levels of diversity if the realized benefits in team creativity and creativity always dominate the cost of diversity generated by conflict and communication problems. Conversely, the net effect could be negative at all levels of diversity if the cost always exceeds the benefits. As the final possibility, the net effect could be nonlinear, depending on the level of diversity. For example, costs could dominate benefits at low levels of diversity, but the relationship could be reversed at high levels of diversity as benefits eventually exceed costs. This would result in a U-shaped relationship between diversity and net effect. Alternatively, the non-linear relationship could be hump-shaped if benefits dominate at low levels of diversity followed by rising dominance of costs at high levels.

Our second major finding concerns the mediating effects of conflicts and creativity. To understand the reasons for the U-shaped relationship between diversity and performance, we examine two channels of transmission that potentially worked in opposite directions. To analyze the negative effect of diversity, we focus on conflicts arising during voyages. Taste-based discrimination between groups may have led to a lack of trust and poor cooperation among crew members, causing social conflicts. Although our records do not have direct information regarding incidents of conflict during voyages, we can infer this information indirectly from the remarks entered in official records. Specifically, we use incidents of the premature departure and accidental death (e.g., due to desertion or getting lost at sea) of crew members as proxies for conflict during voyage. The results show suggestive evidence that more heterogenous crews experienced greater numbers of conflicts. Going in the opposite direction, for an analysis of the positive impact of diversity, we examine creativity among the crew in striking and trying whales. Since creativity might vary across subgroups of the crew, we distinguish among the categories of crew according to skill. The results indicate that racial diversity among the skilled members of the crew (skilled maritime and artisan and service personnel) had a positive effect on sighting, striking and trying out whales.

Third, our results show that crews adapted to diversity over time. Inspired by the observation made by Lazear (1999b) that diverse groups of individuals have strong incentives to assimilate more quickly, we investigate whether the effects of diversity varied over time. We explore this possibility by comparing the impact of diversity between similar voyages that differ only by their duration. Because crew members were compensated by a share of the value of the output at the end of the voyage, they had strong incentives to maximize compensation by coordinating efforts. Although conflicts could arise during the initial stages of a voyage due to discrimination and distrust as well as difficulty of communication, rational workers would progressively realize the negative effects of conflict on their

performance and eventually learn to set aside their differences, develop a common language, and collaborate toward a common goal. This would allow for the positive contribution of diversity to eventually outweigh the initial cost. We test this expectation by examining the relationship between diversity and performance during the short (less than 18 months), medium (19-35 months), and long (36+ months) term voyages at different levels of diversity separately. Our results indicate that racial diversity negatively affected revenue in short voyages, had a null effect in voyages of medium length, and had a strong positive effect in long term voyages. These results demonstrate that having more time allowed crews to grow accustomed to diversity's obstacles and gradually learn to take advantage of its benefits.

Our analysis contributes to the literature on the effects of diversity on performance at the firm level. We are the first, to our knowledge, to document the existence of a causal relationship between racial diversity and team performance at the firm level. Seminal contributions in this literature include microeconometric evidence on the negative effects of ethnic divisions on productivity at a plant in Kenya (Hjort, 2014); experimental studies of the adverse effects of national diversity (Lyons, 2017) and the effects of horizontal and vertical diversity on team performance (Marx, et. al., 2021); survey-based analysis of racial diversity's effect on firm productivity (Richard, et. al., 2007); field experiments that show the benefits of ethnic diversity in business outcomes (Hoogendoorn and van Praag, 2012); and analysis of the way the productivity of firms is negatively associated with the ethnic diversity of firms in Denmark (Parrotta, et al., 2014) and with the linguistic diversity of firms in Norway (Dale-Olsen and Finseraas, 2020). We contribute to this literature by providing empirical evidence from observable firms' behavior that took place in the historical natural experiment of the whaling industry for over a century. Some of the studies in this literature have used data from sports teams, for which information regarding certain worker characteristics (e.g., national origin) and team success (win ratio) is available. Analyses

include the way team performance has been impacted by cultural diversity in the UEFA Champions League (Ingersoll, et. al., 2017); cultural and language diversity in the U.S. National Hockey League (Kahane, et. al., 2013). Given the special characteristics of sports competition (e.g., repeated interactions, changing rosters), however, various endogeneity concerns arise in this setting, including the possibility of reverse causality, for example if higher productivity attracts teams with optimal levels of diversity between seasons, or if existing teams change rosters midseason to achieve optimal diversity.

In addition, this article's findings have important implications regarding the way diversity's effects on performance has varied across aggregate economic units of different size, ranging from small teams to larger ethnic groups, industries, cities, and countries. In the macroeconomic literature, researchers have recently found that ethnic diversity had a positive effect on the growth of small geographical areas (cells of fixed size) (Montalvo and Reynal Querol, 2021); genetic diversity had a similarly positive impact on various socioeconomic outcomes of high school students (Cook and Fletcher, 2018); racial diversity had a mixed effect on the aggregate productivity of U.S. industries (Sparber, 2009); and birthplace diversity had a positive effect on the GDP per capita of nations (Alesina, et al., 2016) and on the worker productivity of U.S. cities (Buchholz, 2021).

Although a vast economics and management literature exists regarding diversity's effects on the performance of firms, the findings have been confined mostly to a linear relationship. The economic literature provides evidence of nonlinear effects, but in limited contexts and without systematic analysis of transmission channels. Our results contribute to these studies by documenting the existence of a causal nonlinear U-shaped effect of diversity on team performance and by uncovering the transmission channels responsible for this shape. Closely related to our results is the finding by Ashraf and Galor (2013) that genetic diversity had a nonlinear hump-shaped effect on incomes at both the national and ethnic group levels. Our finding contrasts sharply with this literature as the effect seems reversed from

being hump-shaped in large economic units to being U-shaped in smaller (whaling) firms. Also focusing on macro units, Alesina et al. (2021) find instead a U-shaped relationship between the share of immigrant workers and altruistic behavior of the native population. At a micro level, the evidence is also mixed. For soccer teams, the type of relationship varies depending on league. A humped-shaped relationship is found between birthplace diversity and team performance in the German *Bundesliga* (Brox and Krieger, 2022), while the relationship is inverted in the Spanish *LaLiga* (Tovar, 2020). Our analysis thus contributes to this literature by raising the question of how and why the effect of diversity changes as the size of the unit falls or its characteristics change.

Finally, our analysis is related to the interdisciplinary literature on time-dependent group level effects of diversity. Researchers have recently argued that persistent exposure to diversity would reduce perceived group differences over time. As time passes, conflicts decrease, task coordination improves, and the positive contribution of diversity in terms of complementarities and cognitive ability outweigh its costs. For example, Bai et al. (2020) and Ramos et al. (2019) have observed that after an initial period where diversity is met with distrust, over time people adapt to diversity, negative effects dissipate, and positive outcomes emerge. Groups may solve communication problems caused by lack of common language by developing a simple language (Selten and Warglien, 2007). A field experiment in India shows that the negative effects of religious diversity disappear over time (Ghosh, 2023). Our results regarding the changing effects of diversity over the short, medium, and long time periods contribute to this literature by showing the precise manner in which whaling crews adjusted to diversity during voyage in isolation at sea.

2. Crew Diversity as a Natural Experiment in the American Offshore Whaling Industry

In this section, we provide a brief overview of the American whaling industry, the crew and teamwork on a voyage, and racial diversity of the crew.

The Importance of Whaling: A Brief Historical Overview

The early American commercial whaling industry had its beginnings in the inshore hunting ventures of the colonists in the Northeast in the seventeenth century. The industry soon developed boat whaling techniques of short-term duration (a few weeks) on vessels that grew in size over time. An important technological innovation that allowed long-term hunting in significantly extended areas was the transfer of the tryworks (i.e., furnace used to boil down blubber to oil) from shore to sea, installed right on the deck of the offshore whalers. This made it possible for American whalers based in the Northeast to hunt whales in not just the North Atlantic, but all over the globe, in voyages that could last several years.[3]

American whaling based on various ports in New England experienced a tremendous rise during the period of peace following the War of 1812. The industry kept growing through the first half of the century, dominating the world in terms of both the number of vessels and the total revenue from various whaling products. As seen in Figure 1, the total number of voyages that originated from New England ports reached a peak just before the civil war. The industry also grew by increasing vessel size, discovering new hunting grounds, and establishing additional operational ports (Davis, et al., 2007: 38-44). At its height during the middle of the nineteenth century, the industry was of great economic significance to New England and the United States as a whole. Thanks to the process of industrialization and urbanization, there was high demand for sperm and whale oil used in lubrication and illumination.

[3] For early accounts of the industry's history, see Hohman (1928), Nordhoff (1856), Starbuck (1877), and Tower (1907). See also Busch (1994), Creighton (1995), Davis, et al. (2007), and Dolin (2007) for various modern perspectives.

The whale baleen (plates of cartilage inside the mouth for filter-feeding system) was also in high demand as a flexible yet strong material, the plastic of that time, used in the production of various consumer products like corsets and umbrellas. In value of output during this period, whaling was estimated to be the fifth among U.S. industries (Davis, et al., 2007: Ch. 4). After the Civil War, however, industry entered a period of sharp decline and eventual disappearance. The start of the decline coincided with the invention of kerosene in 1846, a distillate from coal, and the discovery of petroleum in Pennsylvania in 1859. These alternatives produced a brighter light than a traditional sperm oil lamp. Other reasons include the destruction caused by the Civil war, by hand of Confederate Navy, rising wages in other industries that attracted skilled workers, increasing cost due to decreasing whaling population, and rising importance of other regions (Davis, et. al., 1988).[4]

The Crew and Teamwork on a Voyage

Economic historians of American whaling have typically viewed each voyage as a separate firm.[5] As estimated by Davis et al. (2007: 381-2), over three-quarters of ownership groups of vessels lasted only a single venture. Even for groups that continued multiple ventures, each voyage was practically a separate firm because it typically required the choice of a new destination, provision of new supplies (e.g., food and drink), refitting of the vessel with new equipment (e.g., sails, harpoons, whaleboats), and recruitment of new crew and management. The duration of voyages could vary significantly from one venture to the next depending on visited hunting grounds, success of the campaign, and navigation

[4] Overall, scholars attribute the contraction of the industry to supply-side pressures that prevailed over the reduction of the population densities of targeted whales (Davis, et al., 2007: Ch. 4). Indeed, technological innovation was the leading factor for the declining demand for whaling products. The development of kerosene, together with other cheap petroleum distillates, replaced whale oil as an illuminant and lubricant (Beaton, 1955), while the invention of steel made whale baleen obsolete (Davis et al., 1988).

[5] See, for example, Davis, et. al. (2007: p. 381) and Hilt (2006: p. 203).

decisions taken for the most part by the captain. Because of high turnover and variability between ventures, the firm had to be liquidated anew virtually after every voyage.

Owners of a vessel typically hired an agent to plan and manage the voyage, though the agent could also be a part owner. The agent's role involved most aspects of the voyage, including recruiting the crew including the captain to manage the operation at sea, gathering investors to finance the venture, and handling various business matters regarding the purchase of supplies, payment of bills, sales of products, and distribution of proceeds. The plans for the voyage began with the choice of hunting grounds. This implicitly determined the type of vessel, specifically its rigging and its capacity or tonnage, and the size of the crew needed to operate it. Distant grounds required longer voyages with bigger vessels (e.g., ship or a bark), which consequently involved hiring additional crew with specific expertise, such as a carpenter or a blacksmith. It was normally the responsibility of the agent to hire the crew and negotiate their compensation. Although the agents sometimes delegated this responsibility to captains or recruiters, they nevertheless closely monitored the process (Hilt, 2006; Davis et al., 2007, Ch.10).

Operational decisions at sea were made exclusively by the captain. His primary responsibilities were to manage the crew, navigate the vessel, and locate and hunt whales. In long voyages, he would also be charged with refitting the vessel, hiring replacement crew, and purchasing additional supplies, as necessary. In addition to a captain, each vessel had at least two mates who assisted in directing operations. Similar sized vessels typically had the same crew structure. The specialized personnel included service workers such as a cook and a steward, skilled marine professionals like boatsteerers and harpooners, and several artisans such as a cooper and a blacksmith. The remaining crew was comprised of several unskilled workers called seamen or greenhands.[6]

[6] For detailed descriptions of whaling crews, see Davis, et. al. (2007: Chapter 5) and Hohman (1928: Chapters 6-7)

In nineteenth century offshore whaling, the actual hunt by the crew took place on smaller whaleboats that were kept on large vessels. Propelled and steered by oars, whaleboats provided greater maneuverability than the vessel in chasing whales.[7] Upon sighting and approaching a whale, the captain and mates would command the chase on lowered whaleboats, each packed with gear and additionally staffed by a harpooner and most of the crew to pull oars and join the hunt. In the pursuit that followed, teamwork was essential to striking and killing a whale, while staying alive and unharmed, because of the uncertainties of hunting a large live animal and the obvious dangers of surrounding conditions at sea (Davis, et. al.: Chapter 5). The mate acted as boatheader and directed the boat toward the back of the whale by operating on the steering oar. After the whale was approached, the harpooner cast one or two harpoons and secured the whale to the boat. He then exchanged places with the mate, who stabbed the whale with his lance to kill it. If a whaleboat's crew were successful, they would tow the carcass to the vessel before it could be eaten by sharks and process it, another critical task that required effective teamwork. This implied cutting through the skin, removing the blubber, and boiling it in an onboard tryworks to make the oil and store it tightly in casks.

Racial Diversity in the American Whaling Industry

A well-known distinguishing characteristic of the American whaling industry was the high degree of racial diversity among the crew. A typical mid-nineteenth century crew consisted of not just white men from the dominant demographic of New England towns, but also native Americans from various local tribes and numerous black men, including runaway slaves, from all parts of the country. In addition, the

[7] Whaleboats could also use sail to chase a whale at distance. See Davis, et. al., (2007: pp. 283-94) for the hunting technology on whaleboats.

voyages drew an international mixture of men from a variety of places around the world, including Europe, West Indies, Pacific Islands, and the Azorean and Cape Verde islands in the Atlantic.

Distinctive crew diversity in American whaling has attracted significant attention in the historical literature. In his seminal economic analysis of the American whaling industry, Hohman (1928: 51) observed that "[s]eldom have so many widely assorted specimens of the human family been packed into such small spaces as the forecastles of the latter-day whaleships." Numerous historians have studied the unique features of the racial and ethnic diversity of whaling voyages in the context of broader debates in U.S. history (Raffety, 2008). Noting that blacks constituted as much as one-fifth of American mariners in the early nineteenth century, Bolster's (1997) influential *Black Jacks* argued the crucial importance of seafaring in the history of the black community. Similarly, Shoemaker (2015) focused on the Native Americans of New Bedford area and used various archival records to show how race mattered in various social settings that Indian seamen found themselves in.[8] Finally, a recent special ethnographic report commissioned by the National Park Service has provided a detailed analysis of various racial and ethnic groups in the New Bedford area by tying mariners from these groups to the histories of their communities (Handsman, et. al., 2021).

The Exogeneity of Crew Diversity

Contemporary accounts of recruitment in American whaling indicate that high levels of racial diversity were an unintended consequence of historical circumstances rather than a planned outcome of a selection process. Selection to the data was not random, but the level of diversity on a particular vessel was as good as randomly assigned rather than deliberately chosen by the agent, captain, or hired

[8] See also Mancini (2015a, 2015b) for studies of Indian mariners of Connecticut and southern New England in the eighteenth century, based on colonial census schedules, customs records, and tribal documents.

recruiters based on race. This is supported by descriptions of the recruitment process by historians and contemporary observers. Gilje (2004: 15-23), for example, describes the way men, individually or in groups, joined the crew of certain ships through various channels, including personal connections, upon hearing that hands were wanted, visits to organized places of enrollment like sailor boardinghouses in ports, and encounters with specialized offices of recruitment in big cities like New York and Philadelphia. Descriptions of these channels show numerous interesting episodes of hiring, but no evidence of systematic race-based recruitment. The correspondence of agents, for example, shows that in times of labor shortage they were always busy trying to staff their vessels with the next person that showed up to sign on. When there was a surplus of applicants, as was the case during the economic crises of 1837 and 1857, they were screening based on suitability for open positions and fitness for the difficult life on a whaling voyage, rather than deliberately choosing among potential recruits based on certain racial characteristics to enhance or reduce diversity.

Mid-voyage changes to the crew were likewise made as necessitated by an unexpected illness, desertion, or death, rather than to enhance racial diversity deliberately. Some voyages picked up seamen *en route* in distant islands, such as during reprovisioning stops in the Portuguese archipelagos of the Azores and Cape Verde. This may seem to present a source of potential endogeneity if, for example, a captain sought to recruit additional crew during these stops for the sole purpose of diversifying the crew. Our review of the historical literature and industry records, however, indicate that seamen recruitment *en route* was mostly aimed at filling positions left vacant unexpectedly. For example, Charles Petty, captain of the vessel Aerial, picked up four new seamen in Fayal in August 1851, three months after departure from Fall River, Massachusetts, to replace the same number of men who had left or were discharged for various reasons. In most cases, replacements were young and inexperienced males eager to sign on to whaling voyages to escape slavery, military recruitment, or miserable conditions at low rates of

remuneration (Handsman, et. al., 2021: 300-303). In any case, except for unusual circumstances of unexpected disaster on board, the numbers of new men recruited *en route* were too small to have significant impact on crew diversity as a whole.

Although historical accounts suggest that levels of racial diversity observed in American whaling were not deliberately chosen by hiring agents, we cannot completely rule out the possibility of selection bias in recruitment. For example, agents might have differed in unobserved or unconscious race-based preferences in recruitment, captains might have differed in terms of their abilities to manage race-based conflicts, or whalemen might have self-sorted into departure ports based on racial patterns of migration and settlement. To account for such possibilities of selection bias, we include in our analysis various fixed effects, as detailed in our identification strategy discussed in section 5.

3. Data Sources

For our analysis we use data from multiple sources. The first is the American Offshore Whaling Crew Lists database. It includes the crew lists for whaling voyages recorded at the customs houses in New Bedford, Fall River, and Salem, Massachusetts, and in New London, Connecticut. Before a vessel could depart on a voyage the captain had to produce a list of the crew and give an account to the customs collector at the port of departure if any crew members were not present. The original crew list database includes over 177,000 entries for nearly 6,000 voyages. For each person on a voyage, the database includes their name, age, residence, and a physical description in terms of height and colors of skin, hair, and eye. Additional information regarding rank, compensation (lay), and places of birth and citizenship are also available for some voyages.

The second main source is the American Offshore Whaling Voyages database (Voyage database), which consists of detailed information regarding all of the voyages taken by the American whaling industry in the 1800s for which records were available (for a description see Lund et al., 2008). For most voyages the database includes the port of origin and the declared destination (i.e., hunting grounds), the name and basic characteristics (e.g., capacity and rig) of the vessel, the dates of departure and return,[9] and whether it ended prematurely due to fire, sinking, condemnation, or other reasons. The database also includes the names of the agent and the captain of each voyage, and the total amount of the catch (whale bone, sperm oil, whale oil) brought back or sold *en route*. Typically, the products were returned to the port of origin aboard the whaling vessel. However, when voyages lengthened, part of the cargo could be transferred to freighters or other whaling vessels to be shipped home (Lund et al., 2008).[10]

Although the Crew List and Voyages databases provide sufficient data for the analysis of racial diversity's effect on team performance, they do not include all the information required for the analysis of potential mechanisms. For additional information, we turn to our third source of data, which is the American Offshore Whaling Logbook database. This covers a subset of the voyages included in the Voyages database and provides detailed information regarding the hunt and the catch of the enterprise as recorded in the original whaling logbooks (for a detailed description see Smith et al., 2012).[11] Based on the logbooks of 1,381 voyages departing mainly from New England ports, the Logbook database

[9] The voyage database includes the month of return for about seventy percent of the voyages. To reduce the number of the missing information we proceed in two steps. First, we recover more than five percent of the missing months from the Report to the Congress of the Commissioner of Fish and Fisheries (United States Commission of Fish and Fisheries—Report of the Commissioner for 1875–76). The remaining missing months of return are imputed using an ordered logistic regression using the available months, rigging type, port of departure, destination, vessel tonnage and year of departure.

[10] Researchers from the World Whaling History project have tracked most of the amounts shipped to the home port (Lund et al., 2008). The product entries in the database are representative to the total output of the voyage (personal communication with Judith Lund, advisory curator and lead researcher on the project, May 2022; and our own investigation).

[11] As detailed in the overview section of the Logbook database, the research projects were conducted by Lt. Cmdr. Matthew Fontaine Maury in the 1850s, Charles Haskins Townsend in the 1930s, and a team from the Census of Marine Life project between 2000 and 2010.

includes geocoded- and date-specific information regarding the location of the vessel and whether at this location any whales were seen, captured, and tried out.

Likewise, the Crew List database does not contain complete information regarding the race and ethnicity of all whalemen. Therefore, as our final set of sources, we draw external data from the U.S. Census enumeration schedules, the Registers of Seamans' Protection Certificates, and various other sources. For this, we start with the information regarding the name, age, and residence of the whalemen recorded in Crew Lists and merge with external data regarding the race and ethnicity of crew members, as detailed below and in Appendix A.

Although the original Voyages dataset and crew lists include information for about 15,000 voyages and 119,000 crew members, we do not have complete overlap across the three data sources for all voyages. After merging the data from all sources, the final dataset includes a total of 4,407 voyages made by 1,045 vessels over the period 1807 – 1912.[12] Out of these, 257 vessels made a single voyage, more than 50 percent completed at least five voyages, and about 10 percent completed fourteen or more voyages. Over the entire sample, voyages lasted on average a little more than 27 months. A typical voyage employed a large vessel, a Ship or a Bark, on average with a considerable cargo space of 277 tons and a crew of 27 men.

4. Measuring Diversity

In this section, we describe briefly the procedures we used in constructing indices of racial and ethnic diversity for each voyage. A more detailed description can be found in Appendix A.

[12]We keep all voyages for which we have race information for at least 10 crewmen.

Racial Diversity

Since none of our sources provide comprehensive data regarding the race of all crew members, we combine information from multiple sources to determine whalemen's race with a high degree of certainty. We use a stepwise procedure for this task, starting with sources that include the most direct and definitive information regarding race and continuing with those that provide this information indirectly. Specifically, we determine race in four steps, using information from the enumeration schedules of the 1850-80 U.S. Censuses, the lists of native whalemen compiled by researchers, the physical characteristics of crew members entered in official records, and the information regarding the birthplace and residence of international crew. Since this procedure gives us multiple opportunities to determine the race of each whaleman, we use conservative criteria in each step to avoid misidentification.

The most direct and reliable source regarding race are the enumeration schedules of the U.S. Censuses. Since individual-level schedules started with the 1850 census, we used the enumeration schedules of the U.S. Federal Censuses of 1850-1880, which include the names and race (blacks and whites, but not native Americans during this period) of all individual residents. The difficulty in matching the whalemen in our records with the names of individuals recorded in census schedules lies in mistakes and variations in the spellings of names and places of birth and residence. This is essentially the same type of difficulty that historians have faced in matching the same individuals between two or more different censuses. Therefore, we adapted from the algorithms that researchers have recently developed to account for the variation in the spellings of names and locations in census records (Abramitzky et al., 2020; Berkes et al., 2022). For a highly conservative criteria to minimize errors, we used the birthyear (within 2 years), the first and last names, and the state and city of residence of

whalemen for the match. This method allowed us to identify the race of 2,902 whalemen with a high level of certainty.

Since the enumeration schedules of the U.S. Censuses of this period did not identify the native Americans, in the next step we turned to the literature on the history of New England natives employed in the whaling industry. Particularly useful in this regard were the databases of native whalemen compiled by Shoemaker (2015) and Handsman, et. al. (2021). Generated from a variety of sources, including oral histories as well as official records, these databases contain valuable information regarding 946 native whalemen. Since some of these individuals went on multiple voyages, we were able to use this information to identify 4,119 native crew members in our lists.

In the next step, we used information regarding the physical characteristics of whalemen from the American Offshore Whaling Crew Lists database and the Registers of Seamans' Protection Certificates. Although these records do not contain direct information regarding race, they nevertheless have columns for verbal descriptions of skin and hair (for customs purposes), which several historians have previously used to infer race.[13] Building upon their lead, we adopted a conservative procedure, detailed in Appendix A, designed to determine the race of some of the remaining whalemen indirectly by exploiting information contained in descriptions of skin and hair. Matching this information with our records allowed us to infer the race of an additional 78,185 whalemen, again with a high degree of certainty.

Finally, we turned to whalemen for whom the information used in the first three steps was missing. This was clearly the case for international crew who were not enumerated in U.S. Censuses and for whom information regarding skin and hair was somehow not entered in official records. For some of these individuals, the records nevertheless included their places of birth and residence, which can be

[13] See, for example, Bolster (1997), Craig and Fearn (1993), Malloy (1990), Pariseau (2015), and Putney (1987).

used to infer race indirectly, albeit possibly with less certainty. Whalemen who were born in certain regions of Africa, West Indies, and Cape Verde Islands, for example, could be considered as being black. Likewise, we could lump together in the "other" category the whalemen who were from the Pacific Islands, East Indies, and places in Asia or Latin America. This strategy yielded estimates of the race of an additional 6,659 whalemen.

Overall, our four-step strategy allowed us to determine the race of 91,865 individuals, over three-quarters of the crew included in our records. We categorized race broadly into four simple categories: Black, Native, White, and Other (Asian, Hispanic, East Indian, Pacific islander). For each voyage we calculated the well-known fractionalization index as a standard measure of diversity that has been commonly used by researchers in similar analyses. This index is based on the shares of crew members belonging to different race groups (e.g., Alesina et al., 2016). Formally, fractionalization of the crew in voyage *v* is defined as

$$FRAC_v = 1 - \sum_j^J m_{jv}^2, \qquad (1)$$

where m_{jv} is the population share of the j^{th} racial group. This index is a measure of the probability that two randomly drawn individuals on a voyage were not from the same racial group.

Ethnic Diversity

We used a similar procedure to calculate the index of ethnic fractionalization for each voyage. Specifically, we determined the birthplace of each whaleman as recorded in the American Offshore Whaling Crew Lists database and the Registers of Seamans' Protection Certificates. We categorized individuals into 11 broad groups based on the geographic location of their birthplace, namely Africa, Asia, Central America, East Indies, Europe, North America, Oceania, Portuguese Islands, Pacific

Islands, South America, and West Indies. For each voyage, we calculated the shares of crew members belonging to these groups and the resulting index of fractionalization based on the formula given in (1) above. Similar to racial fractionalization, the index of ethnic fractionalization is an estimate of the probability that two randomly drawn individuals within a voyage were not from the same birthplace region group.

Diversity Over Time

We can use the calculated fractions of each category and the overall indices of fractionalization to observe how racial and ethnic composition of whaling voyages changed over time. As seen in Figure 2, crews were dominated by white whalemen throughout the entire sample period, 77 percent on average. Black whalemen consisted of 17 percent of the entire crew, and natives only 5 percent. However, in the early 1800s native American and black whalemen were also representing a sizeable part of the crew. The white share rose in the early nineteenth century, up to around eighty percent between the 1820s and the 1870s, but eventually declined. The proportion of black whalemen fell below twenty percent until the late 1870s, but then rose considerably afterwards. The change in the ratios of black and white whalemen in the 1870s was likely an outcome of the greater mobility of black men after the civil war.

Figure 3 shows how the two measures of diversity changed over time. After significant fluctuations in the early nineteenth century, the index of fractionalization declined gradually and settled around 0.3 from 1830 to about 1870. Contemporaneously, ethnic fractionalization rose to 0.2 and stayed at that level until the mid-1860s. Both measures of fractionalization grew after the 1860s, as whaling crews became more diverse racially and ethnically. In the following years, while racial diversity remained somewhat constant, ethnic diversity fell sharply after the 1890s.

5. Empirical Strategy.

In this section, we describe the empirical strategy adopted to investigate the causal effect of racial diversity on team performance. We start by outlining the production function, which includes standard inputs and a productivity shock that will allow us to consider the effect of crew racial diversity. To address remaining endogeneity concerns, we additionally include several fixed effects as our identification strategy.

Specification

To investigate the possible effects of labor diversity on performance, we employ the following general expression:

$$Y_{it} = f(K_{it}, L_{it}, S_{it}; \omega_{it}), \qquad (2)$$

where Y_{it} is the total revenue from whaling products captured by vessel *i* during voyage departing at time *t*. $f(\cdot)$ is the production function, where K_{it} denotes the tonnage of the vessel, a measure of the physical capital, L_{it} is the crew size, and S_{it} denotes the duration of the voyage.[14] As discussed above, decisions regarding the vessel and the crew are made prior to departure, which implies that capital and labor demands are predetermined. The duration of the voyage is determined as a result of the day-to-day decisions made by the captain in response to random events faced *en route*. The objective for the voyage was to maximize output and consequently revenue. Revenue maximization was consistent with the incentives of the crew because each member, including the captain, was paid a share (a lay) of the total

[14] The production process is joint in inputs, i.e., it requires all inputs to produce all outputs, because of the complementarity between whale oil and baleen, it is not possible to distinguish the input allocated to the production of each output. We further assume that prices are homogeneous for the New England region and the market is perfectly competitive.

revenue. The term ω_{it} denotes the unobserved productivity shock that occur throughout the duration of the voyage.

Consider the case where the function $f(\cdot)$ is a Cobb-Douglas production function. Adding an unobservable random shock, we obtain:

$$y_{it} = a + \beta^L l_{it} + \beta^K k_{it} + \beta^S s_{it} + \omega_{it} + \eta_{it}, \quad (3)$$

where the lower-case letters stand for the log values of their upper-case variables. We capture the effect of racial diversity through its impact on productivity, which can be expressed as follows: $\omega_{it} = g(\delta_{it}; \boldsymbol{\beta}^{\boldsymbol{\delta}}) + \boldsymbol{\mu}\mathbf{X}_{it}$, where the term δ_{it} is diversity, measured by the index of racial fractionalization calculated as described in equation (1), $\boldsymbol{\beta}^{\boldsymbol{\delta}}$ measures the impact of racial diversity on team performance, and $\boldsymbol{\mu}\mathbf{X}_{it}$ are exogenous factors described in the next section. To capture the nonlinearity in the relationship between crew diversity and productivity, we define the function $g(\cdot)$ with a quadratic form: $g(\delta_{it}; \boldsymbol{\beta}^{\boldsymbol{\delta}}) = \beta_1^{\delta}\delta_{it} + \beta_2^{\delta}\delta_{it}^2$.[15] Thus, β_1^{δ} and β_2^{δ} are our parameters of interest. The term $\mathbf{X}_{it}$ indicates a vector of factors that can affect team performance. We discuss these factors in detail in the following section.

Identification Strategy

Historical accounts suggest that the racial composition of the crew was not considered by agents at the time of hiring. Nevertheless, the identification of the impact of racial diversity on team performance

[15] There are only few examples in the literature of nonlinear effects of genetic diversity or national origin on socio-economic outcomes and sport team performance (Ashraf and Galor, 2013; Alesina et al., 2016; Galor, 2022; Tovar, 2020). We are not aware of studies documenting racial diversity having nonlinear effect on productivity or other socio-economic outcomes.

remains challenging because of the potential presence of factors that may be correlated with racial diversity and determine performance which could then bias our estimates.

First, there may still be selection effects in recruitment by agents. The agent oversaw the planning of the voyage and was responsible for hiring the crew and negotiating their compensation. It is possible that the agent preferred to hire crew members of a specific race because of taste or to choose a specific racial composition of the crew to avoid conflicts during the voyage. We include agent fixed effects in the analysis to account for these unobservable preferences. It is also plausible that the agent hired and rewarded with higher lays whalemen depending on the level of their skills or their experience. If members of a certain race accumulated greater experience by being on more voyages, choosing crew based on experience would indirectly imply a selection bias in racial composition of the crew, which would bias our estimates. To remedy this potential bias, in one of our empirical specifications we include the average number of voyages crew members accumulated in the industry up to the current voyage. Similarly, whalemen of a particular race might have possessed systematically higher skills than others in certain tasks. To separate the effect of inherent skill from race, we additionally control for the mean and the standard deviation of the height of the whaling crew. [16]

Second, selection effects in racial composing may also occur because of self-sorting to ports by whalemen. Motivated by the search for better economic opportunities, individuals from different backgrounds and abilities possibly migrated into areas with higher labor demand or with an already established communities of similar ethnic and racial identities. If workers sorted into the area surrounding departure ports based on their ability or productivity, this would have led to non-random assignment of immigrant workers to ports. We include a fixed effect for the port of departure to control

[16] Although we have no expectation about the relationship between whalemen height and skills, the economic literature shows that height is positively associated with both cognitive and noncognitive skills (Case and Paxson, 2008; Lundborg et al., 2014) as well as leadership (Lindqvist, 2012).

for the potential resulting correlation between racial heterogeneity of the labor supply at the home port and the productivity of the voyages departing from it.

Conditional on the choices made by the agent, the day-to-day operational decisions at sea were made exclusively by the captain. Captains had a major impact on productivity. Focused on navigation and crew management, they had absolute power to choose the necessary means to incentivize the crew and raise effort during the voyage. While whaling captains were excellent seamen and navigators, they were probably heterogeneous in their ability to manage crews of different races and to handle conflicts amongst whalemen and therefore obtained different performance from their teams. We include captain fixed effects to control for this potential bias.[17]

Lastly, we consider the relationship between racial and ethnic diversity and the possibility that racial diversity's effect on revenue could be obscured by the ethnic diversity of the crew. To control this effect, we include a measure of the ethnic fractionalization of the crew, calculated from the places of birth and residence of the whalemen, as described in section 4.2. This allows us to identify the effect of racial diversity conditional on the ethnicity of the crew.

Based on these considerations, our empirical model starts with a baseline specification in which $\mathbf{X}_{it}$ includes fixed effects for the agent, captain, and home port. These fixed effects constitute the basis of our identification strategy. We also add fixed effects for the hunting ground visited by the vessel during the voyage interacted by year of departure to control for the variation in the availability of whales across oceans and over time.[18] The latter subsumes a year fixed effect that accounts for industry-wide

[17] Captains also had limited leeway to change the crew during a voyage, for instance by picking up seamen while visiting distant islands. This occurred only when one or more members of the crew died, deserted or was discharged from duty. If the captain preferred racially diverse crew to enhance performance and accordingly sought to deliberately diversify the crew during voyage, this would undermine the presumed exogeneity of crew diversity. In our data, there is only a handful of voyages in which such events were reported.

[18] Indeed, exogenous natural factors influence the spatial distribution of whales, which also impact productivity.

technological change. We also include fixed effects for the rig type of the vessel (e.g., bark, ship), which controls for differences in size, maneuverability, and power, features that are not captured by cargo tonnage.[19] In the subsequent specifications, we address the remaining concerns related to the possible endogeneity of the measure of racial diversity by adding an index for ethnic fractionalization, mean crew experience, mean and standard deviation of the height of the whaling crew.

6. Results

Table 3 presents the results from estimating regression (3) weighted by the number of voyages taken by the same vessel to account for the fact that some vessels appear much more than others in the data and with standard errors clustered at the port level. We present estimates from five specifications, which, as described in the previous section, include different sets of fixed effects and control for potential confounding factors, to identify and precisely estimate the effects of racial diversity.

There are three main findings from our estimates. First, there is strong evidence for the existence of a highly significant nonlinear effect of diversity. Second, the estimated quadratic relationship takes a U-shaped form with a minimum well identified within the sample. Third, the point estimates for both linear and quadratic terms of diversity are statistically significant and consistent across all specifications. Column 1 shows the estimates for our baseline specification, which includes rig and hunting ground-by-year fixed effects, but most importantly, agent, port, and captain of departure fixed effects. These account for the choices of hiring agents, sorting of the labor force, and management skills that are potentially correlated with the race and matters in the production process. Estimates imply that a 10

[19] In several cases the same vessel could be rebuilt to alter its tonnage or rerigged in a more productive configuration, for instance to improve maneuverability or to extend the potential duration of the voyage and thus allow access to new hunting grounds (Devis et al., 2007; Chapter 8). Section A.3. in the Appendix provides further details on vessel types.

percent increase in diversity for a highly homogenous crew, in the 5th percentiles of the diversity distribution (*FRAC*=0.067), is associated with a decrease in revenue by 0.55 percent; while a 10 percent decrease in diversity for a highly diverse crew, in the 95th percentile of the distribution (*FRAC* =0.56), is associated with a 2.83 percent decrease in revenue.

Adding controls for ethnic fractionalization and experience of the crew has negligeable effects on the estimates, as seen in columns 2 and 3. The effect or racial diversity on performance is still U-shaped, with a minimum estimated at racial fractionalization level of 0.373. This means that voyages in which there is a 37 percent chance that any two members of crew are of different race perform the worst. In column 4 we present estimates after adding the mean height of the crew to separate the effect of skills from race. This increases the absolute magnitude by about eight percent, while the quadratic term is virtually unchanged. However, because the height of the crew is not consistently reported for all voyages in the data, the number of observations is substantially reduced, and the relationship cannot be precisely estimated when clustering the standard errors. To check whether the difference in the magnitude is not caused just by the difference in sample size, we re-estimated the specification by controlling for ethnicity and experience using the smaller sample of voyages. Column 5 shows consistent results, indicating that the estimates of the effect of racial diversity presented in column 3 are not biased by the presence of unobserved skills of the whalemen.

Figure 4 displays the predicted relationship between log of revenue and crew racial fractionalization. Starting from a perfectly homogenous crew, raising racial diversity reduces total revenue, possibly due to rising conflicts associated with taste-based discrimination, as we study in more detail below in our analysis of mechanisms (Hjort, 2014). Revenue continues to decline as teams become increasingly more diverse, until it reaches a minimum at the fractionalization level of 0.373. Thereafter, further increases in racial diversity among the whalemen improve revenue. These results

suggest that beyond a certain level the benefits associated with diversity outweigh the costs, likely due to the declining number conflict incidents and the rising levels of cooperation and creativity. Interestingly, while the in-sample prediction indicates that the revenue is the highest for a homogenous crew, extrapolating the estimated relationship out of sample suggests that performance would increase to even higher levels if racial diversity were to keep increasing, as seen in Figure A.1. Specifically, at very high levels of diversity, specifically when fractionalization level exceeds 0.739, the benefits arising from diversity would largely overcompensate its costs and lead to maximum performance. Later in the paper we discuss potential mechanisms in detail.

Balance Test

To investigate the validity of our identification strategy, we conducted a series of balance tests. Specifically, we regressed vessel tonnage, rig type (bark, bring, schooner, and ship), voyage destination or hunting ground, two additional inputs (crew size and voyage duration), crew experience and skill on the fractionalization index used to measure racial diversity. Based on the dependent variable, the empirical specification also includes ethnicity, and the full set of fixed effects used in the baseline model. Regressions are weighted by the total number of voyages taken by the same vessel over the sample period, and standard errors are clustered at home port level. Figure 5 reports the estimated coefficients and the 95 percent confidence intervals for the fractionalization index of each regression. These results show that racial diversity does not explain any of the covariates included in our model, and thus it is unlikely to be correlated with unobservable factors. Passing the balance test provides support for our identification strategy and the quasi-random nature of racial diversity.

7. Robustness Tests

In this section we report several checks that are used to provide support for the causal interpretation and the robustness of our main results.[20] Specifically, we run three sets of robustness tests. First, we focus on replicating the main analysis by using alternative definitions of the measure of racial diversity, namely predicted racial fractionalization (based on an instrumental variable strategy), the share of black whalemen, the Shannon index of entropy, and a placebo measure of diversity. Then, we run robustness tests to investigate the sensitivity of our results to different specifications of the regression model. We do this by adding a quadratic term for ethnic fractionalization, controlling for the shares of black, native, and other whalemen, excluding the period of the Civil War from the analysis, and expanding the sample to voyages with less than ten crew members. Lastly, we estimate the effect of racial diversity on total factor productivity as an alternative measure of team performance.

7.1 Alternative Measures of Racial Diversity

Instrumental Variable Approach

To remediate potential remaining endogeneity concerns, we adopt an instrumental variable (IV) strategy established in the literature (e.g., Parrotta et al., 2014; Alesina et al., 2016). Specifically, we rely on an instrument that reflects the potential labor supply, distinguished by race, in the area surrounding the ports from which voyages depart. Considering that transportation in the 19th century was somehow more difficult, especially outside large urban centers, it is safe to assume that most of the whalemen were hired locally. Therefore, the racial composition of the voyage crew is likely to be strongly correlated with racial diversity in the labor supply faced by hiring agents. Moreover, each voyage

[20] Sensitivity to the different specifications for the falsification and robustness tests are presented in tables A.2-A.5.

employed a small portion of the available supply, hence agents were likely to hire whoever was available to ship with their vessel. Based on this consideration, we instrument racial diversity with an index that is constructed using pre-existing population of white (non-white) for the counties nearest to each departing port weighted by the total of white (non-white) whalemen employed in all voyages leaving from that port. The index is computed as follows:

$$\sigma_{jkt} = \frac{population_{jk\,(\text{census year})}}{\sum_j^J population_{jk\,(\text{census year})}} \times\ employment_{jkt}, \qquad (4)$$

where $population_{jk\,(\text{census year})}$ is the population of race *j*, for *j* = (white, non-white), recorded in the census as living in the three counties that are closest to port *k*. Starting with the census of 1790, we use population data from a census with a five to fourteen-year lag.[21] The variable $employment_{jkt}$ denotes the employment of whalemen of race group *j* at port *k* for voyages departing in year *t*. So, (4) denotes the sailors of race group *j* employed in whaling voyages departing from port *k* in year *t* weighted by the available workers of race group *j* and resident in area adjacent port *k* well before departure time *t*. We used this to calculate the fractionalization of whaling workers as $1 - \sum_j^J \widetilde{m}_{jkt}^2$, where $\widetilde{m}_{jkt} = \sigma_{jkt}/employment_{kt}$ is the *j*-th share, white/non-white, of all sailors located near port *k*. This is the main instrument used for the racial fractionalization index. To this we also add whaling agent fixed effects. An agent oversees the planning of the voyage, hiring in particular. Including these fixed effects allows us to control the agent's preferences with regard with the composition of the hired crew.

The second column of Table 4 shows that the IV estimates are consistent with the OLS estimates for our preferred specification, presented in the first column. This indicates that conditional on the full

[21] For instance, population recorded in the 1850 census is used to predict living population in the years 1855-1864. It should be noted that the census did not record natives and non-residents. Thus, the non-white population reflects essentially only African Americans. Non-white employment instead also includes natives and individual of other races. We believe that a five- to fourteen-year lag provide sufficient time such that diversity in pre-existing labor supply at the port is not correlated with labor demand when hiring decisions were made.

set of fixed effects, ethnicity, and experience, the OLS estimates of the relationship between racial fractionalization and team performance have a causal interpretation.[22]

Share of Black Crew

The fractionalization index considers the shares of all racial groups. Here we analyze the question of whether it is the share of black whalemen, the largest group, that could be driving the results. To do this, we re-estimate our preferred specification by replacing the fractionalization measure by the share of the crew that is of black race. The results indicate that the relationship between racial diversity and performance is still U-shaped, but it is not precisely estimated. Only the linear term is statistically different from zero. Also, the magnitude of both terms is about half of those obtained by using the index of fractionalization. Furthermore, the estimated minimum is about forty percent higher than the baseline. These findings suggest that our results regarding the effect of racial diversity on performance cannot be explained by the share of black whalemen alone.

Shannon Index

We also investigate whether the U-shaped relationship between racial diversity and performance is specific to the use of the fractionalization index. To do this, we adopt an alternative measure of racial diversity, the Shannon index of entropy (Shannon, 1948), which has been used extensively as a measure of biological and population diversity in economics and natural sciences (e.g., Ginsburgh and Weber,

[22] The F-statistics of the first-stage regressions are 31.74 for the linear term and 12.77 for the quadratic term. The first-stage regression estimates for the linear term of fractionalization are 0.859*** for the linear term of the instrument, and -0.445* for the quadratic term of the instrument. The first-stage regression estimates for the quadratic term of fractionalization are 0.441*** for the linear term of the instrument, and -0.155 for the quadratic term of the instrument.

2020; Parrotta et al. 2014; Whittaker, 1972).[23] We re-estimated equation (3) by replacing the index of fractionalization with the Shannon index. Column 4 of Table 4 shows the results, which are once again consistent with the U-shaped relationship between racial diversity and team performance. Point estimates are not directly comparable with those from the main analysis given that the Shannon index is not confined to a [0-1] range.

Placebo and Falsification Test

We check whether our estimated relationship is nonspurious by replacing the measure of racial diversity with a diversity measure based on last name initials instead of race. Specifically, we classify crew members based on the initial letter of their last names, thereby creating four groups: A-C, D-J, K-R, and S-Z. Unlike full names, letter initials of last names are conceivably uncorrelated with race. Thus, a fractionalization index based on this measure should not be related to team performance. To test this, we re-estimated our preferred specification of equation (3), with the full set of fixed effects, by substituting the index of fractionalization with the placebo measure based on the first letter of whalemen's last names. The last column of Table 4 presents the results. As expected, we find no relationship between this placebo diversity measure and team performance. The results from this falsification test of diversity convey additional credibility to our main results presented for comparison in the first column of this table.

7.2 Alternative Specifications

[23] The Shannon index is calculated here as $SH_{it} = -\sum_j^J m_{it;j} \ln m_{it;j}$, where $m_{it;j}$ is the population share of the j^{th} racial group for voyage *it*.

We proceed by investigating the robustness of the results to alternative specifications of the regression equation. Results are presented in Table 5. First, we introduce a quadratic term for ethnic fractionalization, column 2. The magnitude of the coefficients characterizing the U-shaped relationships are consistent although slightly larger in magnitude and more precisely estimated. The estimated minimum is somewhat lower than for our preferred specification.

Then, in column 3, we control for the shares of the crew of black, native, and other races, explicitly in the regression. By doing this, the effect of racial fractionalization is now conditional on the proportion of whalemen that are of non-white races. The estimated coefficients are now smaller (in absolute value) and less precisely estimated, which leads to a higher estimated minimum for the U-shaped relationship.

Third, we test whether our results depend on the unique circumstances of the Civil War. As seen in Figure 3, ethnic and racial fractionalization increased considerably during and around the Civil War. Part of the results could thus be driven by the large variation caused by the unique nature of this event if the effects of fractionalization on performance are significantly different during this period. Confederate cruisers destroyed more than fifty whaling vessels during the war. Moreover, the city of New Bedford, the main whaling port, sunk nearly forty old whaling vessels at the entrance of Southern harbors to block shipping.[24] To check the sensitivity of our results to these circumstances, we re-estimate our model by excluding voyages that departed during the Civil War period (1861-1865). As seen in column 4 of Table 5, the results are consistent with those obtained over the entire sample period in our baseline analysis. The point estimates are larger in absolute value indicating that the damage caused during the war had an impact on the industry and changed the effect of race on team performance.

[24] Historical accounts reported on a webpage of the New Bedford whaling museum (https://www.whalingmuseum.org/learn/research-topics/whaling-history/yankee-whaling/, accessed in May 2023.

Finally, for the last robustness test, we re-estimate our preferred specification by extending the sample to all voyages for which we have data, rather than those for which race information is available for at least ten crew members. This allows us to gain an additional twelve hundred observations. The estimated coefficients are smaller, but they still show the existence of a U-shaped relationship between racial diversity and team performance.

7.3 The Effect of Racial Diversity on Productivity

We investigate whether the estimated nonlinear effects are specific to using total revenue as the outcome variable or apply to an alternative measure of economic performance, namely productivity. Since racial diversity is a determinant of productivity shocks in our empirical model (equation 3), we want to study how it affects productivity of a voyage directly. To do this, we use the proxy estimator suggested by Levinsohn and Petrin (2003) with the Ackerberg–Caves–Frazer (ACF) correction where the state variable is physical capital, denoted by tonnage, the free variable is labor, denoted by crew size, and the intermediate input is the duration of the voyage (see Ackerberg et al., 2015, for details).[25]

We employ this method to estimate a simpler version of our Cobb-Douglas production function, which includes only voyage duration as intermediate input and crew size and tonnage as main inputs. This function is used to calculate total factor productivity (TFP), indicated by ω_{it} in equation (2). TFP is then regressed on our function for racial diversity, $g(\delta_{it}; \boldsymbol{\beta}^{\boldsymbol{\delta}})$, while controlling for ethnic diversity and the same set of fixed effects as in our main analysis, namely those for the agent, captain, port, rig type,

[25] This method is used in the literature to address the potential endogeneity of input choice. The fact that in our setting all inputs are chosen to maximize profits on an information set that is independent of the productivity shock is consistent with the assumptions on which ACF approach is based. That is, capital is decided before labor, which is chosen before the productivity shock is realized, and the intermediate input is proportional to the output. The latter assumption ensures that the production function is identified for gross outputs.

and hunting ground-by-year. This method is analogous to the "reduced form" approach used in Parrotta et al. (2014).[26]

Table 6 shows the results. We find the effect of racial diversity on productivity to be, as before, nonlinear and U-shaped. The point estimates are consistent with those in our main analysis although the magnitude of the coefficients is larger. Nevertheless, the estimated minimum is essentially identical.

8. Understanding the Mechanisms

We now examine the potential mechanisms contributing to the estimated nonlinear relationship between diversity and performance in the whaling industry. Specifically, we study how both negative, (e.g., from reduced trust and cooperation) and positive (e.g., through ingenuity and creativity) effects may dominate in either direction to reconstruct portions of the U-shaped relationship we estimated with our preferred specification. This is done by including the linear term for diversity to investigate the overall contributors of the estimated relationship, namely the costs (through conflicts) and benefits (through creativity) associated with racial diversity.

Conflicts

We start by investigating the costs related to diversity by focusing on conflicts during the voyage. Conflicts reduce cooperation or coordination among the crew, having a negative impact on team performance. Although the records include no direct information regarding conflicts on board, we can infer this information indirectly from annotations entered in Crew Lists. Captains were legally required

[26] Estimates for the implied TFP are obtained using the Stata command `prodest`, developed by Rovigatti and Mollisi (2018).

to report on the whereabouts of their crew and offer an account of what happened if someone did not return (Davis et al., 2007; Ch.3). For instance, if someone was discharged for illness or another cause in a foreign country the local consul had to consent to this action in writing (Davis et al., p.81). Given this, we can use as proxies for conflict the number of cases in which a whaleman did not return to the home port because he was lost at sea, discharged, drowned, or deserted/left.

In our records this information is available in the form of remarks in the Crew List database. The database includes the remarks for only a small fraction of the voyages, and not all remarks provide information regarding why a whaleman did not complete the voyage with the rest of the crew. Because we do not know whether the remaining voyages did not experience such incidents or they were simply not reported, we decided to keep only the voyages for which we have information relevant to estimating the effect of racial diversity on the occurrence of conflicts among the crew members. Consequently, this left us with conflict information for less than 10 percent of the voyages, a sample of 418 observations with more than 70 percent of the sample with multiple incidents of whalemen not returning from the voyage.

We estimate the effects of diversity on conflicts using a regression as close as possible to our preferred specification, but where the outcome variable is either the number of whalemen who was lost at sea, discharged, drowned, or deserted/left during voyage of vessel *i* that departed in year *t*. Given the small sample size, we do not include agent or captain fixed effects, in vector $\mathbf{X}_{it}$. Table 7 presents the results for the correlations between fractionalization and the four different indicators for conflict. Based on the expectation that diversity's impact on conflict might differ between races, we present the results separately for the whole crew and we also distinguish between the white and non-white crew members.

Overall, the results support the argument that greater diversity led to rising levels of conflict during voyage, though racial groups experienced these effects differently. The coefficient of "Lost at Sea" is

positive and highly significant in all groups, indicating that higher levels of diversity are associated with a larger number of crew members being lost at sea in general, and for each racial group. The magnitude of the coefficient for white whalemen, however, is three times as much as that for non-white crew members, an indication of greater impact on conflict targeting the former group.

Table 7 also shows that higher fractionalization is positively correlated with the number of discharged whalemen, white and non-white alike, though estimates are not statistically significant. Whalemen were discharged for causes due to their fault (e.g., disobedience and insubordination) or for no fault of them (e.g., sickness). When the discharge was unlawful, complaints could be brought against the captain (examples of such cases can be found in Sprague, 1861). Given the considerable burden, the captain would have discharged any member of his crew only because of an important reason, such as critical illness or serious misconduct.[27] The similarity in the magnitudes of the coefficients suggests that increased diversity had about the same effect on the misconduct of both groups.

We find suggestive evidence that racial diversity affects the number of drownings, but only for the entire crew. Regarding incidents of whalemen failing to return due to desertion or that simply left the voyage, we find that diversity's impact on such incidents differed between the two racial groups. Diversity is negatively correlated and insignificant with incidents of desertion for white whalemen. It is instead positive and strongly significant for non-white whalemen. One reason why crew members could desert was that onshore economic opportunities at the locations visited during the voyages could be more favorable than on the whaling vessel.[28] Another was that life on board could become so unbearable for some that they had no choice but leave, and instead join a different crew or just quit whaling altogether. More than three quarters of all desertions were by white crewmen. This is not unexpected

[27] About 26 percent of the reported discharged were due to sickness.
[28] Desertion implied the entire forfeiture of wages (Davies et al., 2007; p157).

considering that they could earn higher wages in shore-based employment, and onshore opportunities for alternative employment were constrained for black sailors (Davis et al., 2007; p.186). So, while the relative wage between onshore-onboard were more favorable to white than non-white crewmen, remuneration onboard of the whaling vessel was more (economically) egalitarian.[29] This suggests that non-white crewmen must have had strong non-economic incentives to abandon the voyage. We speculate that conflicts were the main reason why non-white whalemen abandoned the voyage, probably in search of a less hostile environment. The opposite effect seems to apply for white men. For them, diversity and desertion are negatively correlated, even though the relationship is not precisely estimated. We posit that white whalemen realized the added value of the skills of a more heterogenous crew, which increased the opportunity cost of leaving the voyage. For this to be true, the size of the diverse crew should be large enough to have a significant effect on the opportunity cost.

Overall, these results indicate that racial diversity is correlated with the occurrence of episodes that can be interpreted as symptoms of tension or friction within the crew. Although the results differ somewhat between racial groups, the statistically significant coefficients are all positive, supporting the argument of a strong correlation between diversity and conflict during whaling voyages.

Creativity

To investigate the benefits of diversity, we turn to the potential benefits from creativity that can arise from racially diverse crew during whaling voyages. In analyzing the consequences of the globalization of firms, Lazear (1999a) has argued that greater diversity in multi-cultural teams might impose a cost to communication, but the benefits via differences in background or information complementarities would

[29] Craig and Fearn (1993) do not find evidence of a considerable wage differential between white and black seamen (or minorities).

be sufficiently high to offset these costs. Moreover, gains from diversity would be higher when teams have abilities that are disjoint and are relevant to one another. Expanding on this framework, Parrotta et al. (2014) have drawn attention to the way benefits of diversity might depend on the types of tasks and occupational groups. For example, the benefits of creativity might differ between routine and problem-solving tasks and be generated differently between teams of unskilled and highly skilled workers. These insights have an important implication for our analysis. They suggest that we should differentiate both among the distinct tasks involved in whaling and among the distinct abilities involved in these tasks. Indeed, the mediating effects of diversity might differ, for example, across different stages of hunting a whale, depending on the relative importance of routine versus problem-solving skills in each task.

For an empirical analysis of the mediating benefits of racial diversity in whaling, we use data from the Logbook database. As discussed above, this database includes detailed information regarding the hunt and onboard processing of whaling products for a smaller subset of the voyages included in the all-inclusive Voyages database. The Logbook database shows for each date the crew's involvement in three stages of hunting a whale that required considerable teamwork and group effort, specifically whether on that date a whale was sighted, struck, and tried out or processed. To examine the relationship between the crew's success at these tasks and its racial diversity, we divided the overall crew of a voyage into two distinct groups. The first group consists of all highly ranked whalemen, consisting of officers (the captain and his mates), specialized maritime workers (e.g., boatsteerers, ship keepers, and captain's apprentices), artisans and service providers (e.g., coopers, carpenters, blacksmiths, sailmakers, and service personnel like the cook and engineers). The second group consists of remaining unskilled and semi-skilled seamen, such as greenhands, boys, and other ordinary crew members.

After merging these data with the voyage characteristics and restricting the data to voyages for which we have rank information for at least ten crew members, the final sample including the logbook

data contains 110 voyages. Summary statistics for tonnage, voyage duration, and crew size statistics are comparable to those included in the Voyage database (Table 2); although the logbook sample seems to include slightly larger vessels undertaking longer voyages. Indeed, the share of Ships, the larger rig, is higher. On average, the crew on these voyages is less diverse than in the larger sample (0.314). Looking at diversity within rank, skilled (highly ranked) crew members are the most diverse group because it includes the most diverse rank represented by artisans and service personnel.

For this analysis, we estimate a regression as close as possible to our preferred specification, but where the outcome variable is either the rate of sighting, striking, or trying out whales during voyage of vessel *i* that departed in year *t*. To be consistent with the analysis on the conflict mechanism, we control for the log of crew size, vessel tonnage, and voyage duration. In addition, we include port of departure, rig type, and hunting grounds-by-year of departure fixed effects. To this we also add ethnic diversity and the experience of the crew. Table 8 shows the results of the estimation of the relationship between crew diversity and success in hunting whales, examined separately for the two tasks of striking and trying out the whales and the two skill-level groups. The dependent variable is the number instances in which a whale was sighted, harpooned (struck) or processed (tried out) during a voyage divided by the duration of the voyage, in months. The table shows the coefficients and standard errors of the key variable of interest, the index of fractionalization, corresponding to the relationship between each group's racial diversity and task performance.

The results are consistent with the mediating benefits of racial diversity via the channel of creativity discussed in the previous literature. Overall, team diversity has a positive impact on all the phases of the production process for the skilled group (officers, maritime, artisan, etc.), indicating that the benefits of diversity in these tasks rose among skilled whalemen. The coefficient of the fractionalization index is statistically insignificant for the ordinary seamen for sighting whales, which is not surprising given that

an experienced whaleman was entrusted to be at the lookout. This indicates that gains from diversity are not realized when teams have no skill, or skill sets that are similar (i.e., non-disjoint) and not relevant to one another, consistent with Lazear's (1999a) argument.

However, racial heterogeneity among unskilled workers has a positive effect on trying out whales that is half of the magnitude as the one for skilled workers. This indicates that the contributions of the two groups were independent of the skill level for these tasks, but racial diversity is associated with benefits even for more menial tasks.

9. Adaptation to diversity

The preceding discussion showed the mediating effects of diversity through negative correlations with conflicts and positive correlations with creativity. Put together, these arguments support the main finding of a U-shaped relationship between racial diversity and team performance.

For a different empirical approach to understanding this shape, in this section we explore how team members adapted to the negative effects of racial diversity over time. This approach is based on the observations of Ramos et al. (2022) and Bai et al. (2022), who argued that people adapt to diversity over time due to repeated contact with outgroup individuals. Consequently, as societies become more diverse, distrust and conflict dissipate, and positive outcomes emerge.

A whaling voyage presents a useful quasi-experimental setting that offers the conditions that would allow us to test this hypothesis. Voyages typically involved long periods of forced interaction among the crew in close quarters. As described in Davis et al. (2007; section 2.6) crewmen lived and worked in tight areas, as most of the space on the vessel was taken up by cargo and supplies. For sleeping, unskilled crewmen (seamen and greenhands) shared the small, dark, and fetid forecastle. Skilled crewmen, such as coopers and boatsteerers, had better conditions, but still little space. Working

conditions were also extremely difficult due to the inherent dangerous nature of the hunting process and ocean sailing.

The impact of these conditions on teamwork and cooperation could vary over time. Initially, they could lead to greater conflicts among more diverse crews because of taste-based discrimination. However, as whalemen continued to live in close proximity to each other, however, they might have the opportunity to develop bonding. It is therefore conceivable that conflicts could arise in the short run as diversity increased, especially for more diverse crews, but repeated interaction over time could allow the benefits generated by a diverse background to dominate over the initial costs. We test this argument by investigating how the effect of crew diversity changes with the length of the voyage, and whether such effects also depend on the level of diversity itself. To do this, we interact the terciles of the duration of the voyage with the terciles of the index of racial fractionalization in a regression based on the same specifications estimated in the main analysis, regression (3). Differently from before, for this analysis, the function $g(\cdot)$ takes the following form:

$$g(\delta_{it}; \boldsymbol{\beta}^{\boldsymbol{\delta}}) = \sum_j^3 \beta_j^{short}\, \delta_{it}^j \times 1(\text{duration is in the } Shortest \text{ third of all voyages})$$

$$+ \sum_j^3 \beta_j^{Medium}\, \delta_{it}^j \times 1(\text{duration is in the } Medium \text{ third of all voyages}) \qquad (4)$$

$$+ \sum_j^3 \beta_j^{Long}\, \delta_{it}^j \times 1(\text{duration is in the } Longest \text{ third of all voyages}).$$

where the term δ_{it}^j is the *j*-th tercile of the index of fractionalization: *j* = (*Low, Medium, High*), with *Low* = [0-0.260], *Medium* = [0.261-0.405], and *High* = [0.406-0.667]. The terciles of the distribution of the

time spent at sea for the voyages in our sample is the following: *Short* = [1-18 months], *Medium* = [19-35 months], and *Long* = [36+ months].[30]

Table 9 shows the estimates where each different column presents results. We uncover three important findings. First, in short voyages racial diversity is associated with significant costs. These effects appear to be stronger at higher racial diversity. This confirms the intuition that with racial heterogeneity the initial impact is dominated by intergroup conflict, with a net negative effect on team performance. However, when tested, the coefficients are not statistically different from each other. Second, in voyages of medium length diversity had no on team performance at any level of diversity. That suggests that the initial costs were offset by the rising benefits of diversity, developing over time thanks to the mixing of individuals with different races. Third, for longer voyages, over 36 months, we find that diversity among workers generated sufficiently high benefits of diversity to exceed the cost and have a net positive effect on performance, with particularly strong effects at medium levels of fractionalization.

These three results provide support for the hypothesis that over time extended intergroup contact helped to mediate the initial cost of diversity and allowed benefits to arise as suggested by the literature both in economics (Lazear, 1999a) and psychology (e.g., Ramos et al., 2022). Furthermore, they provide an additional mechanism contributing to the existence of a nonlinear U-shaped relationship between racial diversity and team performance.

[30] The reference is the term Medium Racial Fractionalization × Medium Voyage Duration, so all results for this analysis should be interpreted as in deviation from it.

10. Conclusions

In this paper, we exploit unique data from the history of the American offshore whaling industry to examine the causal effect of racial diversity on team performance at the firm level. Previous analyses of this relationship have encountered significant challenges due to difficulties of data availability, causal identification, and model specification. The advantages of focusing on the historical experience of the whaling industry include not only extremely rich data regarding the racial composition of the crew and the production process of whaling voyages but also an excellent natural experiment to identify the causal effect of racial diversity on team performance. Our empirical analysis is based on a large number of data sources, including the archival records of the whaling industry, the U.S. Federal Census schedules, and external sources regarding the names of native Americans employed in the whaling industry. Determining the race of crew members based on this information, we construct indices of fractionalization for each whaling voyage and estimate the effect of racial diversity on the voyage's total revenue. Although endogeneity concerns regarding crew selection are minimal in this setting, we address potential concerns by including in the analysis several fixed effects that address omitted factors. In our empirical specification crew diversity affects performance in a quadratic form.

We contribute to the literature three main results. First, we present the first robust estimates of racial diversity's effect on team performance at the firm level, which shows a U-shaped relationship. While increases in diversity at low levels induce a sharp decline in the value of output, higher levels of racial heterogeneity yield substantial gains. Second, we study the reasons behind the U-shaped relationship between racial diversity and team performance by examining two channels of transmission that work in opposite directions. We first focus on conflicts arising during voyages by examining cases of whalemen who failed to return to their home port because they deserted or left, or were discharged, drowned, or lost at sea. The results provide suggestive evidence that more diverse crews experienced greater

numbers of conflicts and that the effects varied between racial groups. Regarding the positive mediating effects of diversity, we examine creativity among the crew in sighting, striking, and processing whales. Distinguishing between skill and unskilled whalemen, we find support for the argument that diversity among the skilled members of the crew (e.g., officers, skilled mariners, artisans, service personnel) had a positive effect on all three aspects of hunting whales. Finally, as our third contribution, we investigate whether the effects of diversity varied over time by comparing results across voyages that differ only by duration. The results show that diversity had a strong negative effect on performance in short voyages (less than 18 months), a reduced negative effect in voyages of medium length (18-35 months), and a positive effect in long term voyages (over 35 months). Altogether, these results suggest that the costs of diversity initially dominated, but whaling crews were able to overcome the cost and increasingly realize the benefits of diversity over time.

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Table 1 – Summary Statistics; Voyage Analysis.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Voyage characteristics					
Tonnage	4,327	268.629	105. 053	45	700
Voyage duration (months)	4,263	27.137	15.416	1	143
Crew size (N.)	4,347	26.579	7.933	10	120
Diversity					
Share white	4,347	0.77	0.154	0	1
Share black	4,347	0.171	0.144	0	1
Share native	4,347	0.052	0.058	0	.385
Share other	4,347	0.007	0.023	0	.3
Racial Fractionalization	4,347	0.326	0.153	0	.667
Ethnic Fractionalization	4,347	0.269	0.194	0	.79
Mean crew experience (N. voyages)	4,347	2.36	0.97	1	7.409
Mean crew height (inches)	3,167	66.937	0.87	62.593	70.429
SD crew height (inches)	3,167	2.603	0.745	0.568	7.403
Rigging					
Schooner (Two masts)	4,343	0.118	0.323	0	1
Brig (Two masts)	4,343	0.086	0.280	0	1
Bark (Three masts)	4,343	0.381	0.486	0	1
Ship (Three masts)	4,343	0.416	0.493	0	1
Real output value (1860$)					
Sperm oil	4,207	33,279	54,251	0	626,228
Whale oil	4,207	22,464	52,076	0	924,941
Baleens (bones)	4,207	8,837	29,107	0	554,247
Total	4,207	64,581	96,458	0	1,503,824
Hunting grounds					
Atlantic	4,347	0.423	0.494	0	1
Indian	4,347	0.139	0.346	0	1
Pacific	4,347	0.419	0.493	0	1
Arctic	4,347	0.016	0.124	0	1
Unknown	4,347	0.084	0.277	0	1
Incidents (N.)					
Deserted or Left	418	3.538	4.511	0	37
Discharged	418	1.555	3.849	0	37
Drowned	418	0.141	0.766	0	8
Lost	418	0.211	0.946	0	13

Table 2 – Summary Statistics; Logbook Analysis.

Variable	Obs.	Mean	Std. Dev.	Min	Max
Voyage characteristics					
Tonnage	611	282.499	100.8	66	700
Voyage duration (months)	611	29.221	14.21	2	73
Crew size (N.)	611	28.249	7.740	13	68
Diversity[a]					
Fractionalization: Skilled maritime	110	0.342	0.193	0	0.722
Fractionalization: Unskilled maritime	110	0.243	0.183	0	0.64
Racial Fractionalization	110	0.314	0.146	0	0.556
Ethnic Fractionalization	110	0.210	0.128	0	0.612
Rigging					
Schooner (Two masts)	611	0.106	0.309	0	1
Brig (Two masts)	611	0.043	0.202	0	1
Bark (Three masts)	611	0.367	0.482	0	1
Ship (Three masts)	611	0.484	0.5	0	1
Productivity measures					
Sight rate	611	0.040	0.065	0	0.352
Strike rate	611	0.044	0.049	0	0.375
Tried rate	611	0.057	0.064	0	0.625

[a] Using data for voyages with rank information for at least ten crew members.

Table 3. Effect of Crew Racial Diversity on Log of Real Output Value.

	(1)	(2)	(3)	(4)	(5)
Racial Fractionalization	-1.003	-1.003	-1.007	-1.080	-1.088
	(0.412)**	(0.413)**	(0.413)**	(0.526)**	(0.525)**
	[0.368]**	[0.356]***	[0.359]***	[0.643]	[0.662]
Wild bootstrapping, p-value	0.003	0.004	0.005	0.130	0.165
Racial Fractionalization squared	1.346	1.346	1.350	1.356	1.342
	(0.633)**	(0.634)**	(0.634)**	(0.786)*	(0.786)*
	[0.468]***	[0.468]***	[0.469]***	[0.901]	[0.943]
Wild bootstrapping, p-value	0.003	0.002	0.003	0.330	0.354
p-value for joint significance of linear and quadratic term (clustered SE)	0.026	0.026	0.026	0.257	0.269
Estimated Minimum	0.373	0.373	0.373	0.403	0.406
95% CI (clustered SE)	[0.239-0.506]	[0.256-0.489]	[0.256-0.490]	[0.206-0.600]	[0.199-0.612]
Baseline	✓	✓	✓	✓	✓
Ethnic fractionalization		✓	✓	✓	✓
Mean experience of crew			✓	✓	✓
Mean crew height				✓	
R-squared	0.229	0.229	0.229	0.226	0.225
Number of clusters (ports)	25	25	25	25	25
N. of obs.	3,965	3,965	3,965	2,838	2,838

* p<0.10, ** p<0.05, *** p<0.01. Standard errors in squared brackets are clustered at home port level. Wild bootstrapping, p-value are calculated using the Stata command `boottest` drawing within cluster. The empirical specification also includes the log of tonnage, crew size, voyage duration, rig and ground-by-year fixed effects. The Baseline includes Agent, Port, and Captain FE. Regressions are weighed by the total number of voyages taken by the same vessel over the sample period. The standard error of the minimum of the U-shapes relationship is estimated using the delta method and the Stata command `wherext` (Weesie, 2001). The mean value of the dependent variable, log of revenue ($1,000s) is 3.629. R-squared is the within R-squared.

Table 4. Robustness: Alternative Definition of the Measure of Racial Diversity.

	Main Analysis	IV	Share Black Crew	Shannon Index	Placebo: last name initial
Racial Fractionalization	-1.007 (0.413)** [0.359]***	-0.967 (0.510)* [0.360]***	-0.557 (0.295)* [0.389]	-0.617 (0.246)** [0.264]**	-1.448 (6.137) [4.917]
Racial Fractionalization squared	1.350 (0.634)** [0.469]***	1.417 (0.793)* [0.583]**	0.541 (0.441) [0.322]	0.477 (0.219)** [0.194]**	1.038 (4.584) [4.023]
p-value for joint significance of linear and quadratic term (clustered SE)	0.026	0.027	0.264	0.068	0.868
Estimated Minimum 95% CI (clustered SE)	0.373 [0.256-0.490]	0.341 [0.237-0.446]	0.515 [0.125-0.905]	0.647 [0.468-0.826]	0.697 [-0.068-1.463]
R-squared N. of obs.	0.229 3,965	0.265 3,857	0.228 3,965	0.230 3,965	0.226 3,965

* p<0.10, ** p<0.05, *** p<0.01. Standard errors in squared brackets are clustered at home port level. The empirical specification also includes the log of tonnage, crew size, and voyage duration, ethnic fractionalization, experience, and the full set of fixed effects: agent, port, captain, hunting ground-by-year and rig type. Regressions are weighed by the total number of voyages taken by the same vessel over the sample period. The standard error of the minimum of the U-shapes relationship is estimated using the delta method and the Stata command `wherext` (Weesie, 2001). R-squared is the within R-squared, except for the IV that is the centered R-squared. For the IV model, the F-statistics of the first-stage regressions are 31.74 for the linear term and 12.77 for the quadratic term. The first-stage regression estimates for the linear term of fractionalization are 0.859*** for the linear term of the instrument, and -0.445* for the quadratic term of the instrument. The first-stage regression estimates for the quadratic term of fractionalization are 0.441*** for the linear term of the instrument, and -0.155 for the quadratic term of the instrument. Estimated for the agent fixed effects are not reported.

Table 5. Robustness: Alternative Specifications.

	Main Analysis	Quadratic Ethnicity	Race Shares: black, native, other	Excluding Civil War	Relaxing Min. Crew Constraint
Racial Fractionalization	-1.007 (0.413)** [0.359]***	-1.063 (0.415)** [0.358]***	-0.980 (0.420)** [0.391]**	-1.311 (0.442)*** [0.377]***	-0.891 (0.363)** [0.317]***
Racial Fractionalization squared	1.350 (0.634)** [0.469]***	1.448 (0.637)** [0.476]***	1.257 (0.675)* [0.567]**	1.646 (0.664)** [0.523]***	1.263 (0.560)** [0.463]**
p-value for joint significance of linear and quadratic term (clustered SE)	0.026	0.018	0.061	0.008	0.029
Estimated Minimum 95% CI (clustered SE)	0.373 [0.256-0.489]	0.357 [0.256-0.478]	0.390 [0.251-0.529]	0.399 [0.305-0.492]	0.353 [0.223-0.483]
R-squared N. of obs.	0.229 3,965	0.231 3,965	0.231 3,965	0.248 3,617	0.243 4,801

* p<0.10, ** p<0.05, *** p<0.01. Standard errors in squared brackets are clustered at home port level. The empirical specification also includes the log of tonnage, crew size, and voyage duration, ethnic fractionalization, experience, and the full set of fixed effects: agent, port, captain, hunting ground-by-year and rig type. Race Shares: the share of crew of black, native, and other race are included. Excluding Civil War: voyages departing between 1861 and 1865 are excluded from the analysis. Relaxing Min. Crew Constraint: empirical analysis is extended to voyages for which we have crew data; not only to those with race data for at least 10 crew members. Regressions are weighed by the total number of voyages taken by the same vessel over the sample period. The standard error of the minimum of the U-shapes relationship is estimated using the delta method and the Stata command `wherext` (Weesie, 2001). R-squared is the within R-squared.

Table 6. Effect of Crew Racial Diversity on Total Factor Productivity (TFP).

	(1)	(2)	(3)	(4)	(5)
Racial Fractionalization	-1.116	-1.109	-1.110	-1.287	-1.285
	(0.426)***	(0.427)***	(0.427)***	(0.554)**	(0.554)**
	[0.432]**	[0.419]**	[0.417]**	[0.819]	[0.826]
Wild bootstrapping, p-value	0.003	0.004	0.005	0.130	0.165
Racial Fractionalization squared	1.473	1.473	1.474	1.583	1.576
	(0.655)**	(0.655)**	(0.655)**	(0.829)*	(0.828)*
	[0.579]**	[0.577]**	[0.573]**	[1.135]	[1.153]
Wild bootstrapping, p-value	0.003	0.002	0.003	0.330	0.354
p-value for joint significance of linear and quadratic term (clustered SE)	0.045	0.043	0.042	0.303	0.308
Estimated Minimum	0.379	0.376	0.377	0.406	0.408
95% CI (clustered SE)	[0.225-0.532]	[0.243-0.51]	[0.242-0.511]	[0.205-0.608]	[0.201-0.614]
Baseline	✓	✓	✓	✓	✓
Ethnic fractionalization		✓	✓	✓	✓
Mean experience of crew			✓	✓	✓
Mean crew height				✓	
R-squared	0.005	0.005	0.005	0.009	0.008
Number of clusters (ports)	25	25	25	25	25
N. of obs.	3,965	3,965	3,965	2,838	2,838

* p<0.10, ** p<0.05, *** p<0.01. The estimates for the LP productivity estimator for the Cobb-Douglas production function with ACF correction are obtained using the Stata command `prodest` with `poly(3)` and `reps(50)`: crew size -0.049 (0.046); vessel tonnage 0.579 (0.180)***; voyage duration 0.974 (0.086)***. The empirical specification for the second stage, where the log of TFP obtained with the first stage is regressed on fractionalization, also includes rig and ground-by-year fixed effects. The Baseline includes Agent, Port, and Captain FE. Regressions are weighed by the total number of voyages taken by the same vessel over the sample period. Standard errors in squared brackets are clustered at home port level. Wild bootstrapping, p-value are calculated using the Stata command `boottest` drawing within cluster. The standard error of the minimum of the U-shapes relationship is estimated using the delta method and the Stata command `wherext` (Weesie, 2001). R-squared is the within R-squared.

Table 7. Relationship between Racial Diversity and Conflicts: Total and Incidents by Race.

	All	White	Non-White
Lost at Sea			
Racial Fractionalization	1.707	1.253	0.454
	(0.437)***	(0.338)***	(0.103)***
Mean	0.174	0.154	0.020
R-squared	0.379	0.464	0.213
Discharged			
Racial Fractionalization	0.547	0.222	0.324
	(0.961)	(0.815)	(0.199)
Mean	0.813	0.654	0.159
R-squared	0.375	0.417	0.277
Drowned			
Racial Fractionalization	0.102	0.0853	0.0170
	(0.0453)**	(0.0563)	(0.0180)
Mean	0.071	0.050	0.020
R-squared	0.344	0.338	0.356
Deserted or Left			
Racial Fractionalization	0.891	-0.727	1.617
	(0.730)	(0.574)	(0.250)***
Mean	2.503	1.981	0.521
R-squared	0.494	0.550	0.353
N. of obs.	409	409	409

* p<0.10, ** p<0.05, *** p<0.01. Each column represents a separate regression where the dependent variable is denoted by the number of incidents of the nature indicated by the title of the panel for the whole crew (All) or each racial group. The empirical specification includes the log of tonnage, crew size, and voyage duration, rig, port and hunting grounds-by-year fixed effects, as well as crew ethnicity. Standard errors clustered at home port level. Regressions are weighted by the total number of voyages taken by the same vessel over the sample period.

Table 8. Effect of Creativity on Hunting and Processing Whales.

	Sighted	Struck	Tried Out
Racial Fractionalization of:			
Skilled crew	0.044 (0.002)***	0.064 (0.002)***	0.073 (0.011)**
Unskilled crew	0.012 (0.025)	-0.006 (0.001)*	0.038 (0.001)***
Mean of the dependent variable	0.040	0.044	0.057
R-squared	0.681	0.690	0.657
N. of obs.	110	110	110

* p<0.10, ** p<0.05, *** p<0.01. Dependent variable is the share of whales that were sighted, harpooned (struck) or processed (tried out). These are calculated by dividing the total number of sighted, struck, and processed whales, by the duration of the voyage in months. **Skilled crew** include the captain and his mates, boatsteerers (harpooners), ship keepers, and captain apprentices, artisans, such as coopers, carpenters, blacksmiths, sailmakers, and service personnel, e.g., engineers or cook**. Unskilled crew** includes Seamen are semi-skilled seaman, greenhands, boys, and other ordinary crew members. The empirical specification includes the log of tonnage, crew size, and voyage duration, rig, port and hunting grounds-by-year fixed effects, as well as crew ethnicity. Standard errors clustered at home port level. Regressions are weighted by the total number of voyages taken by the same vessel over the sample period. Regressions use data for voyages with rank information for at least ten crew members.

Table 9. Effect of Racial Diversity by Voyage Duration and Racial Fractionalization Level.

	(1)
Low Racial Fractionalization × Short Voyage Duration	-0.262 (0.081)***
Medium Racial Fractionalization × Short Voyage Duration	-0.294 (0.112)**
High Racial Fractionalization × Short Voyage Duration	-0.311 (0.144)**
Low Racial Fractionalization × Medium Voyage Duration	0.002 (0.053)
Medium Racial Fractionalization × Medium Voyage Duration	OMITTED
High Racial Fractionalization × Medium Voyage Duration	0.026 (0.068)
Low Racial Fractionalization × Long Voyage Duration	0.119 (0.060)*
Medium Racial Fractionalization × Long Voyage Duration	0.253 (0.068)***
High Racial Fractionalization × Long Voyage Duration	0.144 (0.069)**
R-squared	0.242
N. of obs.	3,965

* p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at home port level. The empirical specification also includes the log of tonnage, crew size, voyage duration, rig and ground-by-year fixed effects, as well as Agent, Port, and Captain FE. **Low**, **Medium**, and **High** denote the terciles of the distribution of the index of racial fractionalization: Low = [0-0.260]; Medium = [0.261-0.405]; High = [0.406-667]. **Short**, **Medium**, and **Long** denote the terciles of the distribution of time spent at sea: Short = [1-18] months; Medium = [19-35] months; Long = [36+] months. Regression is weighted by the total number of voyages taken by the same vessel over the sample period. R-squared is the within R-squared.

Figure 1. Total Number of Voyages over Time

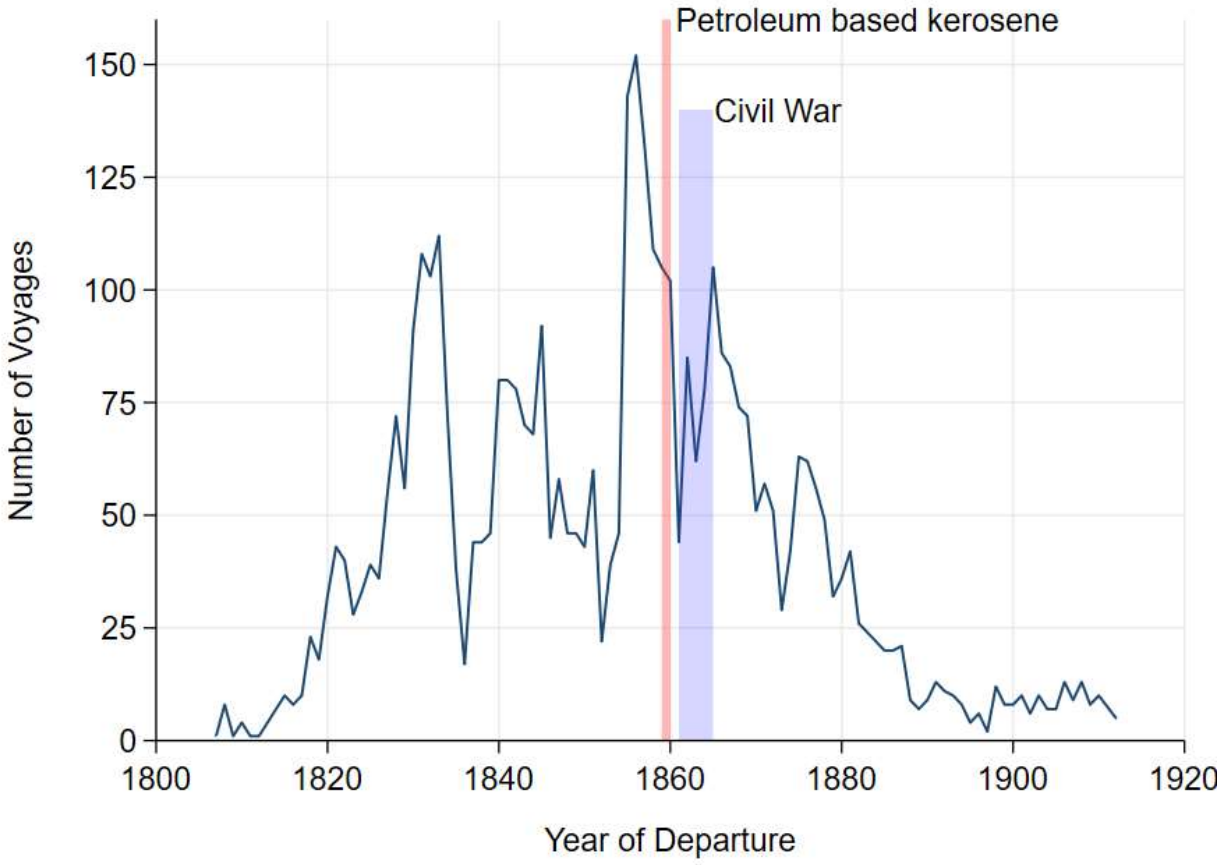


Figure 2 – Fractions of Crew by Race (voyage average) over Time.

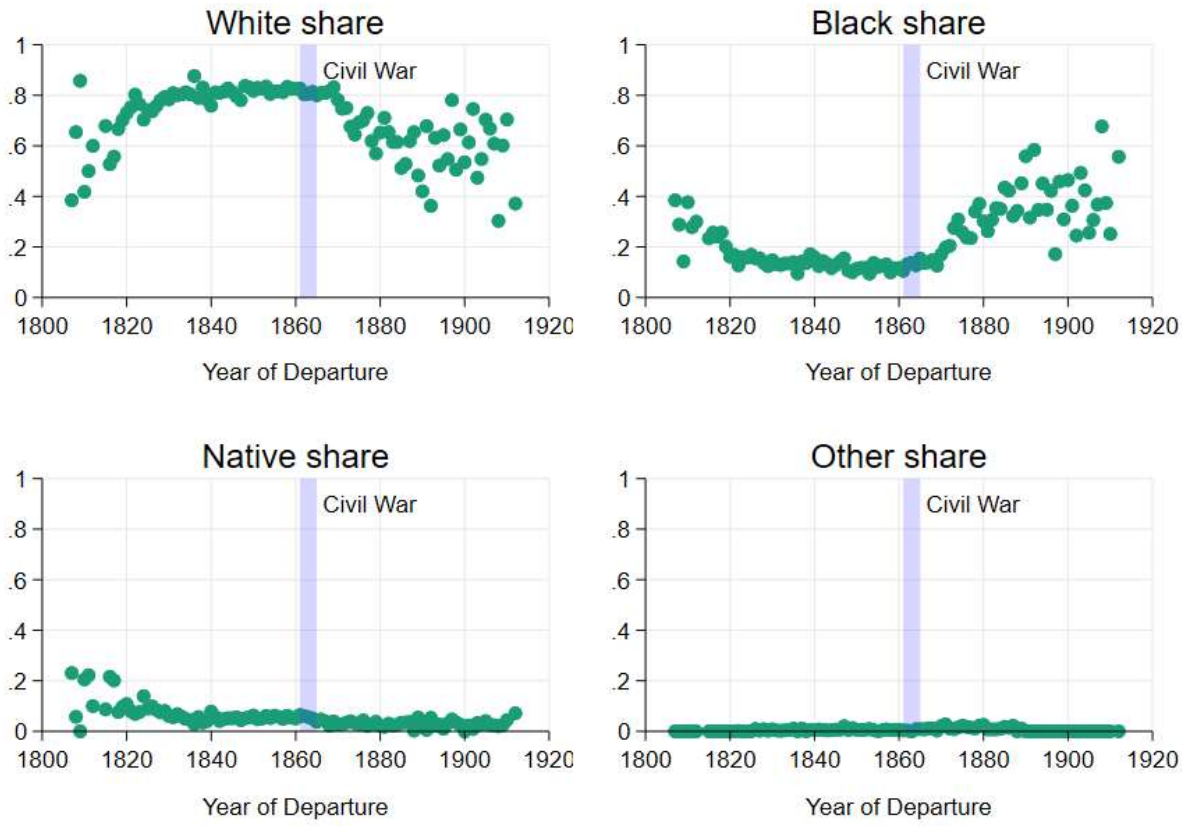


Figure 3 – Index of Racial and Ethnic Fractionalization (voyage average) over Time.

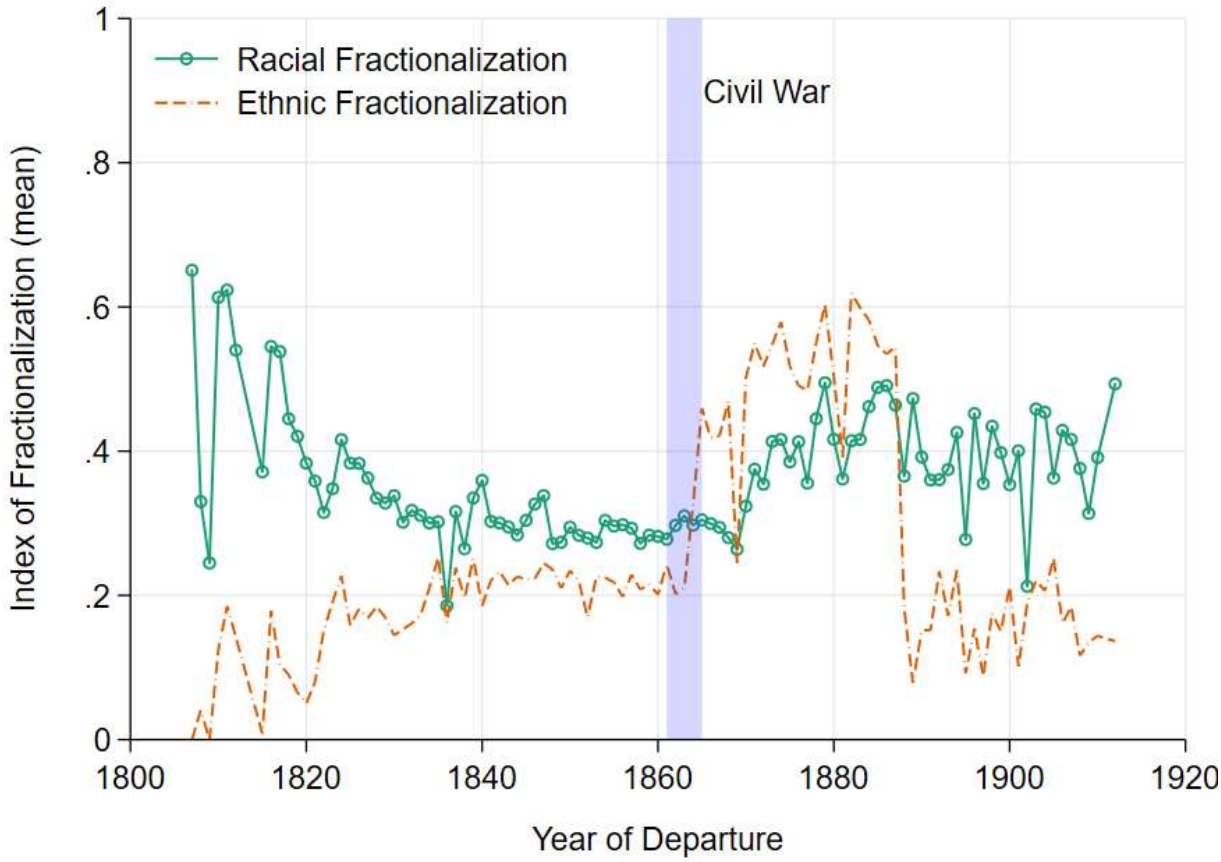
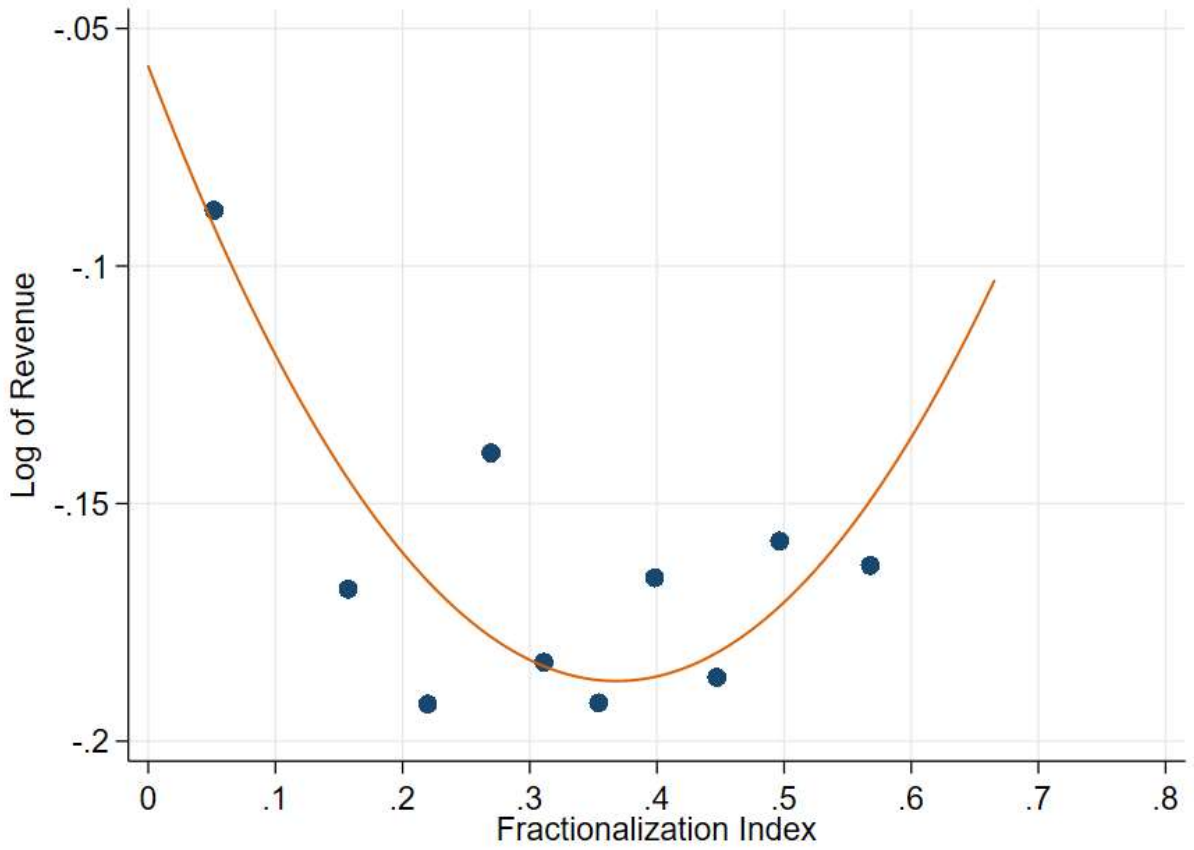
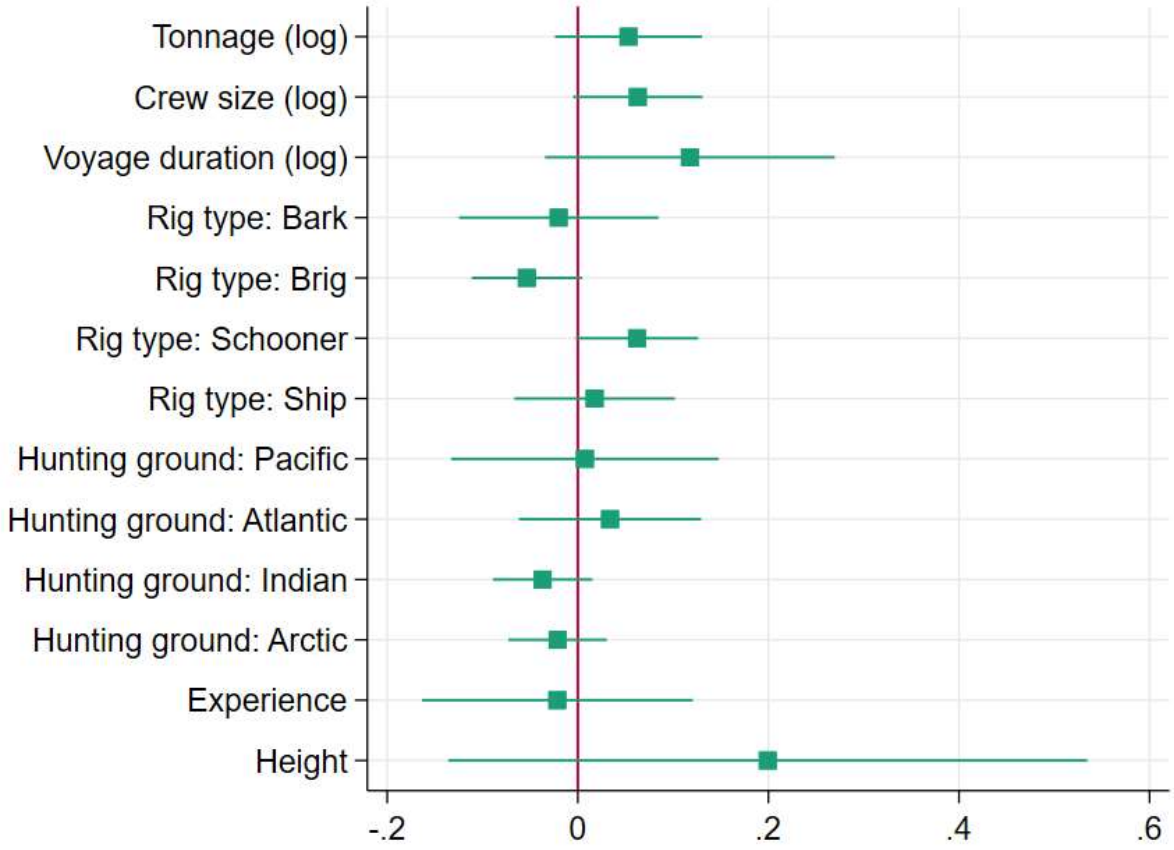


Figure 4 – Racial Diversity and Predicted Output Value



Note: This figure depicts the nonmonotonic effect, estimated using a least squares quadratic fit, of racial diversity on log revenue at the voyage level. Specifically, the vertical axis represents the binned fitted values of log revenue, for ten quantiles, plus the residuals from the full regression model. The fitted values are predicted by the quadratic function of fractionalization $g(\delta_{it}; \widehat{\boldsymbol{\beta}^{\boldsymbol{\delta}}})$ using estimated coefficients of Table 4, column (3).

Figure 5 – Balance Test



Note: The empirical specification includes ethnicity, agent, port, captain, hunting-by-ground, and rig type fixed effects. When the dependent variable is a rig type the specification excludes rig fixed effects. When the dependent variable is the hunting ground, we replace hunting-by-year fixed effects by year fixed effects. Regressions are weighed by the total number of voyages taken by the same vessel over the sample period. Standard errors are clustered at home port level.

APPENDIX A

A.1 Crew Diversity

To determine the race of whalemen, we combine information from the official records of the crew lists registered in customs and the Seamen's Protection Certificates with external data from the enumeration schedules of the U.S. Censuses and lists of native whalemen produced by previous researchers. In this section, we describe the contents of these sources. We will explain in the next section how we used this information to estimate the race of whalemen.

The American Offshore Whaling Crew List database is the product of a joint effort by the New Bedford Whaling Museum and Mystic Seaport Museum. It includes the crew lists of whaling voyages recorded at the customs houses in the ports of New Bedford, Fall River, and Salem in Massachusetts and the port of New London in Connecticut during the period between 1809 to 1927. For crewmen on the list, grouped by voyage, the database includes detailed information about their personal characteristics, such as residence, age, height, and complexion. The Crew List database also includes information from the Shipping Papers (articles), another set of legal documents filed with the customs at the beginning of the voyage. Instituted in 1790, the documents specified for each crew member their "service, pay, voyage, and all other things," to be shared with American consuls, judges, and other parties in cases of disputes between masters and seamen regarding compensation and work conditions. The Database includes over 177,000 entries.

The Registers of Seamen's Protection Certificates include similar information about the whalemen. The Certificates were created after the Congress passed an "Act for the Relief and Protection of American Seamen" in 1796 in response to the impressment of American seamen by British ships. Required by the Act, each seaman was registered with the customs collector and given a certificate. Similar to the Crew List database, the Registers data includes relevant personal characteristics of sailors, such as their names, ages, and places of residence. The information in the database is taken from the copies of original certificates issued from 1796-1871 and kept at the National Archives. The Registers database includes entries for about 31,000 whalemen, though only about 13,500 of these entries contain useful information to determine race.

We supplement the information from databases compiled from the official customs records of the American whaling industry with two sets of external sources. The first are the enumeration schedules of the U.S. Federal Censuses of 1850-1900. Organized by places of residence, these schedules include information regarding the personal characteristics of all individuals, including race. For each whaleman included in the Crew Lists, we matched the information about his name, birthyear, and place of residence with the census records to extract information regarding his race. There are, of course, well-known controversies regarding the recognition and definition of racial categories included in the U.S. Censuses of this period (Hochschild and Powell, 2008). Taking a pragmatic stand in these debates, we simply borrowed the race information as recorded in the enumeration schedules.

Although the U.S. Federal Census enumeration schedules of this period provide information regarding black and white whalemen listed in the schedules, they did not identify the native Americans. For this information, we turn to the lists of Native American whalemen compiled by previous scholars in

two separate research projects. The first is the Native American Whalemen's Database created by Shoemaker (2015). She used the crew lists and shipping papers of whaling voyages in conjunction with various other sources, such as newspaper archives and official government records; her database includes over 600 names. The second source to identify Native American whalemen is the Indian Whaler database produced by Handsman, et. al. (2021). To study ethnic communities of whaling, this collaborative project built several databases, one of which expanded on the data collected from comprehensive samples of crew lists by including information about race. It includes the names of 946 Indian whalemen from various New England locations.

A.2. Determining Race and Measuring Diversity

Since none of the sources discussed above provide comprehensive race information for the crew members of all voyages, we developed a stepwise procedure that combined data from all sources sequentially. We started by building a master list of unique whalemen and their personal characteristics by voyage, based on the information recorded in the Crew Lists database. Although the original database includes over 177,000 entries, there were many duplicates caused by the separate entry of crew-specific data from both the official crew lists prepared for departure and the Shipping Papers. To clean up and improve the original dataset, we eliminated duplications and supplemented incomplete or missing information (e.g., by copying missing characteristics of an individual from one voyage to another). The revised original master list consists of about 119,000 entries for 4,464 voyages. Since some of these whalemen joined multiple voyages, the Crew Lists database includes information for about 64,800 unique names, possibly corresponding to an even lower number of individuals given the likelihood of different spellings of names across voyages.

In the first step of the procedure in identifying race, we digitally matched individuals in our dataset with the enumeration schedules of the U.S. Censuses, which provide race information directly. Although the enumeration schedules of this period did not include Native Americans among the racial categories, it recorded blacks and whites at the individual level starting with the 1850 census (i.e., only heads of household were recorded before 1850). Note also that this step would only apply to whalemen whose legal residence was in the United States.

There are well-known potential problems with digitally matching large numbers of individuals accurately between the censuses and other sources. The problems originate from various types of human errors made in the spelling, recording, copying, and digitization of names. In addition, non-unique names present challenges in choosing the right person. Fortunately, these problems have recently been the focus of a fast-growing literature based on the digitization of complete count historical population censuses of the United States. Scholars have developed robust automated methods that link individuals between consecutive censuses to create large longitudinal datasets, which allow studies of migration, intergenerational mobility, effects of important events, and various other changes over time (Abramitzky et al., 2020; Berkes et al., 2022).

Given the large numbers of individuals in our dataset, we developed a fully automated but conservatively probabilistic method that used the information regarding the name, birthyear, and place of residence (town and state) of the whalemen in our dataset (who resided in the United States) to match

them with individuals recorded in census enumeration schedules. To address the problems of digital match discussed above, we adapted from the method recently proposed by Abramitzky et al. (2020). In addition, we followed the strategies recently proposed by Berkes et al. (2022) to deal with the problem of town names varying over time and between sets of records. We applied conservative parameters by restricting sample to those unique within +-2 years of birthyear. The application of this method to all persons in our dataset resulted in the match of 2,902 whalemen for whom we were able to determine whether they were black or white with a high level of certainty.

Since the U.S. Censuses of this period did not identify the native Americans, in the next step we turned to lists of native American whalemen compiled by Shoemaker (2015) and Handsman, et. al. (2021). Their combined lists included 946 whalemen. Since some of the persons on the list joined multiple voyages, this allowed to us to identify 4,119 entries as belonging to American Indian whalemen with a high degree of certainty. Shoemaker (2015) and Handsman (2021), however, limited their focus somewhat by including in their analysis only a limited number of years or voyages from certain New England ports. Therefore, potentially many other Indian whalemen could be left for identification from other sources in the next step.

In the third step, having already identified the race of about of about 7,000 entries as black, native, or white with a high degree of certainty, we built upon a procedure commonly used by previous researchers to infer the remaining whalemen's race from the information found in the archival records of the whaling industry. Specifically, quantitative historians have previously used the information regarding complexion and hair type entered in the Crew Lists and the Seamans' Protection Certificates to determine race. These records, unlike the census schedules, had no direct column for race on the forms. Instead, they had columns for skin, hair, and eye color that verbally described the physical characteristics of a sailor for identification to relevant authorities, in the absence of photograph technology that currently serves the same function in official documents. In a pioneering quantitative analysis that used skin and hair information to identify blacks, Putney (1987) studied black presence in American merchant fishing and whaling industries from the crew lists of several ports, including Baltimore, New Orleans, New York, and Philadelphia. In his influential *Black Jacks*, Bolster (1997) applied a similar method in his analysis of a large sample of about 50,000 sailors to determine that about one-fifth of them were African American. Craig and Fearn (1993) used the method to categorize a small sample of New Bedford seamen into six different racial groups for an analysis of wage discrimination and occupational crowding in the industry. Finally, in a recent Ph.D. Dissertation, Pariseau (2015) used the method to identify racial minorities in the records for a study of how race relations and activism changed in New England during the nineteenth century.[31]

Following the lead of previous historians who worked on various topics related to race in American whaling, we used the information regarding skin and hair recorded in the Crew List database to categorize whalemen broadly into four simple racial categories: black, Indian, white, and other. Despite the simplicity of categories, however, sorting individuals into them is a highly complicated task. Although the information about skin and hair is extremely useful for identifying race, the problem is that the lists delivered by masters of whaling voyages at New England ports before departure or the copies

[31] See Malloy (1990) for references to other studies based on this method.

kept in uniform hand by the custom collectors did not use a systematic system or a defined set of categories to record the information about skin and hair. Instead, the masters used numerous different terms and notations of their choice to describe the types of skin and hair that they observed. As a result, our records contain 213 different terms used to describe skin and 224 terms for hair.[32]

To deal with these complications and to avoid false identifications, we followed a conservative strategy in determining race based on skin and hair. Specifically, we considered as being black only those with skin recorded as "black" or "colored" or whose hair was recorded as "woolly". Similarly, we considered as white the whalemen whose skin was recorded as "light," "white," "fair," "olive," "ruddy," "blonde," or "sandy," or whose hair was noted as being "light," "blonde," or "fair." Finally, we determined as being native those persons with skin recorded as "Indian" or "copper" or whose hair was entered as "Indian."

In the final step, we looked for ways to estimate the race of whalemen for whom the information used in previous steps was somehow missing. This was clearly the case for international crew who were not residents of the United States during census enumerations. In addition, for some of these individuals, the official records somehow did not include information regarding physical characteristics. The final pieces of information that could still be used in such cases were the places of their birth or residence. Specifically, based on the literature on whaling industry, individuals who joined the crew as citizens of certain countries in Africa, West Indies, and Cape Verde Islands were typically black. Likewise, the whalemen from Germany, Ireland, England, and other European countries during this period were typically white. Finally, we could lump together in the "other" category the small number of individuals from Asia, South America, the Pacific Islands, and East Indies.

Based on this four-step procedure we were able to identify the race of about 77 percent of all whalemen in our dataset. This left behind about 23 percent for whom information regarding birthplace, residence, skin, or hair was missing or race was difficult to categorize because the information was too vague for a definite classification, such as when their skin was listed as brown, dark, or some other indeterminate term. Rather than make questionable assumptions regarding the enumerator's meaning with such terms, we followed a conservative approach by leaving the race information as missing for these whalemen so that our measures of diversity for their voyage would depend on other entries for whom we have more complete and reliable information.

A.3. Capital, Labor, and Output

The vessels used in this industry can be grouped into five different types depending on their rig and cargo capacity. The smallest vessel is the Sloop, used especially in the early years of the industry, which had only one mast, weighed less than 100 tons, and could stay out for a few weeks. Then, there were the Schooner and the Brig, both with two masts. The Schooner was around 100-110 tons, and the Brig reached 150 tons and could make voyage of less than a year. Lastly, there were three-mast vessels, the Bark and the Ship, weighing on average about 270 and 350 tons respectively. Both could stay out for

[32] For examples of difficulties encountered by previous researchers, see Bolster (1997: Appendix), Farr (1983: 164-5), Handsman, et. al. (2021: 52-54, 161-75), Munro (2017: 71-75), Shoemaker (2015: 41-42).

three to four years. In our dataset, we observe mostly three-masted vessels, consisting of almost 75 percent of the sample. The remaining 25 percent of the voyages were made mostly by two-masted vessels. Only a handful of one one-mast Sloops participated in the industry, mainly in the beginning of our sample period.

The average size of a typical whaling crew ranged between 14 and 32 men, depending on the rigging of the vessel. A sloop had 14 members and was out for 9 months on average. A schooner could have a slightly larger crew of 17 with a voyage time of 16 months. A brig could similarly sail for 15 months with a crew of 19. At the larger end of the size spectrum, whereas a bark could on average have voyages of 32 months with a crew of 28, a ship made slightly shorter voyages of 29 months, but had a larger crew of 30 men.

In addition to a captain, each vessel had a few first mates who directed operations. The specialized personnel included service workers such as a cook and a steward, skilled marine professionals like boatsteerers and harpooners, and several artisans such as a cooper and a blacksmith. The remaining crew was comprised of several unskilled workers called seamen or greenhands.[33]

The most visited hunting grounds were the Pacific and the Atlantic Oceans.[34] The average revenue obtained in a voyage amounted to $82,000, mostly made by the value of sperm and whale oil. Output value per voyage increased substantially right after the mid-1800s, a period when output prices rose significantly (Figure A.1). But the rise in voyage revenue lasted only a few years. As the price of sperm and whale oil subsequently decreased, so did average revenues. The sharp increase in the price of whale bone during this period was unable to counteract the trend because of the sharp decline in its output.

A.4. Whales' distribution

As with any other fishing industry, whaling rests on the availability of its prey for profitability. The spatial and temporal distribution of the whale population depends on both natural and anthropogenic factors. Spatial distribution is subject to considerable seasonal variation and exhibits marked latitudinal trends that are common to all cetaceans. The migration of whales is determined to a large degree by the pursuit of foraging opportunities that are in turn highly correlated with the spatial variability of oceanographic features, especially sea surface temperature (SST) and related primary productivity (Smith et al., 1986; Brown and Winn, 1989; Mannocci et al., 2014; Stanistreet et al., 2018). Indeed, whales were more prevalent in colder productive coastal waters (e.g., Smith et al., 1986). [35] The expansion of industry over time raised the pressure on the stock of whales. As a result, the abundance of whales conceivably shrank contributing to the contraction of the whole industry. Davis et al. (2007, Ch. 4) however, disagree with this interpretation. They suggest that the number of whales killed in the nineteenth century was small in comparison to the previously existing stocks. The reason was that hunting pressure induced a change in the behavior of whales. Once unfearful of men, they later on became timid and more difficult to locate. An extensive discussion of the spatial and temporal

[33] For detailed descriptions of whaling crews, see Davis, et. al. (2007: Chapter 5) and Hohman (1928: Chapters 6-7)
[34] For 35 percent of the voyages there is no information of the declared hunting grounds.
[35] Sea surface temperature (SST) is linked to the surface ocean stratification which influences the upwelling intensity, with higher concentrations of chlorophyll, and planktonic productivity (Jaquet, 1996; Kwiatkowski et al., 2017).

distribution of whales is found in Smith et al. (2012). As Jaquet (1996) highlighted, although these migrations might be partially an artefact of the difficulty of hunting in high latitudes during winter, whales concentrate in areas of cold surface temperatures and strong upwelling (i.e., high primary productivity). Colder waters are correlated with higher primary productivity, greater zooplankton abundance, increased prey availability, and consequently increased prevalence of whales (Block et al., 2011; Dodson et al., 2020).

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Table A1. Analysis of Variation in Racial Diversity.

Dep. Var.: Racial Fractionalization	**Agent FE**	**Captain FE**	**Port FE**	**Rigging FE**	**Hunting Ground-by-Year FE**
R-squared	0.125	0.289	0.055	0.016	0.163
N. of obs.	4,347	4,347	4,347	4,343	4,347

Note: The dependent variable is the Racial Fractionalization Index of vessel *i* departing at time *t*. Regressions are weighted by the total number of voyages taken by the same vessel over the sample period.

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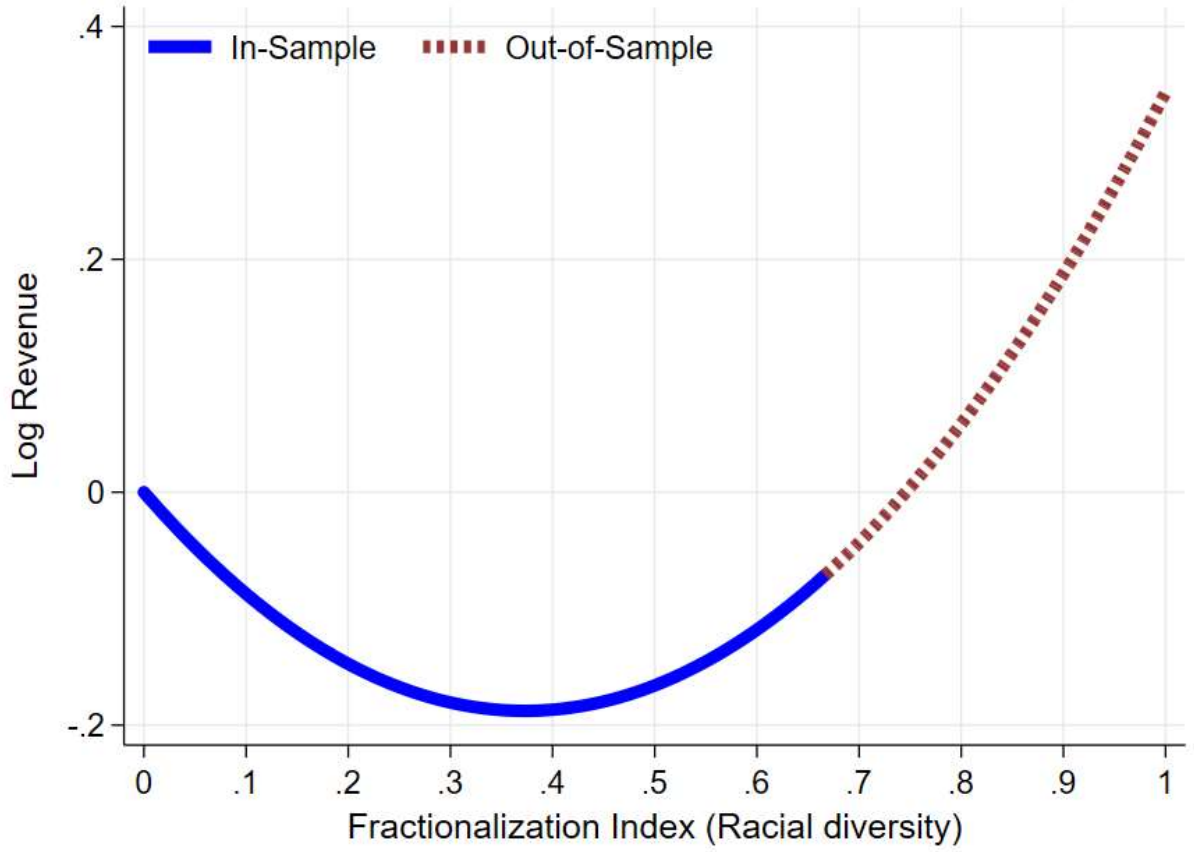
Table A.2. Effect of Crew Diversity on Log of Real Output Value. Full Results.

	(1)	(2)	(3)	(4)	(5)
Log of tonnage	0.723	0.723	0.721	0.959	0.954
	(0.220)***	(0.218)***	(0.216)***	(0.152)***	(0.141)***
Log of crew size	0.005	0.005	-0.006	-0.0742	-0.081
	(0.180)	(0.180)	(0.188)	(0.228)	(0.238)
Log of voyage duration	0.626	0.626	0.625	0.536	0.536
	(0.0905)***	(0.0900)***	(0.0897)***	(0.099)***	(0.0993)***
Racial fractionalization	-1.003	-1.003	-1.007	-1.090	-1.088
	(0.368)**	(0.356)***	(0.359)***	(0.643)	(0.662)
Racial fractionalization squared	1.346	1.346	1.350	1.356	1.342
	(0.468)***	(0.468)***	(0.469)***	(0.900)	(0.943)
Ethnic fractionalization		-0.002	0.003	-0.0534	-0.060
		(0.138)	(0.134)	(0.128)	(0.143)
Experience (mean number of previous voyages for the crew)			-0.011	-0.00470	-0.005
			(0.025)	(0.0246)	(0.025)
Height (mean height of the crew)				-0.0232	
				(0.0427)	
Height (SD height of the crew)				-0.0151	
				(0.0356)	
Constant	-2.065	-2.064	-2.003	-1.218	-2.755
	(0.636)***	(0.609)***	(0.619)***	(2.919)	(0.433)***
Baseline	✓	✓	✓	✓	✓
Ethnic fractionalization		✓	✓	✓	✓
Mean experience of crew			✓	✓	✓
Mean crew height and SD				✓	
R-squared	0.229	0.229	0.229	0.226	0.225
N. of obs.	3,965	3,965	3,965	3,965	3,965

* p<0.10, ** p<0.05, *** p<0.01. Standard errors are clustered at home port level. The Baseline includes Agent, Port, and Captain FE. Regressions are weighed by the total number of voyages taken by the same vessel over the sample period. The mean value of the dependent variable, log of revenue ($1,000s) is 3.629. R-squared is the within R-squared.

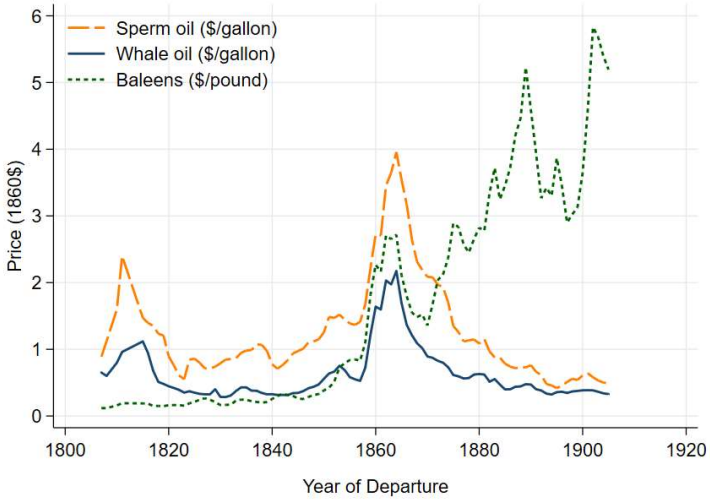
Figure A.1. – Racial Diversity and Predicted Output Value with Out of Sample Prediction.



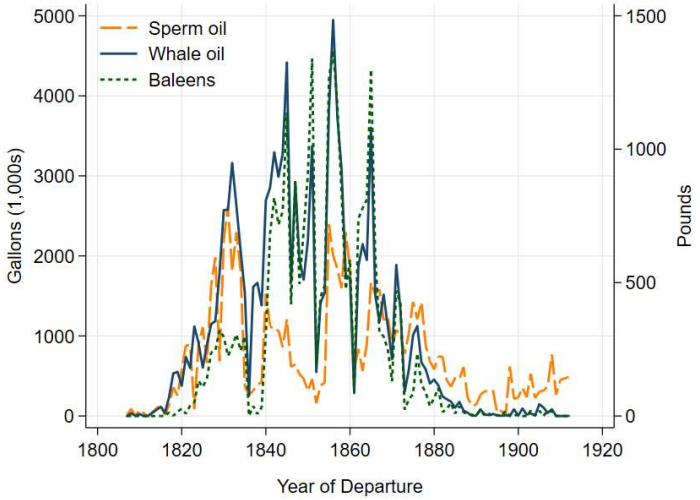
Note: This figure depicts the nonmonotonic effect, estimated using a least squares quadratic fit, of racial diversity on log revenue at the voyage level. Specifically, the solid line represents the fitted values are predicted by the quadratic function of fractionalization $g(\delta_{it}; \widehat{\boldsymbol{\beta}^{\boldsymbol{\delta}}})$ using estimated coefficients of Table 4, column (3). The dashed line represents the simulated (out-of-sample) index of fractionalization.

Figure A.2. – Output Price, Quantity, and Value.

A. Real Prices.



B. Output quantities (Annual Total).



C. Real Output Value.