The Bounty of the Sea and Long-Run Development*

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Abstract

We document that a high level of natural productivity of the ocean – a rich *bounty of the sea* – has had a positive and persistent impact on economic development since pre-industrial times until today. In addition, we document that it is the bounty of the sea of the ancestors of current populations which drives the persistent effect, not geography per se. We argue that an explanation is that a rich bounty of the sea facilitated early coastal settlements and an early coastal orientation of pre-industrial economic activity. This gave rise to occupations outside of agriculture and capabilities that were complementary to early industrialization. In the long run this contributed to an early take-off to sustained economic growth.

Keywords: Comparative development; coastal orientation; industrialization.

JEL classifications: O11, O13, O47, O57.

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1 Introduction

While the natural productivity of land, in the sense of its potential nutritional benefits, has received ample attention in the literature on comparative development, it is surprising to observe that the role played by the natural productivity of oceans – or the *bounty of the sea* – has been ignored.[1] In this paper we take a first step towards changing this state of affairs and explore the impact of the bounty of the sea on long-run development.

We document that a rich bounty of the sea has had a persistent impact on economic development, stimulating economic development since pre-industrial times until the present. Furthermore, we show that it is the bounty of the sea of the ancestors of current populations which drives persistence, not geography per se. To understand the underlying mechanisms, we propose that a rich bounty of the sea facilitated early coastal settlements and an early coastal orientation of economic activity. We argue that this allowed early coastal societies to accumulate experience in non-agricultural production during the pre-industrial period, which produced *capabilities* that were complementary to industrialization and an earlier take-off to sustained economic growth. Our empirical analysis supports these mechanisms and provides estimates that account for the majority of the reduced-form effects of the bounty of the sea on long-run development.

We present our analysis in three steps. We begin with the construction of the Bounty of the Sea (BoS) index: a new measure of the natural productivity of oceans that is conceptually similar to indices of the suitability of land for agriculture. To construct the BoS index, we use georeferenced information on the habitat suitability of most species of marine fish in the world. These data speak to the potential presence of specific species, not of their actual presence in a particular location. We carefully validate the index and find that it (*a*) predicts historical fish landings, (*b*) holds explanatory power vis-á-vis relevant historical occupational structure, and (*c*) is predictive of the subsistence strategy in pre-industrial settings. Overall, these tests paint a coherent picture and support the index's relevance for the analysis we conduct in this study.

As a second step, we explore the explanatory power of the BoS index *vis-á-vis* economic development, both in pre-industrial times and the present. We find that countries with a rich bounty of the sea attained higher levels of pre-industrial development. This result is robust to an extensive set of controls, including geographic access to the ocean and the level of natural of productivity in agriculture. In order to mitigate concerns regarding omitted variables bias, we also examine sub-national variation. This allows us to control for coastal proximity in a more precise manner, as well as for country fixed

[1] By *natural* productivity we refer to eco-climatic factors that impinge on the productivity of agriculture or of the ocean. In the former case that chiefly involves soil conditions, temperature and precipitation, whereas it in the latter case involves sea temperature, salinity, sea depth and more. We return to the definition of the natural productivity of the ocean below.

effects. Across the universe of coastal areas, defined as grid cells of one degree latitude by longitude that are located within 100 km of the coast, we document that a more productive adjacent ocean served to stimulate population in the year 1500.

When we look at the present, we find that the BoS index remains positively correlated with economic development. Similar to our findings on pre-industrial development, we obtain this result across countries as well as within countries. Given that these results uncover a pattern of persistence that runs over half a millennium, we examine if the BoS has exerted its historical influence via factors transmitted across generations. If that is the case, a stronger economic and statistical link should emerge when we invoke an *ancestry-adjusted* version of the BoS index. To test this idea, we re-calculate the BoS index using Putterman and Weil's (2010) historical migration data, which allows us to construct an index of the oceans' natural productivity derived from the location of the ancestors of current populations. We find that the explanatory power of the ancestry-adjusted BoS index is indeed substantially stronger than its non-adjusted counterpart, both in statistical and economic terms. This suggests that the bounty of the sea exerted its influence on contemporary comparative development through indirect channels, such as formal and informal institutions, rather than directly from geography. Quantitatively, the impact from the BoS is economically significant: an increase in the ancestry-adjusted index by one standard deviation increases contemporary income per capita by 0.2 standard deviations.

In the third part of the study we offer and explore empirically a possible explanation for our reduced form findings. Our explanation involves three mechanisms. The first one links the natural productivity of the ocean to early spatial settlement patterns. Conditional on natural productivity inland, we propose that a rich bounty of the sea allowed for more coastal settlements, and consequently for a stronger coastal orientation of pre-industrial economic activity. The second mechanism concerns the ensuing occupational structure. We propose that a greater concentration of the population along the coast reduces the concentration of work in agriculture, and that non-agricultural occupations – for example those related to long distance trade – gain relative importance in the economy. The final mechanism involves the speed of adoption of industrialization. As a consequence of accumulated experience with non-agricultural or proto-industrial occupations, we propose that populations with greater ancestry from countries with a rich bounty of the sea were better positioned to exploit opportunities related to the arrival of industrialization, and therefore experience an earlier take-off to sustained economic growth.

In the empirical analysis we provide evidence corroborating each element in our theory. Moreover, we document that the theory can account for the majority of the reduced-form impact from the bounty on the sea on current comparative economic development. Interestingly, our theory is also consistent with the fact that high natural productivity in agriculture is a characteristic of poor countries today, and that the opposite was true in pre-industrial times. While high natural productivity of the ocean drew people to the coast in the past, high inland productivity did the opposite, and thereby led to a more agricultural occupational structure. Therefore, industrialization should have been comparatively delayed in countries with a larger share of descendants of people from places featuring high natural productivity of agriculture, giving rise to the negative cross-country correlation that emerged in time between agriculture and prosperity.

The present study is the first to examine the long-run impact from the natural productivity of the ocean, and to demonstrate its significance for economic development. By focusing on the benefits of the sea, our study is related to the literature that emphasizes the advantages of coastal proximity. To be sure, at least since the time of Adam Smith it has been well known that economic activity tends to cluster near oceans, or sea navigable rivers, due to the advantages offered by such locations in terms of trade and market access.[2]

Our results also show that the bounty of the sea is positively correlated with economic activity *within* coastal areas. By implication, our study draws attention to differences in prosperity within coastal locations. As can be seen from Figure 1, the level of income inequality within coastal areas today is remarkably close to that across the entire world.[3]. Our analysis provides a direct explanation for this. If a society is to benefit economically from its coastal access, people need to be located in coastal areas, and the bounty of the sea importantly influenced whether people would in fact be located in coastal areas historically.

In contrasting the impact of natural productivity of the ocean with that of agriculture, our study is also related to an extensive literature that explores the impact from the historical legacy of agriculture. There are two strands that can be distinguished within this literature. The first one studies the influence of the emergence of agriculture and its productivity.[4] A second (and also more recent) strand of literature argues that agriculture may have helped to shape non-geographical fundamental determinants of productivity.[5] In this literature, the reversal in the impact of agriculture on economic

[2]"*As by means of water-carriage a more extensive market is opened to every sort of industry than what land-carriage alone can afford it, so it is upon the sea-coast, and along the banks of navigable rivers, that industry of every kind naturally begins to subdivide and improve itself, and it is frequently not till a long time after that those improvements extend themselves to the inland parts of the country*." (Adam Smith, 1776, Ch. 3). More direct evidence of the benefits of access to the sea is provided e.g. by Rappaport and Sachs (2003).

[3]To get a sense of how just how close these numbers are, note that the Gini coefficient can be interpreted as the expected income difference between two randomly selected observations, normalized to the overall average (Pyatt, 1976). Hence, the expected income difference between two randomly selected areas across the world is 54% relative to mean income, whereas it is 51% across (very) coastal areas ($<$50 km). While average income rises when moving to coastal areas, income differences evidently rise almost proportionally.

[4]On the timing of the Neolithic and (early) development, see Diamond (1997); Olsson and Hibbs (2005); Putterman (2008), Ashraf and Galor (2011) and Chanda et al. (2014). The land suitability for agriculture and its impact on development has been examined by Gallup and Sachs (2000) and Masters and McMillan (2001).

[5]Key contributions include Engermann and Sokoloff (2002); Easterly (2001); Buggle and Durante (2017); Michalopoulos (2012); Alesina et al. (2013); Galor and Özak (2014); Michalopoulos et al. (2018); Talhelm et al. (2014); Olsson and

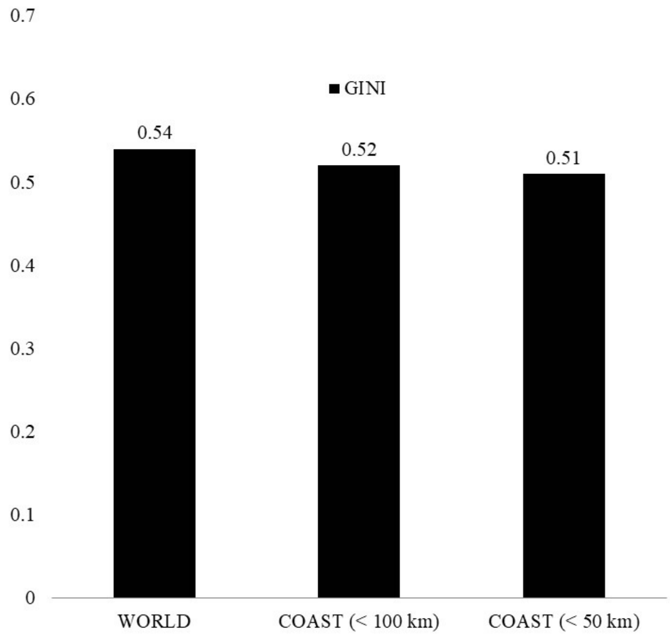

Figure 1: Data source: Inequality in GDP per capita across the World and across selected regions. Notes: Each unit of observation is a pixel of size 1 degree latitude by 1 degree longitude. The bar labelled "World" includes all available data. The bar labelled "Coast ($<$ 100 km)" only includes pixels located less than 100 km from the ocean. The final bar focuses on data for pixels within 50 km of the coast. The observation year for per capita income is 2005. Data Source: Yale GECON project.

development is well known. For example, Olsson and Paik (2020) document that an early transition to agriculture supported economic development early on, but not today. Litina (2016) documents a similar reversal in terms of natural productivity in agriculture. Both studies propose explanations that rely on cultural change. Other theories of how comparative advantages in agriculture can be a benefit in one stage of development but a disadvantage in another one can be found in Matsuyama (1992), and Galor and Mountford (2008). The proposed mechanism behind our results in this paper is consistent with this literature, and at the same time accounts for a persistent and positive impact from the natural productivity of the ocean.[6]

Finally, and more broadly, by emphasizing a persistent positive impact on development from the bounty of the sea, the present study contributes to the literature on long-run persistence in comparative development. Important contributions to the persistence literature include Acemoglu et al. (2001, 2002), Brockstette et al (2002), Olsson and Hibbs (2005), Comin et al. (2010), Ashraf and Galor

Paik (2020); Bentzen et al. (2015) and Litina (2016).

[6]For example, consider the Matsuyama (1992) model, which is a standard two sector model featuring learning-by-doing driven endogenous growth (only manufacturing productivity grows), and non-homothetic preferences that generate Engel's law. In autarky higher productivity in agriculture increases income and ultimately shift labor into the dynamic sector to the benefit of growth. In an open economy setting however, a sufficiently high level of agricultural productivity causes the economy to specialize in agriculture, choking off growth. If natural productivity of the ocean raises manufacturing productivity it would have a persistent positive impact on growth, whereas land productivity would start to decrease growth once globalization emerges, as it arguably did during the second half of the 19th century (e.g. Galor and Mountford, 2008).

(2011, 2013), and Chanda et al. (2014).[7]

The remainder of the paper is organized as follows. In Section 2 we describe the construction of the Bounty of the Sea index and our validation tests. In Section 3 we present the main findings of the paper, which pertain to the relationship between the bounty of the sea and economic development during the pre-industrial and industrial eras. In Section 4 we propose a theory and empirically examine its potential to explain the results obtained in Section 3. In Section 5 we present our conclusions.

2 The Bounty of the Sea index

To what extent have societies been able to live off the exploitation of marine resources? Addressing this question is challenging. First, global historical data on marine fish landings and fishing activities are scarce. Second, and perhaps more important, even if such data were available, its usefulness for a study like this would be limited by the fact that actual landings of fish would be endogenous to regional productivity levels. We therefore propose the Bounty of the Sea (BoS) index as a measure of the potential abundance of exploitable marine fish resources in the oceans. The informational content of our index rests, then, on the assumption that societies adjacent to oceans richer in marine fish resources were more likely to exploit said resources. We test this assumption in subsection 2.2.

2.1 Constructing the index

To construct the BoS index, we rely on the marine biological fact that differences in oceanographic and climatic conditions are key drivers of the abundance and composition of marine resources, and therefore also of the productivity in marine fisheries around the globe (Cheung *et al.*, 2010). First, marine resources are limited in abundance by requirements for nutrition and space. Second, individual species exhibit distinctive preference profiles with relevant ocean conditions. Empirically, the most favorable combination of such conditions for each species tends to coincide with the midpoint of each species' actual geographical range (Jennings *et al.*, 2009). Consistent with this, migratory species migrate along their calculated areas of habitat suitability (Cheung *et al.*, 2010).

Following these insights, we exploit a georeferenced database constructed by *AquaMaps*, which predicts the global habitat suitability of most marine fish species, by matching knowledge of their preference profiles with local environmental conditions. Specifically, the database offers the survival probability of individual species at a 0.5 by 0.5 decimal degrees pixel size, based on the environmental parameters of sea depth, seawater temperature, salinity, primary production, and ice cover. Accord-

[7] Surveys are found in Spolaore and Wacziarg (2013) and Nunn (2014).

ingly, these data speak to whether a particular species of fish *could* be observed in a particular location, not to whether the species in actual fact *is* observed in that location.[8].

We use the *AquaMaps* database to calculate the BoS index as the composite habitat suitability of marine fish species that we identify as carrying substantial weight for global fisheries historically. For the baseline BoS index, we select 15 species that made up for the majority of global marine fish landings in the 1950s, according to the UN's Food Aid Organization (FAO).[9]

Naturally, the more abundant, accessible and (nutritionally) valuable a species is, the more likely it is to be associated with large fishery catches.[10] Therefore, by focusing on the main species, the BoS index will not only reflect the general productivity level of the oceans, but also ocean conditions that support species that share the characteristics of being particularly exploitable. Limiting our attention on an early period is important to ensure that the index is a sensible proxy for the potential abundance of marine resources. The 1950s, the period which we focus on to build the index, is the earliest period for which global fish landings statistics at the species level exist. The period also precedes major developments in modern fishing technology, which took off in the 1970s (McGoodwin, 1990), and allowed for a more pronounced targeting of smaller species of lower trophic levels (Pauly *et al.*, 1998).

There are two main arguments in favor of the usefulness of the index for a historical analysis. First, a majority of the fish species included in the baseline BoS index are continuously found to be among the most important species *before* 1950, as documented by archeological studies of fish bones. For instance codfish (cod, haddock, and pollack among others), one of the main species included in our index, were among the most commonly caught marine fish species during the Stone Age in Denmark (Enghoff *et al.* 2007). In England, cod and herring dominated the expansion of capture fisheries around the year 1000 CE. (Barrett *et al.* 2004a, Barrett *et al.* 2008). Before this period, and dating back to 3500 BCE, codfish have consistently made up the majority of bone assemblages found in Northern Scotland (Barrett *et al.* 1999). Similarly, remains of the Peruvian anchovy, another important species in our index, have been detected in the coastal parts of the Incan Empire for the years 1100-1450 CE. (Marcus 1987) and in ancient settlements on the Peruvian coast dating back to 10,000 BP (Keefer *et al.* 1998).

Second, evidence of historical fishing activities like those mentioned above are found in the regions that today, according to our index, are still blessed with oceans rich in marine resources. There is also evidence that pressure caused by human fishing activity on local availability of marine resources have

[8] In the Supplementary Appendix we provide further details on the raw data from *AquaMaps*.

[9] The 15 species accounted for 52% of the global marine fish catch according to the FAO FIGIS database, which reports the catch volume of fish landed by individual countries, by species or higher taxonomic levels, for the period 1950-2012. The list of these species is reported in Table A1 in the Supplementary Appendix.

[10] See the discussion and evidence by Sethi et al. (2010), Branch et al. (2010), and Pauly et al. (2013).

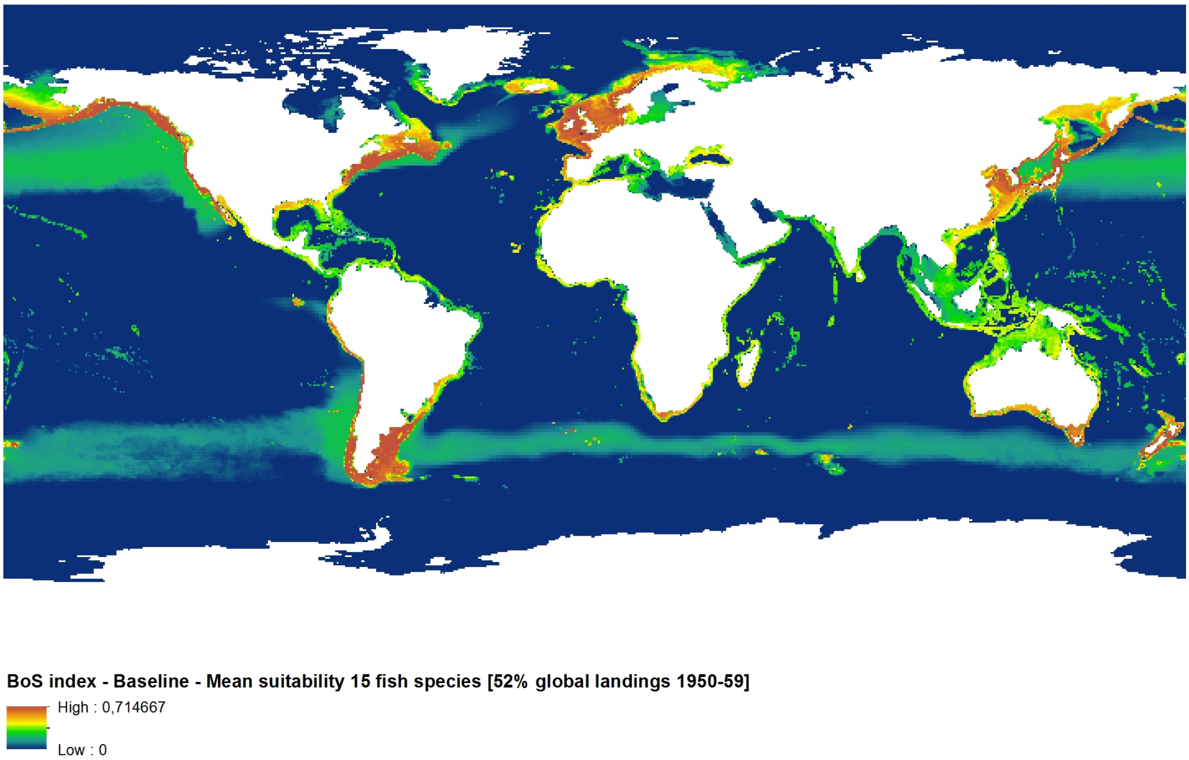

Figure 2: Figure 2: The Bounty of the Sea index. Notes: Baseline index, constructed as the average survival probability for the 15 major fish species landed globally during the 1950s.

not caused long-run differences in the global pattern of oceanic productivity. As Huston and Wolverton (2009) explain, when some species tend to be depleted in a region, "[...] they are typically replaced by a fishery based on a lower trophic level that is often more productive than the original fishery, consistent with ecological theories of trophic dynamics" (p. 344). In other words, the relatively more productive oceans today are likely to have also been the relatively more productive ones in the past, even if the nature of the exact target species have changed over time. It is therefore plausible that areas judged as most productive based on relatively contemporary landings, were also the most productive areas historically.

We calculate the baseline BoS index as the unweighted average habitat suitability of the 15 species identified as most important to global fisheries in the 1950s. The index is aggregated to the country level using each country's Exclusive Economic Zone (EEZ).[11] We assign a BoS index value of zero to landlocked countries. Figure 2 illustrates the baseline BoS index for the world's oceans.

Several observations are worth making in light of the revealed worldwide distribution of exploitable marine fish. First, one observes a higher potential abundance along the coasts, and in particular along the continental shelves.[12] This is in accordance with the marine biological literature, as

[11]The EEZs are prescribed areas by the United Nations and represent territories over which coastal countries have exclusive fishing rights and jurisdiction over natural resources, and that stretch up to 200 nautical miles from each individual country's coastline. A shapefile for exclusive economic zones is found at http://www.marineregions.org/downloads.php

[12]The continental shelves are underwater landmasses that extend from the continents and end with a steep slope towards

shelf waters are characterized by a high content of nutrients derived from the continental landmasses, and released by coastal upwelling effects.[13] Combined with the accessibility of its shallow waters and proximity to land, the continental shelf is the most exploited and productive ocean area in terms of fishing (Watson *et al.*, 2004, King, 2013). The width of the shelf varies considerably from being very narrow around the African continent to stretching the entire North Sea in Europe.

Second, there appears to be a latitude gradient in the BoS index, as places further away from the equator are associated with access to relatively richer maritime environments. This resonates with marine biological insights on the impact of temperature. Warmer surface waters tend to be less productive due to wider vertical sea temperature differences, which prevents nutritious bottom layers from mixing with surface layers (Valavanis *et al.*, 2004). Moreover, it has been observed that temperate and colder waters generally host larger aggregations of single species, which naturally are more easily exploitable (King, 2013).[14] This corresponds with the fact that species diversity declines with increasing latitude and distance from southeast Asia and the Caribbean (Tittensor *et al.*, 2010).[15]

Finally, regional hotspots of marine productivity identified by the literature are well reflected in the BoS index. Such hotspots are the outcome of strong upwelling effects, nutrient terrestrial runoff, and the redistribution of nutrients by ocean currents.[16] These processes also produce regional spots of relatively low productivity like the Mediterranean Sea, where nutrient depleted Atlantic surface waters flow in through the Strait of Gibraltarin exchange for deep and more nutritious Mediterranean waters (Estrada, 1996).

Overall, there appears to be substantial variation in the BoS index across and within continents and these patterns are in accordance with key marine biological principles. However, some concerns may be raised in the context of our baseline measure and its use as a measure of the historical availability of marine fish.

First, one may worry about selection bias: if the most technologically sophisticated nations in the world (in the 1950s) were also the most productive in fishing, the species found in these regions might well end up dominating global landings, and therefore also our BoS index.[17] To address this concern,

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the deep ocean floor. The shelf is characterized by being relatively flat and located at depths no larger than 150 meters.

[13]"Upwelling" is an oceanographic phenomenon that involves wind or current driven motion of dense, cooler, and usually nutrient-rich water towards the ocean surface, replacing the warmer, usually nutrient depleted surface water.

[14]Research has even documented how marine fish in higher latitudes are more mobile as they respond to seasonal changes in temperature, making them more likely to form tight shoals and thereby become easier targets for fisheries (Floeter et al., 2004).

[15]South East Asia has especially been identified as a center of evolution and specification of marine resources as it is home to some of the oldest marine ecosystems of the world (Ursin, 1984).

[16]Major upwelling area are associated with the Canary (off Northwest Africa), Benguela (off Southern Africa), California (off California and Oregon), and Humboldt (off Peru and Chile) currents (King, 2013). Nutrient terrestrial runoff is particularly associated with glaciated, high-latitude soils and, globally, the outflow of major rivers including the Ob, Mackenzie, Mississippi, Amazon, Parana, Congo, Tigris and Euphrates, Indus, Ganges, Irrawaddy, Yangtze, and Huang (Huston and Wolverton, 2009).

[17]Note that similar concerns might be raised in the context of the selection of key crops for indices involving land

we identify the most caught fish in every country around the world in the 1950s, and build an alternative version of the index that avoids a potential "technology bias" in the selection of species. This procedure leads to an alternative index based on 41 different species (cf. Table A1 in the Supplementary Appendix).[18]

Second, one may worry that the size of a country's EEZ is endogenous.[19] To address this concern, our second alternative BoS index aggregates the average survival probability of the top 15 fish during the 1950s using a 10 km buffer zone around each country's coastline instead of the up to 200 nautical miles limit applicable to the EEZ. The reduction in the area considered as relevant for fishing also works to diminish the concern that, in historical times, exploitation of marine resources probably occurred closer to the coast than what is implied by the current EEZ areas.

Finally, one may wonder if "all fish are equally important", and perhaps a superior index would weigh the individual survival probabilities in some way? To address this issue we construct nutrition-weighted BoS indices. The nutritional value of commercially important fish species are reported by FAO (1989) in a comparable manner. These values are used to weigh the baseline BoS index according to the calorie, fat, and protein content of each species, respectively.[20]

In sum, in addition to our baseline measure, we construct five alternatives, which differ in terms of selection of relevant species, aggregation to the country level, and weighting schemes to reflect nutritional differences among different species. Importantly, each of these alternative indices involve changes in assumptions in one dimension at a time, vis-à-vis the baseline index. By comparing regression results when the alternative indices are invoked, we are thereby able to gauge which of our baseline assumptions (if any) may seem critical.

2.2 Validating the BoS Index

We develop the BoS index to capture the potential for marine exploitation in a historical perspective. A natural question is whether this potential seems to have been borne out. To address this question, we begin by exploring the predictive power of the BoS index with respect to actual fishing landings during the 20th century. Then, we explore whether the BoS index predicts the allocation of labor in the 19th century – with available data for the North Atlantic region. Finally, we evaluate whether the

suitability, see Nunn (2014, p. 370).

[18]The downside of this measure is, of course, that it may involve species that are exploitable only to a very limited extent, as reflected in a potentially very low level of global landings. Consequently, this measure may introduce noise, and make regression results sensitive to measurement error.

[19]To be sure, the extent of the EEZ is at times the source of conflict – the "cod-wars" between Iceland and England during the 1960s being a case in point. See Kurlansky (1997, Ch. 10) for a vivid account.

[20]Of the 15 marine fish species in the original Bounty of the Sea Index only 12 are associated with nutritional values in FAO (1989). The species not included are the Gulf menhaden, Atlantic menhaden, and Alaska pollock.

index predicts the contribution from fishing to subsistence in traditional societies in pre-industrial times, as recorded in Murdock's (1967) Ethnographic Atlas.

2.2.1 The harvest of marine resources

Comparable data on total marine fish landings across countries can be obtained back to the year 1900. The source for the period after 1950 is FAO's FIGIS database. For the period before 1950, two historical collections are available: the *ICES Historical Landings 1903-1949* (ICES dataset) for 17 European countries, and *Mitchell's International Historical Statistics* (IHS dataset) for 48 countries around the globe.[21]

Table 1 reports the results of regressing (log) yearly marine fish landings on the Bounty of the Sea index, controlling for the (log) EEZ sea area within which the BoS index is aggregated. In columns 1 and 2, the outcome variable is historical landings before 1950; whereas in columns 3 to 6 it covers different periods after 1950.[22]

Table 1

As seen in Table 1, the BoS index indeed predicts yearly fish landings between 1900 and 1940. The BoS index and EEZ area account for 25% to 40% of the variation. Naturally, the sample sizes are somewhat modest, but it is reassuring that the species included in the index were not selected on the basis of actual landings during this period.

Columns 3 in Table 1 confirms that the BoS index is positively correlated with landings during the 1950s – as expected. This remains true when we explore within-continent variation in column 5. The BoS and EEZ area account for about 1/3 of the variation in global landings data in the 1950s.

As an out-of-sample check, we explore whether the BoS index remains significantly correlated with observed landings after the 1950s (columns 4 and 6). Once again the answer is in the affirmative, and the R^2 even increases to about 0.5. As can be seen from Table A1 the most important species for worldwide fisheries diversified considerably after the 1950s. Hence, the significant explanatory power of the BoS index during this period both supports the prior that data on the potential abundance of marine resources carry predicting power of actual marine fish landings, and the prior that the index most likely proxies the riches of local oceans more broadly than what pertains to the exact species selected for the index.

[21] See the appendix for a description of these data collections.

[22] We disregard the 1940s in order to avoid how the Second World War hampered landings in an asymmetric manner.

2.2.2 Labor force allocation

Besides predicting marine fish landings across countries throughout the 20th century, the Bounty of the Sea index can be contrasted with data going further back in time and reflecting the allocation of societies' labor resources to activities related to the harvest of marine fish. Using historical survey data from the North Atlantic Population Project[23], we compute the number of people engaged in fishing across regions within six North Atlantic countries (Norway, Sweden, Iceland, United Kingdom, United States, and Canada), for different years within the period 1801-1910.[24] Disregarding land-locked regions, we aggregate the Bounty of the Sea index within a 100 km buffer zone from each region, and proceed to test how well the Bounty of the Sea index explains variation in the employment share of fishermen across 80 regions within these 6 countries.

Conditioning on the buffer area of the sea, survey year fixed effects, country fixed effects, and total population or total employment in each regions, the results in Table 2 document that the BoS index is positively correlated with the number of fishermen, the number of ship workers, and the number of boat makers across regions in the six North Atlantic countries mentioned, throughout the 19th century and in the beginning of the 20th century.

Table 2

2.2.3 Food supply in traditional ethnic societies

In the checks above we have focused on whether the BoS carries explanatory power vis-á-vis the actual bounty of the sea, measured by observed landings, and if the index correlates in the expected way with historical occupations; *i.e.*, whether areas adjacent to rich maritime waters also seem to be characterized by more people preoccupied with exploiting them. Another issue is whether the BoS index also predicts the extent to which societies have relied on fishing for subsistence.

To explore this issue we turn to data on traditional societies recorded in Murdock's (1967) Ethnographic Atlas (EA) and Standard Cross Cultural Sample (SCCS), respectively, and identify those located within 200 km from the coast.[25] We find the appropriate value of the Bounty of the Sea index for all these coastal traditional societies, by computing the average BoS within a 100 km buffer from the point on the coastline which is nearest to the centroid of each respective society. With this procedure

[23]Collected by the Minnesota Population Center, this data contains census microdata from Canada, Great Britain, Germany, Iceland, Norway, Sweden, and the United States from 1801 to 1910. Important for this study is the reporting of individual occupation codes. Germany, which is actually just the region Mecklenburg-Schwerin, is left out in the present analysis.

[24]The subnational regions in the data set compare to the present day first-level divisions of these countries.

[25]The geographical coordinates of the ethnic group centroids are reported in the EA and SCCS. From this point we calculate the distance to the nearest coast and disregard those with a distance of more than 200 km. The use of 200 km as the radius within which the ethnic groups have been likely to move around follows Alesina et al. (2013).

we obtain data for 100 traditional societies in the SCCS, and 546 in the EA, which we can use to test whether the potential abundance of marine resources is correlated with the extent to which traditional and ethnic societies across the globe rely on fishing relative to agriculture. This is feasible as both data sets provide information on the contribution of fishing, animal husbandry, and agriculture to the total food supply.[26]

Table 3

Table 3 shows a clear pattern: controlling for the area of the BoS buffer, distance from the centroid of each society to the coastline, and the year in which data for each respective society was collected (which ranges from 800 BCE to 1960 CE.), the BoS index is negatively associated with the contribution of animal husbandry and agriculture to the food supply, but positively correlated with the contribution from fishing. For the group of traditional societies included in the Ethnographic Atlas, which involves a larger selection of societies, we find the same pattern (cf. columns 6-10): the potential abundance of marine resources is positively correlated with fishing, and negatively correlated with animal husbandry and agriculture.

Overall, these results suggest that in areas characterized by a greater BoS index it would be more likely to see societies that relied on the exploitation of marine resources for subsistence to a significant extent, albeit not necessarily exclusively.

3 The Bounty of the Sea and Economic Development

3.1 Empirical Strategy

In this study we explore the links between the BoS index and various outcomes at the country level (y_i): population density, GDP per capita in pre-industrial and modern times, and a range of measures pertaining to the proposed mechanism linking the BoS index to current economic development.

Formally, the regression model that we take to the data can be written

$$y_i = \beta_1 \text{BoS}_i + \beta_2 \text{AG}_i + \mathbf{X}_i' \gamma + \varepsilon_i, \qquad (1)$$

where y_i is the outcome of interest, AG is a measure of agricultural land productivity, whereas the vector $\mathbf{X}_i$ comprises a set of control variables and a constant term.

In the main body of the analysis we restrict $\mathbf{X}_i$ to comprise a relatively limited set of covariates; in the appendix we extend it considerably. Our baseline controls include land productivity, the timing

[26]Specifically, the indices range from 0-9, where 0 represents 0-5% dependence, 1 represents 6-15%, 2 represents 16-25%, so on up to 8, which represents 76-85% dependence, and 9, which represents 86-100% dependence.

of the Neolithic Revolution, sea area and land area, a full set of continental fixed effects, absolute latitude, a dummy variable which takes on the value one if the country is landlocked, and the fraction of land area within 100 km of sea coast or navigable rivers.

Alongside the BoS index, land productivity (AG) is included in all specifications, since we are interested in comparing the long-run impact from natural productivity of the ocean and inland; *i.e.*, the relative size and sign of β_1 and β_2. Similarly, we control for both sea area and land area in all cases, since we are interested in the importance of greater "quality" of the environment, given its size. The timing of the Neolithic Revolution is added since it allows us to assess the importance of sea and land productivity, conditional on the time at which agriculture entered the scene. Distance to the equator (absolute latitude) is in the control set to capture in a parsimonious way climatic conditions that may (through a variety of mechanisms) have influenced productivity in the past, as well as exerted an impact on outcomes today. Moreover, since there appears to be something of a latitude gradient in our baseline BoS index, the omission of absolute latitude would increase the risk that our results become tainted by omitted variable bias. In light of the discernible continental-wide differences in marine productivity, continental fixed effects are included to capture unobserved heterogeneity. Finally, in order to control for the potential access to the sea we include the percentage of land within 100 km of coasts and waterways and a dummy variable which takes on the value of 1 if the country is landlocked. We provide data description, summary statistics, and sources of our control variables in the Supplementary Appendix.

3.2 Pre-Industrial Development

3.2.1 Country level evidence

In Table 4 we report the results from estimating equation (1) with log population density in 1500 as the outcome of interest. The regression parameters are standardized throughout the paper. Accordingly, the individual regression coefficient speaks to the change in the left hand side variable, measured in standard deviations, that results from a change in the right hand side variable by one standard deviation. This facilitates a simple comparison of the economic significance of the individual controls. Statistical significance are reported in parenthesis (p-values).

Table 4

In the first five columns we add the auxiliary controls sequentially, and then collectively (column 5). The BoS index is in all settings significant at the five percent level, or better, and carries a positive point estimate. The same is true both for our measure of soil suitability for agriculture, and for the timing of the Neolithic. Hence, these results suggest that, for given land productivity and length of agrarian history, countries that could rely on a relatively richer bounty of the sea were more densely settled in 1500.[27] Economically, the influence from the timing of the Neolithic is greater than both that of the BoS index and the agricultural counterpart. Conditional on the timing of the Neolithic, the impact from soil conditions is greater than that of the BoS, though the point estimates are of similar order of magnitude.

In column 6 we restrict the sample by excluding all landlocked countries. Naturally, being landlocked may have hampered development in its own right, for which reason it is of interest to inquire whether the BoS index contains explanatory power only between countries that have access to the ocean. Interestingly, the point estimate for the BoS index does not seem to be much affected, statistically and economically.[28]

In columns 7-10 we employ our alternative BoS indices, with and without landlocked nations being present in the sample. The results are very similar. This is reassuring in that it indicates that our BoS index probably is not haunted by selection bias in any substantial way via of the selection of species, nor by a potential endogeneity bias due to the geographical unit we aggregate to.

In the Supplementary Appendix we explore the robustness of these results in several ways. First, we examine if the results hold up if we solely focus on Europe and Asia, respectively. This check is motivated by the potential concern that the quality of the data on population density in 1500 may be lower outside these areas. Reassuringly, however, the size and significance of the BoS indices is very similar, albeit more economically significant (Tables A3-A4).[29]

Second, we study whether the results change if we rely on alternative BoS indices, which weigh individual species by their caloric content, their fat content, or their protein content. As documented in the Supplementary Appendix, the results are qualitatively and quantitatively similar to those reported above (Table A5).

Third, we examine the consequence of expanding the set of controls. We opt for those invoked by Ashraf and Galor (2013) in the context of their study of pre-industrial development, and simply add

[27]It is interesting to note that the parameter estimate for absolute latitude is *negative*, suggesting greater economic development close to the equator in 1500 C.E.. This finding, suggestive of a climatic reversal in economic activity during the last half millennium, was first noticed in Ashraf and Galor (2011). See Dalgaard and Strulik (2017) for a possible explanation for the reversal, and discussion of alternative accounts.

[28]Throughout we include a control for being landlocked, which means we partial out the *average* difference in population density between coastal and non-coastal nations. When we exclude landlocked nations entirely we push matters a bit further by exploring the impact from the BoS index solely *within* coastal countries.

[29]If the measurement error (in the dependent variable) is classical, one would only expect to see more imprecisely estimated parameters, not changes in point estimates (in contrast to measurement error on the independent variables). *A priori*, however, the measurement error could be non-classical. Our results can therefore be interpreted as indicating that the measurement error on population density in 1500 C.E. is approximately classical in nature.

the BoS index (along with EEZ area) on top of their controls.[30] As in Table 4, we also explore the consequences of omitting landlocked nations. The message from Table 4 carries over (see Table A6 in the Supplementary Appendix).

Finally, we revert to our full specification and explore the influence from additional controls with direct bearing on marine conditions: an island dummy, average distance to coast or rivers, ocean biodiversity, the extent of tidal movements, the length of coastline and inland waterways to land area (respectively), the number of natural harbors relative to land area, and the share of the EEZ area which constitutes shelf area or is covered by estuaries, respectively.[31] The BoS index remains significantly correlated with population density in 1500. despite the inclusion of these additional controls (See Table A7 in the Supplementary Appendix).

3.2.2 Within country evidence

While the cross-country results appear robust, concerns regarding omitted variable bias may linger. As a consequence we explore within country variations. For these tests we have obtained data on population density for the year 1500 from the HYDE database, version 3.1, which contains grid-level estimates of population size (Klein Goldewijk *et al.*, 2010, 2011). In order to rigorously control for coastal access we focus on the universe of pixels worldwide that are located within 100 km from the coast. In order to assign a BoS value to a pixel, we calculate the shortest distance to the coast from the center of each pixel, and from this coastal location calculate the BoS value using a 100 km sea buffer zone.

Our control strategy is similar to the one invoked in the last section, but with some modifications. First, we do not have pixel level data on the timing of the Neolithic Revolution, for which reason this control is not included. However, since we only focus on coastal areas, we introduce distance measures and control for geographical characteristics of the nearby ocean: distance to the ocean and natural habor, respectively, as well as the extent of tidal movements, and shelf and estuary area. Finally, continental fixed effects are omitted and replaced by country fixed effects.

The results are reported in Table 5.

Table 5

In column 1 we look at the effect of the BoS index along with land productivity, controlling for pixel and sea buffer zone area. Both productivity measures are positively correlated with population

[30] With this approach we aim to demonstrate that our results are robust to the inclusion of the most commonly agreed upon determinants of pre-industrial development, at present.

[31] Estuaries are places where rivers run into the ocean and thus produce brackish water. In this empirical specification, shelf area constitutes the relatively shallow waters of up to 200 meters in depth.

density. This remains true when we control for country fixed effects (column 2). In the remaining columns we sequentially add controls for distance to the coast and natural habor (column 3), geographic features of the coast such as the extent of tidal movements (column 4), absolute latitude and elevation (column 5), and all of the controls collectively (column 6). In terms of the economic impact of the BoS index it is worth noting that the standardized parameter estimates are very similar to those obtained in the cross-country context.

In the two final columns we check the robustness of our within country results to the use of alternative BoS indices: a version where we limit the buffer zone to 10 km rather than 100 km (column 7) and the "technology-adjusted" version of the BoS index (column 8). While the economic significance shrinks in the latter case, compared with the results from our cross-country sample, the BoS index remains significant at conventional levels. Overall, the pixel-level results support the cross-country results, and confirm that more productive oceans stimulated pre-industrial development.

3.3 Contemporary Development

3.3.1 Country level evidence

Table 6 report the results from exchanging (log) population density in 1500. for (log) real GDP per capita in 2005 as the dependent variable. To begin, the specifications are exactly the same as those presented in Table 4.

Table 6

The positive link between the BoS index and current levels of economic development is rather similar to that detected for the pre-industrial period. This uncovers a remarkable pattern of persistence for the effects of the BoS during the last 500 years. In contrast, the sign of the correlation involving agricultural productivity reverses, and the timing of the Neolithic ceases to carry any significant explanatory power, statistically speaking. The seemingly adverse effect of agricultural productivity on current economic development mirrors the findings of e.g. Litina (2016).

In comparison with the pre-industrial setting, the estimates appear more sensitive to the chosen specification, and in some instances statistical significance is not attained. This raises the question of whether, in the 21st century, the local environment is really what matters to economic activity. For example, it is possible that relative natural endowments influenced and created persistence in economic development today via indirect channels, such as cultural values and preferred institutions, which are embodied in people and transmitted through generations, rather than directly through geographic characteristics of the environment. In that case, an important feature to incorporate in the analysis should be the considerable amount of international migration over the last 500 years, which explains why part of the current population in many countries today have ancestry elsewhere. Hence, a purely geographic variable may be a poor indicator of the environment within which the ancestors of the current population lived, and therefore explain why the BoS index seems less robustly correlated with economic outcomes today than in 1500.

We test this idea in Table 7, and examine the consequences of *ancestry-adjusting* the BoS index using the population migration matrix constructed by Putterman and Weil (2010). The ancestry-adjusted BoS index thus reflects the bounty of the sea in countries of the ancestors of current countries' populations, acknowledging migration during the past 500 years.[32] For the regression analysis, and the same reason, we also ancestry-adjust variables that relate to agriculture.

Table 7

The change in the nature of the results is noticeable. The main estimates become more stable, and increase in size. Moreover, whereas land productivity continues to enter with a negative sign after the migration adjustment, the ancestry-adjusted timing of the Neolithic Revolution now also carries explanatory power and enters with a positive sign. Overall, these results suggest that the positive correlation detected in Table 5 largely reflects the influence from a historical legacy of the people of the country, rather than the place itself.

To follow up on this, Table 8 reports the results from "horse-race" regressions where we simultaneously control for the environment, and the environment of the ancestors of the current population.

Table 8

Intriguingly, the point estimate for the ancestral BoS index maintains its statistical and economic significance whereas the purely geographical indicator ceases to be statistically significant. These results confirm that the importance of the BoS index today is not mainly driven by local geographic conditions per se.

In the Supplementary Appendix we explore the robustness of these results in various ways. First, we study if the impact from the ancestry-adjusted BoS index changes if we employ indices where individual species are weighted by their nutritional value. This is not the case (cf Table A8). Second, we include controls for additional marine conditions, as in the previous section. The impact from the ancestral BoS index is unaffected by augmenting the control set this way (Table A9). Third, we experiment with a different specification, and follow again the specifications in Ashraf and Galor (2013), but in the context of their analysis of contemporary development (Tables A10-A11).

[32]Suppose the fraction π_{ij} of the population in country i descends from country j, the ancestor adjusted BoS index is calculated as $\sum_j \pi_{ij} BoS_j$, where $\sum_j \pi_j = 1$.

Broadly speaking, the results are similar to the ones reported above, with an important corollary. In some specifications Ashraf and Galor (2013) include a measure of institutional quality: the Social Infrastructure index, due to Hall and Jones (1999). In these settings, the ancestry-adjusted BoS index (with or without the simultaneous inclusion of the unadjusted BoS index) tends to loose significance. This result need not be surprising, as a manifestation of differences in relative endowments may be differences in the institutional infrastructure.

If we thus take the estimates at face value, there are two ways in which one may gauge their economic significance. First, one may observe that the standardized regression coefficient for the ancestral BoS index is of the same order of magnitude (in absolute terms) as that of land productivity, and the ancestral timing of the Neolithic Revolution. In light of the importance of agriculture in human history this in itself suggests the impact from the bounty of the sea is substantial.

Second, one may ask how big of an impact the BoS index can create in terms of income per capita. In the specification reported on in column 6 of Table 7, the basic point estimate is 2.78 (not reported), which means that an increase in the ancestral BoS index of one standard deviation (0.1) increases current income per capita by about 28 % ($= 0.1 \times 2.78$). Alternatively, the range of the BoS index in the relevant sample is 0.43, which means that the maximal income difference that can be generated by differences in the natural level of productivity of the ocean is about 112% ($= 0.4 \times 2.78$).

To conclude this subsection, Figure 3 depicts the partial correlation between the ancestry-adjusted BoS index (baseline measure, as well as the technology-adjusted measure in each country), in our full basic specification, and when we employ the Ashraf and Galor (2013) specification omitting the social infrastructure variable. As is visually clear, the results do not seem fragile to any particular influential observation.

3.3.2 Within country evidence

As in the pre-industrial setting, we also explore the consequences of limiting attention to within country, near coast locations. As measures of economic activity we employ either population density or earthlights at night. The control strategy is identical to the one adopted in Section 3.2.2. In the modern setting we would ideally like to ancestor-adjust the BoS index. This is unfortunately not feasible. However, observe that, insofar as the post 1500 immigrants are reasonably evenly distributed within the coastal areas (and potentially within the country in general), the influence from international migration would be picked up by the country fixed effects. In all settings the BoS index is significantly and positively correlated with economic activity, as expected. This demonstrates that variations in the

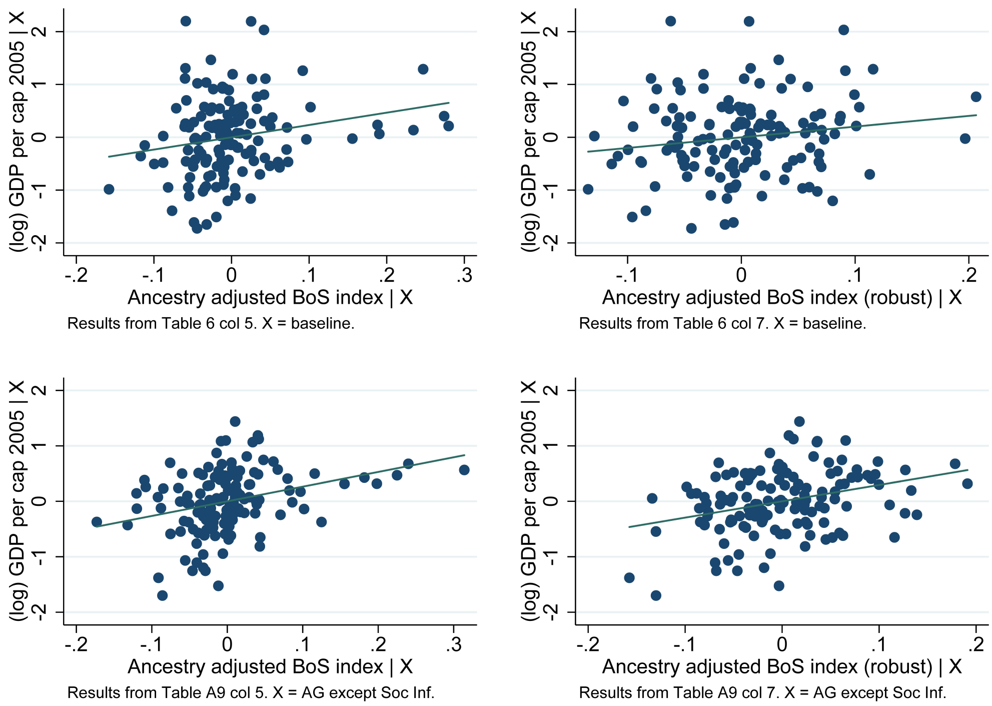

Figure 3: The partial correlation between ancestral BoS index and GDP per capita. Notes: Top left hand side (LHS) picture depicts the baseline full specification and baseline measure whereas the top right hand side (RHS) figure shows the baseline full specification where the "top fish" BoS index is employed (Table 6, cls 5 & 7). Lower LHS shows the result when we employ the baseline measure and controls from Ashraf and Galor (2013) short of Social infrastructure; the lower RHS figure shows the same though employing the "top fish" BoS index (cf Table A9, cls 8 & 10).

bounty of the sea contributes with an explanation of the substantial inequality within coastal locations (*cf.* Figure 1). In the interest of brevity, these results are relegated to the Supplementary Appendix (Table A12).

4 A Mechanism

4.1 The theory

The empirical analysis in Section 3 documents three salient facts. First, the bounty of the sea is positively correlated with measures of economic development, both during pre-industrial times and today. Second, the contemporary links are strengthened if we focus on ancestral productivity levels, rather than their place-specific counterparts. Third, the natural level of productivity in agriculture is positively correlated with economic development in the past, but negatively correlated with prosperity today. The goal of the theory developed in this section is to provide a mechanism, which can potentially account for these findings.

The theory that we propose rests on three elements. The first element concerns the degree of coastal orientation of the economy, or the spatial distribution of economic activity. In pre-industrial times, the existence of adequate food resources was a natural pre-condition for urban centers to emerge. For instance, according to Diamond (1997), the emergence of cities had to await the arrival of the Neolithic Revolution, and even today natural productivity in agriculture is a strong predictor of the spatial distribution of economic activity (Henderson *et al.*, 2018, Motamed *et al.*, 2014).

This is no mystery. In historical and pre-historical times, the ability to transport food over land was limited, implying that the emergence of a population center usually required sufficiently rich agricultural hinterlands to provide sustenance for the population. By the same token, limited inland transport capabilities may have constrained the emergence of early population centers in coastal areas, absent nearby rich agricultural hinterlands. However, a rich marine environment would have helped overcome such constraints, due to the availability of an alternative (or complementary) source of food. Consequently, in regions featuring a highly productive ocean, a greater proportion of the population would be able to settle in close proximity to the ocean early on. Since settlement patterns tend to be very persistent, this pattern might well be still discernible today (*e.g.*, Bleakley and Linn, 2012). In sum:

Prediction 1: The BoS index should predict a greater fraction of total population living near the coast, historically as well as today.

The second element of the theory is that the location of economic activity influenced the occupational structure of the economy, prior to industrialization. More specifically, in coastal communities a range of non-agricultural occupations would be observed. Perhaps most obviously long distance traders and merchants. But the list would likely also involve proto-industrial occupations related to boat making.[33] Due to a differential degree of coastal orientation across societies, heterogeneity in the experience with non-agricultural endeavors would arise with the passing of time.

In the Supplementary Appendix we provide historical case studies concerning the rise of cities and markets, which were deeply connected to the bounty of the sea. The "old world" example concerns the capital of Denmark, Copenhagen. However, during the period after 1000 CE. cities and markets all over Europe seems to have been stimulated by the bounty of the sea, even in a rather direct way. As observed by Hoffman (2005, p. 23-4)

> In about the tenth century, records from several European regions show people catching fish for sale to nearby consumers... Local markets for fish were an integral, indeed

[33] In the validation tests (Section 2.2.2) we documented that the employment rate of boat makers and ship workers is higher in coastal regions featuring a high bounty of the sea (cf Table 2).

> often precocious, element in the early rise of an exchange sector, *i.e.* the start of what historians call the 'Commercial Revolution of the Middle Ages' which became fully visible as it grew during the eleventh and twelfth centuries. Artisan fishers first appeared at inland and coastal sites with access to consuming centres, especially emerging towns such as Ravenna, Gdansk, Dieppe, Lincoln or Worms, and such people 'who make their living from fishing' spread and multiplied from there.

A "new world" example, discussed in the Supplementary Appendix, is the city of Boston, which arguably was similarly stimulated by the bounty of the sea early on. As observed by Adam Smith (1776, Chapter 7, part II: *Causes of the Prosperity of New Colonies*):

> To increase the shipping and naval power of Great Britain by the extension of the fisheries of our colonies, is an object which the legislature seems to have had almost constantly in view. Those fisheries, upon this account, have had all the encouragement which freedom can give them, and they have flourished accordingly. The New England fishery, in particular, was, before the late disturbances, one of the most important, perhaps, in the world. ... Fish is one of the principal articles with which the North Americans trade to Spain, Portugal, and the Mediterranean.

Hence, whereas early coastal settlements quite likely were connected to the bounty of the sea for sustenance, a high natural level of productivity of the ocean arguably also helped the settlements grow, and formed the foundations for markets and trade, with implications for the occupational structure to follow. Namely, a greater proportion of people working outside agriculture. These considerations motivate the second prediction:

Prediction 2: The (ancestrally adjusted) BoS index should predict a more non-agrarian employment structure, *prior* to industrialization.

Prediction 2 considers the ancestrally adjusted BoS index because many of the capabilities attained via non-agricultural endeavors should be portable. This would be the case for the job specific skills themselves, but also for cultural values and preferences for formal institutions that would develop over time in light of the occupational structure. For example, Acemoglu *et al.* (2005) argue that the emergence of the Atlantic trade enriched long-distance traders favoring property rights supporting institutions. If the natural productivity of the ocean helps explain at which locations long-distance merchants would be observed at greater frequency, one might thus anticipate a reduced form link between the bounty of the sea and institutions that are complementary to industrialization. In the year 1500, with the start of Columbus' travels, these capabilities diffused around the world via migration, thereby impacting on the host country's occupational structure. Naturally, before 1500 the purely geographic BoS measure should carry significant explanatory power vis-a-vis the non-agrarian employment share.

The third element of the theory is that the adoption of industrialization would be greatly facilitated by a historical experience with non-agricultural activities. Such experience would be found, according to the proposed hypothesis, in greater measure in locations featuring relatively high natural productivity levels in the oceans. Taken together we have:

Prediction 3: The ancestral BoS index should predict an earlier timing of Industrialization and take-off to sustained growth.

By combining these three elements we can provide an account for the reduced form results above. The theory suggests a persistently positive impact from the BoS on development, whereas the influence from natural inland productivity is reversed in the course of development due to an adverse impact on the timing of industrialization. It also motivates why these regularities should be more salient when the ancestral natural productivities are invoked. Figure 4 provides a schematic overview of the proposed theory.

A final prediction, concerning the theory in its totality, is as follows:

Prediction 4: The ancestral BoS index should have a quantitative impact on the timing of the take-off so as to plausibly account for its reduced form impact on current income per capita.

Prediction 4 follows as the proposed mechanism motivates an impact from the ancestral BoS index on current prosperity through a differentiated timing of the take-off. Andersen *et al.* (2016) show how this sort of a proposed mechanism allows for a simple consistency check, which works as follows.

Imagine that some underlying characteristic (here it is the BoS index) influenced the timing of the take-off, and therefore current income differences. Prior to the take-off per capita income is assumed to stagnate for Malthusian reasons. Ignore convergence effects after the take-off for simplicity. Then the reduced form OLS estimate of the BoS index on income per capita can be interpreted, in the limit where all countries in the sample have emerged from stagnation, as reflecting the marginal impact from the BoS index on the timing of the take-off, multiplied by the average growth rate since the take-off. Hence, if the estimated quantitative impact on the timing of the take-off is either much to large, or much to small, it sheds doubt on the hypothesis in question. In the next sections we examine Predictions 1-4 empirically.

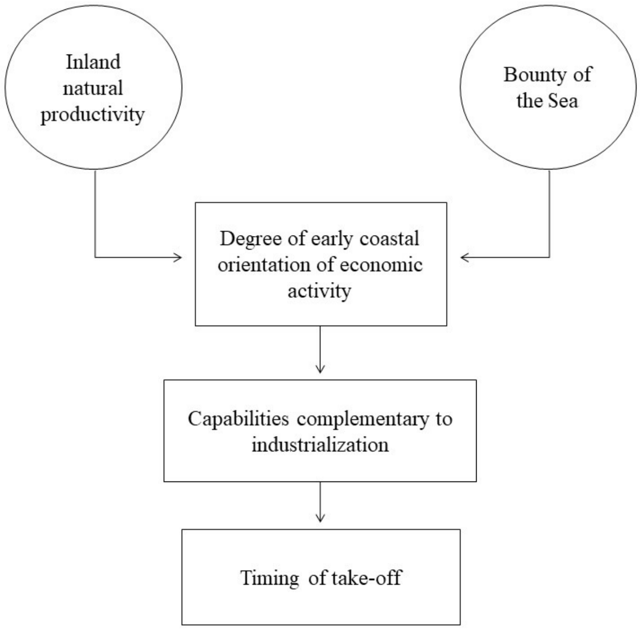

Figure 4: Overview of the theory.

4.2 Testing Prediction 1: Coastal orientation

In testing P1 we rely on several databases. For the year 1500 we draw on the HYDE database, version 3.1, which contains grid-level estimates of population size historically (Klein Goldewijk *et al.*, 2010, 2011). For the contemporary era we invoke the Gridded Population of the World database, version 4.0. As a matter of robustness, we additionally employ earthlights at night as a proxy for current economic activity (Henderson *et al.*, 2012, 2018). The coastal orientation of a country is defined as the fraction of the total population (or total lights) that is located within 100 km of the coast.

Table 9

Panel A of Table 9 focuses on 1500, whereas Panel B examines the determinants of coastal orientation today. The model specification is our baseline specification from the last section, with a minor adjustment: instead of the dummy variable for landlocked nations, we control for the fraction of a country's territory that falls within 100 km of the coast. Naturally, the shape of a country mechanically influences the spatial distribution of the population for which reason it seems prudent to include it as a control when testing P1. Note that landlocked nations are implicitly controlled via this variable, motivating the exclusion of the dummy variable from the model.

Turning to the results we observe that the baseline BoS index is significant in all cases, typically at the one percent level of significance. This continues to hold when we employ our alternative BoS indices (*cf.* column 6 and 7 in Panels A and B). It is also noteworthy that our measure of land productivity is negatively correlated with the fraction of the population living near the coast, suggesting that the levels of natural productivity impact on the distribution of the population in opposite directions.

As alluded to above, the contemporary results are very similar if we employ earthlights rather than population levels (see Table A13 in the Supplementary Appendix). Moreover, as also documented in the Supplementary Appendix (Table A14), the results for 1500 and today are very similar if we define coastal orientation as the fraction of population within 50 km of the coast. Overall, we find that these results are consistent with our findings in Section 3 where we document that within coastal areas adjacent to productive oceans, population density and economic activity is higher both in 1500 and today.

If we assume the estimates reported in Table 9 reflect a causal impact, it becomes possible to gauge the quantitative significance of the bounty of the sea for the spatial distribution of the population. In particular, in Panel B column 5 we find that a reduction in the BoS index by one standard deviation reduces the fraction of the population near the coast today by about 0.15 standard deviations. In the sample, one standard deviation of our left hand side variable is very close to 1. Accordingly, if one reduces the BoS index by one standard deviation it should reduce the population near the coast today by roughly 15 %. In 1500, the corresponding estimate is smaller; a similar calculation leads to an estimated reduction of roughly 2.5%. Accordingly, to square these estimates agglomeration effects playing out over the last half millennium must have served to elevate initial differences in coastal orientation initially caused by differences in the natural productivity of the ocean.

4.3 Testing Prediction 2: Occupational Structure

In testing P2 we rely on two measures of the pre-industrial occupational structure. The first is the urbanization rate in 1500, which is thought to proxy the employment rate in non-agricultural enterprises during the pre-Columbian period; arguably, most service and proto-industrial jobs were found in cities, at the time. The second measure is more direct, namely the employment share in agriculture. This measure is not available in 1500, but it is feasible to obtain it for 1900. While this obviously is too late to capture the pre-industrial occupational structure in a few Western European countries – England first and foremost – it should be a sensible measure for most of the countries around the world. Note that, formally, fisheries would serve to increase the employment share in agriculture by national accounts conventions.

Table 10

Panel A in Table 10 focuses on 1500, whereas Panel B examines the determinants of the agricultural employment rate in 1900. The model specification is our baseline setup from Section 3. When we focus on the occupational structure in 1500, we invoke the baseline BoS index, whereas we employ

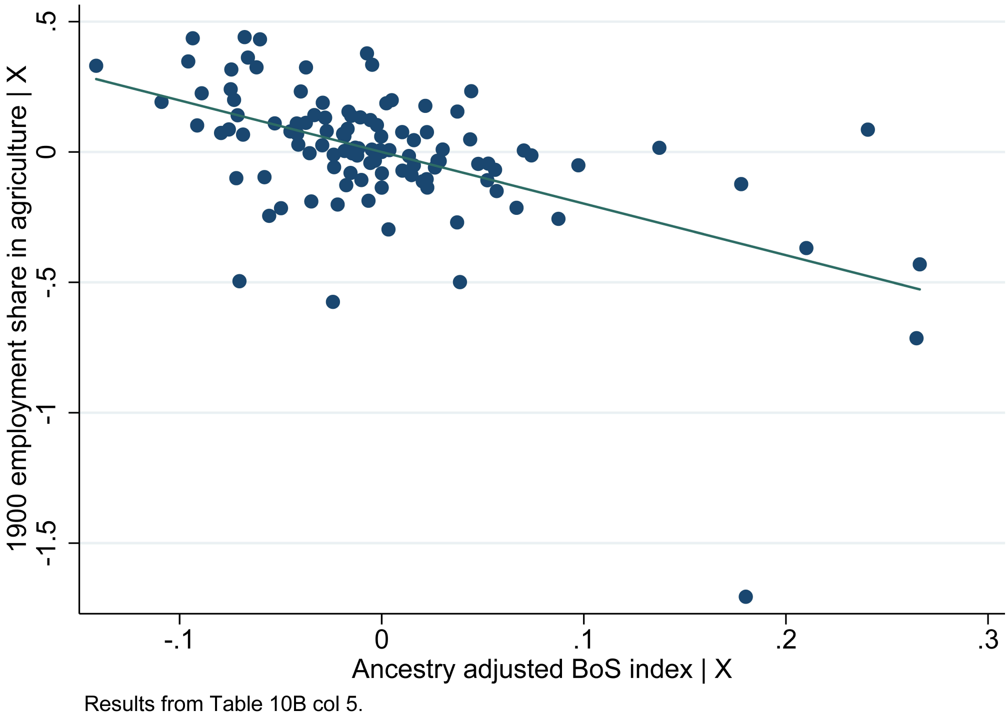

Figure 5: The partial correlation between BoS (ancestor adj) and employment share in agriculture, 1900 C.E. Notes: The figure is based on the results reported in Table 10, column 5.

the ancestral counterpart for the analysis pertaining to 1900, motivated by the migration flows over the intervening period.

As seen from Panel A, the BoS index is strongly positively correlated with the urbanization rate; typically at the one percent level or better. The parameter estimate appears relatively stable when additional controls are added, as long as the continental FE's are included in the model. In contrast, higher land productivity is found to be negatively correlated with urbanization in 1500.

In 1900, as seen from Panel B, the results are similar. That is, the ancestor-adjusted productivity level of the ocean is negatively correlated with the employment share in agriculture, whereas land productivity is positively correlated with reliance on agriculture. Hence, consistent with the proposed hypothesis, we in fact observe that the structure of employment appears to have been influenced by natural productivities. Figure 5 depicts the partial correlation between the ancestor-adjusted BoS index, and the employment share in agriculture; the obvious outlier, featuring low employment in agriculture and high natural productivity of the ocean is England.[34]

A potential concern with these results, however, is the risk of reverse causality in the context of the ancestor adjustment. The reason is that the migration matrix involves migration flows that in part takes

[34]This does not mean that the theory is inconsistent with the experiences of England. But by 1900 C.E. industrialization in England has had time to progress much further than in the remaining countries in the sample, for which reason it presents itself as an outlier.

place during the 20th century, which is after the year in which the employment rates are measured. In order to check if this concern is of substantial importance, we re-run the specifications in Table 10 using the pure geography measure but limiting the sample to countries where more than 90% of the population is native. The results are similar to those reported above (see the Supplementary Appendix, Table A15, columns 1-3)

To conclude this part, we turn to the economic significance of the findings. In our full specification our point estimate implies that a reduction in the BoS index by one standard deviation increases the (log) employment share in agriculture by roughly 0.5 standard deviations. In the sample underlying the regression, the standard deviation of the left hand side variable is about 0.36, implying an impact of *ca.* 18%.

4.4 Testing Prediction 3 and 4: Industrialization and the take-off

In order to examine the last two predictions, we rely on two measures. The first is labeled the "timing of industrialization", which is proxied as the year in which the employment in industry exceeds that of agriculture. The second measure is the year of the fertility decline.[35] The data sources are provided in the Supplementary appendix.

Table 11

In Table 11, Panels A and B, we ask if the BoS is a predictor of either measure of the take-off to sustained growth. In compliance with P3, we find the answer to be affirmative: higher values of the BoS index are associated with an early onset of industrialization as well as of the fertility decline. Moreover, the parameter estimates appear to be stable when additional controls are added.

Once again one may be concerned with the risk of reverse causality due to the ancestor-adjustment. We therefore re-run the specifications in Table 11 using the pure geography measure but limiting the sample to countries where more than 90% of the population is native. The results are again similar to those reported above (see the Supplementary Appendix, Table A15, column 4-9).

In Table 12 we ask if the timing of industrialization and of the fertility decline seems to reduce the impact from the bounty of the sea in explaining current income per capita. If the influence from the BoS index on prosperity is channeled through the take-off, we would expect to see a reduction in the impact from the former on GDP per capita.

Table 12

[35] According to unified growth theory, the onset of the fertility transition marks the onset of modern growth, which thus represents our motivation for using this measure as a marker for the take-off to growth (see Galor and Weil, 2000; Galor and Moav, 2002; Cervellati and Sunde, 2005; Galor 2011 for an overview).

In the first three columns of Table 12, Panels A and B, we estimate the reduced form impact, controlling for the sample available to us in the present setting; in the subsequent columns we add either the timing of industrialization (Panel A) or of the fertility decline (Panel B). Generally, the BoS index remains significant. But the point estimate is visibly reduced, and in some instances it does loose significance (column 4, Panel B). These finding suggest that a significant part of the reduced form impact from the bounty of the sea involves a differential timing of industrialization and the take-off to sustained growth. This issue can also be approached from a more quantitative angle.

Turning to P4, we observe that the impact of the BoS index on industrialization is roughly 0.5 standard deviations (Table 11, column 5). This means that a reduction in the BoS index of one standard deviation delays industrialization by about ($0.5 \times 37 =$) 18.5 years, since the standard deviation of the timing of industrialization in the sample is ca. 37 years. In terms of the fertility decline, we find an impact of 0.3×34.5, or 10.3 years. As seen from Table 12 a delay in either the fertility decline or the timing of industrialization comes at a cost to observed income per capita in 2005; quantitatively each year either transition is delayed reduces income per capita in 2005 by about 1% (not shown).[36] These estimates are probably underestimating the true costs due to measurement error, but if we use them nevertheless, we can calibrate an income loss from one standard deviation reduction in the BoS index of between 11% (using a delay of 10.3 years and an annual cost of one percent) and 20% (using a delay of 18.5 years). Our reduced form estimate, discussed in section 3.3.1 is 28%, which is a bit larger than our calibrated estimate, though clearly in the same ball park.

Overall, the conservative conclusion is that the proposed mechanism can account for a large share of the reduced form estimate, under plausible assumptions. Yet, the mechanism involving a differentiated timing of the take-off does not seem to fully account for our reduced form estimates; the BoS index often remains significant (albeit the parameter estimate shrinks markedly) when either measure of the take-off is introduced into the model, and the internal consistency check also suggests the mechanism does not fully account for the reduced form impact of the BoS index on current income differences. The remainder of the effect must then either be attributed to another mechanism, or to post-take off influences from the bounty of the sea. If the BoS has served to influence fundamental determinants of productivity, such as formal and informal institutions, it would seem likely that it could be convoluting the effect from factors that impinge on growth after the process has begun. Inquiring into which formal and informal institutions the bounty of the sea has influenced is an interesting topic for further research, but well beyond the scope of the present paper.

[36]This is consistent with, though on the low side of, estimates found in Dalgaard and Strulik (2013) and Andersen et al. (2016).

5 Conclusions

In this study, we have taken a first pass at examining the long-run economic consequences of having access to a rich bounty of the sea. We find that resources from the ocean positively influenced economic development from pre-industrial times until today. In the latter respect, however, it is the bounty of the sea of the ancestors of current populations which drives persistence, not geography per se. This suggests that the impact on current economic activity is likely to be indirect, involving formal and informal institutions that have been transmitted across time and space with historical migration.

We propose that an important part of the explanation of these findings is a mechanism that involves an early coastal orientation of the economy, the ensuing occupational structure, and the timing of take-off to sustained growth. Societies with access to a rich bounty of the sea featured more coastal settlements and coastal economic activity early on. We argue that a greater concentration of population in coastal areas subsequently influenced the occupational structure, which became less agricultural in nature. Ultimately, a longer experience in non-agricultural occupations became advantageous when the Industrial Revolution emerged. That is, countries with access to a greater bounty of the sea – or more generally with a population descending from such areas – could benefit earlier from the new opportunities that industrialization offered, which facilitated an earlier take-off to sustained economic growth. Our tests show that this mechanism can account for the lion's share of the reduced form result.

The present study may form the basis for future research in a number of directions. First, in the analysis above we have focused on resources in the ocean, though fishing naturally also may attract people to rivers and lakes. It would clearly be interesting to extend the analysis in the direction of the bounty of rivers and lakes.

Second, while our results suggests that the bounty of the sea influenced coastal orientation and the occupational structure of societies, they do not explicitly speak to precisely what sort of capabilities and institutions were accumulated within coastally oriented societies. Hence, more work is required in order to understand the potential impact from the bounty on the sea on the different formal and informal institutions that developed in these locations.

Third, one may hypothesize that having had access to a rich bounty of the sea may have influenced the diet and dietary traditions of different societies, which could impact on health and economic outcomes today. This too seems well worth exploring in future research.

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Table 1. Validating the BoS Index: Harvesting marine resources

	1	2	3	4	5	6
Dependent variable: (log)	Fish landings (tons/year)					
Dataset:	ICES	IHS	FAO			
Period:	1903-1939	1900-1939	1950s	1960-2009	1950s	1960-2009
BoS index	0.665	0.443	0.350	0.412	0.302	0.282
	(0.001)	(0.005)	(0.000)	(0.000)	(0.000)	(0.000)
(log) EEZ area (sq km)	0.490	0.401	0.446	0.566	0.560	0.728
	(0.095)	(0.019)	(0.000)	(0.000)	(0.000)	(0.000)
Continent FEs	No	No	No	No	Yes	Yes
Observations	17	36	162	162	162	162
R–squared	0.38	0.25	0.31	0.47	0.42	0.63

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant.

Table 2. Validating the BoS Index: Historical labor force allocation

	1	2	3	4	5	6
Dependent variable: log (1+)	Fishermen		Boat makers		Ship workers	
BoS index (100 km buffer)	0.330	0.346	0.136	0.112	0.275	0.345
	(0.000)	(0.000)	(0.009)	(0.000)	(0.000)	(0.000)
(log) 100 km buffer area (sq km)	0.299	0.339	-0.100	-0.023	0.106	0.175
	(0.000)	(0.000)	(0.023)	(0.412)	(0.038)	(0.000)
(log) Employment	0.347	0.615	-0.056	0.269	0.581	0.837
	(0.000)	(0.000)	(0.437)	(0.000)	(0.000)	(0.000)
Country FEs	No	Yes	No	Yes	No	Yes
Census year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Number of regions	80	80	80	80	80	80
Observations	309	309	309	309	309	309
R–squared	0.570	0.607	0.617	0.867	0.544	0.683

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant.

Table 3. Validating the BoS Index: Food supply in traditional ethnic societies

	1	2	3	4	5	6
Dataset:	Standard Cross Cultural Sample			Ethnographic Atlas		
Dependent variable:	Fishing	Animal Husbandry	Agriculture	Fishing	Animal Husbandry	Agriculture
BoS index, 100 km buffer	0.205	-0.171	-0.289	0.083	-0.132	-0.331
	(0.024)	(0.057)	(0.002)	(0.081)	(0.000)	(0.000)
(log) Buffer ocean area	0.007	-0.015	-0.009	-0.014	0.066	0.061
	(0.930)	(0.891)	(0.943)	(0.701)	(0.083)	(0.177)
(log) Distance to coast	-0.560	0.258	0.191	-0.484	0.182	0.167
	(0.000)	(0.031)	(0.112)	(0.000)	(0.000)	(0.000)
Country FEs	No	No	No	Yes	Yes	Yes
Census year FEs	Yes	Yes	Yes	Yes	Yes	Yes
Observations	100	100	100	545	545	545
R–squared	0.35	0.10	0.12	0.42	0.36	0.35

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant.

Table 4. The Bounty of the Sea and Pre–industrial Development – Country level data

	1	2	3	4	5	6	7	8	9	10
Dependent variable: (log)	Population density 1500 CE									
BoS index	0.204	0.137	0.154	0.154	0.187	0.183				
	(0.029)	(0.051)	(0.040)	(0.012)	(0.004)	(0.010)				
BoS index, top fish							0.214	0.208		
							(0.010)	(0.002)		
BoS index, 10 km buffer									0.263	0.235
									(0.000)	(0.000)
Soil suitability	0.239	0.225	0.238	0.251	0.247	0.304	0.236	0.284	0.239	0.292
	(0.001)	(0.002)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)	(0.000)	(0.000)
Country FEs	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	Buffer 10 km	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Absolute latitude	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Share of land near waterways	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Full	Full	Coastal	Full	Coastal	Full	Coastal
Observations	150	150	150	150	150	113	150	113	150	113
R-squared	0.26	0.51	0.55	0.62	0.66	0.70	0.65	0.70	0.68	0.72

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant. Columns marked "Coastal" exclude landlocked nations from the sample.

Table 5. The Bounty of the Sea and Pre–industrial Development – Pixel level data

	1	2	3	4	5	6	7	8
Dependent variable: (log)	Population density in 1500 CE							
BoS index	0.111	0.157	0.129	0.167	0.139	0.124		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
	[0.031]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]		
Bos index, 10 km buffer							0.090	
							(0.000)	
							[0.067]	
Bos index, top fish								0.119
								(0.000)
								[0.000]
Soil suitability	0.551	0.305	0.298	0.285	0.252	0.230	0.229	0.229
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Country FEs	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Pixel area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sea buffer area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Distance to the coast	No	No	Yes	No	No	Yes	Yes	Yes
Distance to natural habors	No	No	Yes	No	No	Yes	Yes	Yes
Estuary	No	No	No	Yes	No	Yes	Yes	Yes
Shelf	No	No	No	Yes	No	Yes	Yes	Yes
Tidal movements	No	No	No	Yes	No	Yes	Yes	Yes
Absolute latitude	No	No	No	No	Yes	Yes	Yes	Yes
Elevation	No	No	No	No	Yes	Yes	Yes	Yes
Observations	5892	5892	5892	5892	5892	5892	5892	5892
R–squared	0.48	0.79	0.80	0.79	0.80	0.81	0.81	0.81

Notes: OLS regressions. Each column displays standardized beta coefficients, p-values based on robust standard errors in parentheses, and p-values based on Conley standard errors (robust to spatial interdependence in a radius of 400 km) in brackets. All regressions include a constant.

Table 6. Bounty of the Sea and Contemporary Development

	1	2	3	4	5	6	7	8	9	10
Dependent variable: (log)						GDP per capita, 2005				
BoS index	0.381	0.176	0.178	0.088	0.092	0.136				
	(0.000)	(0.000)	(0.000)	(0.038)	(0.026)	(0.005)				
BoS index, top fish							0.074	0.077		
							(0.357)	(0.294)		
BoS index, 10km buffer									0.111	0.139
									(0.023)	(0.007)
Soil suitability	0.020	-0.205	-0.206	-0.256	-0.259	-0.313	-0.262	-0.314	-0.259	-0.312
	(0.819)	(0.001)	(0.001)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Continent FEs	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	Buffer 10 km	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Absolute latitude	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Share of land near waterways	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Full	Full	Coastal	Full	Coastal	Full	Coastal
Observations	140	140	140	140	140	103	140	103	140	103
R-squared	0.20	0.63	0.63	0.69	0.69	0.69	0.69	0.68	0.69	0.69

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant. Columns marked "Coastal" exclude landlocked nations from the sample.

Table 7. Ancestral Bounty of the Sea and Contemporary Development

	1	2	3	4	5	6	7	8	9	10
Dependent variable: (log)	GDP per capita, 2005									
BoS index (ancestry adj)	0.428	0.235	0.243	0.135	0.158	0.208				
	(0.000)	(0.000)	(0.000)	(0.009)	(0.002)	(0.001)				
BoS index, top fish (ancestry adj)							0.144	0.088		
							(0.059)	(0.228)		
BoS index, 10 km buffer (ancestry adj)									0.225	0.222
									(0.000)	(0.000)
Soil suitability (ancestry adj)	0.120	-0.167	-0.179	-0.194	-0.213	-0.261	-0.218	-0.256	-0.220	-0.267
	(0.174)	(0.008)	(0.005)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)	(0.001)
Continent FEs	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	Buffer 10 km	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic (ancestry adj)	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Absolute latitude	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Share of land near waterways	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Full	Full	Coastal	Full	Coastal	Full	Coastal
Observations	139	139	139	139	139	102	139	102	139	102
R-squared	0.26	0.64	0.65	0.69	0.70	0.70	0.70	0.68	0.71	0.70

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant. Columns marked "Coastal" exclude landlocked nations from the sample.

Table 8. Bounty of the Sea and Contemporary Development: Place or People?

	1	2	3	4	5	6	7	8	9	10
Dependent variable: (log)					GDP per capita, 2005					
Bos Index (ancestry adj)	0.479	0.379	0.431	0.260	0.304	0.311				
	(0.000)	(0.020)	(0.008)	(0.052)	(0.026)	(0.010)				
BoS index	-0.055	-0.150	-0.194	-0.133	-0.154	-0.107				
	(0.579)	(0.359)	(0.230)	(0.294)	(0.231)	(0.313)				
Bos Index, top fish (ancestry adj)							0.274	0.146		
							(0.027)	(0.306)		
BoS index, top fish							-0.173	-0.065		
							(0.231)	(0.681)		
Bos index, 10 km buffer (ancestry adj)									0.370	0.262
									(0.004)	(0.007)
Country FEs									-0.154	-0.041
Census year FEs									(0.184)	(0.625)
Soil suitability (ancestry adj)	0.122	-0.164	-0.176	-0.187	-0.206	-0.254	-0.207	-0.253	-0.214	-0.265
	(0.174)	(0.010)	(0.006)	(0.003)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Continent FEs	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	Buffer 10 km	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic (ancestry adj)	No	No	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Absolute latitude	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Share of land near waterways	No	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sample	Full	Full	Full	Full	Full	Coastal	Full	Coastal	Full	Coastal
Observations	139	139	139	139	139	102	139	102	139	102
R-squared	0.26	0.64	0.66	0.70	0.71	0.70	0.70	0.68	0.71	0.70

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant. Columns marked "Coastal" exclude landlocked nations from the sample.

Table 9: Coastal orientation in preindustrial and modern times

Panel A: Coastal orientation and the Bounty of the Sea in 1500 CE

	1	2	3	4	5	6	7
Dependent variable: (log)	Fraction of total population near coast in 1500 CE (<100 km)						
BoS index	0.348	0.341	0.342	0.082	0.086		
	(0.000)	(0.000)	(0.000)	(0.008)	(0.008)		
BoS index, top fish						0.240	
						(0.000)	
BoS index, 10 km buffer							0.103
							(0.002)
Soil suitability	-0.100	-0.155	-0.155	-0.122	-0.119	-0.122	-0.119
	(0.224)	(0.042)	(0.045)	(0.007)	(0.009)	(0.004)	(0.008)
Observations	152	152	152	152	152	152	152
R-squared	0.26	0.34	0.34	0.85	0.85	0.88	0.85

Panel B: Coastal orientation and the Bounty of the Sea in 2005

	1	2	3	4	5	6	7
Dependent variable: (log)	Fraction of total population near coast in 2005 (<100 km)						
BoS index	0.370	0.369	0.370	0.126	0.129		
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)		
BoS index, top fish						0.300	
						(0.000)	
BoS index, 10km buffer							0.159
							(0.000)
Soil suitability	-0.123	-0.175	-0.174	-0.140	-0.137	-0.140	-0.137
	(0.123)	(0.017)	(0.018)	(0.002)	(0.002)	(0.001)	(0.002)
Observations	152	152	152	152	152	152	152
R-squared	0.27	0.36	0.36	0.81	0.82	0.86	0.82
Continent FEs	No	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic	No	No	Yes	No	Yes	Yes	Yes
Absolute latitude	No	No	No	Yes	Yes	Yes	Yes
Share of land near waterways	No	No	No	Yes	Yes	Yes	Yes
Share of land near coast	No	No	No	Yes	Yes	Yes	Yes

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant.

Table 10: Occupational structure in preindustrial and modern times

Panel A: Occupational structure and the Bounty of the Sea in 1500 CE

	1	2	3	4	5	6	7
Dependent variable: (log)	Urbanization rate in 1500 CE						
BoS index	0.275	0.366	0.399	0.430	0.442		
	(0.029)	(0.007)	(0.003)	(0.011)	(0.007)		
BoS index, top fish						0.343	
						(0.057)	
BoS index, 10 km buffer							0.450
							(0.001)
Soil suitability	-0.230	-0.158	-0.237	-0.048	-0.182	-0.080	-0.233
	(0.052)	(0.157)	(0.020)	(0.718)	(0.160)	(0.571)	(0.076)
Observations	71	71	71	71	71	71	71
R-squared	0.14	0.32	0.44	0.37	0.45	0.30	0.46

Panel B: Occupational structure and ancestral bounty of the sea in 1900

	1	2	3	4	5	6	7
Dependent variable: (log)	Employment share in agriculture in 1900						
BoS index (ancestry adj)	-0.597	-0.452	-0.452	-0.510	-0.525		
	(0.000)	(0.003)	(0.002)	(0.002)	(0.001)		
BoS index, top fish (ancestry adj)						-0.383	
						(0.017)	
Bos Index, 10 km buffer (ancestry adj)							-0.540
							(0.004)
Soil suitability (ancestry adj)	-0.072	0.091	0.104	0.096	0.134	0.141	0.141
	(0.286)	(0.164)	(0.103)	(0.163)	(0.052)	(0.082)	(0.058)
Observations	111	111	111	111	111	111	111
R-squared	0.42	0.55	0.58	0.59	0.62	0.52	0.61
Continent FEs	No	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic	No	No	Yes	No	Yes	Yes	Yes
Absolute latitude	No	No	No	Yes	Yes	Yes	Yes
Share of land near waterways	No	No	No	Yes	Yes	Yes	Yes
Landlocked	No	No	No	Yes	Yes	Yes	Yes

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant.

Table 11: Industrialization and demographic transition

Panel A: Timing of Industrialization and the ancestral bounty of the sea

	1	2	3	4	5	6	7
Dependent variable:	Year of Industrialization						
BoS index (ancestry adj)	-0.598	-0.408	-0.422	-0.423	-0.457		
	(0.000)	(0.001)	(0.000)	(0.001)	(0.000)		
BoS index, top fish (ancestry adj)						-0.329	
						(0.008)	
Bos Index, 10 km buffer (ancestry adj)							-0.395
							(0.026)
Soil suitability (ancestry adj)	-0.024	0.117	0.121	0.140	0.163	0.169	0.178
	(0.757)	(0.066)	(0.048)	(0.058)	(0.022)	(0.024)	(0.036)
Observations	101	101	101	101	101	101	101
R-squared	0.41	0.60	0.61	0.65	0.66	0.59	0.62

Panel B: Timing of the Fertility Decline and ancestral bounty of the sea

	1	2	3	4	5	6	7
Dependent variable:	Year of the fertility decline						
BoS index (ancestry adj)	-0.521	-0.258	-0.277	-0.233	-0.271		
	(0.000)	(0.000)	(0.000)	(0.001)	(0.001)		
BoS index, top fish (ancestry adj)						-0.244	
						(0.018)	
Bos Index, 10 km buffer (ancestry adj)							-0.303
							(0.003)
Soil suitability (ancestry adj)	-0.153	-0.050	-0.050	-0.048	-0.031	-0.031	-0.015
	(0.131)	(0.326)	(0.343)	(0.431)	(0.591)	(0.546)	(0.788)
Observations	92	92	92	92	92	92	92
R-squared	0.37	0.73	0.74	0.75	0.75	0.74	0.75
Continent FEs	No	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	EEZ	EEZ	EEZ	EEZ	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic (ancestry adj)	No	No	Yes	No	Yes	Yes	Yes
Absolute latitude	No	No	No	Yes	Yes	Yes	Yes
Share of land near waterways	No	No	No	Yes	Yes	Yes	Yes
Landlocked	No	No	No	Yes	Yes	Yes	Yes

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant.

Table 12: Testing the proposed mechanism

Panel A: Channeling the influence from ancestral bounty of the sea via industrialization

	1	2	3	4	5	6
Dependent variable: (log)	PPP GDP per capita, 2005					
Year of industrialization				-0.233	-0.247	-0.216
				(0.058)	(0.030)	(0.070)
BoS index (ancestry adj)	0.248			0.139		
	(0.001)			(0.108)		
BoS index, top fish (ancestry adj)		0.301			0.217	
		(0.003)			(0.030)	
Bos Index, 10 km buffer (ancestry adj)			0.336			0.250
			(0.000)			(0.002)
Soil suitability (ancestry adj)	-0.148	-0.164	-0.167	-0.115	-0.125	-0.132
	(0.038)	(0.021)	(0.021)	(0.105)	(0.078)	(0.061)
Observations	96	96	96	96	96	96
R-squared	0.72	0.72	0.74	0.74	0.75	0.75

Panel B: Channeling the influence from ancestral bounty of the sea via fertility decline

	1	2	3	4	5	6
Dependent variable: (log)	PPP GDP per capita, 2005					
Year of fertility decline				-0.307	-0.315	-0.252
				(0.033)	(0.037)	(0.072)
BoS index (ancestry adj)	0.169			0.103		
	(0.071)			(0.282)		
BoS index, top fish (ancestry adj)		0.162			0.097	
		(0.107)			(0.340)	
Bos Index, 10 km buffer (ancestry adj)			0.283			0.218
			(0.003)			(0.024)
Soil suitability (ancestry adj)	-0.276	-0.281	-0.290	-0.293	-0.297	-0.303
	(0.006)	(0.006)	(0.003)	(0.004)	(0.003)	(0.003)
Observations	84	84	84	84	84	84
R-squared	0.65	0.65	0.67	0.67	0.67	0.68
Continent FEs	Yes	Yes	Yes	Yes	Yes	Yes
Sea area	EEZ	EEZ	Buffer 10 km	EEZ	EEZ	Buffer 10 km
Land area	Yes	Yes	Yes	Yes	Yes	Yes
Yrs since Neolithic (ancestry adj)	Yes	Yes	Yes	Yes	Yes	Yes
Absolute latitude	Yes	Yes	Yes	Yes	Yes	Yes
Share of land near waterways	Yes	Yes	Yes	Yes	Yes	Yes
Landlocked	Yes	Yes	Yes	Yes	Yes	Yes

Notes: OLS regressions. Each column displays standardized beta coefficients, and p-values based on robust standard errors in parentheses. All regressions include a constant.