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JEL Classification: Z10

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Does a sea fishing legacy explain differences in risk attitudes?

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1 Introduction

Adaptation to one's environment has influenced the development of human culture and traits in many ways (Fairbank and Goldman 2006). For instance, Chinese farmers living on flat, vast plains were at the mercy of the weather. This was in sharp contrast to Europeans, who lived in a land of variegated topography. Many of them were never far from water and could usually supplement their earnings from agriculture by hunting or fishing. As a result, seaborne commerce has played an important role in Western economies since ancient times. This in turn opened their horizons and encouraged them to conquer lands across the ocean, followed by navigation, commerce, colonization and even space exploration at a later stage. This adventurous spirit emerging from seaborne commerce may have been passed on from generation to generation and may also have influenced entrepreneurial activity and the shaping of entrepreneurial spirit in modern society. A review of the literature on personality traits of entrepreneurs since 2000 indicates the importance of risk-taking (Kerr et al. 2018). The authors find that risk aversion is a predictor of whether a person will become an entrepreneur (low risk aversion) or be an employee (high risk aversion). Greater risk tolerance has been shown to be a key characteristic of entrepreneurs in many contexts (see, e.g., Kihlstrom and Laffont 1979, Hvide and Panos 2014, Kerr et al. 2014, Kerr et al. 2019).

Recent research examining economic preferences at the global level suggests that risk preferences vary significantly across countries (see, e.g., Falk et al., 2018).[1] This heterogeneity of risk attitudes could lead to varying levels of innovation and entrepreneurship in different countries, which in turn is critical for the emergence of societies as knowledge-based and sustainable.

While differences in tolerance towards risk have been documented, there is less research on why individuals exhibit these differences across countries. We propose that idiosyncratic environmental parameters throughout history may generate differences in human preferences and behaviors. To this end, we aim to explore the relationship between natural environments, individuals' risk preferences and societies' economic characteristics. Contemporary economic behaviors and performance in the modern world can be rooted in history to some extent, and historical legacies can persist in modern times. For instance, societies that are based on agriculture and farming rely on interdependence and cooperation compared to societies that depend on hunting. This heterogeneity in subsistence activities has been argued to have led

[1] Becker et al. (2020) document global variation in several economic preferences and argue this is partly due to its origins in the structure and timing of distant ancestral migration patterns in the evolutionary process. Relatedly, Falk et al. (2021) examine how differences in preferences arise due to variation in socio-economic status.

to more individualistic cultures in hunting societies and more collectivist cultures in farming societies (e.g., Berry, 1967). More recently, Talhim et al. (2014) elaborate on subsistence style theory and establish that the heterogeneity of cooperative cultures within China is largely determined by historical patterns of rice versus wheat cultivation, with those living in the rice growing regions more cooperative in nature.

In this paper, we examine whether a historical dependence on sea fishing (determined by structural and geographical factors in the natural environment) affects the current patterns of human risk preferences as well as other related economic behaviors. Importantly, while some studies suggest that individual characteristics and parental attributes may determine risk attitudes (e.g., Dohmen et al. 2012), we propose an explanation for the origin of risk preferences based on the external physical environments in history. Economic theories also suggest that preferences (Bisin and Verdier, 2000, 2001) and beliefs (e.g., Alesina and Angeletos, 2005; Bénabou and Tirole, 2006; Dessi, 2008; Dessi and Zhao, 2018) can persist through intergenerational transmission, leading to a long-term influence of physical environments on modern individual traits, including risk preferences. In the economics literature, a few recent studies explore the link between sea fishing and related cultural/environmental traits. Among them, notably, BenYishay et al. (2017) demonstrate that the reliance on sea-fishing predicts matrilineal inheritance's persistence. Gneezy et al. (2016) indicate that people from a lake fishing community tend to trust and cooperate less than their sea fishing counterparts. Leibbrandt et al. (2013) suggest that fishermen from individualistic societies tend to be more competitive than those from collectivistic societies.

Building on the ideas developed in the literature discussed above, our paper takes an important first step by focusing on the link between sea fishing and risk preferences. To illustrate the main idea, consider the following. Suppose a group of individuals have a risk-free endowment w and decide whether to invest the entire w in sea fishing. Sea fishing is risky. Each fisher obtains a return $X(> w)$ if successful with probability p, and receives zero otherwise. Risk attitudes of individuals are heterogenous. For simplicity, assume that there are only two types of individuals: extremely risk averse types who stay away from the ocean, whereas the extremely risk seeking types, always prefer to opt for sea fishing. If $w < pX$, sea fishing resources are relatively abundant in the region. In such an environment, risk-seeking fishers will accumulate a higher level of wealth in expectation. In the long run, risk-seeking fishers will become dominant in the population. If instead $w > pX$, this relatively poor sea-fishing environment favours risk-averse individuals. We anticipate that risk-averse individuals will thrive in the population over generations in this environment. In a nutshell, people in countries with a natural (geographical) advantage for sea fishing as compared to agriculture, would have developed preferences that were more risk seeking, as they adapted their preferences to their natural physical environment. Over the generations, the entire population's risk preferences are amplified when they have a dependence on sea fishing and this is what we expect to observe in their preferences today.

We thus conjecture that a history of sea fishing may lead to a culture of high levels of risk-taking activities that demand risk-tolerant preferences. Fishing in the sea is inherently dangerous, and sea fishers need to be sufficiently risk seeking to venture into the unpredictable ocean. Risk tolerance may have instrumental value, as it encourages investment behaviors such as voyage, which, though risky, also leads to high returns. We shed light on the important role of the legacy of sea fishing in understanding contemporaneous risk preferences. Individuals living in environments that were conducive to sea fishing adapted their risk preferences and those risk preferences were transmitted across generations, to people in the current times. Our use of historical data on sea fishing allows for a clean examination of this causal effect, as current risk preferences are unable to influence the choice of subsistence occupations in the past, hence avoiding reverse causality. Further, to ensure that the relationship we uncover is causal we also use an instrumental variable approach and confirm that the results remain robust. In addition, we report the sensitivity of our results to alternative measures of key variables and to different specifications. Moreover, we find a positive relationship between the historical dependence on sea fishing and modern economic characteristics in the data, such as entrepreneurship and the tendency to consume addictive products such as alcohol and cigarettes.

2 Research Methods

2.1 Data

We use data from multiple sources. Data on ancestral characteristics are obtained from a publicly accessible database of ancestral economic, cultural, political, and environmental characteristics constructed by Giuliano and Nunn (2018). The database, which has global coverage, provides average measures of various characteristics of the ancestors of current populations at the country, district, and grid-cell levels. The data are constructed by combining preindustrial ethnographic information on over 100 ancestral characteristics for 1,265 ethnic groups with information on the current distribution of groups that speak approximately 7,000 different languages or dialects, reported at the grid-cell level. The database uses the languages and dialects spoken by current populations to create measures of their ancestors' characteristics. We focus on country-level averages of the measure "subsistence economy", which is an additional variable in the extended version of the Ethnographic Atlas. It codes which economic activity contributed most to the society's subsistence: gathering, hunting, fishing, or one of a number of types of agricultural activities. A higher value of this measure for fishing indicates that the country had higher dependence on fishing for subsistence.

The data on economic preferences are from the Global Preferences Survey (GPS), a globally representative dataset with measures of risk and time preferences, positive and negative reciprocity, altruism, and trust (see Falk et al., 2018). The Global Preferences Survey dataset use an experimentally validated survey module to measure the six key economic preferences. For most of the preferences, the optimization procedure led to a combination of two survey items, including one qualitative item that is more abstract and one quantitative item that puts the respondent into a precisely defined hypothetical choice scenario (see Falk et al. 2016 and Falk et al. 2018 for the wording of the questions and a discussion of the weights). The dataset covers 80,000 people in 76 countries and was collected using a standardized data collection protocol across countries. The GPS data have an important feature: they measure preferences among a nationwide representative sample for each of the 76 countries included. Therefore, they can be used to examine how preferences vary within a given country's population and to construct country-level averages to study how preferences vary across countries. For ease of interpretation, each preference measure is standardized at the individual level to have a mean of zero and a standard deviation of one.

Several additional datasets are used to complement and control for potential confounding factors. For example, we use a range of data on meteorological and geographical characteristics, such as average temperature, average precipitation, distance to equator, terrain ruggedness, island country and continent, which are taken from several publicly available data sources.

Furthermore, in addition to the GPS data, we use the World Values Survey as a secondary dataset, which enables us to examine whether our results are robust to different measures of risk preferences. Finally, we consider behaviors that are associated with risk, such as smoking, alcohol consumption and entrepreneurship. The data relating to these are obtained from the Global Burden of Diseases Study 2015, Global Health Observatory data and Global Entrepreneurship Monitor data separately. We merge all these datasets by country.

The Appendix provides a description of the variables used and their summary statistics. Online Appendix Table A1 and Table A2 report the summary statistics for several of the key outcome variables, as well as our rich set of covariates at the country level and at the individual level respectively.

2.2 Estimation Framework

To explore the effect of the legacy of sea fishing on risk-taking cultures in modern societies, we consider the following linear, fixed-effects model and use an ordinary least squares estimation method:

$$\begin{aligned} Y_{ic} &= \beta_0 + \beta_1 Fishing_c + \beta_2 Soilsuit_c + \beta_3 Inlandwater_c \\ &\quad + \beta_4 GDP_c + \mathbf{X}_{cj}\gamma_{0j} + \mathbf{W}_{cj}\gamma_{1j} + \mathbf{V}_{cj}\gamma_{2j} + \boldsymbol{\delta}_{cw}\gamma_{cw} + \varepsilon_{cw}, \end{aligned} \tag{1}$$

where c denotes country; i denotes individual; Y_{ic} denotes different economic preferences of individual i in country c; $Fishing_c$ is the measure of historical dependence on sea fishing, which is measured by the degree to which fishing contributed most to country c's subsistence, such that a higher value of $Fishing_c$ indicates that fishing contributed more to subsistence activity of the ancestors in country c. Note that we are interested in the estimate of coefficient β_1, a positive value of β_1 indicates that countries which have historically relied more heavily on sea fishing, are more likely to undertake oceanic exploration than other countries, which in turn affects the risk preferences of their people in modern times.

We control the impact of preferences developed in relation to agricultural production by introducing the measure of ancestry adjusted soil suitability, which is denoted by $Soilsuit_c$. To exclude the confounding factors from fishing in rivers or lakes and isolate the effects of sailing far, we include a measure of the length of inland water, which can control for the impact of lake fisheries. This measure is denoted by $Inlandwater_c$. To control for the effect of economic growth, we use GDP per capita, which is denoted by GDP_c. The analysis also controls for a series of meteorological and geographical characteristics that may correlate with the traditional form of subsistence. Specifically, the vector $\mathbf{X}_{cj}$ consists of a set of geographical variables including average distance to the nearest ice-free coast, fraction of land within 100 km of an ice-free coast, coral reef area, and distance to equator. The vector $\mathbf{W}_{cj}$ consists of a set of meteorological factors including the logarithm of average temperature and the logarithm of average precipitation. The vector $\mathbf{V}_{cj}$ consists of a set of soil quality related variables including soil fertility, fraction of the land area covered by desert, and terrain roughness. The vector $\boldsymbol{\delta}_{cw}$ includes island fixed effects and continent fixed effects. ε_{cw} is the error term. Finally, we cluster the standard errors at the country level to control for any heteroskedasticity and serial correlation.

3 Results

The distributions of historical dependence on sea fishing and risk seeking in modern societies are plotted in Figure 1. Two key patterns emerge from this figure. First, we observe considerable heterogeneity in both Panel A, which reports the historical dependence on sea fishing and Panel B, which reports current risk seeking behavior. Second, the distribution appears similar in both Panels, such that regions with a higher dependence on sea fishing also show higher risk seeking behaviors.

[Insert Figure 1 here]

Next, we turn to a formal empirical analysis. Estimates of equation (1), with preference measures taken from the Global Preference Survey, are reported in Table 1. The first column reports the estimates of Eq. (1) without any controls. One potentially confounding factor, which may have differential effects on individual's economic preference in the modern society, is the other subsistence activities which have been traditionally practiced in different societies. Therefore, in the second column, we add two variables that capture the potential impact of two other important subsistence activities, agriculture and lake-fishing. In both specifications, the estimated relationship between historical dependence on sea fishing and risk seeking in modern societies is positive and statistically significant. In column (3), we further control for the island fixed effects and continent fixed effects. The estimated coefficient for historical dependence on sea fishing remains positive and significant, and the magnitude of the estimated coefficient actually increases. In column (4), we include additional control variables to account for differences in geographical conditions across countries. As shown, including these additional control variables does not affect the historical dependence on sea fishing coefficient, which remains positive and statistically significant. It is also possible that in general, the areas that relied more on fishing historically have worse soil quality. To control for this possibility, we add three measures of soil quality in column (5). The results show that the effect of the legacy of sea fishing remains robust to controlling for soil quality. In column (6), we further control the average temperature and average precipitation to capture the potential effect of climate. As shown, controlling for countries' meteorological factors does not alter the results. The final factor that we control for is differences in countries' economic development. To account for this, in column (7), we also control for the annual average GDP per capita between 1970 and 2000. Again, the results remain robust.

[Insert Table 1 here]

Fig.2A presents the regression results graphically. We find that our regressor of interest, $Fishing_c$, is positive and statistically significant only for risk taking, implying that people from countries whose ancestors made a living from fishing have a greater appetite for risk than those from other countries. However, as demonstrated in Fig.2A, the estimated relationship between $Fishing_c$ and all the other economic preferences, including patience, positive and negative reciprocity, altruism and trust, are statistically insignificant and small in magnitude. Similarly, the relationship between historical dependence on sea fishing and math skills is also not significant. The corresponding regressions are presented in online Appendix Table A3. These two findings together provide evidence that ancient fishing traditions influence risk preferences by increasing the risk taking of descendants in modern society, and these traditions do not affect a range of other economic preferences.

[Insert Figure 2 here]

So far, we have investigated whether the legacy of sea fishing caused the descendants of those exposed to it to become more risk taking, as the earliest sea fishers needed to be sufficiently risk seeking to venture into the unpredictable ocean. The evidence we presented is consistent with our hypothesis that the evolution of risk preference was influenced by the ancient fishing traditions. A natural question that arises is whether the historical dependence on sea fishing led to more marine exploitation. To address this question, we explore the links between the historical dependence on sea fishing and coastal settlements and harvesting of marine resources at the country level. In historical times, due to transport constraints, population centers were often located in agricultural hinterlands that could provide enough food for the population. However, those who lived in areas with a lack of tractable land had to rely on climate-dependent resources for their livelihood. In order to survive, the people who live in the area which is rich in marine resources would naturally cling to the sea. As a result, we should observe that people in areas that historically relied more on marine fishing for their subsistence chose to settle closer to the ocean. Furthermore, the pattern of settlement tends to pass on from one generation to the next (Henderson et al. 2018; Motamed et al. 2014). In testing this prediction, we rely on the measures of country's coastal orientation constructed by Dalgaard et al. (2020). These measures capture the coastal orientation of a country by the fraction of the total population or total earthlights that are located near the coast in both the year 1500 and the year 2005. In Table 2 we report the results from estimating Equation 1 at the country level with these measures of country's coastal orientation as the outcome of interest. As shown in columns (1) to (3), we observe that the coefficient of $Fishing_c$ is positive and significant in all cases. The estimates thus provide strong support that countries' historical reliance on marine fishing positively affected their coastal orientation both in 1500 and in recent times.

Further, we take another approach to investigate the differences in marine exploitation across countries, by examining their marine fish landings. The country which historically relied heavily on marine fishing would be more likely to have higher marine fish landings. In order to examine this prediction, we rely on the measures taken from Dalgaard et al. (2020), which are developed using FAO's FIGIS database. Columns (5) and (6) of Table 2 confirm that the coefficient of $Fishing_c$ is positively correlated with fish landing in both the 1950s and 1960-2009. Overall, Table 2 documents that the historical dependence on sea fishing led to more coastal settlement and a harvest of more marine resources historically as well as today.

[Insert Table 2 here]

3.1 An Instrumental Variable Approach

The positive correlation between historical dependence on fishing and risk taking that is documented in the previous section is consistent with our hypothesis that a history of sea fishing engendered a culture of high levels of risk-taking. An important concern regarding the interpretation of Eq. (1) is that risk preferences may affect the choice of subsistence activities. We pursue two strategies to determine whether the correlations we uncover are causal. Our first strategy to overcome this concern about reverse causality is reported above and uses the recent insights from a series of studies that link historical factors to current economic outcomes (see Nunn 2008; Ashraf and Galor 2013; Galor and Özak 2016). In particular, our research specifically exploits variations in sea fishing legacy in the past to identify contemporary risk preferences. Arguably, the risk preferences in modern societies would be unlikely to affect the choice of subsistence activities (such as fishing) in ancient times.

The second strategy that we pursue is to use instruments that are correlated with the historical dependence on fishing, but are uncorrelated with any characteristics of the ancient group that may affect the risk preference of descendants. The instruments we used are the share of area within 50 km of the coast and the Bounty of the Sea index. For each country, the share of area within 50 km of the coast is an exogenous geographical condition. The Bounty of the Sea (BoS) index is a measure of the potential abundance of exploitable marine fish resources in the oceans, which is constructed by Dalgaard et al. (2020). It is built in two steps. First, relevant marine fish species were identified using FAO global fish landing statistics, and second, the unweighted average habitat suitability of these species was calculated using *AquaMaps* grid data. Most notably, the Bounty of the Sea (BoS) index capture the natural productivity of oceans using a historical perspective, it is conceptually similar to indices of the suitability of land for agriculture. And the substantial variation in the BoS index is in accordance with key marine biological principles. Taking into account international migration, Dalgaard et al. (2020) construct an ancestry adjusted BoS index by using the population migration matrix constructed by Putterman and Weil (2010). Thus, the ancestry adjusted BoS index reflects the bounty of the sea in countries of the ancestors of current countries' populations. Overall, these two instruments capture an ancient group's exposure to the potential for marine exploitation, since the groups that lived in a country with a larger share of area closer to the coast and with rich marine resources were more likely to rely on fishing as a form of subsistence. Further, these two instruments are plausibly uncorrelated with other factors that affected the risk preference of their descendants. The Instrumental Variable (IV) estimates are reported in the column (8) and (9) of Table 1 (the first stage results are reported in online Appendix Table A7 in the appendix). The column (8) of Table 1 reports estimates using two instruments, the share of area within 50 km of the coast and the BoS index. The column (9) reports estimates replacing the BoS index with the ancestry adjusted BoS index as the instrumental variable.

The IV results confirm the positive relationship between the historical dependence on sea fishing for subsistence by an individual's ancestors and the individual's current level of risk preferences, estimated by OLS. A comparison with column 1, Table 1, indicates that the magnitudes of the coefficients are significantly larger than the magnitudes of the OLS estimates. This finding suggests that the OLS estimates may be a lower bound estimate of the strength of the relationship between the historical dependence on sea fishing and risk preferences in modern society.

3.2 Sensitivity to Alternative Variables, Specifications and Counterfactual Groups

Next, we consider a number of sensitivities checks to ensure that our findings are robust. First, we use alternative measures of economic preferences taken from the World Values Survey (WVS) data. The WVS is a widely used global survey which provides measures that are related to individual preferences. The measures used are explained in the online Appendix. Second, we examine whether the results from Table 1 are driven by some particularly influential outliers of the independent variable. We construct an indicator variable which equals one if our main independent variable $Fishing_c$ is greater than zero and equals zero otherwise. The last robustness check we perform is a test of whether our results hold when we restrict the sample by excluding all landlocked countries. For all of these sensitivity checks, we use our baseline specification, with the full set of control variables. The results are presented in online Appendix Table A4. We find that the positive effect of the ancient fishing tradition on risk preferences is significant, and this term has an insignificant effect on all the other economic preferences. We also find that our main results are robust to using an indicator measure of the independent variable or excluding the landlock countries.

Furthermore, online Appendix Table A5 explores the potential impact of a historical fishing tradition on some economically relevant characteristics in modern times. We gathered country-level statistics on variables that have been linked to risk preferences: entrepreneurship, smoking and alcohol consumption. To measure entrepreneurship, we use both entrepreneurial intentions and views of entrepreneurship as a good career choice from the Global Entrepreneurship Monitor dataset. The measure of smoking is based on the variable "smoking prevalence and attributable disease burden in 195 countries and territories" in the Global Burden of Disease Study 2015. The "recorded alcohol per capita consumption by country" and "total recorded and unrecorded alcohol per capita" in the Global Health Observatory data are used to measure alcohol consumption. Fig.2B presents the results graphically. As demonstrated in Fig.2B, the $Fishing_c$ variable has a positive and significant effect on this range of risk-related behaviors.

Our study aims to bring attention to an important determinant of an individual's risk preference: sea-fishing legacy. To explore this relationship further, we create counterfactual groups that can provide comparisons between nearby countries that share similar historical backgrounds. This approach is particularly illustrative because nearby countries that share a similar historical and cultural heritage may have different marine fishery resources due to geographical differences. Below we undertake a number of comparisons between counterfactual groups. First, we examine two groups of selected nearby countries with similar heritage. Second, we compare risk preferences in a cross-country comparison between landlocked versus non-landlocked countries. Finally, we take advantage of survey data from China to do a within-country comparison. To be more specific, we compare the risk preferences of individuals who live in the coastal versus the inland regions within the country.

Figure 3 illustrates the first two comparisons. The first is based on cultural similarity in terms of language and religion. We compare two pairs of countries, the United States versus Canada and Argentina versus Chile. The first country in each pair has fewer marine fishery resources, as measured by the ratio of coastline length to land area. We plot the average risk preference for each country using the Global Preferences Survey (individual level) data in Figure 3A. As shown in Figure 3A, the country that has the most marine fishery resources in each pair tends to have a higher level of risk tolerance ($p = 0.0513$ and 0.0034, t test).

The second comparison is between landlocked countries and their coastal neighbors. Three pairs of countries that share the same language are included in this comparison: Bolivia versus Chile, Afghanistan versus Iran, and Uganda versus Tanzania. We plot the average risk preference for each country using the Global Preferences Survey data in Figure 3B. The landlocked country indeed has a lower level of risk-seeking preferences than its coastal neighbors ($p = 0.0910$, 0.0000 and 0.0000, t test).

[Insert Figure 3 here]

Next, we conduct the cross-country comparison by dividing all the countries into two groups, landlock versus non-landlocked countries. To isolate the landlock effect from other explanatory variables, we regress the risk preference on all the control variables in Eq 1 and use the group average of these residuals to plot Figure A1. The residuals represent the remaining variation in risk preferences after we control for other factors. As shown in Figure A1, the group of landlock countries have a lower level of risk tolerance compared to the non-landlock countries.

Finally, we test whether this pattern remains consistent when we compare the risk preference of people who lived in the coastal and inland regions within a country. We use China as a test case and exploit the fact that it is a large country that is relatively homogeneous in language and religion to mitigate the problem of unobserved confounders. The data used for this exercise is from the Chinese College Students Survey (CCSS) which is a nationally representative survey conducted by the China Data Center and the School of Higher Education at Tsinghua University. See Li et al. (2012) for details on the survey. The risk preference is assessed through the questions "Some people say that when investing, it is more important to invest safely and get a certain return than to take a certain risk to get the maximum possible return. Do you agree or disagree with this statement? Responses are provided on a five-point scale ranging from 1 to 5 (1. Strongly disagree; 2. Disagree; 3. Neutral; 4. Agree; 5. Strongly agree). We construct an indicator variable to measure risk taking, it takes the value of one if the response strongly disagrees with this statement and zero otherwise. We regress risk taking on the inland province dummy controlling for age, gender, ethnic group and the hukou dummy. The estimates are reported in the online Appendix Table A6. We find the students from the inland provinces have a significant lower risk tolerance than their counterpart. Moreover, we do not find evidence of a significant relationship between the inland province dummy and the student's time preference or trust in the CCSS data.

Taken together, these results indicate that geographical factors such as sea fishing legacy have considerable explanatory power in explaining differences in risk attitudes.

4 Discussion

This paper aims to rationalize heterogeneous risk preferences across countries. These differences across locations suggest that attitudes towards risk adapt depending on the environment. Since its origin, seafaring is considered to be amongst the most dangerous occupations in the world. Motivated cognition and emotion including sailors' superstitions may induce people to bear this high risk in sea fishing (See Bénabou and Tirole 2016). For instance, British and Irish sailors were known to adopt a "ship's cat" as they believed that a black cat can bring good luck. (See Eyers 2011) A sea fishing environment allows individuals the opportunity to benefit from being risk seeking, leading to a high number of voyages. As part of the emerging literature in economic history, our empirical study provides a new explanation for the emergence of diversity in risk attitudes. In a variety of contexts, individuals adapt to their environments by shaping their beliefs and preferences, including preferences for risk, and acting in a rational way. Our results suggest that the condition for voyages in the past gives rise to risk-seeking preferences in modern times. While many studies in psychology and economics attempt to link risk preferences to personal characteristics, our study is the first to address why individuals in certain cultures are risk averse while others are relatively risk seeking and confirm its solid root in a sea fishing legacy.

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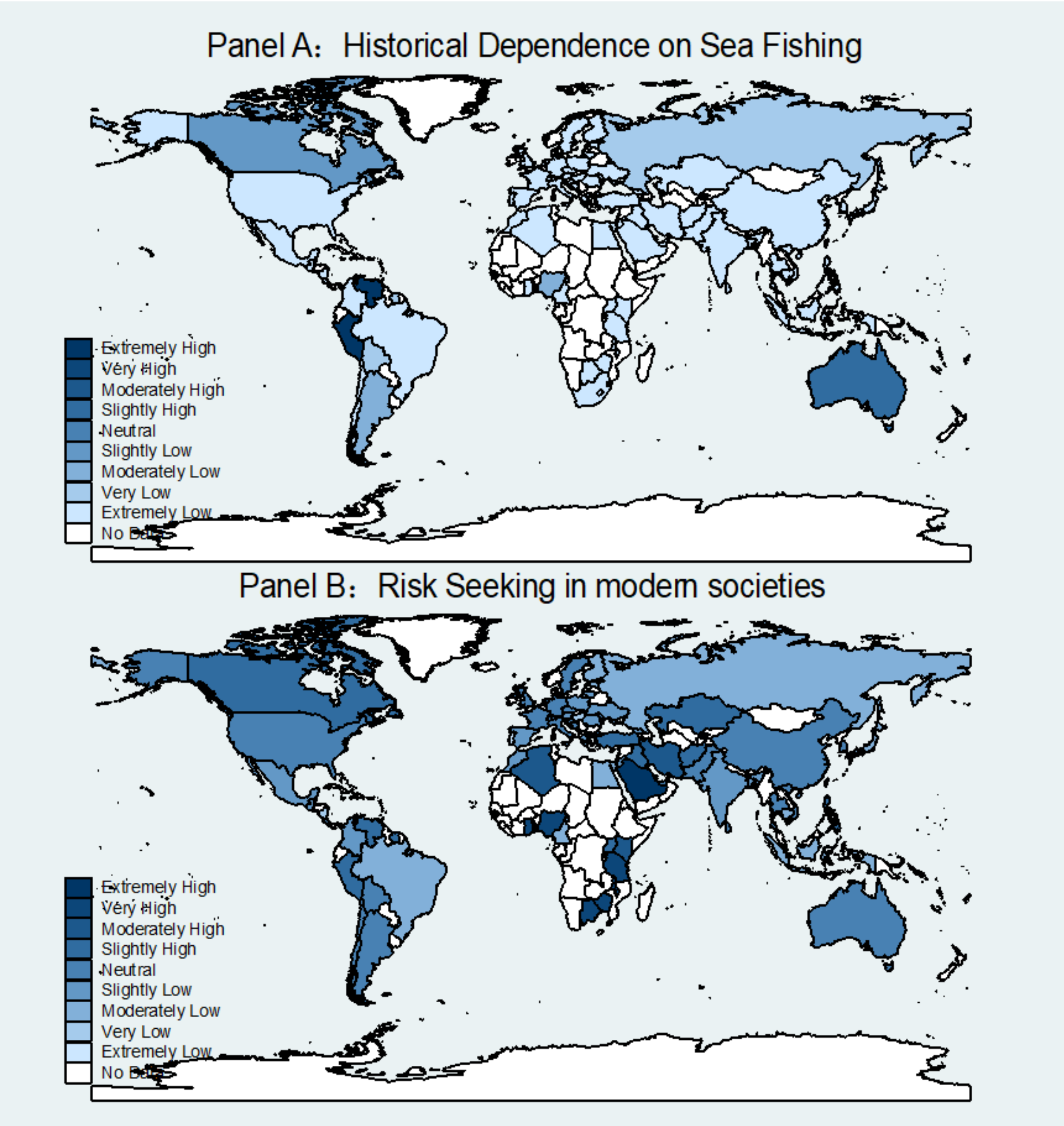
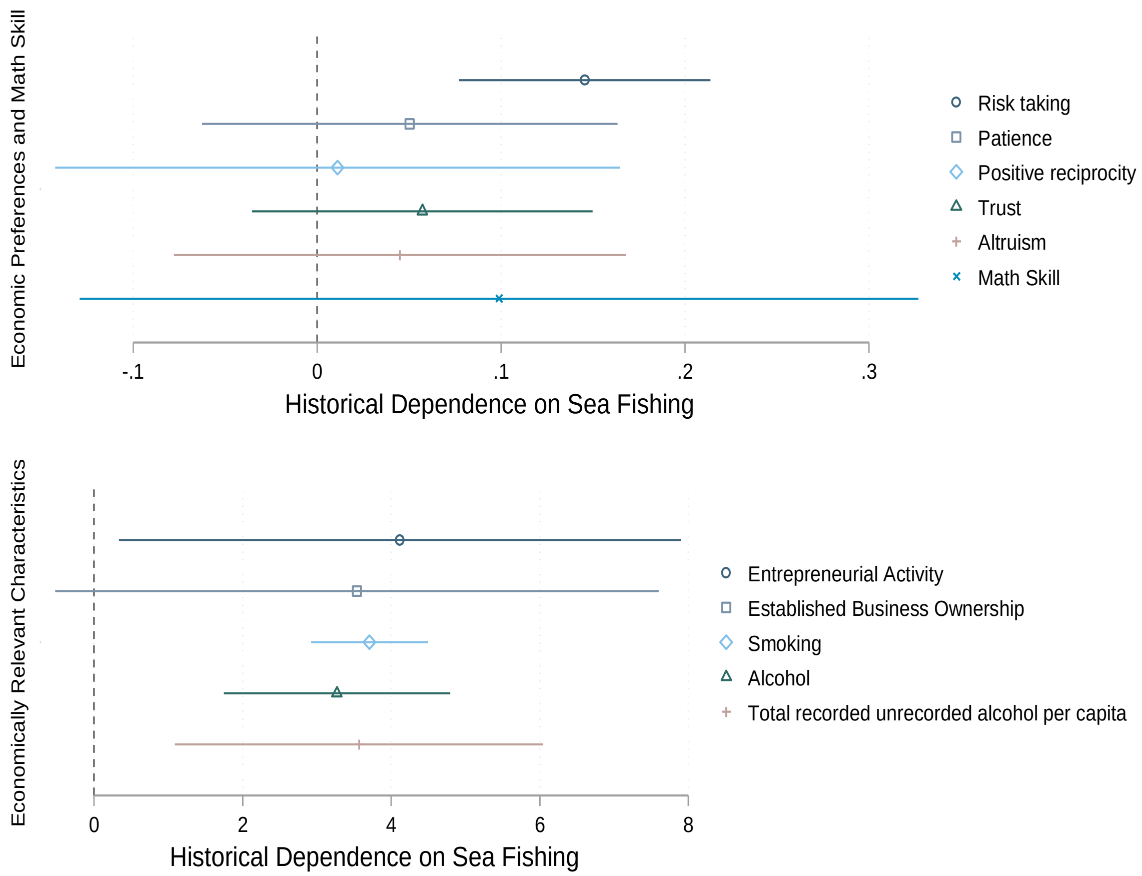
Figures and Tables

Figure 1. Historical dependence on sea fishing and risk attitudes in modern societies in visual format.



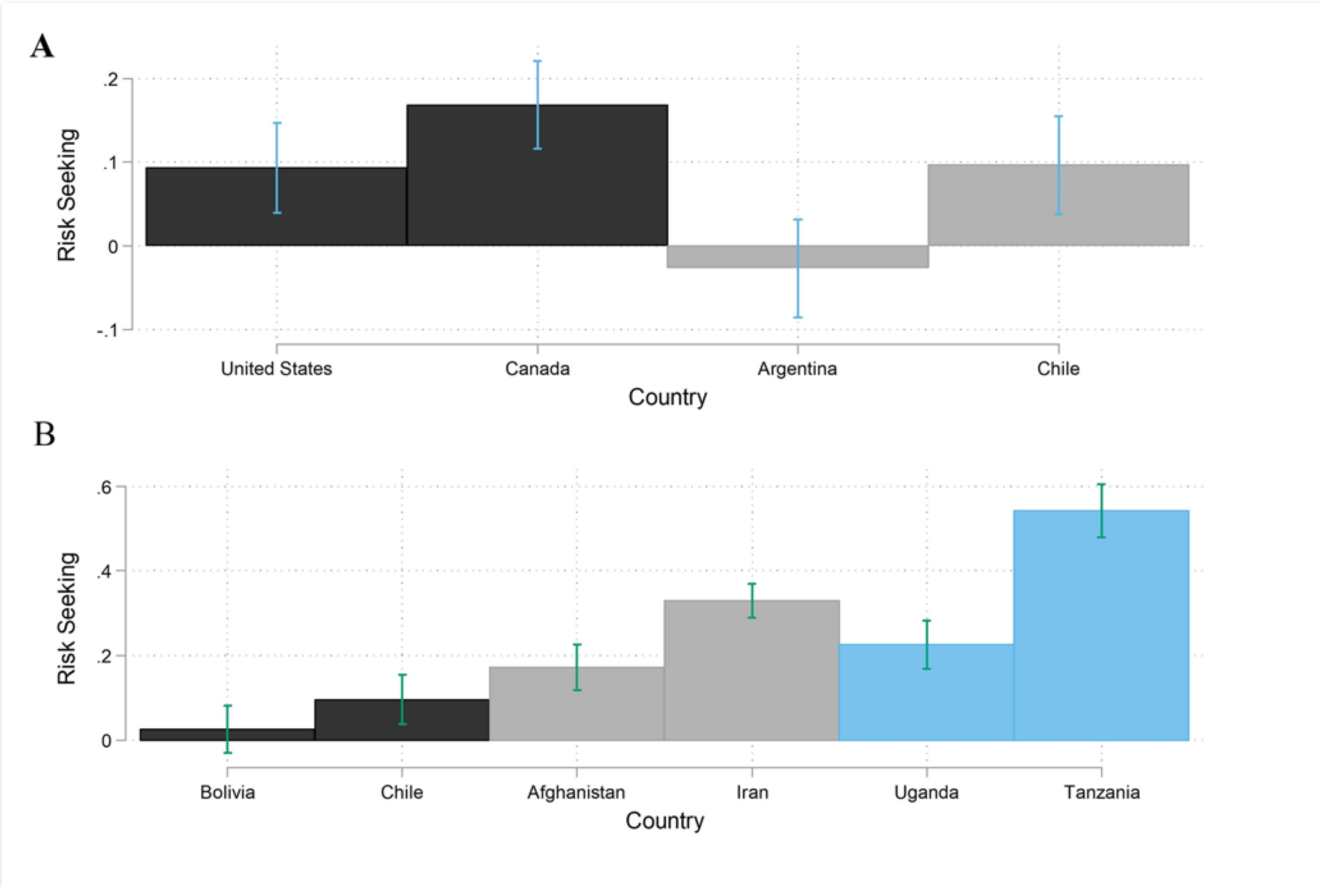
Note: In both panels, the darkness of the color indicates the ranking: dark blue marks the highest value, while light blue marks the lowest. Areas in white are areas for which no data are available. (A) Historical dependence on sea fishing. (B) Risk seeking in modern societies.

Figure 2. Historical Dependence on Sea Fishing and Economic Preferences.



Note: (A) Estimates for Economic Preference and individual's Math Skills. (B) Estimates for some economically relevant characteristics in modern times. All Panels report the point estimates and confidence intervals from estimating Eq. 1 when the outcome variables are the individual-level measures (A), and some economically relevant characteristics (B), separately. Contains confidence at the 95% level. For full details, see online Appendix Table A3 for (A), and online Appendix Table A5 for (B).

Figure 3. Risk preference between nearby countries that share similar historical backgrounds.



Note: (A) Risk preference for pairs of countries with cultural similarities but different marine fishery resources. (B) Risk preferences for pairs of countries, with each including a landlocked country and its coastal neighbor. Mean risk preferences reported. Error bars represent the mean± standard error of the mean.

Table 1: Historical Dependence on Sea Fishing and Risk Preferences

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Fishing	0.078**	0.083***	0.128***	0.131***	0.142***	0.146***	0.145***	0.722***	1.014***
	[0.030]	[0.028]	[0.034]	[0.033]	[0.032]	[0.035]	[0.034]	[0.064]	[0.074]
Soil Suitability		-0.445**	-0.137	-0.089	-0.159	-0.166	-0.129	-0.197	-0.231
		[0.205]	[0.211]	[0.219]	[0.281]	[0.286]	[0.281]	[0.342]	[0.388]
Inland Waterways		-0.002*	-0.002**	-0.003***	-0.003***	-0.003***	-0.002**	-0.002	-0.001
		[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]	[0.001]
Model	OLS	OLS	OLS	OLS	OLS	OLS	OLS	IV	IV
Continental FE	No	No	YES	YES	YES	YES	YES	YES	YES
Island FE	No	No	YES	YES	YES	YES	YES	YES	YES
Geographical Factors	No	No	No	YES	YES	YES	YES	YES	YES
Control for soil quality	No	No	No	No	YES	YES	YES	YES	YES
Meteorological Factors	No	No	No	No	No	YES	YES	YES	YES
GDP	No	No	No	No	No	No	YES	YES	YES
Observations	78,692	77,245	77,245	75,255	75,255	75,255	75,255	75,255	75,255
R-squared	0.001	0.011	0.030	0.035	0.036	0.036	0.038	0.036	0.038

Notes: Each column represents the coefficient from a separate regression. The dependent variables are the risk preferences. The independent variables are the country's ancient fishing tradition. The geographical factors variables including average distance to nearest ice-free coast, fraction of land within 100 km of an ice-free coast, coral reef area, and distance to equator. The meteorological factors including the average temperature and average precipitation. The soil quality related variables including soil fertility, fraction of the land area covered by desert, and terrain roughness. We also control for island fixed effects and continental fixed effects. In column (1) to (7), we cluster the standard errors at country level. In column (8) and (9), we use the bootstrap standard errors. Standard errors are in parentheses. *Significant at 10%, ** significant at 5%, *** significant at 1%.

Table 2: Historical Dependence on Sea Fishing: Coastal Settlement and Harvesting Marine Resources

	(1)	(2)	(3)	(4)	(5)
	Fraction of total population near coast in 1500 CE	Fraction of total population near coast in 2005	Fraction of lights near coast	FAO 1950s	FAO 1960-2009
Fishing	0.074***	0.124***	0.098***	2.821**	2.969**
	[0.026]	[0.033]	[0.031]	[1.313]	[1.157]
Continental FE	YES	YES	YES	YES	YES
Island FE	YES	YES	YES	YES	YES
Geographical Factors	YES	YES	YES	YES	YES
Control for soil quality	YES	YES	YES	YES	YES
Meteorological Factors	YES	YES	YES	YES	YES
GDP	YES	YES	YES	YES	YES
Observations	71	71	71	71	71
R-squared	0.874	0.804	0.857	0.465	0.563

Notes: Each column represents the coefficient from a separate regression. We also control for the length of inland waterway, ancestral soil suitability. Heteroskedasticity-robust standard error estimates are reported in parentheses. *Significant at 10%, ** significant at 5%, *** significant at 1%.

Appendix

This document contains the following**:**

Description of the Data and Summary Statistics (Tables A1, A2)

Supporting Analysis (Tables A3-A7)

Description of the Data

1. Economic preferences measures in the Global Preferences Survey

The data on economic preference measures are obtained from Falk et al. (2018), where the authors use an experimentally validated survey module to measure the six key economic preferences described below. For most of the preferences, the optimization procedure led to a combination of two survey items, including one qualitative item that is more abstract and one quantitative item that puts the respondent into a precisely defined hypothetical choice scenario (see Falk et al. 2016 and Falk et al. 2018 for the wording of the questions and a discussion of the weights.).

Risk taking.
The risk preference measure is based on two items: one is the lottery choice sequence using the staircase method, and the other is the respondents' self-assessment regarding their willingness to take risks in general.

Patience.
The patience measure is based on two items: one is the intertemporal choice sequence using the staircase method, and the other is the respondents' self-assessment regarding their willingness to wait.

Positive reciprocity.
The positive reciprocity measure is based on two items: one is the respondents' behavior in the experiment focusing on gifts in exchange for help, and the other is the respondents' self-assessment regarding how willing they are to return a favor.

Altruism.
The altruism measure is based on two items: one is the respondents' experimental donation decision, and the other is the respondents' self-assessment regarding their willingness to give to good causes.

Trust.
The trust measure is based on one item: the respondents' self-assessment regarding whether they assume that other people have only the best intentions.

Subjective self-assessment of math skills.
The subjective self-assessment of math skills is elicited by asking people to assess themselves regarding the statement "I am good at math" on an 11-point Likert scale. A 0 means "does not describe me at all" and a 10 means "describes me perfectly".

2. Candidate Preference Proxies in the WVS

The Candidate Preference Proxies in the WVS follow the definitions used by Falk et al. (2018).

Risk taking.
The WVS survey item used to capture risk taking asks the respondent to judge their similarity with a hypothetical person described as follows: "Adventure and taking risks are important to this person; to have an exciting life."

Patience.
The WVS survey item used to capture patience or the "long-term orientation" is taken from the following

question. The survey asks, “Here is a list of qualities that children can be encouraged to learn at home. Which, if any, do you consider to be especially important?” This variable is coded as 1 if the individual chose “thrift, saving money and things,” regardless of what other qualities the respondent listed.

Altruism.
The WVS survey item used to capture altruism asks respondents how similar they are to a hypothetical person for whom “it is important [...] to do something for the good of society.”

Benevolence.
The WVS survey item used to measure benevolence asks respondent how they think “It is important to this person to help the people nearby; to care for their well-being.”

Conformity.
The WVS survey item used to measure conformity asks respondent how they think “It is important to this person to always behave properly; to avoid doing anything people would say is wrong.”

3. Country-Level Variables

Ancestry adjusted soil suitability
Index of land suitability for agriculture, based on indicators of climate, suitability for cultivation and soil suitability for cultivation. From Ashraf and Galor (2013) based on underlying data from Ramankutty et al. (2002). Ancestry adjusted soil suitability adjust the Index of land suitability for agriculture using the population migration matrix constructed by Putterman and Weil (2010).

Length of inland water
Source: Dalgaard et al. (2020). It is calculated based on Parker (2000).

Fraction of land within 100 km of an ice-free coast
Source: Dalgaard et al. (2020), Ashraf and Galor, (2013), originally calculated by Gallup, Sachs and Mellinger, (1999)

Distance to equator
Source: the CEPII geo database.

Soil fertility
Index of land suitability for agriculture, based on indicators of climate, suitability for cultivation and soil suitability for cultivation. From Ashraf and Galor (2013) based on underlying data from Ramankutty et al. (2002).

Reef.
Reef area rounded to the nearest 10 square kilometer; this number is missing for countries with small areas of coral reefs (<100 square kilometers). Source: Spalding MD, Ravilious C, Green EP (2001) World Atlas of Coral Reefs. University of California Press, Berkeley, USA.

Temperature.
The average monthly temperature of a country in Celsius, 1961-1990, taken from Ashraf and Galor (2013). The data are originally based on the geospatial average monthly temperature data for this period reported by the G-ECON project (Nordhaus, 2006).

Terrain ruggedness.
The average terrain ruggedness of the country’s land area, taken from Nunn and Puga (2012).

Mean distance from the nearest waterway.
Distance from the GIS grid cell to nearest ice-free coastline or sea-navigable river, averaged across cells. Taken from Ashraf and Galor (2013).

Precipitation.
Average monthly precipitation of a country in mm per month, 1961-1990, taken from Ashraf and Galor (2013). Data are originally based on geospatial average monthly precipitation data for this period reported by the G-ECON project (Nordhaus, 2006).

GDP per capita.
Annual GDP per capita over the 2000–2012 period in a constant local currency. Aggregates are based on 2010 constant U.S. dollars and taken from the World Bank national accounts data.

Entrepreneurial Activity.
Percentage of the adult population between the ages of 18 and 64 years who are in the process of starting a business or already started a business (a nascent entrepreneur or owner-manager of a new business) which is less than 42 months old. Taken from "The Global Entrepreneurship Monitor".

Established Business Ownership.
Percentage of 18-64 population who are currently an owner-manager of an established business, i.e., owning and managing a running business that has paid salaries, wages, or any other payments to the owners for more than 42 months. Taken from "The Global Entrepreneurship Monitor".

Smoking.
Smoking prevalence and attributable disease burden in 195 countries and territories from 1980 to 2015. Taken from the Global Burden of Disease Study 2015.

Alcohol.
Recorded alcohol per capita consumption by country in 2016, taken from the Global Health Observatory data.

Total recorded and unrecorded alcohol consumption per capita.
The total (sum of recorded and unrecorded) amount of alcohol consumed per person (15 years of age or older) over a calendar year, in liters of pure alcohol, adjusted for tourist consumption. Recorded alcohol consumption refers to alcohol consumed according to official statistics at the country level based on production, import, export, and sales or taxation data. Unrecorded alcohol consumption refers to alcohol that is not taxed and is outside the usual system of governmental control, such as home or informally produced alcohol (legal or illegal), smuggled alcohol, surrogate alcohol (which is alcohol not intended for human consumption), or alcohol obtained through cross-border shopping (which is recorded in a different jurisdiction). The data are from 2010 to 2016 and taken from the Global Health Observatory data.

Summary Statistics

Table A1 reports the summary statistics for several of the key outcome variables, as well as our rich set of covariates at the country level.

Table A1 Summary Statistics (country or country-year level)

	Observations	Mean	SD
Fraction of total population near coast in 1500 CE	71	0.246	0.210
Fraction of total population near coast in 2005	71	0.276	0.216
Fraction of lights near coast	71	0.355	0.236
FAO 1950s	71	8.265	5.152
FAO 1960-2009	71	9.844	5.019
Entrepreneurial Activity	768	11.419	7.862
Established Business Ownership	767	7.779	5.366
Smoking	1574	0.149	0.068
Alcohol	496	6.082	3.991
Total recorded unrecorded alcohol per capita	75	7.275	4.102

Table A2 reports the summary statistics for several of the key outcome variables, as well as our rich set of covariates at the individual level.

Table A2 Summary Statistics (individual level)

	Observations	Mean	SD
Risk taking	75255	0.011	1.002
Patience	74857	0.011	1.008
Positive reciprocity	75142	-0.009	1.002
Altruism	74931	0.009	0.997
Trust	73945	0.005	0.999
Trust	74378	5.216	2.811
Math skills	74378	5.216	2.811
Fishing	75255	0.143	0.486
Adjusted soil suitability	75255	0.605	0.170
Island dummy	75255	0.073	0.260
GDP per capita	75255	12102.89	14963.10
Fraction of land within 100 km of an ice-free coast	75255	0.396	0.407
Average distance to nearest ice-free coast	75255	30.964	32.453
Reef	75255	2.638	8.570
Soil fertility	75255	36.256	20.147
Fraction of the land area covered by desert	75255	3.611	10.552
Terrain roughness	75255	0.187	0.117
Length of inland water	75255	10.576	26.237
Distance to equator	75255	31.309	16.331
Log of average temperature	75255	3.565	0.275
Log of average precipitation	75255	4.097	0.863

Supporting Analyses

Table A3: Historical Dependence on Sea Fishing and Economic Preferences: Evidence from GPS

	(1)	(2)	(3)	(4)	(5)	(6)
	Risk Taking	Patience	Positive reciprocity	Trust	Altruism	Math Skills
Fishing	0.145***	0.050	0.011	0.057	0.045	0.099
	[0.034]	[0.057]	[0.077]	[0.046]	[0.062]	[0.114]
Continental FE	YES	YES	YES	YES	YES	YES
Island FE	YES	YES	YES	YES	YES	YES
Geographical Factors	YES	YES	YES	YES	YES	YES
Control for soil quality	YES	YES	YES	YES	YES	YES
Meteorological Factors	YES	YES	YES	YES	YES	YES
GDP	YES	YES	YES	YES	YES	YES
Observations	75,255	75,264	75,672	74,369	75,428	74,821
R-squared	0.038	0.106	0.024	0.043	0.033	0.030

Notes: Each column represents the coefficient from a separate regression. We also control for the length of inland waterway, ancestral soil suitability. Standard errors are cluster on country. SEs are in parentheses. *Significant at 10%, ** significant at 5%, *** significant at 1%.

Table A4: Historical Dependence on Sea Fishing and Economic Preferences: Robustness Checks

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	WVS					Independe nt variable (Dummy)	Exclude Landloc k
	Risk Taking	Patience	Altruism	Benevolenc e	Conformity		
Fishing	0.086*	-0.051	-0.026	0.051	-0.013	0.230**	0.136***
	[0.050]	[0.054]	[0.022]	[0.032]	[0.025]	[0.090]	[0.037]
Continental FE	YES	YES	YES	YES	YES	YES	YES
Island FE	YES	YES	YES	YES	YES	YES	YES
Geographical Factors	YES	YES	YES	YES	YES	YES	YES
Control for soil quality	YES	YES	YES	YES	YES	YES	YES
Meteorological Factors	YES	YES	YES	YES	YES	YES	YES
GDP	YES	YES	YES	YES	YES	YES	YES
Observations	108,317	255,407	82,114	51,771	109,235	75,255	62,319
R-squared	0.047	0.044	0.016	0.044	0.031	0.038	0.033

Notes: Each column represents the coefficient from a separate regression. We also control for the length of inland waterway, ancestral soil suitability. Standard errors are cluster on country. SEs are in parentheses. *Significant at 10%, ** significant at 5%, *** significant at 1%.

Table A5: Historical Dependence on Fishing and Risk-taking Behaviors: Country-level OLS Estimates.

	(1)	(2)	(3)	(4)	(5)
	Entrepreneurial Activity	Established Business Ownership	Smoking	Alcohol	Total recorded unrecorded alcohol per capita
Fishing	4.115**	3.535*	0.037***	3.268***	3.567***
	[1.888]	[2.028]	[0.004]	[0.764]	[1.059]
Continental FE	YES	YES	YES	YES	YES
Island FE	YES	YES	YES	YES	YES
Geographical Factors	YES	YES	YES	YES	YES
Control for soil quality	YES	YES	YES	YES	YES
Meteorological Factors	YES	YES	YES	YES	YES
GDP	YES	YES	YES	YES	YES
Observations	530	464	1,538	469	71
R-squared	0.703	0.573	0.748	0.749	0.699

Notes: Each column represents the coefficient from a separate regression. We also control for the length of inland waterway, ancestral soil suitability. For column (1), (2) and (4), the standard errors are cluster on country. Heteroskedasticity-robust standard error estimates are used for column (3) and (5) because we have a small number of clusters in column (3). SEs are in parentheses. *, **, *** indicates statistically significant at the 10%, 5% and 1% levels respectively.

Table A6: Risk preference between the coasts and inland regions within a country

	(1)	(2)	(3)
		CCSS	
	Risk Taking	Patience	Trust
Inland Province	-0.011**	-0.010	-0.005
	[0.005]	[0.014]	[0.013]
Demographic controls	YES	YES	YES
Observations	5,172	4,545	5,287
R-squared	0.017	0.017	0.006

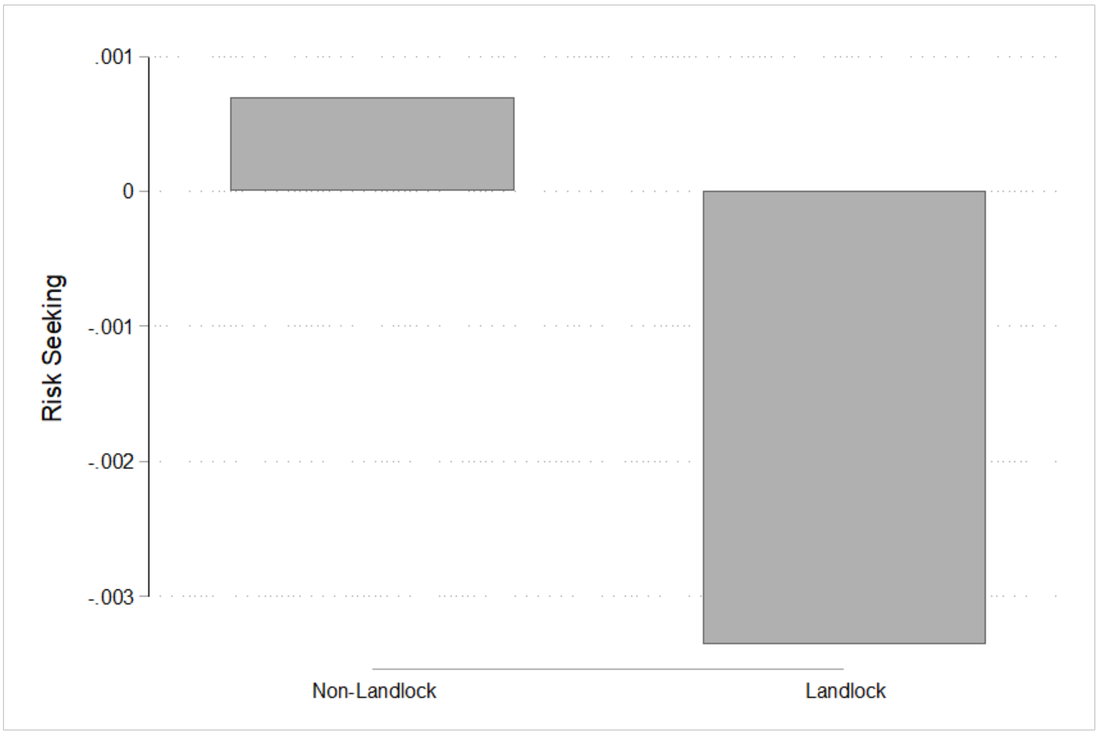
Notes: Each column represents the coefficient from a separate regression. Demographic controls include age, gender, ethnic group and the hukou dummy. Heteroskedasticity-robust standard errors are in parentheses. *Significant at 10%, ** significant at 5%, *** significant at 1%.

Table A7: Historical Dependence on Sea Fishing and Risk Preferences: IV estimates first stage results

	(1)	(2)
Share of area within 50 km of the coast and	0.700***	0.766***
	[0.017]	[0.021]
Bounty of the Sea index	0.006***	
	[0.00002]	
Ancestry adjusted Bounty of the Sea index		0.006***
		[0.0003]
Cragg-Donald Wald F statistic	978.98	842.53
Continental FE	YES	YES
Island FE	YES	YES
Geographical Factors	YES	YES
Control for soil quality	YES	YES
Meteorological Factors	YES	YES
GDP	YES	YES
Observations	75,255	75,256

Notes: Each column represents the coefficient from a separate regression. We also control for the length of inland waterway, ancestral soil suitability. Robust standard errors are reported in parentheses *Significant at 10%, ** significant at 5%, *** significant at 1%.

Figure A1. Risk preference between Landlock and Non-landlock countries.



Note: Mean residual risk preferences reported. These residuals are taken after we regress the risk preference on all the control variables in Eq 1.

References

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