Environmental Roots of Labor-Leisure Preference

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Abstract

This research explores the origins of labour-leisure preference and the variation in its prevalence across regions and nations. It advances the hypothesis and establishes empirically that the evolution of predisposition towards labour and leisure in the course of human history can be traced to the adaptation of humans to the modes of production, characterized by the different return to effort in the long-run. Exploiting regional variations in the potential suitability for hunting and agriculture and their exogenous changes in the course of the Columbian Exchange, the research establishes that consistent with the predictions of the theory, individuals that are originated in regions marked by greater suitability for hunting have higher predisposition towards leisure, while descendants of regions in which agriculture was more productive are characterized by greater predisposition towards labour.

Keywords: preference for labour, preference for leisure, cultural evolution, evolution of preferences, natural selection, group selection, Malthusian epoch, growth, development

JEL Classification: D81, D91, Z10, O10, O40

1 Introduction

Labor and leisure are the two main classes of activities human beings engage in through out their lives. The intriguing question of the decision-making process that determines the supply of labour and demand for leisure time has been in a focus of a number of theoretical and empirical studies (e.g., Azariadis et al., 2013; Hokayem and Ziliak, 2014; Blundell et al., 2016) and remarkable implications of the labour-leisure choice has been established in the economic and social arenas. Nevertheless, despite the importance of this decision for the understanding of human and social behavior, and conceivably in the exploration of the roots of comparative economic development across globe, the origins of the variation in the labour-leisure decision across societies have remained largely obscured.

This research explores the roots of the variation in the labour-leisure choice across regions and nations. It advances the hypothesis and establishes empirically that the evolution of preference for labour and leisure in the course of human history reflects the adaptation of humans to an ancestral environments, which were more suitable for certain subsistence production strategies rather than others (e.g., large game hunting versus agriculture and gathering), that in turn are characterized by different relations between the working effort and long-run reproductive success.

The study develops an evolutionary theory of group selection that captures the labour-leisure decision as well as the split of working effort between two production sectors: large game hunting and agriculture within the Malthusian framework. In light of the difference between the dynamic nature of the production in hunting and agriculture, former of which is subjected to overkill and later is not, the gain in terms of long-run reproductive success that is generated by the working effort varies fundamentally across the sectors. In particular, more intensive labour effort in agriculture results in higher production level and leads to greater reproductive success on the group level. Contrary, higher labour effort in hunting not only increases the production short run, but can also have an over-extraction effect, reducing hunting game population in the long-run and, as a result, lowering the reproductive success of the group.

In a Malthusian environment characterized by the higher suitability for hunting and, as a result, greater dependence of a local human population on this production for subsistence the force of natural selection would select for the groups with the intermediate level of predisposition towards labour, while overly industrious and overly passive groups would be brought to extinction, due to over-extraction or low production respectively. Furthermore, in an environment more suitable for agriculture, groups

with the highest predisposition for labour would be selected for in the long-run, in light of the positive association between the effort and reproductive success.

The theory generates two fundamental testable predictions about the environmental origins of the observed predisposition toward leisure and labour. It suggests that individuals, as well as societies, that are originated in regions of the world in which environment is more suitable for hunting for subsistence production, would be characterized by lower intensity of predisposition towards labour (i.e., greater predisposition towards leisure). In contrast, descendants of regions of the world that were characterized by greater suitability for agricultural production will tend to exhibit a higher degree of labour preference (i.e., lower degree of leisure preference).

Exploiting variations in the degree of labour and leisure preference among second generation migrants in Europe and the US, as well as across individuals across the Globe, the research establishes that consistent with the predictions of the theory, individuals that are originated in regions in which environment is more suitable for hunting (e.g., characterized be the greater abundance of large mammal fauna), and ancestral population is more dependent on hunting, are characterized by greater intensity of leisure preference, while descendants of regions characterized by greater suitability for and ancestral dependence on agriculture have higher propensity towards labour.

The empirical analysis is conducted at different layers that are designed to establish the robustness of the findings in distinct samples and units of analysis. It exploits variation in preferences and behavior across individuals based on the European Social Survey (ESS), General Social Survey (GSS) and World Value Survey (WVS). In particular, the analysis explores: (i) variation in the intensity of labour and leisure preference across second-generation migrants in the US as well as Europe, accounting for time-invariant host country fixed effects, potentially confounding geographical characteristics of the parental countries of origin, as well as migrants' individual characteristics such as, age, gender, income and education; (ii) variation in predisposition towards labour across individuals within each country, accounting for a wide range of potentially confounding geographical characteristics, regional fixed effects, as well as individual characteristics, such as age, gender, income and education.

In light of the predictions of the theory, the intensity of labour and leisure preference is linked to the suitability of environment for hunting or agriculture. In addition, the degree of labour-leisure preference could be directly linked to the ancestral choice of production activities. Several measures are used to capture determinants of predisposition towards labour and leisure. In particular, following the

methodology of Galor and Özak (2016) the potential suitability of a particular region for agriculture is captured using the Caloric Suitability Indices (CSI), which are constructed on a $5' \times 5'$ resolution exploiting the the data from the Global Agro-Ecological Zones (GAEZ) project of the Food and Agriculture Organization (FAO). In addition, to reflect the potential historic productivity of hunting as a subsistence production mode a novel measure of the potential large mammal fauna abundance was constructed as a share of large mammal species out of all mammal species that potentially resided in a given location. The measure is calculated using the Phylogenetic Atlas of Mammal Macroecology (PHYLACINE) database collected by Faurby et al. (2018) which documents the potential natural ranges all mammal species would occupy if they had never experienced strong anthropogenic pressures. Moreover, Ethnographic Atlas data is used to capture the ancestral dependence of countries population on different production modes for subsistence. The ancestral dependence on hunting relative to agriculture and gathering is calculated at a country level using the weighting methodology developed by Giuliano and Nunn (2018a) and is used as an additional predictor of labour-leisure preference.

Variations in the prevalence and the distribution of labour and leisure preference across individuals is captured by a variety of measures capturing attitudes towards work and leisure time. In particular, exploiting the ESS the degree of individual's preference for leisure is captured as respondents evaluation of the importance of 'having a good time' in her life. In addition, one of the questions introduced in GSS allows to capture individual's subjective attitude towards industriousness as a quality that children should learn and is used to reflect predisposition towards work and labour. Finally, exploiting WVS an additional measure of individual's labour preference is introduced based on the question which evaluates the importance of work in the respondent's life.

The first part of the empirical analysis explores the effect of potential suitability for hunting and agriculture as well as the resulting relative dependence on hunting for subsistence on the preferences of second-generation migrants in Europe and the US for labour or leisure, as reported by the ESS and the GSS. In line with the predictions of the theory, the analysis establishes: (i) a statistically and economically significant positive (negative) effect of potential suitability for hunting in the parental country of origin on the predisposition towards leisure (labour) among second-generation migrants, (ii) a statistically and economically significant negative (positive) effect of potential agricultural suitability in the parental country of origin on the predisposition towards leisure (labour) among second-generation migrants, and (iii) a statistically and economically significant positive (negative) effect of ancestral

dependence on hunting relative to agriculture and gathering in the parental country of origin on the predisposition towards leisure (labour) among second-generation migrants. Moreover, consistent with the proposed theory that underlines the role of intergenerational transmission in the evolution of labour-leisure preference, the estimated effects of the environmental factors and ancestral production strategies in the parental country of origin (rather than those in country of residence) on predisposition towards work and leisure, capture the culturally-embodied, intergenerationally-transmitted effect, rather than the direct effect of geography. Furthermore, the findings are robust to the inclusion of country-of-birth fixed-effects, and for accounting for the potentially confounding effects of a wide range of geographical characteristics at the parental county of origin, the years elapsed since the parental country transitioned to agriculture, and a range of individual characteristics, such as age, gender, education and income.

The results are further robust to a large number of placebo and robustness tests. In particular, while predisposition towards labour and leisure may potentially be correlated with other cultural dimensions, the environmental conditions and historic context that governed the evolution of labour-leisure preference, do not have an effect of the evolution of these cultural traits (e.g., long term orientation, attitudes towards gender roles and tradition obedience, altruism, attitudes towards equality and preference for strong government). In addition, the results are robust to alternative estimation methods (e.g., ordered probit) and selection on unobservables. Importantly, the effect of ancestral hunting dependence on labour-leisure preference is robust to the potential reversed causality problem. The concern is addressed via the Instrumental Variable (IV) estimation, where potential large mammal fauna abundance is used as an exogenous instrument for ancestral relative dependence on hunting.

The second part of the empirical analysis focuses on the effect of potential productivity of hunting and agriculture as well as resulting ancestral relative dependence on hunting on the variation in labour-leisure preference across individuals within each country, as reported by the WVS. These results further support the proposed theory. They establish: (i) a statistically and economically significant negative association between potential large mammal fauna abundance and the degree of predisposition towards labour among individuals, (ii) a statistically and economically significant positive association between potential crop yield and preference for labour, and (iii) a statistically and economically significant negative association between ancestral relative dependence on hunting and importance of labour. The findings are robust to the inclusion of country-of-birth fixed-effects, and for accounting for the

potentially confounding effects of a wide range of geographical characteristics, as well as individual characteristics, such as age, gender, education and income. Importantly, the results are unaffected qualitatively if one adjust the environmental variables for the ancestral composition of the contemporary population, reinforcing the hypothesized intergenerationally-transmitted and culturally-embodied nature of the effect. In addition, the results with respect to ancestral dependence on hunting are robust to the reversed causality concern.

The research represent an attempt to shed light on the environmental origins of predisposition towards labour and leisure and the distribution of this trait across the globe. Moreover, it contributes to the understanding of the evolution of preferences (e.g., Bisin and Verdier, 2001; Galor and Moav, 2002; Robalino and Robson, 2019), and the biogeographical roots of preferences (e.g., Alesina et al., 2013; Galor and Özak, 2016; Giuliano and Nunn, 2017; Galor and Savitskiy, 2018) and comparative economic development (e.g., Diamond, 1997; Ashraf and Galor, 2011, 2013; Spolaore and Wacziarg, 2013; Mayshar et al., 2016).

2 An Evolutionary Theory of Labour-Leisure Preference

Consider an ecological environment characterized by the co-existence of game animals along with human groups that subsist on these game animals as well as plant based food (e.g., agriculture).[1] The environment consists of I ecological niches that are identical within and across time periods in their size and quality for game animals, X^h, and plant life, X^a. However ecological niches may differ over time in the size of the human population and the number of game animals that reside in each niche, due to the effect of hunting on the reproductive success of the human population as well as the evolution of the animal population.

2.1 Individuals

In every period t, in each ecological niches, $i \in \{1, \ldots, I\}$, a group of humans of size L_{it} produces food collectively, and equally shares the hunted game animals and produced plant food. Individuals live for two periods: childhood and adulthood. In childhood, individuals are not involved in hunting or agriculture and their consumption requirement, τ, is provided by their parents. In adulthood, individuals split their unit time endowments between production, l_{it}, and leisure, $1 - l_{it}$, allocating

[1] In general this could also include gathering as an alternative production strategy.

share χ_{it} of their labour time to hunting and share $1 - \chi_{it}$ to agriculture, so that the total time individual spends hunting is $l_{it}^h = \chi_{it} l_{it}$ and the total time devoted to agriculture is $l_{it}^a = [1 - \chi_{it}] l_{it}$. Individuals use their share in produced food, y_{it}, for personal consumption, c_{it}, and for the asexual reproduction of n_{it} children.

Hence, the individual's budget constraint is:

$$c_{it} + \tau n_{it} \leq y_{it}, \tag{1}$$

where τ is the consumption of each child.

2.1.1 Individual's Preferences

Individuals generate utility from consumption, leisure, and the quantity of their offspring. Individual's preferences are identical in all respects, except for their predisposition towards leisure.

In particular, preferences of each individual within a group $i \in \{1, \ldots, I\}$, who operates in period t, are represented by the time invariant utility function:

$$U_i(c_{it}, n_{it}, l_{it}) = (1 - \gamma) \ln c_{it} + \gamma \ln n_{it} + \theta_i \ln (1 - l_{it}), \tag{2}$$

where θ_i reflects the time invariant, group-specific, predisposition towards leisure, $1 - l_t$ (i.e., the weight that human group i attribute to the disutility associated with the time devoted to labour, l_t).[2] Furthermore, γ captures the universal (i.e., time and group independent) predisposition towards children, n_t, relative to consumption, c_t.

2.1.2 Output

The total output of a group occupying niche i in period t is composed of hunting and agricultural output. The hunting output (measured in kilograms of meat) is equal to the number of animals hunted multiply by the average size of these animals, A^h. The output of hunting is determined by the number of humans, L_{it}, and their hunting intensity, l_{it}^h, as well as by the existing number of game animals, N_{it}, and their size, A^h.

[2] If preferences differ within a hunting group, income sharing among members of the group, would preclude selection across individuals and thus the average level of θ_i within the group will remain constant over time. Hence, without loss of generality, the behaviour of a group can be modeled by the behaviour of a representative individual within the group.

The output of hunting in niche i, in period t, Y_{it}^h, is governed by the hunting technology:

$$Y_{it}^h = A^h N_{it}^{\alpha}(l_{it}^h L_{it})^{1-\alpha} = A^h N_{it}^{\alpha}(\chi_{it} l_{it} L_{it})^{1-\alpha}, \tag{3}$$

reflecting the positive and diminishing effects of: (i) the aggregate hunting effort, $\chi_{it} l_{it} L_{it}$, and (ii) the number of game animals, N_{it}, on the number of hunted animals in the niche, as well as the mechanical multiplicative impact of the size of the animals, A^h, on the hunting output measured in kilograms of meat.

The per capita hunting output, $y_{it}^h \equiv Y_{it}^h / L_{it}$, in group i in period t is therefore:

$$y_{it}^h = A^h \left(\chi_{it} l_{it}\right)^{1-\alpha} \left(\frac{N_{it}}{L_{it}}\right)^{\alpha} \equiv y^h(\chi_{it} l_{it}, N_{it}/L_{it}). \tag{4}$$

The agricultural output is equal to the amount of plant food produced and is determined by the number of humans, their agricultural production intensity ,l_{it}^a, size of the land endowment, X^a, and productivity of land in terms agriculture, A^a.[3]

The agricultural output in niche i, in period t, Y_{it}^a, is governed by the agricultural technology:

$$Y_{it}^a = A^a (X_{it}^a)^{\alpha}(l_{it}^a L_{it})^{1-\alpha} = A^a (X_{it}^a)^{\alpha}([1-\chi_{it}] l_{it} L_{it})^{1-\alpha}, \tag{5}$$

reflecting the positive and diminishing effects of: (i) the aggregate effort in agriculture, $[1-\chi_{it}] l_{it} L_{it}$, and (ii) land size, X^a, on the amount of plant food produced, as well as the impact of the agricultural productivity, A^a.

The per capita agricultural output, $y_{it}^a \equiv Y_{it}^a / L_{it}$, in group i in period t is therefore:

$$y_{it}^a = A^a \left([1-\chi_{it}] l_{it}\right)^{1-\alpha} \left(\frac{X^a}{L_{it}}\right)^{\alpha} \equiv y^a([1-\chi_{it}] l_{it}, X^a/L_{it}). \tag{6}$$

The total output of a group occupying niche i in period t, Y_{it}, is equal to the sum of the hunting output, Y_{it}^h, and agricultural production, Y_{it}^a

$$Y_{it} = Y_{it}^h + Y_{it}^a \tag{7}$$

[3]To make agricultural production comparable to hunting production, agricultural productivity, A^a, can be viewed as a caloric suitability of dominating crops in the location, which is then converted to a corresponding amount of kilograms of meat.

while the per capita output, $y_{it} \equiv Y_{it}/L_{it}$, in group i in period t is therefore:

$$y_{it} = Y_{it}^h/L_{it} + Y_{it}^a/L_{it} = y_{it}^h + y_{it}^a \equiv y(\chi_{it}, l_{it}, N_{it}/L_{it}). \tag{8}$$

2.1.3 Individual's Optimization

Individuals who operate in ecological niche i, in period t, allocate their unit time endowment between leisure, $(1 - l_{it}) \in [0; 1]$, and labour, $l_{it} \in [0; 1]$, which they then split between hunting effort $\chi_{it} l_{it}$ and agricultural effort $[1 - \chi_{it}]l_{it}$ with $\chi_{it} \in [0; 1]$, and divide their share in the total output, y_{it}, between consumption, $c_{it} \geq 0$, and children, $n_{it} \geq 0$, so as to maximize their utility function subject to the budget constraint (1).

Given the log-linearity of preferences, regardless of the labor-leisure choice and split of time between the prodcution activities, given the level of output per capita, y_{it},

$$\begin{cases} c_{it} = (1 - \gamma) y_{it} \\ n_{it} = (\gamma/\tau) y_{it}. \end{cases} \tag{9}$$

In addition, in period t member of a group i, given the choice of a total labour time l_{it}, splits it between hunting and agriculture (i.e., determines the share $\chi_{it} \in [0; 1]$) so as to maximize the total output per capita

$$\chi_{it} = \arg \max_{\chi \in [0;1]} = y(\chi, l_{it}, N_{it}/L_{it})] \tag{10}$$

which, given (4), (6) and (8) is equal to

$$\chi_{it} = \frac{(A^h)^{1/\alpha} N_{it}}{(A^h)^{1/\alpha} N_{it} + (A^a)^{1/\alpha} X^a} \equiv \chi(N_{it}) \tag{11}$$

Moreover, given (11), and noting that

$$\begin{aligned} y_{it} &= y(\chi(N_{it}), l_{it}, N_{it}/L_{it}) \\ &= l_{it}^{1-\alpha} \left[A^h \left(\chi(N_{it})\right)^{1-\alpha} \left(\frac{N_{it}}{L_{it}}\right)^{\alpha} + A^a \left(1 - \chi(N_{it})\right)^{1-\alpha} \left(\frac{X^a}{L_{it}}\right)^{\alpha} \right] \\ &\equiv y^*(l_{it}, N_{it}, L_{it}), \end{aligned} \tag{12}$$

the supply of labor, l_{it}, of each individual in niche i, in period t, is determined such that

$$l_{it} = \arg\max_{l\in[0;1]}[\ln y^*(l, N_{it}, L_{it}) + \theta_i \ln(1 - l_{it}) + \delta], \tag{13}$$

where $\delta \equiv (1-\gamma)\ln(1-\gamma) + \gamma\ln(\gamma/\tau)$. It follows from (12) and (13) that the optimal labor supply of each hunter in niche i, in period t, is

$$l_{it} = \frac{1-\alpha}{1-\alpha+\theta_i} \equiv l(\theta_i). \tag{14}$$

Namely, there exists a time invariant mapping between the predisposition of hunters towards leisure and their total supply of labor.

Thus, in light of (9), (11), (12) and (14), the levels of consumption and fertility of hunters of group i in period t are

$$\begin{cases} c_{it} = (1-\gamma) l(\theta_i)^{1-\alpha} \left[(A^h)^{1/\alpha} N_{it} + (A^a)^{1/\alpha} X^a\right]^{\alpha} / L_{it}^{\alpha} \\ \\ n_{it} = \frac{\gamma}{\tau} l(\theta_i)^{1-\alpha} \left[(A^h)^{1/\alpha} N_{it} + (A^a)^{1/\alpha} X^a\right]^{\alpha} / L_{it}^{\alpha}. \end{cases} \tag{15}$$

2.1.4 The Evolution of the Human Population

The evolution of the human population in niche i, given the individual's fertility rate in the niche, n_{it}, is

$$L_{it+1} = n_{it} L_{it}. \tag{16}$$

Hence, in light of (15),

$$L_{it+1} = (\gamma/\tau)\left[(A^h)^{1/\alpha} N_{it} + (A^a)^{1/\alpha} X^a\right]^{\alpha} [l(\theta_i) L_{it}]^{1-\alpha} \equiv \phi^i(L_{it}, N_{it}). \tag{17}$$

2.2 The Evolution of the Population of Game Animals

The evolution of the animal population is determined by two opposing forces. The level of extraction, due to hunting, operates towards a reduction of the animal population, whereas net reproduction (beyond natural mortality) operates towards an increase in this population.

The level of extraction from the stock of animals in period t, E_{it}, (i.e., the number of animals

hunted in period t), is equal to the aggregate hunting output, Y_{it}^h, divided by the size of the animals, A^h, (i.e., $E_{it} = Y_{it}^h/A^h$). Hence, as follows from (3),

$$E_{it} = N_{it}^{\alpha}(\chi_{it} l_{it} L_{it})^{1-\alpha}. \tag{18}$$

In contrast, the natural net reproduction rate of animals is positively affected by the size and the quality of the niche in which they operate, X^h and negatively by the competition of animals over this scarce resources, as reflected by the aggregate caloric needs of the existing animals in the niche, as captured by $A^h N_{it}$. In particular, animals' net reproduction rate in niche i, ρ_{it}, is

$$\rho_{it} = [X^h/(A^h N_{it})]^{\beta}. \tag{19}$$

Hence, given the level of animals extraction in period t, E_{it}, the animal population in period $t+1$ is determined the net reproduction of those animals in the niche that survived were during period t, $N_{it} - E_{it}, i.e.$,

$$N_{it+1} = [X^h/(A^h N_{it})]^{\beta} (N_{it} - E_{it}), \tag{20}$$

where β captures the speed of convergence of the animal population within each niche to its steady state level. Thus, in light of (18) and (20),

$$N_{it+1} = (X^h/A^h)^{\beta} {N_{it}}^{(\alpha-\beta)} \{ {N_{it}}^{1-\alpha} - [\chi(N_{it}) l(\theta_i) L_{it}]^{1-\alpha} \} \equiv \psi^i(L_{it}, N_{it}). \tag{21}$$

2.3 The Dynamical System

The joint evolution of the human and the animal populations in every ecological niche i, $\{N_{it}, L_{it}\}_{t=0}^{\infty}$, is governed by the hunters' fertility rate, n_{it}, the animal's net natural reproduction rate, ρ_{it}, and the level of animal extraction, E_{it}.

As follows from (17) and (21), the joint evolution of the hunter and the animal population in niche

i, is governed by the two-dimensional dynamical system:

$$\begin{cases} N_{it+1} = \psi^i(N_{it}, L_{it}) \\ \\ L_{it+1} = \phi^i(N_{it}, L_{it}). \end{cases} \tag{22}$$

where the initial conditions, (N_{i0}, L_{i0}), are given.

The trajectory of the joint evolution of these two populations and their steady-state equilibria are affected, among other things, by three important parameters: the predisposition towards leisure, θ_i, the average size of the animals' population, A^h, and agricultural productivity A^a.

2.4 The Phase Diagram

The global joint evolution of the hunter and the animal population in niche i, $\{N_{it}, L_{it}\}_{t=0}^{\infty}$, is derived based on the phase diagram of the dynamical system.

2.4.1 The '$\Delta N_{it} = 0$' Locus

Let the '$\Delta N_{it} = 0$' Locus be the geometrical place of all non-negative pairs, $(N_{it}, L_{it}) \geq 0$, such that $\Delta N_t \equiv N_{it+1} - N_{it} = 0$. As follows from (21),

$$\Delta N_{it} = 0 \Leftrightarrow \begin{cases} L_{it} = \left[1 - \left(\frac{A^h N_{it}}{X^h}\right)^{\beta}\right]^{\frac{1}{\alpha}} \frac{N_{it} + (A^a/A^h)^{\frac{1}{\alpha}} X^a}{l(\theta_i)} \equiv \zeta^N(N_{it}, \theta_i) \\ \\ N_{it} = X/A \quad \& \quad L_{it} = 0 \\ \\ N_{it} = 0 \quad \forall L_{it}. \end{cases} \tag{23}$$

Hence, as depicted in Figure 1, the '$\Delta N_{it} = 0$' Locus in the plain (N_{it}, L_{it}) consists of (i) the point, $(X^h/A^h, 0)$, (ii) curve $\zeta^N(N_{it}, \theta_i)$ and (iii) the entire y-axis.

Moreover, for $(N_{it}, L_{it}) \geq 0$ that are not on '$\Delta N_{it} = 0$' Locus,

$$\begin{cases} \Delta N_{it} < 0 \Longleftrightarrow L_{it} > \zeta^N(N_{it}, \theta_i) \\ \\ \Delta N_{it} > 0 \Longleftrightarrow L_{it} < \zeta^N(N_{it}, \theta_i). \end{cases} \tag{24}$$

Hence, as depicted in Figure 1, for $(N_{it}, L_{it}) \geq 0$, that are above the curve $L_{it} = \zeta^N(N_{it}, \theta_i)$, the dynamical system induces a decrease in N_{it} (i.e., $\Delta N_{it} < 0$), as reflected in a left-oriented horizontal arrow of motion, whereas for $(N_{it}, L_{it}) \geq 0$, that are below this curve the dynamical system induces an increase in N_{it} (i.e., $\Delta N_{it} > 0$), as reflected in an right-oriented horizontal arrow of motion.

2.4.2 The '$\Delta L_{it} = 0$' Locus

Let the '$\Delta L_{it} = 0'$ Locus be the geometrical place of all non-negative pairs, $(N_{it}, L_{it}) \geq 0$, such that $\Delta L_t \equiv L_{it+1} - L_{it} = 0$. As follows from (17),

$$\Delta L_{it} = 0 \Leftrightarrow \begin{cases} L_{it} = \left\{\frac{\gamma l(\theta_i)^{1-\alpha}}{\tau}\right\}^{\frac{1}{\alpha}} \left[(A^h)^{1/\alpha} N_{it} + (A^a)^{1/\alpha} X^a\right] \equiv \zeta^L(N_{it}, \theta_i) \\ \\ L_{it} = 0 \quad \forall N_{it}. \end{cases} \tag{25}$$

Hence, as depicted in Figure 1, the '$\Delta L_{it} = 0$' Locus in the plain (N_{it}, L_{it}) consists of two connected line segments: (i) the entire x-axis, and (ii) a ray from the $(0, \left\{\frac{\gamma l(\theta_i)^{1-\alpha}}{\tau}\right\}^{\frac{1}{\alpha}} (A^a)^{1/\alpha} X^a)$ with a positive slope of $\{\gamma A^h [l(\theta_i)]^{1-\alpha}/\tau\}^{1/\alpha}$.

Moreover, for $(N_{it}, L_{it}) \geq 0$, that are not on '$\Delta L_{it} = 0'$ Locus,

$$\begin{cases} \Delta L_{it} < 0 \Longleftrightarrow L_{it} > \zeta^L(N_{it}, \theta_i). \\ \\ \Delta L_{it} > 0 \Longleftrightarrow L_{it} < \zeta^L(N_{it}, \theta_i). \end{cases} \tag{26}$$

Hence, as depicted in Figure 1, for $(N_{it}, L_{it}) \geq 0$, that are above the ray $L_{it} = \zeta^L(N_{it}, \theta_i)$, the dynamical system induces a decrease in L_{it} (i.e., $\Delta L_{it} < 0$), as reflected in a downward vertical arrow of motion, whereas for $(N_{it}, L_{it}) \geq 0$, that are below this ray the dynamical system induces an increase

in L_{it} (i.e., $\Delta L_{it} > 0$), as reflected in an upward vertical arrow of motion.

2.4.3 Steady-State Equilibria

A steady-state equilibrium of the joint evolution of the human and the animal populations in niche i is a pair, $(\bar{N}_i, \bar{L}_i)$, such that

$$\begin{cases} \bar{N}_i = \psi^i(\bar{N}_i, \bar{L}_i) \\ \\ \bar{L}_i = \phi^i(\bar{N}_i, \bar{L}_i). \end{cases} \tag{27}$$

As follows from (22), using (14), for a given set of parameters (A^h, A^a, θ_i), there exists a unique steady-state equilibrium, $(\bar{N}_i, \bar{L}_i) >> 0$, characterized by the co-existence of the human and the animal population, i.e.,

$$\begin{cases} \bar{N}_i = \frac{X^h}{A^h}\left[1 - \left(\frac{\gamma A^h}{\tau}\right)^{\frac{1-\alpha}{\alpha}} l(\theta_i)^{\frac{1-\alpha}{\alpha}}\right]^{\frac{1}{\beta}} \equiv \bar{N}_i(A^h, \theta_i) \\ \\ \bar{L}_i = \left(\frac{\gamma}{\tau}\right)^{\frac{1}{\alpha}} l(\theta_i)^{\frac{1-\alpha}{\alpha}} \left[(A^h)^{\frac{1}{\alpha}} \bar{N}_i(A^h, \theta_i) + (A^a)^{\frac{1}{\alpha}} X^a\right] \equiv \bar{L}_i(A^h, A^a, \theta_i), \end{cases} \tag{28}$$

if $\theta_i > \underline{\theta} \equiv \max\{(1-\alpha)(\gamma A/\tau - 1), 0\}$.

A steady-state equilibrium is geometrically represented by the point of intersection between the '$\Delta L_t = 0$' Locus and the '$\Delta N_t = 0$' Locus. As depicted in Figure 1, if the predisposition towards leisure, $\theta_i > \underline{\theta}$, the dynamical system is characterized by 4 steady-state equilbira:

- $(0, 0)$ – where the human and the animal populations are extinct;
- $(0, X^h/A^h)$ – where the humans are extinct but animals exists;
- $\left(\left(\frac{\gamma}{\tau}\right)^{\frac{1}{\alpha}} l(\theta_i)^{\frac{1-\alpha}{\alpha}} (A^a)^{\frac{1}{\alpha}} X^a, 0\right)$ – where the humans exist but animals are extinct;
- $(\bar{L}_i, \bar{N}_i) >> 0$ – where the human and the animal populations co-exist.

2.4.4 Stability of the Co-Existence Steady-State Equilibria

In light of the vector field that characterizes the dynamical system, as derived in (24) and (26), and depicted in Figure 1, it follows from the *Stable Manifold Theorem* that the global dynamics of the

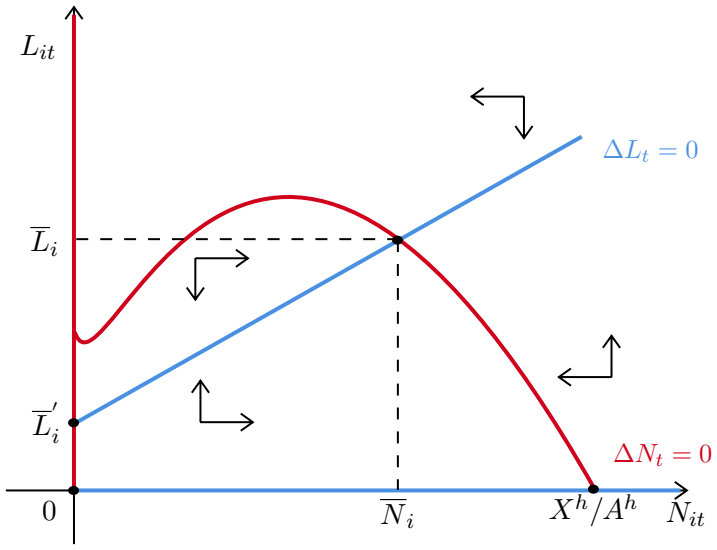


Figure 1: Phase Diagram

the dynamical system can be derived based on the analysis of the characteristic polynomial by the *Jacobian Matrix,* $J_i(\bar{L}_i, \bar{N}_i)$, of the dynamical system, (22), evaluated at the steady-state, in which humans and animals co-exist:

$$J_i(\bar{L}_i, \bar{N}_i) = \begin{bmatrix} 1-\alpha & \alpha\chi(\bar{N}_i)\frac{\bar{L}_i}{\bar{N}_i} \\ -(1-\alpha)\left\{\left(\frac{X}{A\bar{N}_i}\right)^{\beta} - 1\right\}\frac{\bar{N}_i}{\bar{L}_i} & 1-\beta+(1-\alpha)\chi(\bar{N}_i)\left\{\left(\frac{X}{A\bar{N}_i}\right)^{\beta} - 1\right\} \end{bmatrix} \equiv J_i(A^h, A^a, \theta_i) \tag{29}$$

Proposition 1. *The predisposition of group i towards leisure, θ_i, determines the local stability of the steady state equilibrium in which humans and animals co-exist. For the range of $\theta_i > \underline{\theta}$ in which this steady-state equilibrium exists, there exist a threshold, $\hat{\theta}$,*

$$\underline{\theta} < \hat{\theta}$$

such that the steady-state equilibrium is:

- *unstable,* *if* $\theta_i \in (\underline{\theta}, \hat{\theta}]$;
- *asymptotically stable,* *if* $\theta_i \in [\hat{\theta}, \infty)$.

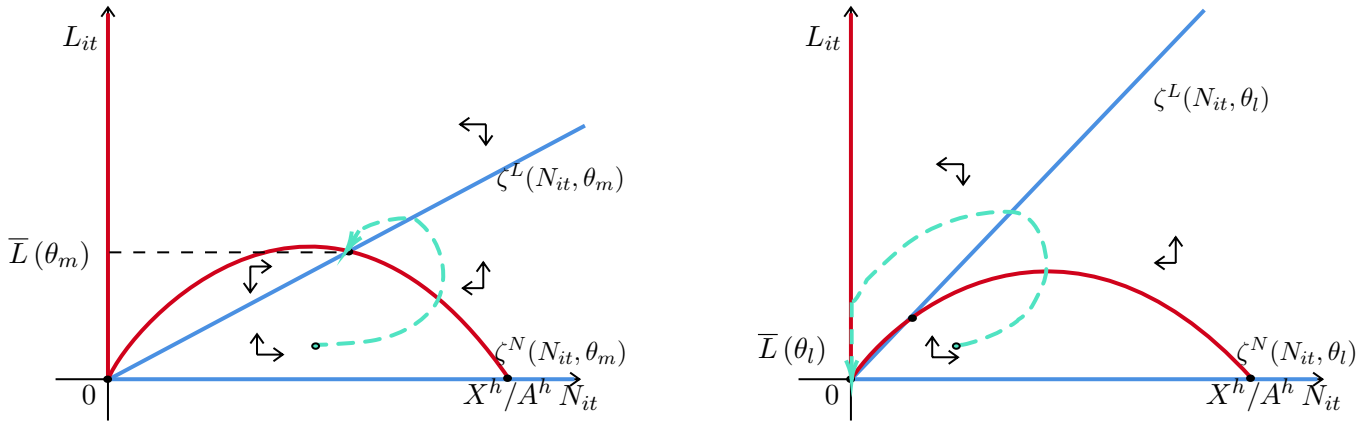
Proof (Appendix).[4]

The global dynamics, as depicted in Figure 1, follows from the application of the *Stable Manifold Theorem* to the local stability analysis established in Proposition 1. It establishes that effect of the predisposition of group i towards leisure, θ_i, and the size of the human population in the long-run.

Corollary 1. *There exist* $\hat{\theta}$ *such that*

- *If* $\theta_i > \hat{\theta}$, *the dynamical system converges to a steady-state equilibrium in which the human and animal population co-exist,* $(\bar{L}_i, \bar{N}_i) >> 0$;
- *If* $\theta_i < \hat{\theta}$, *the dynamical system converges to a steady-state equilibrium in which animals are extinct and humans exist,* $\left(\left(\frac{\gamma}{\tau}\right)^{\frac{1}{\alpha}} l(\theta_i)^{\frac{1-\alpha}{\alpha}} (A^a)^{\frac{1}{\alpha}} X^a, 0\right)$.

Proof The corollary follows directly from Proposition 1 and the feasible trajectories depicted in the phase diagrams in Figures 2.



(a) Co-existence Steady State (b) Animals are extinct in the Steady State

Figure 2: Feasible Trajectories

[4]In principle, there might exist an additional threshold level, θ', such that $\underline{\theta} < \theta' < \hat{\theta}$ and the steady-state equilibrium is asymptotically stable for $\theta_i \in (\underline{\theta}, \theta']$. Co-existence steady-state under such levels of θ_i is characterized by high labour effort, high share of effort in agriculture and is stable. Qualitatively it is similar to the purely agricultural steady-state $\left(\left(\frac{\gamma}{\tau}\right)^{\frac{1}{\alpha}} l(\theta_i)^{\frac{1-\alpha}{\alpha}} (A^a)^{\frac{1}{\alpha}} X^a, 0\right)$ and is replaced by one in the analysis for simplicity. Nevertheless, the qualitative results of the theory hold if the existence of θ' is explicitly taken into account.

2.5 The Evolution of Predisposition Towards Leisure

Under a given level of agricultural productivity, variations in the predispositions of human groups towards leisure generates two conflicting effects on the long-run level of consumption, and thus reproductive success, of each of the human groups. While, given the supply of game animals, lower predisposition towards leisure has a positive effect on the level of hunting, over-extraction that may be associated with more intense hunting, has an adverse effect on the supply of game animals, and thus on hunting output in the long-run. Hence, in light of the trade-off associated with the predisposition towards leisure, human groups with a a moderate predisposition towards leisure, that maximizes the hunting population in the long-run, dominate the population of humans in the long-run, while other hunting groups that are overly zealot or overly passive will be brought to extinction in the long-run.

Greater relative productivity of agriculture compared to hunting, on the other hand, sways the allocation of effort towards agricultural sector, which is not subjected to over-extraction. As a result, groups with lower predisposition towards leisure (i.e., groups with greater labour effort) gain the upper hand in the process of natural selection, increasing the representation of more industrious individuals in the total human population and reducing the population average level of leisure preference.

2.5.1 Preference for Leisure & Long-Run Human Population

As established in the previous subsection, the steady state level of the human population in niche i is determined by the predisposition of group i towards leisure, θ_i. In particular, as follows from Proposition 1 and Corollary 1, the animal population will become extinct if $\theta_i < \hat{\theta}$, and thus it follows from (28), using (14), that

$$\bar{L}(\theta_i, A^h, A^a) = \begin{cases} \left(\frac{\gamma}{\tau}\right)^{\frac{1}{\alpha}} l(\theta_i)^{\frac{1-\alpha}{\alpha}} \left[(A^h)^{\frac{1}{\alpha}} \bar{N}_i(A^h, \theta_i) + (A^a)^{\frac{1}{\alpha}} X^a\right] & if \;\; \theta_i > \hat{\theta} \\ \left(\frac{\gamma}{\tau}\right)^{\frac{1}{\alpha}} l(\theta_i)^{\frac{1-\alpha}{\alpha}} (A^a)^{\frac{1}{\alpha}} X^a & if \;\; \theta_i \leq \hat{\theta}. \end{cases} \tag{30}$$

Thus, since groups are assumed to occupy identical niches (i.e., X^h, X^a and A^h, A^a are identical across niches) and since the populations of each niche evolves independently,[5] the long run distribution of the predisposition towards leisure across all groups will be proportional to the steady state population of each group.

[5]If there is interaction and potential conflicts across groups group selection may emerge. This scenario is analyzed in the Appendix.

The average long run level of predisposition towards leisure in the entire population in all niches, $\bar{\theta}$, is the weighted average of the predisposition towards leisure in each location, θ_i, weighted by the fraction of the population that resides in niche, i, $\bar{L}(\theta_i, A^h, A^a)/\sum_i \bar{L}(\theta_i, A^h, A^a)$:

$$\bar{\theta} = \frac{\sum_i \bar{L}(\theta_i, A^h, A^a)\theta_i}{\sum_i \bar{L}(\theta_i, A^h, A^a)}. \tag{31}$$

2.5.2 Animal Size and Crop Yield: Roots of Preference for Leisure

This subsection explores the impact of the size of animals and crop yield and their on the average level of the predisposition towards leisure in the human population.

Proposition 2. *The long run average level of predisposition towards leisure in the overall population increases with the productivity of hunting as captured by the size of animals populating the environment, i.e.,*

$$\partial\bar{\theta}/\partial A^h > 0. \tag{32}$$

Proof (Appendix).

Proposition 3. *The long run average level of predisposition towards leisure in the overall population decreases with the productivity of agriculture as captured by the potential crop yield generated by the environment, i.e.,*

$$\partial\bar{\theta}/\partial A^a < 0. \tag{33}$$

Proof (Appendix).

Conditional on the productivity of agriculture (i.e., potential crop yield), larger animals increases human productivity in hunting, increasing the rate of human population growth, the demand for animals for consumption, and thus could bring the animal population in the niche to extinction, unless its predisposition towards leisure is sufficiently large to mitigate the excessive human productivity. While, given the size of game animals, lower predisposition towards leisure has a positive effect on the level of hunting, over-extraction that may be associated with more intense hunting, has an adverse

effect on the supply of game animals, and thus on hunting output in the long-run. Hence, in light of the trade-off associated with the predisposition towards leisure, human groups with a moderate predisposition towards leisure that maximizes the hunting population in the long-run, dominate the population of hunters in the long-run, while other hunting groups with either high or low predisposition towards leisure may stagnate or may be brought to extinction in the long-run.

On the other hand, conditional on the productivity of hunting (i.e., size of game animals), greater suitability for agriculture leads to an allocation of labour effort towards agricultural production among human groups. Due to the fact that this sector of subsistence production is not subjected to the over-extraction, greater labour effort leads to the higher reproductive success, ultimately favoring relatively more industrious groups in the process of natural selection. As a result, environments with the greater suitability for agriculture would be characterized by lower average predisposition towards leisure in the long-run.

3 Empirical Strategy and Data

This section presents the empirical strategy developed to analyze the effect of the potential historic productivity of hunting and agriculture and the resulting ancestral dependence on hunting relative to agriculture and gathering on contemporary variations in the preference for labour and leisure. Moreover, it describes the global measures of the potential historic large mammal fauna abundance that are designed to capture the potential productivity of hunting as a subsistence activity, as well as a range of proxies for labour and leisure preference, at the individual level.

3.1 Dependent Variable: Proxies for Labour-Leisure Preference

Adequately capturing variation in the rate of labour and leisure preference is crucial for the correct identification of the theoretically established effect. To address this challenge several measures of labour-leisure preference at an individual are introduced exploiting European Social Survey (ESS), General Social Survey (GSS) and World Value Survey (WVS).

Variations in the prevalence and the distribution of preference for labour and leisure across individuals is captured by a variety of measures of the importance of leisure and work in individuals' lives. In particular, exploiting ESS the degree of individual's preference for leisure is captured as respondents evaluation of the importance of 'having a good time' in her life. The measure can take six

categorical values which identify the intensity of the 'good time' importance in individual's life and is interpreted as the rate of individual's preference for leisure. Additionally, one of the questions introduced in GSS allows to capture individual's subjective attitude towards industriousness as a quality that children should learn. The measure assigns one of five categorical values to this quality and thus reflects one's valuation of the importance of being hard working for children, other people and herself, capturing the individual rate of labour preference. Finally, exploiting WVS an additional measure of individual's labour preference is introduced. Namely, the measure is constructed based on the question which evaluates the importance of work in the respondent's life, reflecting her subjective preference for labour.

It should be noted that all of the proposed measures are categorical by design allowing for the linear ordinary least square (OLS) estimation as well as the application of the ordered probit approach, both of which are implemented.

3.2 Independent Variables: Potential Productivity of Hunting and Agriculture, Subsistence Strategy

This section describes the measures the will be used to capture the impact of the potential productivity of hunting and agriculture, and the resulting choice of production modes on labour-leisure preference. In light of the predictions of the theory, the rate of leisure and labour preference is linked to the relative productivity of hunting and agriculture as well as ancestral dependence on hunting relative to agriculture and gathering.

3.2.1 Potential Productivity of Hunting

This subsection describes the construction of the measure that captures the potential historic productivity of hunting as a subsistence production mode. In particular, to reflect the suitability of a particular location for hunting, the measure of a potential large mammal fauna abundance was calculated as a share of large mammal species out of all mammal species that potentially resided in a given location. Conditional on other geographical characteristics of a given ecological niche, the skewness of a mammal distribution towards larger species, as captured by this share, reflects an abundance of potential hunting game which is greater in size and, as a result, is more desirable for a hunter, allowing for a more beneficial cost-to-gain ratio and making hunting more attractive as a subsistence

production mode (e.g., Hawkes et al., 1991; Martin et al., 2013).

The measure is constructed using the The Phylogenetic Atlas of Mammal Macroecology (PHYLACINE) database collected by Faurby et al. (2018). The data are comprised of the maps of both current and present natural ranges of all 5,831 known late Quaternary mammals (i.e., ones that lived since 130,000 years ago until present) as well as rich trait data, including, among other things, the mean body mass of adult species. Unlike, the current range maps that reflect the real present day habitats of the mammal species, present natural ranges are the potential natural ranges the species would occupy if they had never experienced strong anthropogenic pressures. In particular, using a wide range of techniques (e.g., estimation of ranges based on the natural ranges of the extant and extinct species that the target species co-occurred with at fossil sites, expansion of ranges to entire islands and suitable areas contiguous with the current range, etc.) present natural ranges are constructed to reflect the areas that could have been potentially occupied by mammal species, including extant and extinct, if humans were not around. Exploiting the present natural ranges instead of current ones in the empirical analysis allows to overcome the potential concern over the reversed causality stemming from the influence of early humans on the mammals and their habitats that could be correlated with labour-leisure preference of humans. The range maps are constructed at a resolution with a cell size of 96.5 km by 96.5 km at 30° North and 30° South.

Exploiting the present natural ranges and the mean body mass trait data allows to construct the measure of the large mammal fauna abundance for a particular location. Namely, for a given grid cell l the share of mammal species with an adult body mass larger than 10 kg out of all mammal species that reside where is calculated according to the following formula

$$share\_lm_l \equiv \frac{\#\{i|i \in I_l, m_i \geq 10\}}{\#\{i|i \in I_l\}}, \tag{34}$$

where $share\_lm_l$ capture the share of mammals with adult body mass greater than 10 kg, I_l is the set of all terrestrial mammal species residing in a grid cell l and m_i is an adult body mass of a specie i in kilograms. As a result, for each terrestrial grid cell a corresponding measure of potential large mammal fauna abundance is calculated. The measure can then be aggregated on the country or ethnic group level.

Tables 1 and 2 establish that the proposed measure of the potential large mammal fauna abundance is indeed associated with greater dependence of ethnic groups in their subsistence on large-game in

Table 1: Determinants of the Large-Game Hunting: Ethnic Groups in SCCS

	Large-Game Hunting					
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Large Mammals (Potential)	0.60***	0.65***	0.45**	0.59***	0.62***	0.69***
	(0.13)	(0.14)	(0.19)	(0.22)	(0.22)	(0.24)
Crop Yield		-0.23**	-0.07	-0.09	-0.07	-0.08
		(0.10)	(0.11)	(0.14)	(0.14)	(0.14)
Region FE	No	No	Yes	Yes	Yes	Yes
Geographical Controls	No	No	No	Yes	Yes	Yes
Climatic Controls	No	No	No	No	Yes	Yes
Year of Observation	No	No	No	No	No	Yes
Pseudo-R^2	0.10	0.14	0.22	0.27	0.33	0.35
Observations	139	139	139	139	139	139

Note: Using Probit regression, this table establishes based on the Standard Cross Cultural Survey that dependence on large-game hunting is positively affected by share of large mammals in the region. Region fixed effects include dummy variables for world bank regions. Geographical controls island dummy, mean ruggedness, mean elevation, absolute latitude and distance to coast or river. Climatic controls include the mean annual temperature and the level of precipitation as well as within year variation in temperature and precipitation. Year of observation is the year when the data was collected. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

particular (Table 1) and on hunting rather than agriculture and gathering in general (Table 2). Both sets of the results are robust to the confounding effects of the potential crop yield (column 2), world bank regional fixed effects (column 3), geographical and climatic controls (columns 4 and 5) and year the observation of the group was conducted (column 6).

3.2.2 Potential Productivity of Agriculture

This subsection describes the measure that is exploited in the analysis to capture the potential productivity of agriculture as a subsistence production mode.

To capture the potential productivity of agriculture in a particular location a measure of the historical potential crop yield, first introduced in Galor and Özak (2016), is utilized. In particular, the empirical analysis exploits the Caloric Suitability Indices (CSI) that have been constructed using the data from the Global Agro-Ecological Zones (GAEZ) project of the Food and Agriculture Organization (FAO), which supply global estimates of crop yield for 48 major crops in grids with cells size of $5' \times 5'$. The measures hinge on: (i) estimates of potential crop yield under low level of inputs and rain-fed

Table 2: Determinants of the Relative Dependence on Hunting: Ethnographic Atlas

	Relative Dependence on Hunting					
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Large Mammals (Potential)	0.01**	0.02***	0.02***	0.02***	0.02***	0.02***
	(0.00)	(0.00)	(0.01)	(0.01)	(0.01)	(0.01)
Crop Yield		-0.05***	-0.02***	-0.02***	-0.02***	-0.02***
		(0.01)	(0.00)	(0.00)	(0.00)	(0.00)
Region FE	No	No	Yes	Yes	Yes	Yes
Geographical Controls	No	No	No	Yes	Yes	Yes
Climatic Controls	No	No	No	No	Yes	Yes
Year of Observation	No	No	No	No	No	Yes
Adjusted-R^2	0.00	0.13	0.42	0.57	0.58	0.58
Observations	1042	1042	1042	1042	1042	1042

Note: Using OLS regression, this table establishes based on the Ethnographic Atlas that dependence on hunting relative to agriculture and gathering is positively affected by share of large mammals and negatively affected by potential agricultural productivity in the region. Region fixed effects include dummy variables for world bank regions. Geographical controls island dummy, mean ruggedness, mean elevation, absolute latitude and distance to coast or river. Climatic controls include the mean annual temperature and the level of precipitation as well as within year variation in temperature and precipitation. Year of observation is the year when the data was collected. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

agriculture - cultivation methods that characterized early stages of development, and (ii) agro-climatic conditions that are orthogonal to human intervention. As a result, the measure reflects the potential historic productivity of agriculture for subsistence and is immune to the potential concern that the level of agricultural inputs, the irrigation method, and soil quality, reflect endogenous choices that could be potentially correlated with labour-leisure preference.

In addition, the fact that the CSI are calculated at a crop-level allows to exploit the variation in the potential crop yield in the course of the Columbian Exchange by focusing on the subsets of crops which were available is a certain region before and after the Columbian Exchange (i.e., prior and after the year 1500) and calculating the change of the potential crop yield due to the Exchange. All of these measures are aggregated at an ethnic and country levels.

Columns (2) through (6) of Table 2 establish negative and highly significant effect of potential crop yield on the relative dependence on hunting across ethnic groups in the Ethnographic Atlas. The result is robust to the confounding effects world bank regional fixed effects (column 3), geographical and climatic controls (columns 4 and 5) and year the observation of the group was conducted (column

6).

3.2.3 Ancestral Relative Dependence on Hunting

This subsection describes the construction of the measure that captures the historic dependence on hunting relative to agriculture and gathering on the country level.

The measure of relative dependence on hunting for subsistence can be easily calculated on an ethnic group level using the data supplied in the Ethnographic Atlas or Standard Cross Cultural Survey (SCCS). To construct this measure on a country level the database of Ancestral Characteristics of Modern Populations developed by Giuliano and Nunn (2018b) is exploited. The database covers the Globe providing measures of the cultural and ethnographic characteristics of the pre-industrial ancestors of the countries' current populations, with the ancestral adjustment being based on the current population weights of ethnolinguistic groups residing in the country today. Among other measures, the data captures the dependence of the current populations' ancestors on hunting, agriculture and gathering for subsistence. In particular, the database identifies what proportion of the current population's ancestors in a given country had a certain level of dependence on each of the subsistence strategies, allowing to calculate the country average level of dependence on each production mode accounting for an ancestral composition of the current population.[6]

Country specific ancestry adjusted measures of dependence on hunting, agriculture and gathering are then used to construct a measure of the relative dependence on hunting. Namely, for a country c a relative share of hunting compared to agriculture and gathering in ancestral subsistence is calculated as follows

$$share\_hunt_c \equiv \frac{hunt_c^{anc}}{hunt_c^{anc} + agric_c^{anc} + gath_c^{anc}}, \tag{35}$$

where $share\_hunt_c$ captures ancestral dependence on hunting elative to agriculture and gathering, while $hunt_c^{anc}$, $agric_c^{anc}$ and $gath_c^{anc}$ reflect the dependence of ancestors of country c's population on hunting, agriculture and gathering respectively.

[6]The dependence is captured at a level of 10 brackets ranging from the lowest – 0% to 5%, to the highest – 86% to 100%. The middle of the bracket is used when averaging across ancestral populations, using ancestral population shares as weights.

3.3 Identification Strategy

The empirical analysis surmounts significant hurdles in the identification of the causal effects of hunting and agriculture productivity and resulting subsistence production choice on the evolution of labour-leisure preference. In particular, the research adopts an empirical strategy that is designed to mitigate concerns about the reverse causality, as well as the potential role of omitted variables, in the observed association between environmental characteristics and labour-leisure preference.

First, since by design, measures of the potential productivity of hunting and agriculture are constructed to be orthogonal to human interventions, the focus on these characteristics assures that the association between the environmental measures and labour-leisure preference is not driven by reversed causality in the identification. In particular, the measure of the potential large fauna abundance is calculated using the present natural (rather than current) mammal ranges that species would occupy if they had never experienced strong anthropogenic pressure. Thus, by construction, this measure of potential productivity of hunting is independent from human influence and preferences. In addition, the measure of the agricultural productivity captured by the potential (rather than actual) crop yield is constructed exploiting variation in agro-climatic conditions that are orthogonal to human intervention.

Second, potential concerns about the role of omitted geographical, institutional, cultural, and human characteristics in the observed association between environmental characteristics and subsistence strategy and labour-leisure preference are mitigated by accounting for a large set of confounding characteristics that might have determined preference for labour or leisure and are correlated with the potential productivity of hunting and agriculture as well as relative dependence on hunting. In particular the analysis accounts for: potentially confounding effects of: geographical characteristics (e.g., absolute latitude, mean elevation, terrain ruggedness, distance to coast or navigable river, percentage of land in the tropical, subtropical and temperate zones and landlocked societies), as well as the time elapsed since of the neolithic revolution; (ii) regional fixed effects, capturing unobserved time-invariant heterogeneity at the regional level; (iii) host country fixed effects, and thus time-invariant country-of-birth specific factors, (e.g., geography, institutions, history, and culture); for second-generation migrants; (iv) individual characteristics (e.g., age, gender, number of siblings, religion, education level and income); (v) measures of pre-industrial development (e.g., population density and urbanization rate).

Third, the adoption of the epidemiological approach and the exploration of the factors influencing

the evolution of labour and leisure preference among second-generation migrants, permits the analysis to overcome two major concerns: (i) it distinguishes between the effect of potential suitability of the parental country of origin (rather than those in country of residence) for hunting and agriculture as well as its ancestral relative dependence on hunting on labour-leisure preference, capturing the culturally-embodied, intergenerationally-transmitted component of the effects of geography and ancestral subsistence strategy, rather than their direct effects; (ii) it accounts for time invariant unobserved heterogeneity in the host country (e.g., geographical, cultural and institutional characteristics), and thus mitigating possible concerns about the confounding effect of host country-specific characteristics.

Fourth, the natural experiment associated with the Columbian Exchange introduces the opportunity to exploit differential assignment of crops to indigenous populations across the globe and resulting exogenous variation in the relation between potential productivity of agriculture and hunting. As a result, it allows to shed light on the contribution of the forces of cultural evolution to the origins of variation in labour-leisure preference, as opposed to the sorting of more industrious individuals into environments more suitable for agriculture relative to hunting, mitigate concerns about the confounding effects of unobservables geographical factors in the parental county of origin and demonstrates the importance of evolutionary processes in the pre-1500 and the post-1500 period.

Fifth, to overcome the potential concern of the reversed causality in the association between the ancestral relative dependence on hunting and labour-leisure preference of population the Instrumental Variable (IV) approach was implemented when estimating the effect. In particular, the measure of the potential large mammal fauna abundance (i.e., share of large mammals) is exploited as an exogenous instrument for the ancestral dependence on hunting relative to agriculture and gathering.

Finally, to account for post-1500 population flows and adequately capture the effect of the environment on the evolution of a population's ancestors rather than the history of the place they live today the ancestry adjustment of the potential hunting and agricultural productivity measures is performed whenever the analysis exploits countries with a significant share of descended from people in different source countries (e.g., New World countries). In particular, the adjustment is accomplished by exploiting the matrix developed by Putterman and Weil (2010).

4 Empirical Analysis: Second Generation Migrants

This section analyzes the effect of the potential historic large mammal fauna abundance, agricultural productivity and the resulting ancestral dependence on hunting as opposed to agriculture and gathering on the second-generation migrants' preferences for leisure and labour in Europe and the United States. In particular, it analyses the effect of potential share of large mammals and agricultural productivity, as well as the effect of ancestral relative dependence on hunting on preferences for having a good time as reported in the European Social Survey (ESS), and on preferences for working hard as reported in the General Social Survey (GSS). The analysis of second-generation migrants accounts for time invariant unobserved heterogeneity in the host country (e.g., geographical and institutional characteristics). Moreover, since historic composition of mammal fauna and potential agricultural productivity in the parental country of origin are distinct from those of the country of residence, the estimated effect of temperature volatility and correlation in the country of origin captures the culturally-embodied, intergenerationally-transmitted effect, rather than the direct effect of geography.

The reduced form effect of large mammal fauna abundance and agricultural productivity on preferences for labour or leisure is estimated via ordinary least squares (OLS) according to the following specification

$$\begin{aligned} y_{ict} = \beta_0 + \beta_1^{lm} share\_lm_{ip} + \beta_1^{ag} agrc\_prod_{ip} \\ + \sum_j \gamma_{1j} X_{ipj} + \sum_j \gamma_{2j} Z_{ij} + \sum_c \gamma_c \delta_{ic} + \sum_t \gamma_t \delta'_{it} + \epsilon_i \end{aligned} \tag{36}$$

where y_{ict} captures either preference for leisure or hard work of second-generation migrant i in country c measured in round/wave t, $share\_lm_{ip}$ – historical potential share of large mammals – and $agrc\_prod_{ip}$ – potential agricultural productivity – are measured in the country of origin of parent p of individual i, X_{ipj} is geographical characteristic j of the country of origin of parent p of individual i, Z_{ij} is characteristic j of individual i (age, gender, number of siblings, religion, education level, income), δ_{ic} is the country of birth fixed effect of individual i, δ'_{it} is the round/wave fixed effect of individual i, and ϵ_i is the error term. In case when y_{ict} captures preference for leisure the theory predicts positive effect of large mammals abundance and negative effect of agricultural productivity (i.e., $\beta_1^{lm} > 0$ and $\beta_1^{ag} < 0$). Whenever y_{ict} captures preference for labour and hard work the theory, naturally, predicts an opposite effect (i.e., $\beta_1^{lm} < 0$ and $\beta_1^{ag} > 0$).

In addition, to addresses a potential concern that the established result might be driven by the sorting of industrious individuals into the relatively more agriculturally productive regions the natural experiment of the Columbian exchange and corresponding exogenous variation in the change of agricultural productivity is exploited according to the following specification of the empirical model

$$\begin{aligned} y_{ict} = \beta_0 + \beta_1^{lm} share\_lm_{ip} + \beta_1^{ag\_pre1500} agrc\_prod_{ip}^{pre1500} + \beta_1^{ag\_change} agrc\_prod_{ip}^{change} \\ + \sum_j \gamma_{1j} X_{ipj} + \sum_j \gamma_{2j} Z_{ij} + \sum_c \gamma_c \delta_{ic} + \sum_t \gamma_t \delta'_{it} + \epsilon_i. \end{aligned} \tag{37}$$

Theory predicts, that both the potential agricultural productivity and the magnitude of its change due to the Columbian Exchange should have a positive effect on the preference for leisure and negative effect on labour preference.

The effect of ancestral relative dependence on hunting compared to agriculture and gathering on preferences for labour or leisure is estimated via ordinary least squares (OLS) according to the following specification

$$y_{ict} = \beta'_0 + \beta_1^{hn} share\_hunt_{ip} + \sum_j \psi_{1j} X_{ipj} + \sum_j \psi_{2j} Z_{ij} + \sum_c \psi_c \delta_{ic} + \sum_t \psi_t \delta'_{it} + \eta_i \tag{38}$$

where $share\_hunt_{ip}$ is the share of ancestral subsistence coming from hunting as opposed to agriculture and gathering measured in the country of origin of parent p of individual i. In addition, to overcome a potential concern of reversed causality between the labour-leisure preference and choice of the subsistence production mode, the effect is also estimated using an Instrumental Variable (IV) strategy, utilizing the potential historic large mammal fauna abundance measure as an instrument for relative historic dependence on hunting according to the following first-stage specification

$$share\_hunt_{ip} = \alpha_0 + \alpha_1 share\_lm_{ip} + \sum_j \xi_{1j} X_{ipj} + \sum_j \xi_{2j} Z_{ij} + \sum_c \xi_c \delta_{ic} + \sum_t \xi_t \delta'_{it} + \nu_p. \tag{39}$$

In case when y_{ict} captures preference for leisure the theory predicts positive effect of ancestral dependence on hunting (i.e., $\beta_1^{hn} > 0$). Whenever y_{ict} captures preference for labour and hard work the theory predicts an opposite effect (i.e., $\beta_1^{hn} < 0$).

4.1 Determinants of Leisure Preference among Second Generation Migrants in Europe

This subsection analyzes the effect of the potential historic large mammal fauna abundance, agricultural productivity and the resulting ancestral dependence on hunting as opposed to agriculture and gathering on the second-generation migrants' preferences for leisure in Europe. The reduced form effect of potential large mammal fauna abundance and the effect of agricultural productivity on preference for having good time is estimated via ordinary least squares (OLS) using the empirical models (36) and (37), while the effect of the ancestral relative dependence on hunting for substance on the leisure preference is estimated using an ordinary least squares (OLS) and Instrumental Variable (IV) approach as specified in empirical models (38) and (39).

4.1.1 Reduced Form Effect and Natural Experiment of Columbian Exchange

This subsection analyzes the reduced form effect of the potential historic large mammal fauna abundance and the effect of the potential agricultural productivity on the second-generation migrants' preferences for leisure in Europe, as captured by the valuation of the importance of having good time in their lives.

Table 3 establishes the positive statistically significant effect of potential historic share of large mammals and negative significant effect of agricultural productivity on preferences for leisure as suggested by the theory. The estimated effect implies that increasing the share of large mammals in the parental country of origin by one standard deviation increases the second-generation migrant's valuation of having a good time between 0.12 and 0.05 units[7], while increasing agricultural productivity in the parental country of origin by one standard deviation decreases the second-generation migrant's valuation of leisure between 0.07 and 0.02 units.

The pure relationship between potential historic large mammal fauna abundance and preferences for leisure is established in column (1). The estimated effect of large mammals share is positive and statistically significant at the 1% level, implying the effects suggested by the theory. Results of Column (2) establish similar effect, accounting for country of birth fixed effects, and therefore for unobserved time-invariant omitted variables at the country of birth level. The effect remains highly statistically significant at the 1% level.

[7]The characteristic is evaluated by the scale from 1 to 6.

Table 3: Determinants of Preference for Leisure: Second Generation Migrants in Europe (OLS)

	Importance of Having a Good Time							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of Large Mammals (Potential)	0.12***	0.06***	0.05***	0.07***	0.07***	0.05***	0.05***	0.05***
	(0.04)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)
Crop Yield			-0.02**	-0.05**	-0.05**	-0.07***	-0.07***	
			(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Crop Yield (pre-1500)								-0.08***
								(0.02)
Crop Yield Change (post-1500)								-0.04**
								(0.02)
Country FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	No	Yes	Yes	Yes	Yes	Yes
Round FE	No	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	No	Yes	Yes
Adjusted-R^2	0.01	0.10	0.10	0.10	0.10	0.14	0.14	0.14
Observations	16631	16631	16631	16631	16631	16631	16631	16631

Notes: Using OLS regressions, this table establishes that preference for leisure among second generation migrants in Europe is positively affected by the share of large mammals and negatively affected by the agricultural productivity today, prior to 1500 and its change due to Colombian exchange in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

Column (3) considers the effect of potential agricultural productivity on the second-generation migrant's valuation of good time, establishing a negative relationship as predicted by the theory. The estimated effect of potential crop yield is statistically significant at the 5% level.

Column (4) accounts for the whole set of confounding geographical characteristics of the country of origins, which includes mean elevation, mean terrain ruggedness, distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability, percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Reassuringly, coefficients on large mammals abundance and agricultural productivity are stable in magnitude and remain statistically significant at the 1% level and the 5% level correspondingly.

Columns (5) and (6) sequentially account for the survey round fixed effects and second-generation

migrant's individual characteristics (i.e., age, gender, number of siblings, religion, education level, and income). The estimated effects of large mammals share and crop yield on leisure preference continue to be statistically significant at the 1% and 5% level and are remarkably stable in terms of absolute values across specifications.

Column (7) considers the potential confounding effect of the advent of sedentary agriculture, as captured by the years elapsed since the onset of the Neolithic Revolution, on the evolution of leisure preference. Despite the concern of the potential multicollinearity between the timing of the Neolithic Revolution and measures of large mammal fauna abundance and agricultural suitability, the estimated effects of interest remain virtually unchanged in terms of magnitude and statistical significance, continuing to be significant at the 1% level. Additionally, the effect of the timing of transition to the Neolithic has no significant effect on the leisure preference.

Finally, results reported in Column (8) address a potential concern that the established result might be driven by the sorting of industrious individuals into the relatively more agriculturally productive regions. To overcome this hurdle the natural experiment of the Columbian exchange and corresponding exogenous variation in the change of agricultural productivity were utilized. In particular, the analysis focuses on the measure of agricultural productivity that captures potential yield of the crops native to the specific location prior to the Columbian exchange (i.e., pre-1500) and explores the effect of the change in this measure due to the arrival of new crops in the course of the exchange. Column (8) establishes that the preference for leisure of second generation migrants in Europe is negatively and significantly affected by the potential agricultural productivity prior to year 1500, as well as its change due to the Columbian Exchange. Reassuringly the positive effect of large mammals share on the leisure preference stays qualitatively and quantitatively unaltered, compared to the corresponding baseline specification captured in the column (7). This finding identifies the effect of a "random assignment" of potential crop yield on the evolution of leisure preference and suggests that sorting played an insignificant role in its determination. An extended set of results with respect to the effect of crop yield and its change in the course of the Columbian Exchange are reported in Table 9 in the Appendix.

4.1.2 Effect of the Ancestral Subsistence Strategy

This subsection analyzes the effect of the ancestral relative dependence on hunting for subsistence as opposed to agriculture and gathering on the second-generation migrants' preferences for leisure in Europe, as captured by the valuation of the importance of having a good time.

Ordinary Least Squares (OLS) estimation results of the empirical model (38) as well as the Instrumental Variable (IV) estimation of the corresponding model using the first-stage specification (39) are reported in Table 4, establishing the positive statistically significant effect of ancestral relative dependence on hunting over agriculture and gathering on preferences for leisure as suggested by the theory. The estimated effect implies that increasing the relative dependence on hunting by one standard deviation increases the second-generation migrant's valuation of having a good time between 0.15 and 0.04 units.

Column (1) reports pure effect of ancestral hunting dependence on the preferences for leisure, establishing positive and highly significant relationship as predicted by the theory. In addition, columns (2) through (6) sequentially account for: (i) the potential confounding effects of unobserved time-invariant omitted variables at the country of birth level, as captured by the country of birth fixed effects, (ii) geographical characteristics of the country of origin (i.e., mean elevation, mean terrain ruggedness, distance to nearest coast or navigable river, island and landlocked dummy, absolute latitude etc.), (iii) survey round fixed effects, (iv) second-generation migrant's individual characteristics (i.e., age, gender, number of siblings, religion, education level, and income), (v) potential confounding effect of the Neolithic Revolution timing. It should be noted that estimates of ancestral hunting dependence effect on the leisure preference are rather stable across specifications and statistically significant at the 1% and 5% levels.

Column (7) addresses a concern over the reversed causality between the leisure preference and ancestral choice of the subsistence production mode. In particular, using the potential historic share of large mammals as an instrument for the ancestral dependence on hunting, Instrumental Variable (IV) estimation of the empirical model (38) establishes a positive and strongly significant relation between ancestral relative dependence on hunting rather than agriculture and gathering and second-generation migrants' leisure preference, reaffirming theoretical predictions, while mitigating the reversed causality concern.

Table 4: Determinants of Preference for Leisure: Second Generation Migrants in Europe

	Importance of Having a Good Time						
	OLS						IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependence on Hunting (Anc.)	0.06**	0.07***	0.06***	0.06***	0.04**	0.04**	0.19**
	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.02)	(0.07)
Country FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	Yes	Yes	Yes	Yes	Yes
Round FE	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	Yes	Yes
Adjusted-R^2	0.02	0.10	0.10	0.10	0.14	0.14	0.14
Observations	16578	16578	16578	16578	16578	16578	16578
FIRST STAGE							Dependence on Hunting (Anc.)
Share of Large Mammals (Anc., Potential)							0.28***
							(0.07)
Firs-Stage F-statistics							14.94

Notes: Using OLS and IV regressions, this table establishes that preference for leisure among second generation migrants in Europe is positively affected by the share of ancestral dependence on hunting over agriculture and gathering in the parental country of origin. IV exploits the potential ancestry adjusted share of large mammals in the parental country of origin as an instrument to predict ancestral relative dependence on hunting. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. First-stage F-statistics id a Kleibergen-Paap rk Wald F-statistic, which is robust to standard errors clustering. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

4.2 Determinants of Labour Preference among Second Generation Migrants in the US

This subsection examines the effect of the potential historic large mammal fauna abundance, agricultural productivity and the resulting ancestral dependence on hunting as opposed to agriculture and gathering on the second-generation migrants' preferences for labour in the US. The reduced form effect of potential large mammal fauna abundance and the effect of agricultural productivity on preference for hard work is estimated via ordinary least squares (OLS) using the empirical models (36) and (37), while the effect of the ancestral relative dependence on hunting for substance on the labour preference is estimated using an ordinary least squares (OLS) and Instrumental Variable (IV) approach as speci-

fied in the empirical models (38) and (39). It should be noted that since the analysis of the subsection focuses on the labour preference, as opposed to leisure, the theory predicts negative effect of large mammals abundance and positive effect of agricultural productivity (i.e., $\beta_1^{lm} < 0$ and $\beta_1^{ag} > 0$) and the effect of ancestral dependence on hunting is expected to have a negative sign (i.e., $\beta_1^{hn} < 0$).

4.2.1 Reduced Form Effect and Natural Experiment of Columbian Exchange

This subsection analyzes the reduced form effect of the potential historic large mammal fauna abundance and the effect of the potential agricultural productivity on the second-generation migrants' preferences for labour in the US, as captured by the valuation of the importance of hard work in their lives. It should be noted that since a significant share of second-generation migrants in the GSS have originated in the New World (e.g., Canada and Mexico) it is important to account for the ancestral composition of the contemporary population when constructing the measures of historic large mammals share and potential agricultural productivity.

Table 5 establishes a negative statistically significant effect of historic potential large mammal fauna abundance and positive significant effect of potential agricultural productivity on second-generation migrants' preferences for hard work. In particular, Column (1) reports the pure relationship between potential historic large mammal fauna abundance and preferences for labour. As predicted by the theory, the effect is negative and statistically significant on the 1% level. Results of Column (2) establish similar effect, accounting for country of birth fixed effects, and therefore for unobserved time-invariant omitted variables at the country of birth level. The effect remains quantitatively similar and continues to be highly statistically significant.

Columns (3) through (7) establish both the effect of large mammals share and potential crop yield on preferences for labour, sequentially accounting for the confounding effects of unobserved time-invariant omitted variables at the region of birth level, potentially confounding geographical characteristics (mean elevation, mean terrain ruggedness, distance to nearest coast or navigable river, island and landlocked dummy, absolute latitude etc.), survey wave fixed effects, individual characteristics of second generation migrant (age, gender, number of siblings, religion, education level, and income) and the advent of sedentary agriculture, as captured by the years elapsed since the onset of the Neolithic Revolution. The estimated effects imply that increasing historic share of large mammals in the parental country of origin by one standard deviation deceases the valuation of the importance

Table 5: Determinants of Preference for Labour: Second Generation Migrants in the US (OLS)

	Importance of Working Hard							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of Large Mammals (Anc., Potential)	-0.09***	-0.08***	-0.06***	-0.07**	-0.14***	-0.17***	-0.23***	-0.17***
	(0.02)	(0.02)	(0.01)	(0.03)	(0.05)	(0.05)	(0.07)	(0.06)
Crop Yield (Anc.)			0.12***	0.15***	0.16**	0.18***	0.24***	
			(0.04)	(0.05)	(0.07)	(0.06)	(0.07)	
Crop Yield (Anc., pre-1500)								0.27***
								(0.08)
Crop Yield Change (Anc., post-1500)								0.07**
								(0.03)
Region FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	No	Yes	Yes
Adjusted-R^2	0.02	0.02	0.03	0.02	0.04	0.05	0.05	0.05
Observations	1474	1474	1474	1474	1474	1474	1474	1474

Notes: Using OLS regressions, this table establishes that preference for hard work among second generation migrants in the US is negatively affected by the share of large mammals and positively affected by the agricultural productivity today, prior to 1500 and its change due to Colombian exchange in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability, percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

of hard work between 0.06 and 0.23 units[8], while increasing potential agricultural productivity by one standard deviation increases the valuation of hard work importance between 0.12 and 0.24 units. It should be noted that coefficients on the temperature volatility and spatial correlation are rather stable across specifications and statistically significant at the 1% level in most of the specifications.

In addition, Column (8) establishes that the preference for labour of second-generation migrants in the US is positively and significantly affected by the potential agricultural productivity prior to year 1500, as well as by its change due to the Columbian Exchange. The use of the natural experiment of Columbian Exchange and the resulting random assignment of the potential agricultural productivity across the Globe helps to identify a direct effect of relative productivity of hunting and agriculture on

[8]The importance of hard work is evaluated by the scale from 1 to 5.

the evolution of the labour-leisure preference suggesting that sorting played an insignificant role in its determination. An extended set of results with respect to the effect of crop yield and its change in the course of the Columbian Exchange are reported in Table 10 in the Appendix.

4.2.2 Effect of the Ancestral Subsistence Strategy

This subsection analyzes the effect of the ancestral relative dependence on hunting for subsistence as opposed to agriculture and gathering on the second-generation migrants' preferences for labour in the US, as captured by the valuation of the hard work importance.

Table 6 establishes negative and highly statistically significant effect of ancestral dependence on hunting relative to agriculture and gathering on the modern day second-generation migrants' valuation of hard work importance. The estimates are acquired through Ordinary Least Squares estimation of the empirical model (38) as well as the Instrumental Variable (IV) approach, where relative ancestral dependence on hunting is instrumented by the potential historic large mammals share using the first-stage specification (39). The estimated effect implies that increasing the relative dependence on hunting by one standard deviation decreases the second-generation migrant's valuation of hard work between 0.09 and 0.34 units.

Column (1) reports pure effect of ancestral relative dependence on hunting on the preferences for labour, establishing negative and highly significant relationship as predicted by the theory. Columns (2) through (6) report the same relationship sequentially account for potentially confounding effects of: (i) unobserved time-invariant omitted variables at the country of birth level, as captured by the country of birth fixed effects, (ii) geographical characteristics of the country of origin (i.e., mean elevation, mean terrain ruggedness, distance to nearest coast or navigable river, island and landlocked dummy, absolute latitude etc.), (iii) survey wave fixed effects, (iv) second-generation migrant's individual characteristics (i.e., age, gender, number of siblings, religion, education level, and income), (v) Neolithic Revolution timing. It should be noted that estimates of ancestral hunting dependence effect on the labour preference are rather stable across specifications and statistically significant at the 1% and 5% levels.

Column (7) report the results of IV estimation, where the ancestral dependence on hunting relative to agriculture and gathering is instrumented by its potential productivity as captured by the historical abundance of large mammals. This helps to address a potential concern of the reversed causality

Table 6: Determinants of Preference for Labour: Second Generation Migrants in the US

	Importance of Working Hard						
	OLS						IV
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Dependence on Hunting (Anc.)	-0.09**	-0.11***	-0.17***	-0.19***	-0.21***	-0.20***	-0.34***
	(0.04)	(0.04)	(0.05)	(0.06)	(0.06)	(0.05)	(0.12)
Region FE	No	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	Yes	Yes
Adjusted-R^2	0.02	0.03	0.02	0.04	0.05	0.05	0.05
Observations	1474	1474	1474	1474	1474	1474	1474
FIRST STAGE							Dependence on Hunting (Anc.)
Share of Large Mammals (Anc., Potential)							0.64***
							(0.17)
Firs-Stage F-statistics							13.83

Notes: Using OLS and IV regressions, this table establishes that preference for working hard among second generation migrants in the US is negatively affected by the share of ancestral dependence on hunting over agriculture and gathering in the parental country of origin. IV exploits the potential ancestry adjusted share of large mammals in the parental country of origin as an instrument to predict ancestral relative dependence on hunting. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude, mean temperature and precipitation and temperature volatility . Individual controls include age, gender, number of siblings, religion, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. First-stage F-statistics id a Kleibergen-Paap rk Wald F-statistic, which is robust to standard errors clustering. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

between the labour preference and ancestral choice of the subsistence activity. Column (7) establishes a negative, strongly significant relation between ancestral relative dependence on hunting rather than agriculture and gathering and second-generation migrants' preference for hard work, as predicted by the theory.

4.3 Robustness

4.3.1 Alternative Estimation Method: Ordered Probit

The results are robust to the use of an alternative estimation method, rather than OLS. In particular, using Ordered Probit, one can estimates the probability of observing each rank of preference for

leisure preference (i.e., across second-generation migrants in Europe) and labour preference (i.e., across second-generation migrants in the US), conditional on the historical potential share of large mammals and potential agricultural productivity. In line with the OLS estimates, as established in Tables 11 and 12, and as interpreted and further discussed in Appendix A, larger historical share of large mammals increases significantly the probability that second generation migrants in Europe, as well as in the US, will have higher preference for leisure (i.e., lower preference for labour), whereas greater potential crop yield decreases the probability that a second generation migrants in Europe and the US will be more leisure-loving (i.e., less labour-loving).

4.3.2 Selection on Unobservables

This subsection examines the likelihood that omitted variables could alter the qualitative findings. Tables 14 and 15 establish that it is very improbable that omitted variables could have affected the qualitative results presented in Tables 3 and 5 as well as 4 and 6. In particular, as established in columns (2) and (4) of Table 14, (using columns (1) and (3) as the baseline specifications), the estimated value of the coefficient on potential abundance of large mammals, if unobservables where as correlated as the observables (i.e., Oster's β^* statistic), are very close to the estimated OLS coefficients. The same is true for the results with respect to ancestral relative dependence on hunting as can be judged by columns (2) and (4) of Table 15, (using columns (1) and (3) as the baseline specifications). Furthermore, since in both cases zero does not belong to the interval created by the estimated value on and Oster's β^*, one can reject the hypothesis that the value of the coefficients is driven exclusively by unobservables. In addition, the indexes AET (Altonji et al., 2005; Bellows and Miguel, 2009) and δ (Oster, 2014) measure how strongly correlated unobservables would have to be in order to account for the full size of the coefficient on temperature volatility and spatial correlation (v and c subscripts correspondingly), are mostly different from the critical value of 1.

4.3.3 Orthogonality of the Environmental Variables to Other Cultural Dimensions

This subsection establishes that the effects of potential large mammal fauna abundance, agricultural productivity and ancestral relative dependence on hunting on labour-leisure preference does not capture their effects on a wide range of other cultural characteristics.

In particular, as established in Tables 16 and 17, potential large mammal fauna abundance, agri-

cultural productivity and ancestral relative dependence on hunting in the parental country of origin mostly do not affect long term orientation, obedience, altruism, and attitudes towards equality, gender roles, government and creativity among second-generation migrants in Europe and the US.

5 Individuals Level Analysis (WVS)

This section uses the World Values Survey (WVS) to analyze the effect of potential historic large mammal fauna abundance, agricultural productivity and the resulting ancestral dependence on hunting as opposed to agriculture and gathering on the individuals' preferences for labour, as captured by their valuation of hard work importance in their lives.

The effect of large mammal fauna abundance and agricultural productivity on preferences for labour is estimated using an ordinary least squares (OLS) approach via the following empirical specification:

$$y_{icw} = \beta_0 + \beta_1^{lm} share\_lm_c + \beta_1^{ag} agrc\_prod_c + \sum_j \gamma_{1j} X_{cj} + \sum_j \gamma_{2j} Z_{icj} + \sum_{cw} \gamma_{cw} \delta_{cw} + \epsilon_{icw} \tag{40}$$

where y_{icw} is the valuation of the importance of work in life (i.e., preference for labour) of individual i in country c measured in wave w, $share\_lm_c$ and $agrc\_prod_c$ are measured in the country c, X_{cj} is geographical characteristic j (i.e., mean elevation, mean terrain ruggedness, distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability , absolute latitude etc.) of the country c, Z_{icj} is characteristic j of individual i (age, gender, number of siblings, religion, education level, income) in country c, δ_{cw} is a complete set of world bank regions and wave fixed effects and ϵ_{icw} is the error term. The theory predicts negative effect of large mammals share and positive effect of potential crop yield on labour preference (i.e., $\beta_1^{lm} < 0$ and $\beta_1^{ag} > 0$).

Additionally, to addresses a potential concern that the established result might be driven by the sorting of labour-loving individuals into the agriculturally productive regions the natural experiment of the Columbian exchange and associated quasi-random variation in the change of agricultural productivity is exploited via the following empirical model

$$\begin{aligned} y_{icw} = \beta_0 + \beta_1^{lm} share\_lm_c + \beta_1^{ag\_pre1500} agrc\_prod_c^{pre1500} + \beta_1^{ag\_change} agrc\_prod_c^{change} \\ + \sum_j \gamma_{1j} X_{cj} + \sum_j \gamma_{2j} Z_{icj} + \sum_{cw} \gamma_{cw} \delta_{cw} + \epsilon_{icw}. \end{aligned} \tag{41}$$

Once again, as predicted by the Theory, that both the potential agricultural productivity and the magnitude of its change due to the Columbian Exchange should have a negative effect on labour preference.

The effect of ancestral relative dependence on hunting compared to agriculture and gathering on preferences for labour across individuals is estimated via ordinary least squares (OLS) according to the following specification

$$y_{icw} = \beta_0' + \beta_1^{hn} share\_hunt_c + \sum_j \psi_{1j} X_{cj} + \sum_j \psi_{2j} Z_{icj} + \sum_{cw} \psi_{cw} \delta_{cw} + \eta_{icw} \tag{42}$$

where $share\_hunt_c$ is the share of ancestral subsistence consumption coming from hunting relative to agriculture and gathering measured at the level of country c. In light of the potential endogenoeity of the production mode choice to the ancestral labour preference, the instrumental variable (IV) approach is also implemented to estimate the effect. In particular, the measure of potential historic large mammal fauna abundance is utilized as an exogenous instrument for ancestral relative dependence on hunting. The corresponding first stage is estimated according to the following empirical model

$$share\_hunt_c = \alpha_0 + \alpha_1 share\_lm_c + \sum_j \xi_{1j} X_{cj} + \sum_j \xi_{2j} Z_{icj} + \sum_{cw} \xi_{cw} \delta_{cw} + \nu_{icw}. \tag{43}$$

The theory predicts negative relation between the ancestral relative dependence on hunting and modern day preference for hard work (i.e., $\beta_1^{hn} < 0$).

5.1 Reduced Form Effect and Natural Experiment of Columbian Exchange

This subsection analyzes the reduced form effect of the potential historic share of large mammals and the effect of the potential agricultural productivity on the individuals' preferences for labour across the Globe using the empirical models (40) and (41). Due to the fact that a significant share of respondents reside in the New World, it is crucial to adjust country-level measures for the ancestral composition of population.

Table 7 establishes a negative statistically significant effect of potential share of large mammals and positive significant effect of potential crop yield on individuals' valuation of importance of work. The result is robust to the inclusion of world bank regional fixed effects (column 1 and 2), geograph-

Table 7: Determinants of Preference for Labour: Individuals in WVS (OLS)

	Importance of Working Hard						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share of Large Mammals (Anc., Potential)	-0.03***	-0.04***	-0.03***	-0.04***	-0.04***	-0.04***	-0.04***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)
Crop Yield (Anc.)		0.06***	0.09***	0.07***	0.07***	0.07***	
		(0.00)	(0.01)	(0.01)	(0.01)	(0.01)	
Crop Yield (Anc., pre-1500)							0.06***
							(0.01)
Crop Yield Change (Anc., post-1500)							0.02***
							(0.01)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	Yes	Yes
Adjusted-R^2	0.05	0.05	0.07	0.07	0.11	0.11	0.11
Observations	224509	224509	224509	224509	224509	224509	224509

Notes: Using OLS regressions, this table establishes that preference for working hard among individuals in WVS is negatively affected by the share of large mammals and positively affected by the agricultural productivity today, prior to 1500 and its change after the Columbian exchange in the country of residence. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude, mean temperature and precipitation and temperature volatility. Individual controls include age, gender, religion, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

ical controls (columns 3), wave fixed effects (column 4), individual characteristics (column 5) and the number of years since transition to agriculture (column 6). The estimated effects suggest that increasing historic share of large mammals by one standard deviation decreases the valuation of hard work importance by between 0.03 and 0.04 units[9], while one standard-deviation increase in potential agricultural productivity increases this valuation by between 0.06 and 0.09 units.

In addition, Column (7) establishes that preference for labour of individuals across the Globe is positively and significantly affected by the potential agricultural productivity prior to year 1500, as well as its change due to the Columbian Exchange, identifying the effect of a "random assignment" of potential crop yield on the evolution of labour preference and suggesting that sorting played an

[9]The characteristic is evaluated by the scale from 1 to 4.

insignificant role in its determination.

5.2 Effect of the Ancestral Subsistence Strategy

This subsection analyzes the effect of the ancestral relative dependence on hunting for relative to agriculture and gathering on the individuals' preferences for labour, as captured by the valuation of the importance of work in their lives.

Columns (1) through (6) of Table 8 report Ordinary Least Squares (OLS) estimation results of the empirical model (42). A negative and highly statistically significant relationship between ancestral relative dependence on hunting and modern individual-level labour preference is established through out alternative specifications which sequentially account for: world bank regional fixed effects (column 2), geographical controls (columns 3), wave fixed effects (column 4), individual characteristics (column 5) and the number of years since transition to agriculture (column 6). Reassuringly, the effect is highly stable in terms of magnitude and remains significant at the 1% and 5% level across specifications.

In addition, column (7) addresses a concern over the reversed causality between the labour preference and ancestral decision over the subsistence production mode. By instrumenting the ancestral relative dependence on hunting with the exogenous measure of potential large mammal fauna abundance, it is established that regions characterized by greater historic dependence on hunting are now characterized by lower preference for labour. This result reaffirms theoretical prediction, while overcoming a potential reversed causality hurdle.

5.3 Robustness

As establish in the Appendix XX, the effects of potential historic large mammal fauna abundance, agricultural productivity and the resulting ancestral dependence on hunting relative to agriculture and gathering on preferences for labour across individuals are robust to: (i) the use of an alternative estimation method: Ordered Probit (Table 13), (ii) controls for preindustrial development (columns 5 and 6 of Table 18 and 19), and (c) accounting for selection on unobservables (columns 5 and 6 of Table 14 and 15).

Table 8: Determinants of Preference for Labour: Individuals in WVS

	Importance of Working Hard					
	OLS					IV
	(1)	(2)	(3)	(4)	(5)	(6)
Dependence on Hunting (Anc.)	-0.02***	-0.02***	-0.01**	-0.01***	-0.01***	-0.16***
	(0.00)	(0.00)	(0.00)	(0.00)	(0.00)	(0.01)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	Yes	Yes
Adjusted-R^2	0.05	0.06	0.07	0.11	0.11	-0.23
Observations	224509	224509	224509	224509	224509	224509
FIRST STAGE						Dependence on Hunting (Anc.)
Share of Large Mammals (Anc., Potential)						0.11***
						(0.01)
Firs-Stage F-statistics						22.30

Notes: Using OLS and IV regressions, this table establishes that preference for working hard among individuals in WVS is negatively affected by the share of ancestral dependence on hunting over agriculture and gathering in the parental country of origin. IV exploits the potential ancestry adjusted share of large mammals in the parental country of origin as an instrument to predict ancestral relative dependence on hunting. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude, mean temperature and precipitation and temperature volatility . Individual controls include age, gender, religion, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. First-stage F-statistics id a Kleibergen-Paap rk Wald F-statistic, which is robust to standard errors clustering. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

6 Concluding Remarks

This research explores the origins of the variation in the predisposition towards labour and leisure across regions and nations around the Globe. It advances the hypothesis and establishes empirically that the evolution of labour-leisure preference in the course of human history can be traced to the adaptation of individuals to the effect of over-extraction in hunting in light of the presence of alternative subsistence strategies such as agriculture and gathering.

The study develops an evolutionary theory that captures the fundamental difference in the long-term reproductive success gains from effort in hunting and agriculture, which in tern impact the evolution of predisposition towards leisure and optimal labour effort in a given environment.

Exploiting variations in the degree of labour and leisure preference among second generation migrants in Europe and the US, as well as across individuals across the Globe, the research establishes that consistent with the predictions of the theory, individuals and ethnic groups that are originated in regions which are potential more suitable for hunting are characterized by greater predisposition towards leisure, while descendants of regions potential more suited for agricultural production have greater propensity towards labour.

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A Additional Robustness Checks

A.1 Natural Experiment: Columbian Exchange

A.2 Alternative Estimation Method: Ordered Probit

This subsection establishes that the results obtained in sections 4 and 5 are robust to the use of an alternative estimation method, rather than OLS. In particular, using Ordered Probit for the same data collected exploiting ESS, GSS and WVS, one can estimates the probability of observing the ranked preference for labour and leisure, conditional on intertemporal hunting productivity (potential large mammal fauna abundance) as well as on productivity of agriculture (potential crop yield).

In line with the predictions of the theory, as well as with the OLS estimates, as established in Tables 11, 12 and 13 larger potential productivity of agriculture increases significantly the probability that: (i) second generation migrants in Europe, (ii) second generation migrants in the US and (iii) individuals across the Globe will be more industrious (i.e., less loss-loving), whereas greater potential productivity of hunting decreases the probability that individuals in these distinct samples will have high labour preference (i.e., low leisure preference).

A.3 Selection by Unobservables

This subsection examines the likelihood that omitted variables could alter the qualitative findings. Tables 14 and 15 establishes that it is very improbable that omitted variables could have affected the qualitative results presented in Tables 3, 4 (ESS), Tables 5, 6 (GSS) and Tables 7, 8 (WVS). In particular, as established in Column (2), (4) and (6), (using Columns (1), (3) and (5) as the baseline

Table 9: Determinants of Preference for Leisure: Random Assignment of Agricultural Productivity (ESS)

	Importance of Having a Good Time					
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Large Mammals (Potential)	0.06***	0.05***	0.05***			
	(0.02)	(0.02)	(0.02)			
Crop Yield		-0.07***				
		(0.02)				
Crop Yield (pre-1500)			-0.08***			
			(0.03)			
Crop Yield Change (post-1500)			-0.04**			
			(0.02)			
Share of Large Mammals (Anc., Potential)				0.04**	0.04**	0.03**
				(0.02)	(0.02)	(0.02)
Crop Yield (Anc.)					-0.07***	
					(0.02)	
Crop Yield (Anc., pre-1500)						-0.07***
						(0.02)
Crop Yield Change (Anc., post-1500)						-0.04**
						(0.02)
Country FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes	Yes
Round FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.14	0.14	0.14	0.14	0.14	0.14
Observations	16631	16631	16631	16580	16580	16580

Notes: Using OLS regressions, this table establishes that preference for leisure among second generation migrants in Europe is positively affected by the share of large mammals and negatively affected by the agricultural productivity today, prior to 1500 and its change due to Colombian exchange in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

specifications), the estimated value of the coefficient on potential productivity of hunting and ancestral relative dependence on hunting, if unobservables where as correlated as the observables (i.e., Oster's β^* statistic), are very close to the estimated OLS coefficients. Furthermore, since zero does not belong to the interval created by the estimated value on and Oster's β^*, one can reject the hypothesis that

Table 10: Determinants of Preference for Labour: Random Assignment of Agricultural Productivity (GSS)

	Importance of Working Hard					
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Large Mammals (Potential)	-0.21**	-0.16*	-0.16**			
	(0.08)	(0.08)	(0.08)			
Crop Yield		0.31***				
		(0.08)				
Crop Yield (pre-1500)			0.28***			
			(0.07)			
Crop Yield Change (post-1500)			0.11**			
			(0.05)			
Share of Large Mammals (Anc., Potential)				-0.17**	-0.16***	-0.17***
				(0.06)	(0.06)	(0.06)
Crop Yield (Anc.)					0.33***	
					(0.09)	
Crop Yield (Anc., pre-1500)						0.28***
						(0.08)
Crop Yield Change (Anc., post-1500)						0.07**
						(0.03)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
YST	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.04	0.05	0.05	0.04	0.05	0.05
Observations	1474	1474	1474	1474	1474	1474

Notes: Using OLS regressions, this table establishes that preference for working hard among second generation migrants in the US is negatively affected by the share of large mammals and positively affected by the agricultural productivity today, prior to 1500 and its change due to Colombian exchange in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude, mean temperature and precipitation and temperature volatility . Individual controls include age, gender, number of siblings, religion, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

the value of the coefficient is driven exclusively by unobservables. In addition, the indexes AET (Altonji et al., 2005; Bellows and Miguel, 2009) and δ (Oster, 2014) measure how strongly correlated unobservables would have to be in order to account for the full size of the coefficient, are mostly

Table 11: Determinants of Preference for Leisure: Second Generation Migrants in Europe (Ordered Probit)

	Importance of Having a Good Time							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of Large Mammals (Potential)	0.10***	0.05***	0.05***	0.06***	0.06***	0.04***	0.04***	0.04***
	(0.03)	(0.01)	(0.01)	(0.02)	(0.02)	(0.01)	(0.01)	(0.01)
Crop Yield			-0.02*	-0.04*	-0.04*	-0.05***	-0.05***	
			(0.01)	(0.02)	(0.02)	(0.02)	(0.02)	
Crop Yield (pre-1500)								-0.07***
								(0.02)
Crop Yield Change (post-1500)								-0.03**
								(0.01)
Region FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	No	Yes	Yes
Pseudo-R^2	0.00	0.03	0.03	0.03	0.03	0.05	0.05	0.05
Observations	16631	16631	16631	16631	16631	16631	16631	16631

Notes: Using Ordered Probit regressions, this table establishes that preference for leisure among second generation migrants in Europe is positively affected by the share of large mammals and negatively affected by the agricultural productivity today, prior to 1500 and its change due to Colombian exchange in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

different from the critical value of 1.

A.4 Orthogonality to other Cultural Dimensions

This subsection establishes that the effects of the potential productivity of agriculture and hunting as well as ancestral relative dependence on hunting on labour-leisure preference does not capture their effects on a wide range of other cultural characteristics.

In particular, as established in Tables 16 and 17, potential large mammal fauna abundance, potential crop yield and resulting relative dependence on hunting in the parental country of origin do not affect long term orientation, obedience, altruism, creativity, and attitudes towards equality, gender roles and government among second-generation migrants in Europe and the US.

Table 12: Determinants of Preference for Labour: Second Generation Migrants in the US (Ordered Probit)

	Importance of Working Hard							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Share of Large Mammals (Anc., Potential)	-0.10***	-0.10***	-0.08***	-0.08***	-0.15***	-0.19***	-0.26***	-0.20***
	(0.02)	(0.02)	(0.02)	(0.03)	(0.05)	(0.05)	(0.07)	(0.06)
Crop Yield (Anc.)			0.13***	0.16***	0.17**	0.20***	0.27***	
			(0.04)	(0.05)	(0.07)	(0.06)	(0.07)	
Crop Yield (Anc., pre-1500)								0.30***
								(0.08)
Crop Yield Change (Anc., post-1500)								0.08**
								(0.03)
Region FE	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	No	Yes	Yes
Pseudo-R^2	0.01	0.01	0.01	0.01	0.02	0.04	0.04	0.04
Observations	1474	1474	1474	1474	1474	1474	1474	1474

Notes: Using Ordered Probit regressions, this table establishes that preference for hard work among second generation migrants in the US is negatively affected by the share of large mammals and positively affected by the agricultural productivity today, prior to 1500 and its change due to Colombian exchange in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability, percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

A.5 Robustness to Preindustrial Development

This subsection establishes that the effect of the potential productivity of hunting and agriculture as well as ancestral relative dependence on hunting preference for labour and leisure is orthogonal to the potentially confounding effect of historical levels of population density and urbanization. In particular, Table 18 demonstrates that, accounting for population density in 1500 and urbanization in 1800 the potential share of large mammals and potential crop yield on labour-leisure preference in the ESS (columns (1)-(2)), GSS (columns (3)-(4)), and WVS (columns(5)-(6)) remain stable and mostly highly significant. In addition, Table 19 establishes that the effect of ancestral dependence on hunting relative to agriculture and gathering on labour-leisure preference remains stable and significant when accounting for population density in 1500 and urbanization in 1800 across these samples.

Table 13: Determinants of Preference for Labour: Individuals in WVS (Ordered Probit)

	Importance of Working Hard						
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Share of Large Mammals (Anc., Potential)	-0.06***	-0.07***	-0.06***	-0.08***	-0.08***	-0.08***	-0.06***
	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Crop Yield (Anc.)		0.10***	0.17***	0.13***	0.13***	0.13***	
		(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	
Crop Yield (Anc., pre-1500)							0.13***
							(0.01)
Crop Yield Change (Anc., post-1500)							0.03**
							(0.01)
Region FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	No	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	Yes	Yes	Yes	Yes
Individual Controls	No	No	No	No	Yes	Yes	Yes
YST	No	No	No	No	No	Yes	Yes
Pseudo-R^2	0.03	0.03	0.04	0.05	0.07	0.07	0.07
Observations	224509	224509	224509	224509	224509	224509	224509

Notes: Using Ordered Probit regressions, this table establishes that preference for working hard among individuals in WVS is negatively affected by the share of large mammals and positively affected by the agricultural productivity today, prior to 1500 and its change after the Columbian exchange in the country of residence. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude, mean temperature and precipitation and temperature volatility . Individual controls include age, gender, religion, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

B Variable Definitions

B.1 Outcome Variables

B.1.1 Measure of Labour and Leisure Preference

- **Importance of "Having a Good Time" (Second-generation analysis: ESS)**: Based on the answer to the question " Please listen to each description and tell me how much each person is or is not like you. Use this card for your answer. Having a good time is important to her/him. She/he likes to 'spoil' herself/himself." Coded as 6 if the answer is 'Very much like me' and 1 – 'Not like me at all', taking additional 4 categorical values in between.

- **Importance of Hard Work (Second-generation analysis: GSS)**: Based on the answer to

Table 14: Determinants of Labour-Leisure Preference: Robustness to Selection on Unobservables

	Labour-Leisure Preference					
	(1) ESS	(2) ESS	(3) GSS	(4) GSS	(5) WVS	(6) WVS
Share of Large Mammals (Potential)	0.06***	0.05***	-0.08***	-0.23***	-0.03***	-0.04***
	(0.02)	(0.02)	(0.02)	(0.07)	(0.00)	(0.00)
Country/Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	No	Yes	No	Yes	No	Yes
Round/Wave FE	No	Yes	No	Yes	No	Yes
Individual Controls	No	Yes	No	Yes	No	Yes
YST	No	Yes	No	Yes	No	Yes
AET		3.41		-1.44		-3.15
δ		3.50		-1.07		-5.21
β^*		0.03		-0.29		-0.05
R^2	0.10	0.15	0.03	0.10	0.05	0.11
Adjusted-R^2	0.10	0.14	0.02	0.05	0.05	0.11
Observations	16628	16628	1474	1474	224509	224509

Notes: This table shows the robustness of the results to selection by unobservables. It presents the Altonji et al. (2005) AET ratio as extended by Bellows and Miguel (2009). Additionally, it presents the δ and $\beta^*(1, R^2_{max})$ statistics suggested by Oster (2014), where R^2_{max} is 1.33 of R^2 in the full specification. All statistics suggest that the results are not driven by unobservables. Heteroskedasticity robust standard errors in round parenthesis. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

the question "If you had to choose, which thing on this list would you pick as the most important for a child to learn to prepare him or her for life?" Coded 5 if the answer "to work hard" is ranked as the most important and coded 1 – least important. Takes 3 additional intermediate categorical values.

- **Importance of Work (Second-generation analysis: WVS)**: Based on the answer to the question "Indicate how important Work it is in your life." Coded as 4 if the answer is 'Very important' and 1 – 'Not at all important', taking additional 2 categorical values in between.

B.1.2 Measures of Cultural Values

- **LTO (Second-generation analysis: GSS)**: Based on the answer to the question "Do you smoke?" taken from the core module of the General Social Survey.

- **Obedience (Second-generation analysis: GSS)**: Based on the answer to the question "If you had to choose, which thing on this list would you pick as the most important for a child to

Table 15: Determinants of Labour-Leisure Preference: Robustness to Selection on Unobservables

	Labour-Leisure Preference					
	(1) ESS	(2) ESS	(3) GSS	(4) GSS	(5) WVS	(6) WVS
Dependence on Hunting (Anc.)	0.06**	0.04**	-0.09**	-0.20***	-0.02***	-0.01***
	(0.02)	(0.02)	(0.04)	(0.05)	(0.00)	(0.00)
Country/Region FE	No	Yes	No	Yes	No	Yes
Geographical Controls	No	Yes	No	Yes	No	Yes
Round/Wave FE	No	Yes	No	Yes	No	Yes
Individual Controls	No	Yes	No	Yes	No	Yes
YST	No	Yes	No	Yes	No	Yes
AET		1.81		-1.78		8.89
δ		4.73		-1.37		16.83
β^*		0.03		-0.25		-0.01
R^2	0.02	0.15	0.03	0.10	0.04	0.11
Adjusted-R^2	0.02	0.14	0.02	0.05	0.04	0.11
Observations	16578	16578	1474	1474	224509	224509

Notes: This table shows the robustness of the results to selection by unobservables. It presents the Altonji et al. (2005) AET ratio as extended by Bellows and Miguel (2009). Additionally, it presents the δ and $\beta^*(1, R^2_{max})$ statistics suggested by Oster (2014), where R^2_{max} is 1.33 of R^2 in the full specification. All statistics suggest that the results are not driven by unobservables. Heteroskedasticity robust standard errors in round parenthesis. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

learn to prepare him or her for life?" taken from the core module of the General Social Survey. Coded 5 if "To Obey" is the most preferred characteristic, 4 if it is the second most preferred, 3 – third most important, 2 – fourth most important, 1 – least important.

- **Altruism (Second-generation analysis: GSS)**: Based on the answer to the question "If you had to choose, which thing on this list would you pick as the most important for a child to learn to prepare him or her for life?" taken from the core module of the General Social Survey. Coded 5 if "To help others when they need help" is the most preferred characteristic, 4 if it is the second most preferred, 3 – third most important, 2 – fourth most important, 1 – least important.

- **Equality (Second-generation analysis: GSS)**: Based on the answer to the question "It is the responsibility of the government to reduce the differences in income between people with high incomes and those with low incomes. Do you agree or disagree?" taken from the "ISSP Social Inequality" module of the General Social Survey.

- **Gender (Second-generation analysis: GSS)**: Based on the answer to the question "Do you

Table 16: Orthogonality of other Cultural Dimensions to Share of Large Mammals: Second Generation Migrants in Europe

	Alternative Cultural Dimensions				
	Obidience	Individualism	Gender	Strong Gov.	Creativity
	(1)	(2)	(3)	(4)	(5)
Share of Large Mammals (Potential)	0.01	0.02	0.02	0.00	0.00
	(0.02)	(0.01)	(0.04)	(0.01)	(0.01)
Crop Yield (pre-1500)	-0.00	-0.02	-0.04	-0.01	0.01
	(0.03)	(0.02)	(0.04)	(0.02)	(0.02)
Adjusted-R^2	0.10	0.06	0.15	0.10	0.07
Observations	16596	16664	4472	16872	16670
Dependence on Hunting (Anc.)	-0.00	0.02	0.00	-0.02*	0.01
	(0.02)	(0.02)	(0.03)	(0.01)	(0.01)
Adjusted-R^2	0.10	0.06	0.15	0.10	0.07
Observations	16601	16669	4472	16877	16675
Country FE	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes
Round FE	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes
YST	Yes	Yes	Yes	Yes	Yes

Notes: Using OLS regression, this table establishes that other cultural values of second generation migrants in Europe (i.e., obedience, individualism, attitude towards gender roles, preference for strong government and creativity) are neither affected by the share of large mammals and negatively affected by the agricultural productivity in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

approve or disapprove of a married woman earning money in business or industry if she has a husband capable of supporting her?" taken from the core module of the General Social Survey.

- **Government (Second-generation analysis: GSS)**: Based on the answer to the question "As far as the people running these institutions are concerned, would you say you have a great deal of confidence, only some confidence, or hardly any confidence at all in them? Executive branch of the federal government" taken from the core module of the General Social Survey.

- **Obedience (Second-generation analysis: ESS)**: Based on the answers to the question "Now

Table 17: Orthogonality of other Cultural Dimensions to Share of Large Mammals: Second Generation Migrants in the US

	Importance of Working Hard					
	Obidience	Individualism	Gender	Strong Gov.	Altruism	LTO
	(1)	(2)	(3)	(4)	(5)	(6)
Share of Large Mammals (Anc., Potential)	-0.06	-0.07	-0.03	-0.01	0.11	-0.06
	(0.11)	(0.08)	(0.02)	(0.14)	(0.07)	(0.16)
Crop Yield (Anc., pre-1500)	0.08	0.04	0.02	-0.18	0.14*	0.03
	(0.08)	(0.10)	(0.03)	(0.16)	(0.08)	(0.12)
Adjusted-R^2	0.13	0.11	0.11	0.07	0.03	0.10
Observations	1474	1474	1526	2059	1783	789
Dependence on Hunting (Anc.)	0.10	-0.03	-0.02	0.04	0.06	-0.08
	(0.17)	(0.08)	(0.07)	(0.02)	(0.06)	(0.08)
Adjusted-R^2	0.07	0.10	0.11	0.11	0.03	0.13
Observations	2059	789	1474	1526	1783	1474
Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
YST	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Using OLS regression, this table establishes that other cultural values of second generation migrants in the US (i.e., obedience, individualism, attitude towards gender roles, preference for strong government, altruism and long term orientation) are not affected by the potential share of large mammals, agricultural productivity and ancestral dependence on hunting rather than agriculture and gathering in the parental country of origin. Geographical controls include logarithm of mean elevation, mean terrain ruggedness, logarithm of distance to nearest coast or navigable river, island and landlocked dummy, gini index of land suitability ,percentage of land in the tropical and temperate zones, absolute latitude and plant diversity. Individual controls include age, gender, number of people in the household, religiosity, education level, and income. All independent variables have been normalized by subtracting their mean and dividing by their standard deviation. Thus, all coefficients can be compared and show the effect of a one standard deviation in the independent variable. Heteroskedasticity robust standard error estimates clustered at the parental country of origin level are reported in parentheses; *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

I will briefly describe some people. Please listen to each description and tell me how much each person is or is not like you. Use this card for your answer. She/he believes that people should do what they're told. She/he thinks people should follow rules at all times, even when no-one is watching" taken from the "Human Values" module of the European Social Survey.

- **Altruism (Second-generation analysis: ESS)**: Based on the answers to the question "Now I will briefly describe some people. Please listen to each description and tell me how much each person is or is not like you. Use this card for your answer. It's very important to her/him to help the people around her/him. She/he wants to care for their well-being" taken from the "Human

Table 18: Determinants of Labour-Leisure Preference: Robustness to Preindustrial Development

	Labour-Leisure Preference					
	(1) ESS	(2) ESS	(3) GSS	(4) GSS	(5) WVS	(6) WVS
Share of Large Mammals (Anc., Potential)	0.05***	0.06***	-0.22***	-0.23***	-0.05***	-0.04***
	(0.02)	(0.01)	(0.07)	(0.07)	(0.00)	(0.00)
Crop Yield (Anc.)	-0.06***	-0.05***	0.22**	0.27**	0.09***	0.06***
	(0.02)	(0.02)	(0.09)	(0.10)	(0.01)	(0.01)
Population density in 1500 CE	-0.01		0.02		-0.07***	
	(0.01)		(0.06)		(0.00)	
Urbanization rate in 1800 CE		-0.15***		-0.09		-0.08***
		(0.05)		(0.12)		(0.02)
Country/Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes	Yes
Round/Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
YST	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.14	0.14	0.05	0.05	0.12	0.12
Observations	16628	16487	1474	1474	224509	216458

Notes: This table shows the robustness of the results to the level of historical development as captured by the population density in year 1500 CE and urbanization rate in 1800 CE. Heteroskedasticity robust standard errors in round parenthesis. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

Values" module of the European Social Survey.

- **Equality (Second-generation analysis: ESS)**: Based on the answers to the question "Now I will briefly describe some people. Please listen to each description and tell me how much each person is or is not like you. Use this card for your answer. She/he thinks it is important that every person in the world should be treated equally. She/he believes everyone should have equal opportunities in life" taken from the "Human Values" module of the European Social Survey.

- **Gender (Second-generation analysis: ESS)**: Based on the answers to the question " Using this card, please say how much you agree or disagree with each of the following statements. A woman should be prepared to cut down on her paid work for the sake of her family" taken from the "Welfare Attitudes" module in the fourth round of the European Social Survey.

- **Strong Government (Second-generation analysis: ESS)**: Based on the answers to the

Table 19: Determinants of Labour-Leisure Preference: Robustness to Preindustrial Development

	Labour-Leisure Preference					
	(1) ESS	(2) ESS	(3) GSS	(4) GSS	(5) WVS	(6) WVS
Dependence on Hunting (Anc.)	0.04**	0.04**	-0.20***	-0.21***	-0.02***	-0.02***
	(0.02)	(0.02)	(0.07)	(0.06)	(0.00)	(0.00)
Population density in 1500 CE	-0.00		0.00		-0.05***	
	(0.02)		(0.05)		(0.00)	
Urbanization rate in 1800 CE		-0.12**		-0.05		-0.12***
		(0.05)		(0.13)		(0.02)
Country/Region FE	Yes	Yes	Yes	Yes	Yes	Yes
Geographical Controls	Yes	Yes	Yes	Yes	Yes	Yes
Round/Wave FE	Yes	Yes	Yes	Yes	Yes	Yes
Individual Controls	Yes	Yes	Yes	Yes	Yes	Yes
YST	Yes	Yes	Yes	Yes	Yes	Yes
Adjusted-R^2	0.14	0.14	0.05	0.05	0.11	0.12
Observations	16578	16492	1474	1474	224509	216458

Notes: This table shows the robustness of the results to the level of historical development as captured by the population density in year 1500 CE and urbanization rate in 1800 CE. Heteroskedasticity robust standard errors in round parenthesis. *** denotes statistical significance at the 1% level, ** at the 5% level, and * at the 10% level, all for two-sided hypothesis tests.

question "Now I will briefly describe some people. Please listen to each description and tell me how much each person is or is not like you. Use this card for your answer. It is important to her/him that the government ensures her/his safety against all threats. She/he wants the state to be strong so it can defend its citizens" taken from the "Human Values" module of the European Social Survey.