NBER WORKING PAPER SERIES

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Working Paper 31663
http://www.nber.org/papers/w31663

NATIONAL BUREAU OF ECONOMIC RESEARCH
1050 Massachusetts Avenue
Cambridge, MA 02138
September 2023

We thank Toke Aidt, Ingela Alger, Maiguel Ballester, Roland Benabou, Chris Bidner, Meredith Crowley, Gregory Dow, Martin Fiszbein, Paola Giuliano, Karla Hoff, Sriya Iyer, Rachel Kranton, Max Kwiek, Jonathan Newton, Jean-Philippe Platteau, Hillel Rapoport, Imran Rasul, Arthur Robson, Michael Sacks, Claudia Senik, Moses Shayo, Ludvig Sinander, Josh Tasoff, Thierry Verdier, Cole Williams, Peyton Young, Liyu Zheng, and conference/seminar participants at the 2023 NBER Political Economy Spring Meeting, 2023 ERINN Conference, British Academy Conference on Toward 'Cohesive' Societies, 10th Oxford workshop on Global Priorities, 2022 ASREC Annual Conference, 2022 CNEH Conference, LSE Hayek workshop, PolEconUK, Simon Fraser University, University of Cambridge, University of York, and Aix-Marseille School of Economics for useful discussions and comments on the paper. We thank Michele Bernadine, Grace Finley, and Fernando Secco for outstanding research assistance. Funding for the data collection in Kananga, DRC, was provided by the Behavioral Research Initiative on Technology Adoption (BRITE Africa) Grant. The views expressed herein are those of the authors and do not necessarily reflect the views of the National Bureau of Economic Research.

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NBER Working Paper No. 31663
September 2023
JEL No. N10,O10,Q55

ABSTRACT

We study the evolution of belief systems that suppress productive effort. These include concerns about the envy of others, beliefs in the importance of luck for success, disdain for competitive effort, and traditional beliefs in witchcraft. We show that such demotivating beliefs can evolve when interactions are zero-sum in nature, i.e., gains for one individual tend to come at the expense of others. Within a population, our model predicts a divergence between material and subjective payoffs, with material welfare being hump-shaped and subjective well-being being decreasing in demotivating beliefs. Across societies, our model predicts a positive relationship between zero-sum thinking and demotivating beliefs and a negative relationship between zero-sum thinking (or demotivating beliefs) and both material welfare and subjective well-being. We test the model's predictions using data from two samples in the Democratic Republic of Congo and from the World Values Survey. In the DRC, we find a positive relationship between zero-sum thinking and the presence of demotivating beliefs, such as concerns about envy and beliefs in witchcraft. Globally, zero-sum thinking is associated with skepticism about the importance of hard work for success, lower income, less educational attainment, less financial security, and lower life satisfaction. Comparing individuals in the same zero-sum environment, we observe the divergence between material outcomes and subjective well-being predicted by our model.

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A data appendix is available at http://www.nber.org/data-appendix/w31663

1. Introduction

Beliefs and values that discourage effort and productive activity are surprisingly common around the world today and throughout history. They often take the form of warnings against, and even punishment for, personal ambition and success. A well-known example is belief in witchcraft and the evil eye, i.e., the ability of certain people to intentionally cause harm via supernatural means, which acts as a psychic tax on success (Gershman, 2014, 2015, 2022b, Henrich, 2009). However, demotivating beliefs come in many forms and can even be found, although perhaps more subtly, in industrialized countries. For example, in the Nordic countries, the laws of Jante state, "Du skal ikke tro at du er noget" ("do not think that you are anything"), discourage personal pride or aggrandizement. Similarly, in Australia and New Zealand, "tall poppy" beliefs encourage people to cut down those who stand out in terms of personal achievement. In Japan, a common phrase warns that "the nail that sticks out will be hammered down." Sometimes these beliefs and norms are embedded in class-based status systems that stigmatize aspiration and effort as "social climbing" (McCloskey, 2010). Accordingly, British Prime Minister Herbert Asquith praised the students of his Oxford College for exhibiting "effortless superiority." Other forms of demotivating belief systems include pessimistic beliefs in an "unjust world" (Bénabou and Tirole, 2006), fatalism (Whelan, 1996), and anti-materialistic beliefs that reduce the enjoyment of consumption (Flouri, 1999). If such beliefs reduce effort and investment, why are they prevalent historically and across the world today?

We study this question theoretically and empirically by building on insights from anthropology about the 'image of limited good,' first highlighted by George Foster (1962, 1965, 1967, 1972). According to Foster, the limited and fixed nature of resources in some settings means that anything "good" in society is scarce and competed over. "If 'Good' exists in limited amounts which cannot be expanded," Foster writes (1965, p. 296), "and if the system is closed, it follows that *an individual or a family can improve their position only at the expense of others*" (emphasis in original). In other words, the dominant presumption in many small-scale societies is that if one person does better, somebody else must do worse. If someone gets ahead, someone else must fall behind. Based on his extensive ethnographic research, Foster argued that this zero-sum worldview was at the root of many decision-making and cultural traits that curbed daily social, economic, and political ambition. Such traits included beliefs in the importance of moderation,

feelings of envy and concerns about the envy of others, witchcraft beliefs, an emphasis on the importance of sharing, and a de-emphasis on the value of hard work and thrift. Foster believed that this worldview, and the accompanying cultural beliefs, inhibited entrepreneurial activity, wealth accumulation, innovation, and, ultimately, economic development.

The first contribution of our study is to provide a theoretical representation of Foster's hypothesis. Modeling the cultural evolution of belief systems, we study the emergence and spread of demotivating beliefs in zero-sum environments, where benefits to one person are obtained at the expense of others. Evolutionary models are underutilized in economics, especially in connection with empirical work. Given the extensive evidence that cultural values change and adapt, but not instantaneously, to the external environment (e.g., Tabellini, 2008, Bisin and Verdier, 2017), it is crucial to have theory (and predictions) in a setting where values and beliefs are in motion and not assumed to be fixed or in some stable equilibrium. Thus, we rely on a cultural evolutionary approach where individuals make important life decisions relying on intergenerationally transmitted knowledge (Boyd and Richerson, 1988, 2005). The belief systems we have in mind evolve over generations, and the dynamics of demotivating beliefs and their interaction with effort and innovation matter for long-term development. Indeed, we find that when there is a zero-sum component to economic interactions, demotivating beliefs emerge and spread, reducing incentives for productive effort and inhibiting economic development.

In the model, members of a population are matched and engage in production. While an individual's effort increases their output, a fraction α of their output comes at the cost of their partner; thus, α represents the zero-sumness of the environment. Our production function captures a range of economic interactions with different degrees of rivalry, ranging from merchants competing over the same fixed set of customers (a completely zero-sum situation) to business partners working together in an enterprise but ultimately dividing the profits from their joint endeavor (a partially zero-sum situation).[1]

The model allows individuals to hold demotivating beliefs θ, which amount to an incorrect perception about the return to effort. Individuals can also have a neutral belief system ($\theta = 0$) corresponding to the true return to effort. While individuals choose effort based on subjective beliefs, cultural evolution is driven by the (true) material payoffs. Despite the distortions in

[1]We also introduce an extension of our model that also allows for pro-social effort in interactions with positive spillovers, e.g., public good provision, and show that our predictions are robust to this extension.

effort generated by demotivating beliefs, we show that such beliefs can survive and spread when economic interactions are partly zero-sum and there is positive sorting (e.g., when people with the same cultural beliefs are geographically or socially clustered). In such environments, the direct cost of holding a demotivating belief is overwhelmed by the benefit of being matched with players who hold demotivating beliefs and do not compete aggressively with others.

When interactions are zero-sum, effort is socially inefficient since it primarily redistributes resources, and demotivating beliefs improve short-run efficiency by limiting excessive competition. As a result, within a society with a given degree of zero-sumness, there is an intensity of demotivating belief $\theta^* > 0$ that maximizes an individual's income. Thus, the model predicts a hump-shaped (strictly concave) relationship between demotivating beliefs and economic welfare. However, this same relationship is not found for subjective well-being. Because demotivating beliefs make an individual's situation seem worse than it is, it reduces their perceived well-being. Thus, for a given degree of zero-sumness, subjective well-being is maximized at the true (non-demotivating) belief $\theta = 0$, strictly convex, and generally decreasing in demotivating beliefs. Thus, our model generates testable predictions about a divergence between material welfare and subjective well-being and places structure on this difference.

Having examined predictions focusing on cross-individual variation in an environment with a fixed degree of zero-sumness, we then turn to the model's predictions across societies and environments with different degrees of zero-sumness. Looking across groups, the model predicts a positive relationship between the zero-sumness of the environment and demotivating beliefs. Additionally – and in contrast to predictions within a fixed zero-sum environment – across environments characterized by different degrees of zero-sumness, the model predicts that both the zero-sumness of the environment and demotivating beliefs are negatively related to material welfare and subjective well-being. These negative relationships are due to the direct negative effect of zero-sum interactions on both objective and subjective payoffs.

Having formalized and further developed Foster's arguments, we turn to the data and test the model's predictions. We begin by analyzing data collected from Kananga, an urban hub and provincial capital in the Democratic Republic of the Congo (DRC). The city is home to approximately 1.8 million people from various socio-economic and ethnic groups, originally from villages and towns across the provinces of Kasai, Kasai Central, and Kasai Oriental. We use this setting to test the model's prediction of a positive relationship between the zero-sumness of a

person's environment and their demotivating beliefs. We collect and analyze data from two samples: a 200-person sample from surveys collected in 2015 and a 1,000-person sample collected in 2019. We use the 2015 sample to develop our zero-sum measure and explore its relationship with demotivating beliefs. The larger 2019 sample is used to replicate and validate the findings.

We measure the zero-sumness of a respondent's environment – α in the model – using multiple survey questions asking whether each of the following types of gains comes at the expense of others: earnings, profits, wealth, gains in trade, power, and happiness. Using principal components analysis we can distill one factor that captures the extent to which a person views their world as being zero-sum, which is the baseline zero-sum measure used in the analysis.

We estimate the relationship between zero-sum thinking and the emergence of the demotivating beliefs that were the focus of Foster's ethnography: envy and traditional religious beliefs, commonly called 'witchcraft.' We also consider beliefs in Christianity, which is the alternative to traditional religion in the area. In contrast to traditional beliefs, Christianity, particularly the popular born-again denominations, emphasize that devotion and hard work lead to prosperity and blessing from God. In both samples, we find that respondents with a more zero-sum view of the world are more envious of the success of others, more likely to hold traditional religious beliefs, and less likely to hold Christian beliefs. The estimates are consistent with the model's prediction of a positive relationship between zero-sumness α and demotivating beliefs θ.

We then examine the same relationships globally using data from the World Values Survey (WVS), which asks about respondents' perception of whether wealth is zero-sum in four waves. Although the survey does not ask about envy or witchcraft, it does collect information on a broader set of demotivating beliefs that are particularly relevant to more developed populations, which comprise most of the WVS sample. The beliefs include: the importance the respondent places on hard work or economic success, skepticism about the importance of effort in determining success, and the acceptability of receiving help from others. In line with the model's predictions, we find a robust positive association between zero-sum thinking and demotivating beliefs. Thus, although the nature of demotivating beliefs is different in the Congolese and WVS samples, we observe the same relationship with zero-sum thinking.

The global WVS sample also allows us to test the predictions of our model regarding material welfare and subjective well-being. Consistent with the model's predictions, we find that more zero-sum thinking is associated with lower material welfare, as measured by income, educational

attainment, savings, and occupational status. It is also associated with lower subjective well-being, as measured by questions about a person's life satisfaction and happiness.

We also use the global WVS sample to test the model's prediction that there is an optimal level of demotivating belief within a fixed zero-sum environment, i.e., the predicted hump-shaped relationship between demotivating beliefs and economic welfare. Our empirical analysis confirms this prediction: among individuals with the same degree of zero-sum thinking, those with an intermediate level of demotivating beliefs have the highest incomes. By contrast, the model predicts that within a fixed zero-sum environment, subjective well-being is maximized by the true (non-demotivating) belief $\theta = 0$, is strictly convex and (generally) decreasing in θ. We also find support for this prediction in the WVS data. For individuals with the same zero-sum thinking level, those with stronger demotivating beliefs report lower life satisfaction and lower happiness.

Lastly, motivated by Foster's arguments, we connect demotivating beliefs to long-run innovation by adding technological innovation through learning-by-doing to our model. We find that demotivating beliefs can have harmful long-term consequences on innovation. When technological innovation arises from productive effort, demotivating beliefs by discouraging such effort can trap a society in a low-technology state. Thus, demotivating belief systems can act as a *kludge*: an adaptation that compensates for but does not eliminate and even deepens inefficiencies (Ely, 2011). However, we also show that a temporary decline in the zero-sumness of the environment can lead to a permanent transition from a low to high-growth regime through a cultural shift to a less demotivating belief system. This dynamic provides potential insights into the cultural changes that economic historians have argued helped fuel the industrial revolution.

In short, by providing a formal theory that builds on Foster's insights and testing its predictions, we establish a strong link between zero-sum thinking, demotivating beliefs, and economic activity in small-scale non-industrial societies as well as industrialized societies.

Our theoretical and empirical analysis follows from the pioneering work on cultural evolution by Boyd and Richerson (1988, 2005) and Boyd, Gintis, Bowles and Richerson (2003), as well as the theoretical literature in economics on the cultural transmission of preferences (Bisin and Verdier, 2000, 2017). In modeling the evolution of demotivating beliefs, we draw on the literature on the evolution of preferences or indirect evolution (Frank, 1987, Güth and Yaari, 1992), especially the recent approach developed by Alger and Weibull (2013, 2016), in which preferences are private, and there is positive assortativity in matching (see Alger and Weibull, 2019, for a review). Our

model of the evolution of demotivating beliefs is conceptually and mathematically distinct from the evolution of other-regarding preferences, which has been the focus of much of this literature. Our paper is also connected to the literature on the evolution of cooperation, especially under cultural group selection (e.g., Cooper and Wallace, 2004, Henrich, 2004).[2] We apply techniques from this literature to model the evolution of demotivating beliefs and provide a rare empirical application and test of an evolutionary game-theoretic model in economics.

Our empirical findings contribute to an important and growing empirical literature on intergenerationally-transmitted cultural traits (e.g., Giuliano, 2007, Fernandez, 2007, Fernández and Fogli, 2009, Voigtländer and Voth, 2012). In particular, our analysis contributes to the literature that seeks to shed light on how the external environment affects the evolution of cultural traits (Nunn and Wantchekon, 2011, Guiso, Sapienza and Zingales, 2016, Grosjean and Khattar, 2018, Schulz, Bahrami-Rad, Beauchamp and Henrich, 2019, Buggle and Durante, 2021, Giuliano and Nunn, 2021), as well as our understanding of the consequences of these evolved traits for economic development (Spolaore and Wacziarg, 2009, Becker and Woessmann, 2009, Guiso, Sapienza and Zingales, 2009, Algan and Cahuc, 2010, Enke, 2019). We add to this literature an understanding of demotivating beliefs, their connection to economic environments that are zero-sum in nature, and their consequences for economic development.

Our analysis also contributes to the body of work on second-best social institutions (e.g., Carvalho, 2013, Nunn and de la Sierra, 2017, Akerlof, Matouschek and Rayo, 2020), and especially on the social consequences of the economic success of others. Most closely related is Gershman's (2015, 2016, 2020) seminal work on witchcraft beliefs within economics. On the theoretical front, Gershman (2015) develops a model in which evil-eye and witchcraft beliefs emerge to reduce an individual's output and thereby discourage envious destruction. On the empirical front, consistent with our findings, he documents a positive relationship between the 'image of limited good' and witchcraft beliefs (Gershman, 2022a) and a negative relationship between witchcraft beliefs and subjective well-being (Gershman, 2023). Our findings also speak to work on egalitarian social institutions sharing norms (Platteau, 2000). For example, Bowles (2006) shows that sharing norms and other forms of reproductive leveling favor the evolution of cooperation

[2]Other connections to our theory include work on motivated beliefs and subjective well-being (Bénabou and Tirole, 2006) and games with misspecified beliefs (Esponda and Pouzo, 2016, Massari and Newton, 2020). Neither motivated reasoning nor misspecification are assumed in our model; instead, they arise endogenously through cultural evolution, even when the true beliefs can be learned.

by reducing the gains from defection. We show how a seemingly unproductive cultural trait – i.e., demotivating beliefs equivalent to *incorrect* beliefs that output will be confiscated and burned rather than redistributed – can improve short-run efficiency and proliferate when the economic environment is zero-sum.

Finally, our findings complement the analysis of Chinoy, Nunn, Sequeira and Stantcheva (2023), which shows the importance of Foster's insights for contemporary U.S. politics. Their empirical analysis document relationships between zero-sum thinking and political views and show that they explain much of the variation that is not captured by party affiliation. They also show how the distribution zero-sum thinking in the U.S. today has been shaped by the primary historical experiences of the U.S.; namely, slavery, immigration, and economic mobility.

We now turn to the model and its predictions, followed by the empirical analysis. In the following section, we provide an overview of the hypothesis from anthropology about the importance of zero-sum thinking and the "image of limited good." In Section 3, we build on these arguments and insights and develop a formal model which generates predictions that, in Section 4, we then bring to the data, examining a contemporary pre-industrial population in the DRC. In Section 5, we examine the generality of the insights by expanding the empirical analysis to include countries worldwide. Section 6 endogenizes innovation and economic growth, and discusses insights the theory provides for long-term comparative economic development. Section 7 concludes.

2. The "Image of Limited Good"

In the introduction, we provided examples of demotivating beliefs. At first glance, it is paradoxical that beliefs and value systems that depress productive effort could emerge and survive. To explain why demotivating beliefs have been so prevalent in human history, we start with the work of anthropologist George Foster, which arose from fieldwork in rural Mexico in the 1960s (Foster, 1967). Based on his observations, he concluded that people in most small-scale pre-industrial societies have a zero-sum view of the world, which he referred to as an "image of limited good." This view of the world suggests that if one person does better, somebody else must do worse and that if you get ahead, someone else must fall behind.

This "cognitive orientation," to use Foster's term, arises in a world where all essential resources and assets are in limited supply, so the world is essentially zero-sum. The land is limited, so

more land for one individual means less land for another. The same applies to romantic partners (especially in polygynous societies), authority, and social status. In such environments, the only way for an individual to get ahead is at the expense of others. Therefore, driven by the actual zero-sumness of social and economic life, beliefs that embody the "image of limited good" are likely to have arisen in many parts of the world, particularly in pre-industrial societies that have not yet experienced rapid economic growth.

Although Foster proposed the "image of limited good" as a model of rural Mexican society, the theory was believed to be more general, and he gave many examples from other parts of the world (Foster, 1962, 1967, 1972). He also described a relationship between a zero-sum world and demotivating beliefs, noting that zero-sum societies exhibit an apparent lack of what McClelland (1961) called the "need for achievement" Foster (1965).

The paper's first goal is to combine these insights into a formal model that connects a zero-sum world, demotivating beliefs, effort, material welfare, and economic growth. The second is to take the assumptions of the model and its predictions to the data. In doing so, an important consideration is identifying and measuring demotivating beliefs. Foster's writings emphasize envy and supernatural beliefs like witchcraft or the evil eye, primarily because of his interest in smaller-scale pre-industrial societies.

Our empirical analysis therefore begins by examining the types of beliefs that Foster had in mind, which continue to be prevalent, especially in the developing world. We analyze the relationship between zero-sum views, indigenous supernatural beliefs, and envy in the Democratic Republic of the Congo. Indigenous supernatural beliefs are commonly labeled "witchcraft" in Western European cultures. One feature of such belief systems, which can lead them to discourage effort, is that success is often thought to derive from the use of witchcraft at the expense of others. A vivid example is the conception of power (*tsav*) among Nigeria's Tiv people. It is believed that "men attain power by consuming the substance of others" (Bohannan, 1958, p. 4). It is common to blame misfortune on those who are fortunate and are suspected of using witchcraft. In the words of Holland (2001):

> an anthropological concept known as the Image of Limited Good... prevails throughout Africa and lies at the heart of witchcraft accusations. It is the belief that the pie is limited and one person's success is always at the expense of another's. If an individual prospers beyond the expectations of the others in his community, the successful one

may be labeled a witch because he is believed to have augmented personal progress via witchcraft and to have impoverished others in the process.

The other common component of this bundle of demotivating beliefs is envy. Success can generate feelings of envy in any society. But with a zero-sum view of achievement – the fortune of one person creates misfortune for another – such feelings might be more pronounced. Envy can thus fuel the use of witchcraft. In fact, envy can lead to harm, it is thought, either through intentional (witchcraft) or unintentional (evil eye) supernatural means. As Holland (2001) puts it: "Africans believe the witch's damaging hatred comes from her remorseless jealousy of others. And ordinary people are assumed to run a greater risk of being attacked by witchcraft if they become more prosperous than their neighbors."

In contemporary post-industrial societies, the specific content of demotivating beliefs may differ. But, as noted in the introduction with examples from Scandinavia, Australia, New Zealand, and Japan, a range of beliefs explicitly discourage personal ambition and success. We use data from the World Values Survey to examine the relationship between zero-sum views and beliefs that discourage ambition and effort globally.

3. The Model

As described in the introduction, there is a great variety of demotivating belief systems with the common feature being that they reduce incentives for productive effort. We turn to a model that examines the evolution of such beliefs in an environment that is more or less zero-sum in nature.

A. *Basic Set Up*

Players. We consider populations assumed to each be a continuum of mass one. Each population is a group of individuals who have the potential to interact with each other. This could be a neighborhood within a city, a social group, a village, a district within a country, or a country. For the purpose of the theory, the boundaries of the group do not matter. However, it does have empirical implications and we will return to this point before the empirical analysis.

Time. Time is continuous and denoted by $t \in \mathbb{R}_+$.

Belief systems. There is a potentially large (but finite) set of potential belief systems $\Theta = \{\theta_1, \theta_2, \ldots, \theta_n\}$, where the intensity of belief i is $\theta_i \in [0,1]$, $i = 1, 2, \ldots, n$. As we shall see, $\theta_i = 0$ is

the true belief and any $\theta_i > 0$ is a demotivating belief. The share of each type i in the population is denoted by q_i, with the population state denoted by $\mathbf{q} = (q_1, q_2, \ldots, q_n)$ and $\sum_{i=1}^{n} q_i = 1$.

Actions. Individuals are paired and engage in production. The effort exerted by type i is denoted by $x_i \in \mathbb{R}_+$. The cost of production is $\frac{1}{2}x_i$ and the production function is $A\sqrt{x_i}$, where $A > 0$ is the state of technology in the economy (which we endogenize in Section 6).

A positive fraction of tasks $\alpha \in (0, 1]$ are zero-sum in nature, meaning that the benefit to the individual undertaking the task comes at the expense of the player with whom they are paired.[3] The environment in which the players interact is not perfectly observable. In particular, players do not know which of their tasks, if any, are zero-sum and impose a negative externality on the other player. For example, if player i invests in better marketing for her shop and this increases her sales, she does not know whether the increased sales stem from increased demand or displacement of player j's customers.

Payoffs. The true (objective) payoff function to type i when matched with type j is

$$\begin{aligned} U(x_i, x_j) &= A\left[\alpha\left(\sqrt{x_i} - \sqrt{x_j}\right) + (1-\alpha)\sqrt{x_i}\right] - \tfrac{1}{2}x_i \\ &= A\left[\sqrt{x_i} - \alpha\sqrt{x_j}\right] - \tfrac{1}{2}x_i. \end{aligned} \tag{1}$$

If $\alpha = 0$, we have a simple production decision: each individual's payoff is independent of their partner's effort. If $\alpha = 1$, the environment is purely zero-sum: all gains come at the expense of one's partner. This is what Foster (1965) describes as a "limited good" environment.

Players maximize a potentially distorted version of the true payoff function. Specifically, a type i player chooses production effort x_i to maximize the following subjective payoff:

$$\hat{U}_i(x_i, x_j) = A\left[(1-\theta_i)\sqrt{x_i} - \alpha\sqrt{x_j}\right] - \tfrac{1}{2}x_i. \tag{2}$$

That is, an individual with belief system i discounts the return to her effort by a factor $(1 - \theta_i) \in [0, 1]$. This specification captures various kinds of demotivating belief systems. For example, individuals may have a (potentially-inaccurate) perception about the economic return to effort in the economy (Bénabou and Tirole, 2006). $\theta_i > 0$ could also be the product of a supernatural belief, such as belief in the evil eye, according to which envious individuals cause harm to others through supernatural forces (Gershman, 2014, 2015). Hence, envy exacts a kind of supernatural

[3] An alternative interpretation is that there is a probability α that the environment is zero-sum, and whatever type i gains through production, their partner j loses. With probability $1 - \alpha$, i 's effort is truly productive and does not come at the expense of j. Under both interpretations, α measures the degree to which the environment is zero-sum.

tax on effort with believers expecting to lose a fraction θ_i of their output. These belief systems reduce perceived returns to effort and are thus demotivating. The higher is the belief intensity θ_i, the more demotivating is the belief of individual i.

In Appendix B, we show that our model of the evolution of demotivating beliefs generates different results to a model of the evolution of altruism or other-regarding preferences, which is the focus of much of the indirect evolution literature.[4] We also show that our results are robust to the inclusion of different types of effort, i.e., pro-social and anti-social, with demotivation only occurring with respect to the latter.

Maximizing (2) with respect to x_i, we get optimal production effort for each type i:

$$x_i^* \;=\; \arg\max_{x_i \in \mathbb{R}_+} \hat{U}_i(x_i, x_j) \;=\; (1-\theta_i)^2 A^2.$$

Match Payoffs. While individual choices are based on their subjective payoff functions given by (2), evolution is determined by the true payoff function (1).[5] Denote the equilibrium (true) payoff to a type i individual matched with a type j individual by

$$\begin{aligned} U_{ij} &= U(x_i^*, x_j^*) \\ &= \left(1-\theta_i-\alpha(1-\theta_j)-\tfrac{1}{2}(1-\theta_i)^2\right) A^2. \end{aligned}$$

By observation, the payoff to i in an i,j match is strictly decreasing in the intensity of i's belief θ_i and strictly increasing in the intensity of j's belief θ_j. Therefore, one would ideally wish to hold the true belief $\theta_i = 0$, but be matched with individuals who hold a highly demotivating belief.

Assortative Matching. The success of trait i is based on its "cultural fitness," which we denote by $F_i(\mathbf{q})$, and is given by the expected payoff across all possible matches; it is, thus, a function of the population state $\mathbf{q}$. We assume partial assortative matching as in Cavalli-Sforza and Feldman (1981). Specifically, we introduce a degree of positive assortativity σ such that a fraction σ of the population matches with its own type and a fraction $1-\sigma$ is matched at random with another member of the population. In many biological models, positive assortativity is generated by a "limited dispersal", i.e., a spatial structure to reproduction in which

[4] In particular, the degree of altruism that would evolve in our setting is independent of the degree to which the environment is zero-sum, α, in contrast to our theoretical and empirical findings regarding demotivating beliefs.

[5] Our main results are preserved qualitatively when the fitness function is a convex combination of material and subjective payoffs.

genetic/cultural offspring occupy neighboring locations, so that interactions are more likely among genetic/cultural relatives (e.g., Hamilton, 1964, West, Griffin and Gardner, 2007).[6]

Another interpretation is that σ is a proxy for group-level selection in the population. For example, consider the population being split into two groups, labeled 1 and 2. Suppose trait i has achieved fixation (i.e., is present in 100% of the population) in group 1 and trait j has achieved fixation in group 2 so that the share of trait i in the population, q_i, is also the share of group 1. The index of assortativity σ is then the likelihood of a within-population match.

Given an index of assortativity σ, the cultural fitness of trait i is

$$\begin{aligned} F_i(\mathbf{q}) &= \sigma U_{ii} + (1-\sigma)\sum_{j=1}^{n} q_j U_{ij} \\ &= (1-\theta_i)\left(1-\tfrac{1}{2}(1-\theta_i)\right)A^2 - \sigma\alpha(1-\theta_i)A^2 - (1-\sigma)\alpha A^2 \sum_{j=1}^{n} q_j(1-\theta_j). \end{aligned} \tag{3}$$

B. ***Cultural Evolution***

The evolution of beliefs in the population is given by a dynamic system operating on the n-dimensional unit simplex. We place only a minimal restriction that the distribution of beliefs/types $\mathbf{q}$ evolves according to a deterministic payoff monotone dynamic: for all i, j such that $q_i > 0$ and $q_j > 0$,

$$F_i(\mathbf{q}) \begin{array}{c} > \\ = \\ < \end{array} F_j(\mathbf{q}) \iff \frac{dq_i}{dt} \begin{array}{c} > \\ = \\ < \end{array} \frac{dq_j}{dt}.$$

That is, if the payoff to type i is higher than the payoff to type j, then i's population share grows faster. A leading example is the replicator dynamic, which can be the product of natural selection, imitation, or reinforcement learning (Sandholm, 2010).

We first show that the belief intensity with the highest relative cultural fitness vis-à-vis any other belief intensity is $\theta^* = \sigma\alpha$, i.e., the product of the degree of positive sorting in interactions and the degree to which the environment is zero-sum. Recall that the (true) non-demotivating belief is $\theta = 0$. We denote the population shares of these beliefs at time t by $q^*(t)$ and $q^0(t)$, respectively.

Proposition 1 . ***Evolution of Demotivating Beliefs.*** *Cultural evolution selects a belief system as follows. If there is a belief close to $\theta^* = \sigma\alpha$, then the true belief $\theta = 0$ will be driven to extinction and all*

[6]Positive assortativity could also be generated by social institutions, including groups that select for specific traits and rituals that screen out non-believers (e.g., Iannaccone, 1992, Carvalho and Sacks, 2021a). We are, however, silent on this process.

individuals will have a 'distorted' view of the world. If θ^* is in the set of beliefs, then eventually the entire population will hold this belief. Formally:

(i) If the set of beliefs Θ contains $\theta_i < 2\sigma\alpha$ and the initial state is such that $q^0(0) < 1$, then $q^0(t)$ converges monotonically to zero. Otherwise, $\lim_{t\to\infty} q^0(t) = 1$.

(ii) If the set of beliefs Θ contains $\theta^* = \sigma\alpha$ and the initial state is such that $q^*(0) > 0$, then $q^*(t)$ converges monotonically to one.

All proofs are in Appendix A.

Even though they represent inaccurate representations of the world, demotivating belief systems such as the evil eye and witchcraft can survive and spread through the population. According to part (*i*) of the proposition, as long as demotivating beliefs are present initially and are not too intense given the degree of zero-sumness $\alpha > 0$ and index of assortativity $\sigma > 0$, the true belief $\theta = 0$ will be driven to extinction. Only demotivating beliefs will survive in the population. Part (*ii*) tells us that the demotivating belief with intensity $\theta^* = \sigma\alpha$ will win out, driving all other belief systems to extinction. Hence, under positive assortativity ($\sigma > 0$), the belief intensity that is selected is strictly increasing in the degree of zero-sumness α. This result also helps us to understand part (*i*). Specifically, the (true) non-demotivating belief $\theta = 0$ is driven to extinction whenever there is a demotivating belief that is closer than it to the relative fitness maximizing belief $\theta^* = \sigma\alpha$. These results do not depend on the specific form of the payoff monotone cultural dynamic.

In addition, even when $q^*(0) = 0$, evolution will select a belief intensity in support of $\mathbf{q}(0)$ that is approximately equal to θ^*. Defining a *regular environment* as one in which the set of beliefs is the discrete grid, $\Theta = \left\{0, \frac{1}{\Delta}, \frac{2}{\Delta}, \ldots 1\right\}$ and where the initial state $\mathbf{q}(0)$ has full support on Θ and referring to Δ as the degree of fineness of the set of beliefs, we can then state the following corollary:

Corollary 1 . ***Evolution of Optimal Demotivating Beliefs.*** *Consider a regular environment. If the set of beliefs is sufficiently fine (Δ large), cultural evolution selects a belief that is approximately $\theta^* = \sigma\alpha$. That is, $q_i(t)$ converges monotonically to one for some $\theta_i \in \left(\theta^* - \frac{1}{\Delta}, \theta^* + \frac{1}{\Delta}\right)$.*

This follows from θ^* being the relative cultural fitness maximizing belief and the strict concavity of $F_i(\mathbf{q}) - F_j(\mathbf{q})$ with respect to θ_i for all $j \neq i$.

The intuition behind the survival of (incorrect) demotivating beliefs is as follows. By discounting the return to effort, the belief $\theta > 0$ depresses productive effort below the first-best level. The direct effect of this distortion is to reduce cultural fitness. There is also a secondary effect that we call the 'interactive effect,' which is to increase the likelihood of being matched with another believer who exerts low effort. When interactions are primarily zero-sum (α large) and there is a high degree of assortative matching (σ large), the interactive effect dominates the direct effect. In this case, demotivating beliefs evolve to internalize part of the negative externalities in such an environment.

C. *Zero-Sum, Cultural Institutions, and Demotivating Beliefs*

Rather than being determined by cultural evolution, it could be that the distribution of demotivating beliefs is directed by a community leader or cultural institution in a top-down manner. To examine this alternative formulation, suppose the set of beliefs is binary, $\Theta = \{\theta_1, \theta_2\}$, with $\theta_1 = 0$ the correct belief and $\theta_2 = \theta(t)$ a demotivating belief. We assume that community leaders or some impersonal institutions dynamically tune $\theta(t)$ in a way that maximizes the spread of the demotivating belief. This is meant to capture the influence that political or religious leaders can have on beliefs $\theta(t)$ (e.g., Verdier and Zenou, 2018, Carvalho and Sacks, 2021b). For religious beliefs, examples would be the church doctrine, such as the Marriage and Family Program of the Catholic Church dating back to the medieval period (Schulz et al., 2019). When considering supernatural beliefs, such as beliefs in the evil eye or witchcraft, they can be influenced by prestigious individuals such as chiefs, shamans, and witchdoctors (Henrich, Chudek and Boyd, 2015).

Because the demotivating belief $\theta^* = \sigma\alpha$ maximizes relative cultural fitness regardless of the state, it is chosen by the leader for all time without having to be dynamically tuned. In addition, the demotivating belief spreads from all interior initial states and achieves fixation. Thus, we expect the belief system produced by community leaders or cultural institutions to be the same as that selected by cultural evolution. In both cases, a population in which interactions are more zero-sum (larger α) will have more intense demotivating beliefs.

D. *The Effect of Demotivating Beliefs on Material Welfare and Subjective Well-Being*

We have seen that demotivating beliefs produce interactive benefits at the individual level that enable them to spread through the population. We now turn to the social efficiency of such beliefs and will show that demotivating beliefs can improve efficiency by limiting excessive competition.

Our efficiency criterion, which we refer to as material welfare, is a function of the objective payoffs, which serve as the cultural fitness of each belief. Specifically, material welfare at time t for a person holding belief θ_i is the objective (or true) payoff given by (1) evaluated at the equilibrium effort levels $(x_i^*)_{i=1}^n$ and averaged over all interactions:

$$W_i(t) \quad = \quad F_i\left(\mathbf{q}(t)\right) \quad = \quad \left[\sigma U(x_i^*, x_i^*) + (1-\sigma)\sum_{j=1}^{n} q_j(t) U(x_i^*, x_j^*)\right]. \tag{4}$$

Proposition 2 . ***Demotivating Beliefs and Material Welfare.*** *Material welfare at time t is highest for the holders of belief $\theta^* = \sigma\alpha$ and strictly concave in θ.*

The demotivating belief θ^* improves welfare by internalizing the negative externalities from production in zero-sum environments. In addition, there is a hump-shaped relationship between material welfare and the intensity of demotivating beliefs. In other words, there is a demotivating belief that maximizes i's material welfare. This holds regardless of the initial condition $\mathbf{q}(0)$.

We can also examine the effect of demotivating beliefs on perceived welfare, which we refer to as "subjective well-being." Let us define subjective well-being at time t for a person holding belief θ_i as the subjective payoff given by (2) evaluated at the equilibrium effort levels $(x_i^*)_{i=1}^n$ and averaged over all interactions as

$$\hat{W}_i(t) \quad = \quad \left[\sigma \hat{U}_i(x_i^*, x_i^*) + (1-\sigma)\sum_{j=1}^{n} q_j(t) \hat{U}_i(x_i^*, x_j^*)\right]. \tag{5}$$

Proposition 3 . ***Demotivating Beliefs and Subjective Well-Being.*** *Subjective well-being at time t is strictly decreasing in the intensity of demotivating beliefs θ if $\theta < 1 - \sigma\alpha$. Otherwise, it is increasing in the intensity of demotivating beliefs. Subjective well-being is also strictly convex in θ. Finally, for $\sigma\alpha < 1/2$, subjective well-being is highest for the true belief $\theta = 0$.*

Unlike material welfare, which is hump-shaped in the intensity of demotivating beliefs, subjective well-being is strictly decreasing in θ if the most intense demotivating belief in the set of beliefs is not too intense, specifically if $\max \Theta \leq 1 - \sigma\alpha$. Otherwise, subjective well-being is U-shaped in the intensity of demotivating beliefs, increasing for higher values of θ. Even when $\max \Theta > 1 - \sigma\alpha$, numerical examples indicate that subjective well-being only rises slightly for higher values of θ, even for high degrees of positive sorting (see Appendix Figure A1). Thus, in general, subjective well-being is decreasing in θ.

In line with this and regardless of the shape of the function, subjective well-being is largest for the true non-demotivating belief $\theta = 0$. This is true as long as $\sigma < \frac{1}{2}$, a condition that we expect to hold in reality. For example, in the case of genetic evolution, $\sigma = \frac{1}{2}$ means that all interactions are with siblings, which is an extreme level of positive sorting. Thus, subjective well-being contrasts with material welfare, which we have shown is maximized at $\theta^* > 0$ (for $\sigma\alpha > 0$). Again, the results hold independently of the initial condition $\mathbf{q}(0)$.

The reason for the divergence between the effect of demotivating beliefs on material welfare and subjective well-being is as follows. With material welfare, there is a tradeoff between the direct cost of a distorted belief system and the interactive benefit of being matched with a less motivated partner. With subjective well-being, there is no direct cost from a distorted belief system since individuals choose effort to maximize their subjective payoff. Instead, there is an "affective cost" from discounting the return to effort by $1 - \theta$, i.e., making people feel that they are doing worse than they actually are. Unlike the direct cost of distortion in terms of welfare, which is strictly increasing in θ, the affective cost in terms of well-being is strictly decreasing in θ, because as θ rises there is less effort and hence less return on effort to discount. Propositions 2 and 3 predict a specific form of divergence between material welfare and subjective well-being, which provide testable predictions of the model that we will take to the data.

E. *Comparative Dynamics across Populations*

Thus far, we have considered a population interacting in an environment characterized by a degree of zero-sumness α. In reality, even within a given society, there can be multiple socioeconomic and geographic niches, each with their own degree of zero-sumness. This is certainly true across societies. We now generate results for pooled populations of individuals interacting in environments that have different degrees of zero-sumness, which we will also take to the data.

Consider a finite set of populations (or subpopulations) indexed by $k \in \{1,2,\ldots,K\}$. The degree to which the environment faced by population k is zero-sum is α^k, and the populations are ordered such that $k > k'$ implies $\alpha^k > \alpha^{k'}$. To focus on the degree of zero-sumness, the parameter of interest in the empirical analysis, we assume each population has the same index of assortativity $\sigma > 0$ and set of beliefs Θ.

We begin by analyzing the relationship between zero-sumness and demotivating beliefs across populations $k \in K$. Define the population k share of belief i at time t by $q_i^k(t)$ and the population k state by $\mathbf{q}^k(t)$. As before, an interior population k state is one with full support on Θ. In addition, define the mean demotivating belief in population k at time t as

$$\theta^k(t) = \sum_{i=1}^{n} q_i^k(t)\theta_i.$$

We can then state the following proposition.

Proposition 4 . ***Zero-Sum Environments and Demotivating Beliefs.*** *Consider a regular environment with a sufficiently fine set of beliefs. If cultural evolution is allowed enough time to operate, the mean demotivating belief will be higher in populations with higher degrees of zero-sumness.*

That is, there exists a finite time T such that for all $t \geq T$ the mean demotivating belief $\theta^k(t)$ is strictly increasing in α^k.

Therefore, where a population interacts in a more zero-sum environment, it will eventually hold more intense demotivating beliefs. Again, this applies independently of the initial conditions for each population, as long as they are interior. The result also does not depend on the precise form of payoff monotone cultural dynamic.

Let us now turn to the relationship between zero-sumness and economic outcomes across populations: effort and material welfare. The mean level of effort in population k at time t is

$$\begin{aligned} X^k(t) &= \sum_{i=1}^{n} q_i^k(t) x_i^* \\ &= A^2 \sum_{i=1}^{n} q_i^k(t)(1-\theta_i)^2. \end{aligned} \tag{6}$$

and the mean material welfare in population k at time t is the mean (objective) payoff averaged over all interactions:

$$W^k(t) = \sum_{i=1}^{n} q_i^k(t) W_i(t), \tag{7}$$

where $W_i(t)$ is given by (4). We can now show how effort and material welfare vary with the degree to which the environment is zero-sum.

Proposition 5 . ***Zero-Sum Environments and Economic Outcomes.*** *Consider a regular environment with a sufficiently fine set of beliefs. If cultural evolution is allowed enough time to operate, mean effort and material welfare will be lower in populations with higher zero-sumness.*

That is, there exists a finite time T such that for all $t \geq T$ mean effort $X^k(t)$ and mean material welfare $W^k(t)$ are strictly decreasing in α^k.

Hence, worse economic outcomes are produced in more zero-sum environments.

We can also examine the effect of the environment on subjective well-being. Define subjective well-being in population k at time t as the mean subjective payoff given by (2) evaluated at the equilibrium effort levels and averaged over all interactions:

$$\hat{W}^k(t) \quad = \quad \sum_{i=1}^{n} q_i^k(t)\hat{W}_i(t), \tag{8}$$

where $\hat{W}_i(t)$ is given by (5). Subjective well-being varies across populations as follows.

Proposition 6 . ***Zero-Sum Environments and Subjective Well-Being.*** *There exist mild conditions under which subjective well-being is lower in populations with a higher degree of zero-sumness.*

Specifically, in addition to the conditions of Proposition 5, if $\sigma \leq \frac{1}{2}$ or $\alpha^K \leq \frac{1}{\sigma}\frac{1+\sigma}{2+\sigma}$, then there exists a finite time T such that for all $t \geq T$ subjective well-being $\hat{W}^k(t)$ is strictly decreasing in α^k.

The reason behind the qualification in Proposition 6 is as follows. There are three effects of a more zero-sum environment on subjective well-being. The first is to increase negative externalities and thereby lower subjective well-being. The remaining two effects depend on the limiting demotivating belief, $\theta^* = \sigma\alpha^k$, being increasing in zero-sumness. Specifically, the second effect arises because increased demotivating beliefs discount the returns to effort by approximately $1 - \theta^*$, which reduces well-being by making an individual's situation seem worse than it is. The third effect raises well-being by producing demotivating beliefs that internalize part of the negative externalities from zero-sum interactions. When positive assortativity σ and the degree of zero-sumness α^k are large, the third effect dominates and subjective well-being can rise with α^k. Empirically, this is unlikely because $\sigma = \frac{1}{2}$ is an implausibly high degree of positive sorting. In

addition, as illustrated in Appendix Figure A2, even when $\hat{W}^k$ is increasing in α^k over part of the domain, numerical results indicate that the magnitude of the increase is very modest. Essentially, the curve becomes close to flat for the highest values of zero-sumness, α^k.

Taken together, these results also yield relationships between demotivating beliefs, economic outcomes, and subjective well-being across populations.

Corollary 2 . ***Demotivating Beliefs, Economic Outcomes, and Subjective Well-being.*** *Mean effort, material welfare, and subjective well-being are all strictly decreasing in a population's mean demotivating belief. Specifically:*

(i) Under the conditions of Proposition 5, there exists a finite time T such that, for all $t \geq T$, $\theta^k(t) > \theta^{k'}(t)$ implies $X^k(t) < X^{k'}(t)$ and $W^k(t) < W^{k'}(t)$.

(ii) Under the conditions of Proposition 6, there exists a finite time T such that, for all $t \geq T$, $\theta^k(t) > \theta^{k'}(t)$ implies $\hat{W}^k(t) < \hat{W}^{k'}(t)$.

The theory generates a subtle but important point: if we look within a society that has a given degree of zero-sumness, then demotivating beliefs can increase material welfare within a population (Proposition 2). However, if we look across societies with varying degrees of zero-sumness, then more intense demotivating beliefs are associated with lower material welfare (Proposition 5). This is driven by the variation in zero-sumness across populations, which leads to more intense demotivating beliefs and lower material welfare.

Summary of the Theoretical Predictions

We now take the primary predictions from our theory to the data. Propositions 2 and 3 concern the effect of demotivating beliefs when one holds constant the degree to which the environment is zero-sum. They predict a divergence between material welfare and subjective well-being: although an intermediate demotivating belief maximizes income, happiness is maximized by the true (non-demotivating) belief $\theta = 0$.

The remaining propositions examine variation across environments with varying degrees of zero-sumness. Proposition 4 predicts that demotivating beliefs – such as envy and witchcraft, which were the focus of Foster's original studies – are increasing in the underlying degree of zero-sumness. Propositions 5 and 6 connect zero-sumness to reduced effort, lower levels of material

welfare, and worse subjective well-being. Corollary 2, which follows directly from Propositions 5 and 6, shows that demotivating beliefs are also associated with lower levels of effort, material welfare, and subjective well-being.

4. Testing the Model in the Developing World: Evidence from the DRC

A. *Data Collection*

Our empirical analysis first studies two samples from the city of Kananga in the Democratic Republic of the Congo (DRC). The city is the capital of the Kasai-Central province and has a population of roughly 1.8 million. The first sample, from 2015, includes about 200 individuals, while the second sample, from 2019, includes about 1,000 individuals. Respondents were chosen randomly, subject to inclusion criteria to ensure sufficient spread across ethnic groups, and the surveys took place face-to-face at the respondent's place of residence. The finer details of the surveys and sampling are provided in Appendix C.

We use the first, smaller sample to develop and validate measures of zero-sum thinking, and to provide exploratory evidence on the relationship with demotivating beliefs (Proposition 4). We then replicate this finding using the second, larger sample.

B. *Zero-Sum Measures*

Central to our analysis is the extent to which the world is zero-sum, parameter α in the model. Although we cannot directly measure the zero-sumness of each respondent's environment, we can ask for their perception of its zero-sumness. As a proxy for the perceived α faced by the respondent, we ask individuals six survey questions regarding the extent to which they believe that the gains achieved by an individual or group come at the expense of others. The questions ask respondents the extent to which they agree with one of two contrasting statements.

- Statement 1: In Kananga, people only make money when others lose money.
  Statement 2: In Kananga, no one needs to lose money for others to make money.
- Statement 1: In Kananga, businesses only make money when others lose money.
  Statement 2: In Kananga, no one needs to lose money for businesses to make money.
- Statement 1: If one person in a village gets very wealthy, other people in the village will become poorer.
  Statement 2: If one person in a village gets very wealthy, other people in the village will not necessarily become poorer.

- Statement 1: In trade, if one party gains the other party loses.
  Statement 2: In trade, it is possible for both parties to gain at the same time.
- Statement 1: A person can only gain power by taking it away from others.
  Statement 2: A person can gain power without taking it away from others.
- Statement 1: Gaining happiness requires taking it away from others.
  Statement 2: It is possible for everyone to be happy.

The potential response options are: "agree strongly with statement 1," "agree with statement 1," "agree with statement 2," or "agree strongly with statement 2." For each survey question, we create a variable that takes on an integer value from 1–4 increasing in how zero-sum the choice of the respondent is. We then use principal component analysis (PCA) to create an index of zero-sumness, based on the first principal component (capturing 34% of the variance in the 200-person sample and 36% in the 1,000-person sample).

Table 1 reports the estimated weights for the first principal component. In both samples, all six variables load positively and have estimates that are similar in magnitude (columns 1 and 2). These facts are informative. *Ex ante*, it is not clear whether there is a generalized perception – or "worldview" as Foster puts it – of zero-sumness that applies similarly to income, wealth, trade, power, and happiness, and to life in Kananga and in the village. The similar weights from the principal component estimation are consistent with a zero-sum view of the world that applies to different domains and settings similarly.

The fact that happiness is perceived as being zero-sum might be initially surprising. Indeed, everyone can be happy. However, if happiness is derived from prestige, power, income, and wealth, which are viewed as zero-sum, one might also view happiness as zero-sum. Put differently, if preferences are Veblen and thus based on one's relative standing, then the respondents are right to perceive happiness as zero-sum. This finding is very much in line with Foster's perception that people view "good" as limited and zero-sum in pre-industrial societies.

In the 200-person sample, we also asked additional zero-sum questions, adding different scenarios (e.g, farming) and asking zero-sum relationships using more diverse language (e.g., "created" vs. "taking from others"; "exploiting others" vs. "without exploiting"; "helps people" vs. "hurts people"). The additional four questions are:

- Statement 1: If one farmer has a huge crop, his neighbor is likely to also have a huge crop.
  Statement 2: If one farmer has a huge crop, his neighbor is likely to have a small crop.

Table 1: Principal Component Analysis for Zero-Sum indices

Zero-sum survey questions	(1) 6 question index (200 sample)	(2) 6 question index (1,000 sample)	(3) 10 question index (200 sample)	(4) 12 question index (200 sample)
1. In Kananga, people only make money when others lose money 2. In Kananga, no one need lose money for others to make money	0.467	0.469	0.434	0.392
1. In Kananga, businesses only make money when others lose money 2. In Kananga, no one need lose money for businesses to make money	0.400	0.471	0.381	0.368
1. If one person in a village gets very wealthy, other people in the village will become poorer 2. If one person in a village gets very wealthy, other people in the village will not necessarily become poorer	0.320	0.378	0.306	0.240
1. In trade, if one party gains the other party loses 2. In trade, it is possible for both parties to gain at the same time	0.325	0.413	0.289	0.229
1. A person can only gain power by taking it away from others 2. A person can gain power without taking it away from others	0.453	0.362	0.451	0.434
1. Gaining happiness requires taking it away from others 2. It is possible for everyone to be happy	0.456	0.336	0.436	0.426
1. If one farmer has a very large crop, his neighbor is likely to also have a very large crop 2. If one farmer has a very large crop, his neighbor is likely to have a small crop			0.277	0.302
1. The success of the wealthy generally helps other people in the community 2. The success of the wealthy generally hurts other people in the community			0.127	0.216
1. Most wealth is created without exploiting others 2. Most wealth is obtained by exploiting others			0.049	0.135
1. Most of the wealth of the rich was created without taking it from others 2. Most of the wealth of the rich was obtained by taking it from others			-0.032	0.009
1. If God is looking out for my brother, He is less likely to be looking out for me 2. If God is looking out for my brother, He is more likely to also be looking out for me				0.258
1. If my ancestors' spirits are looking out for my brother, they are less likely to be looking out for me 2. If my ancestors' spirits are looking out for my brother, they are more likely to also be looking out for me				0.093
Eigenvalue	2.067	2.169	2.209	2.272
Observations	205	984	193	163

Notes: The table reports the estimated factor loadings from four principal component analyses. Each set of estimates are reported in one column with the eigenvalue of the first principal component reported in the bottom panel. The questions used in the principal component analyses are respondents' self-reported perceptions of how zero-sum the world is, and respondents choose from one of four options: "agree strongly with statement 1," "agree with statement 1," "agree with statement 2," and "agree strongly with statement 2." Columns 1 and 2 report the factor loadings from the first principal component using the set of six survey questions with the 200-person person and 1,000-person samples, respectively. Columns 3 and 4 report the factor loadings of the first principal component using the set of 10 and 12 questions for the 200-person sample.

- Statement 1: The success of the wealthy generally helps other people in the community.
  Statement 2: The success of the wealthy generally hurts other people in the community.
- Statement 1: Most wealth is created without exploiting others.
  Statement 2: Most wealth is obtained by exploiting others.
- Statement 1: Most of the wealth of the rich was created without taking it from others.
  Statement 2: Most of the wealth of the rich was obtained by taking it from others.

We create another measure of zero-sum views that includes these four additional questions. The PCA estimates are reported in column 3 of Table 1. The variables load in an expected manner, although the factor loadings are very close to zero for the wealth question that uses that language of "created" versus "taking from others" and the question that uses the phrase "exploiting." This suggests that, consistent with Foster, people don't literally view a person's wealth as being stolen or exploited by others. Instead, the larger system creates a world with "limited good" that is zero-sum.

Lastly, we also add two questions about specific but important domains in this setting: namely, benefits that arise due to blessings from God or from one's ancestors.

- Statement 1: If God is looking out for my brother, he is less likely to be looking out for me.
  Statement 2: If God is looking out for my brother, he is more likely to also be looking out for me.
- Statement 1: If my ancestors' spirits are looking out for my brother, they are less likely to be looking out for me.
  Statement 2: If my ancestors' spirits are looking out for my brother, they are more likely to also be looking out for me.

The principal components analysis with these two additional measures added are reported in column 4 of Table 1. We find that the factor loads positively onto both questions and most strongly on the question that asks about 'God' than on the question that asks about ancestors.

Figure 1 shows the bivariate relationships between the three zero-sum measures based on six, ten, or twelve questions. As shown, they are very highly correlated with correlation coefficients that range from 0.93 to 0.98. All of the findings we report here using our baseline 6-question zero-sum index are very similar if we use the 10- or 12-question indices.

C. *Validating the Zero-Sum Indices*

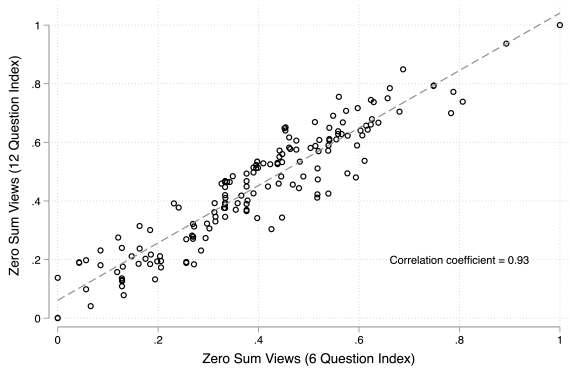
Although it is reassuring that the zero-sum survey questions about different outcomes (happiness, power, gains from trade, income, wealth, crop yields) and different parties (individuals/people, trading parties, villagers, farmers, citizens in Kananga, and businesses in Kananga) are correlated with one another, we further validate our measure of zero-sumness by examining their relationship with a revealed measure of whether individuals view the world as zero-sum.

In the 200-person sample, we presented respondents with several vignettes. We outline the logic here, supplying the exact text of the questions in Appendix C. Each vignette uses an image to help explain the situation. In one scenario, the respondent is asked about two women, named Kapinga and Tshilomba, who sell bananas (Figure 2a). On day 1, Kapinga sells 10 bananas and Tshilomba sells 20 bananas. This is shown in the first column of the vignette. On day 2, Kapinga sells 20 bananas (shown in the second column of the vignette). The respondent is then asked how many bananas they think Tshilomba sold on day 2. They can choose either 10 bananas or 40 bananas. If one perceived sales to be zero-sum, then it would be natural to believe that Tshilomba sold 10 bananas. If one believed that sales were not zero-sum, then a logical assumption is that there was a demand shock and everyone sold 100% more than the previous day. According to this logic, Tshilomba would have sold 40 bananas. The second vignette presents an analogous scenario where two farmers are cultivating corn (Figure 2b).

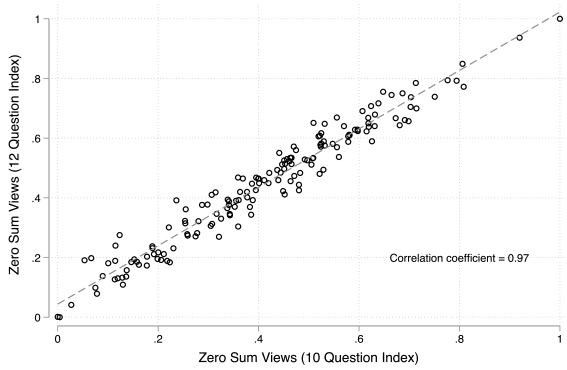
Figure 1: Correlation Plots of the Zero-Sum Indices based on 6, 10, and 12 Survey Questions

(a) Zero-Sum View indices: 6 Questions vs. 10 Questions

(b) Zero-Sum View indices: 6 Questions vs. 12 Questions



(c) Zero-Sum View indices: 10 Questions vs. 12 Questions

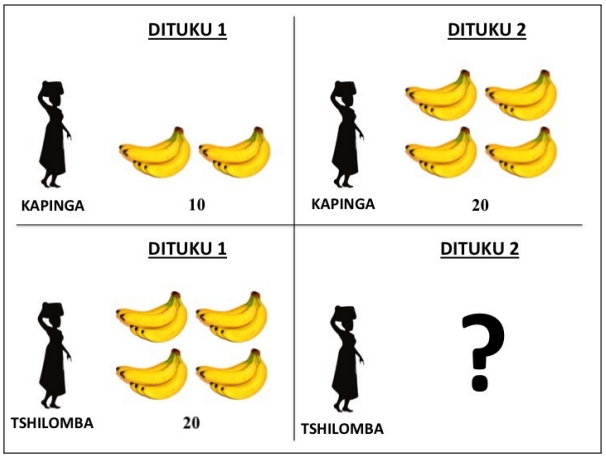


Notes: The figure reports the bivariate relationships between the zero-sum indices, constructed as the first principal component of 6, 10, or 12 survey questions, each normalized to lie between zero and one. panel (a) reports the correlation between the zero-sum indices based on 6 and 10 questions, panel (b) reports the correlation between the zero-sum indices based on 6 and 12 questions, and panel (c) reports the correlation between the zero-sum indices based on 10 and 12 questions. Each panel reports the correlation coefficient for the corresponding bivariate relationship between the zero-sum indices.

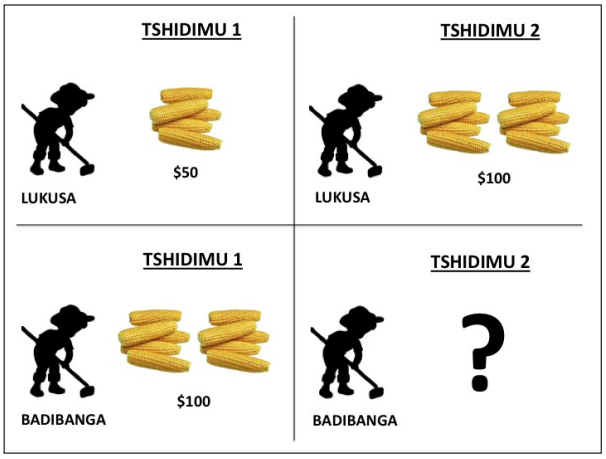
We use these vignette questions as an alternative measure of zero-sumness and compare it to the six-question index noted above. Figures 2c and 2d provide the distribution of the zero-sum index for respondents who chose the zero-sum vignette response and those who chose the non-zero-sum response. On average, individuals who chose the zero-sum response have a significantly higher zero-sum index. The vertical lines show the mean difference. Appendix Figures A4a–A5b show robustness to using the alternative 10-question zero-sum index (Appendix Figures A4a and A4b) and 12-question index (Appendix Figures A5a and A5b).

Figure 2: Zero-Sum Index of Six Survey Questions and Zero-Sum Choice in the Banana and Maize Vignettes

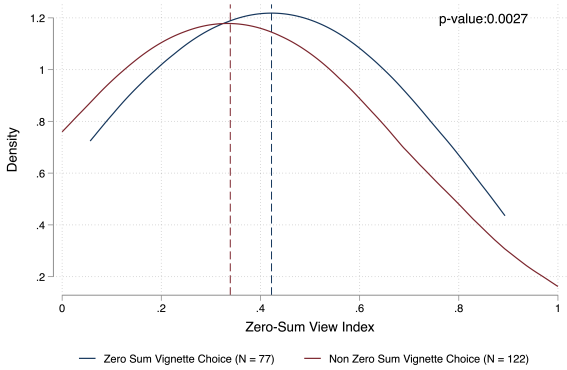
(a) Banana vignette: 10 or 40 bananas?



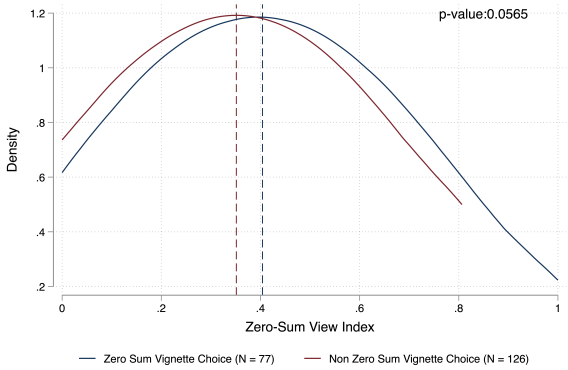
(b) Maize vignette: $50 or $200 of corn?



(c) Banana vignette



(d) Maize vignette



Notes: This figure reports the images provided to the respondents to illustrate the banana (in panel (a)) and maize (in panel (b)) vignettes questions. It reports the distribution of the zero-sum view index, constructed as the first principal component of the six zero-sum statements, by respondents' choice in the vignette questions (in panels (c) and (d)). Specifically, it reports the Kernel Density of the zero-sum view index when the zero-sum answer is chosen in the vignette question (in blue) and when the non-zero-sum answer is chosen in the vignette question (in dark red). Panel (c) reports results for the banana vignette and panel (d) for the maize vignette. The Kernel densities use the default Epanechnikov kernel and bandwidth. Both panels report the *p*-value associated with the t-test of equality of the zero-sum view index for respondents who chose the zero-sum response and those who chose the non zero-sum response.

D. *Equations and Estimates*

We now examine the relationship between the zero-sum index and both envy and beliefs in witchcraft. This is motivated by Proposition 4 of the model, which predicts that a group that lives in a more zero-sum environment will have more demotivating beliefs.

In the model, we do not take a stand on defining a group. In Kananga, a city of 1.8 million, we expect multiple groups to live in environments with different degrees of zero-sumness. The extent to which a person's world is zero-sum is likely affected by a host of factors, including who they interact with (i.e., their social and business networks), which can be determined by their neighborhood of residence, ethnic group, gender, kinship relations, education, occupation, business experience, etc. Consistent with the coexistence of multiple groups in our setting, we see rich variation in the extent to which respondents view the world as zero-sum.

Because we cannot identify the specific groups indexed by k in the model, we estimate relationships at the individual level while checking the robustness of our inference to different assumptions about the non-independence of standard errors. Since our samples are just 200 or 1,000 people from a population of 1.8 million, our baseline assumption is that each observation is drawn from a different "group" in the city, but as we will show, none of our findings rest on this assumption. Our individual-level estimating equation is given by:

$$y_i = \alpha_{e(i)} + \beta \, \text{Zero Sum}_i + \mathbf{X}_i \mathbf{\Omega} + \epsilon_i, \tag{9}$$

where i indices individuals. The dependent variable y_i captures one of our demotivating beliefs of interest, either envy or indigenous religious beliefs. $\alpha_{e(i)}$ denote ethnicity fixed effects. The vector $\mathbf{X}_i$ includes demographic controls for age, age squared, a gender indicator and its interaction with age and age squared. Our baseline estimates use robust standard errors, but we also report estimates that allow for various forms of non-independence of observations in case multiple observations are drawn from the same group k. As hypothesized by Foster and predicted by our theory, we expect a more zero-sum view of the world to be associated with more envy and stronger indigenous witchcraft beliefs: $\beta > 0$.

Table 2 reports the estimates of equation (9) using the 200-person (panel A) and 1,000-person (panel B) samples.[7] We begin by looking at envy as the outcome of interest, which we measure

[7] As we report in Appendix Tables A5 and A6, the relationship between zero-sum perceptions and each of envy, beliefs in witchcraft, and beliefs in Christianity are of similar magnitude and significance when we use the alternative zero-sum indices that are based on the ten or twelve survey questions available in the 200-person sample and introduced in Section 4.B.

as the first principal component of four survey questions. The first three questions ask about experiencing frustration when people succeed in life easily, resentment when neighbors are successful, or feelings of injustice when some people seem to have all the talents. The fourth question asks if the respondent sometimes wishes that rich and powerful people lose their advantage. The precise wording of each question is provided in Appendix C and the factor loadings for the first principal component are reported in Appendix Table A1. (The first principal component loads positively on all variables with roughly equal weight.) An important caveat is that our variable measures the envy of respondents themselves rather than their perceived envy of others, which would be the outcome of interest. Here, we rely on the fact that a primary determinant of people's belief about others' behavior is their own behavior. Thus, we take a respondent's own feelings of envy as a proxy for their perceived envy of others. According to this measure, we find a strong positive relationship between zero-sum and envy in both samples and this relationship is robust to controlling for covariates (column 1) and ethnicity fixed effects (column 2).

We then turn to the relationship between zero-sum thinking and traditional religious beliefs. The outcome in columns 3 and 4 is the intensity of witchcraft beliefs, measured as the first principal component of four questions that ask about the strength of belief in traditional religion, frequency of prayer to ancestors, frequency of participation in rituals devoted to ancestors, and how close they feel to non-Christians who live in Kananga.[8] There is a strong positive relationship between zero-sum thinking and witchcraft beliefs in the 200-person sample and weaker one in the 1,000 person sample. In the model, demotivating beliefs such as envy and beliefs in witchcraft, denoted θ, arise and spread culturally in response to the degree of zero-sumness in a person's environment, denoted α.

Another empirical implication of Proposition 4 is that beliefs systems characterized by a low θ belief, i.e., those with less of a psychological tax on effort and success, should diminish in response to the degree of zero-sumness of a person's environment, denoted α. One such belief system is Christianity, which has boomed in recent decades across Africa, challenging and yet coexisting alongside traditional religious beliefs (White, Muthukrishna and Norenzayan, 2021). Unlike traditional religious systems, Christianity teaches that everyone who is faithful can receive

[8]The exact wording of the questions are provided in Appendix C and Appendix Table A2 reports the factor loadings of the principal component analysis.

Table 2: Zero-Sum Index of Six Survey Questions, Envy, and Witchcraft in the DRC

	Dependent Variable: Principal-Component Based Measures of:							
	Envy of Others' Success		Witchcraft Beliefs		Christianity Beliefs		Difference Between Witchcraft & Christianity	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Panel A: 200 Person Sample (2015)								
Zero-sum thinking, 0-1	0.333***	0.349***	0.319***	0.276**	-0.146**	-0.147**	0.465***	0.423***
	(0.064)	(0.076)	(0.092)	(0.089)	(0.065)	(0.068)	(0.122)	(0.121)
Observations	204	204	197	197	197	197	197	197
R squared	0.117	0.164	0.072	0.127	0.034	0.096	0.067	0.140
Panel B: 1,000 Person Sample (2019)								
Zero-sum thinking, 0-1	0.158***	0.155***	0.038	0.037	-0.050**	-0.051**	0.088**	0.088**
	(0.026)	(0.026)	(0.027)	(0.027)	(0.016)	(0.016)	(0.033)	(0.034)
Observations	984	984	984	984	984	984	984	984
R squared	0.047	0.053	0.017	0.022	0.009	0.016	0.016	0.022
Gender, age, age squared	Y	Y	Y	Y	Y	Y	Y	Y
Ethnicity FEs	N	Y	N	Y	N	Y	N	Y

Notes: This table examines the relationship between zero-sum views and an individual's self-reported envy of others, beliefs in witchcraft and beliefs in Christianity, for the sample of about 200 respondents collected in 2015 (panel A) and the sample of about 1,000 respondents collected in 2019 (panel B) in Kananga, DRC. It reports estimates of equation (9). In all the columns, the explanatory variable is the first principal component of the six zero-sum statements. In columns 1 and 2, the dependent variables are the principal-component of four survey questions measuring self-reported envy of others' success. The first three questions ask about experiencing frustration when people succeed in life easily, resentment when neighbors are successful, or feelings of injustice when some people seem to have all the talents. The fourth question asks if the respondent sometimes wishes that rich and powerful people lose their advantage. In columns 3 and 4, the dependent variables are the principal-component based measure of beliefs in witchcraft using four survey questions that ask about the strength of belief in traditional religion, frequency of prayer to ancestors, frequency of participation in rituals devoted to ancestors, and how close they feel to non-Christians who live in Kananga. In columns 5 and 6, the dependent variables are the principal-component based measure of beliefs in Christianity using four survey questions that ask about the strength of one's belief in the Christian God, frequency of prayer, frequency of attending church, and how close the respondent feels to Christians who live in Kananga. In columns 7 and 8, the dependent variables are the difference in the principal-component based measure of beliefs in witchcraft and Christianity. We include controls for gender, age, and age squared in all columns. Coefficients are reported with robust standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

blessings from God (Norenzayan, 2013).[9] Moreover, many Pentecostal denominations, which account for the rapid recent growth of Christianity in Africa (Ranger and Ranger, 2008), promote versions of the prosperity gospel with explicit encouragement of hard work and economic ambition (Comaroff and Comaroff, 2000, Freeman, 2012). Interestingly, the link between zero-sum perceptions and Christianity is also found in Foster's account of Tzintzuntzan, where one of the

[9]We empirically validate this using two survey questions about the extent to which blessings from "one's ancestors" and "God" are viewed as limited (see Appendix C for the precise wording of each question). When asked about "God" rather than "ancestors," respondents were twice as likely to choose that they "agree strongly" that blessings are not limited and that everyone can benefit from them (see Appendix Figure A6). The results are consistent with qualitative evidence from focus groups, where gains obtained through witchcraft were typically described as limited, coming at the expense of someone, and likely to induce jealousy. By contrast, blessings from God were understood as the result of individuals' devotion and due to God's grace, which is not scarce, does not come at the expense of others, is less likely to induce jealousy.

accepted sources of income that did not generate envy and expectations of redistribution was a success due to favor from "saints" (see e.g., Foster, 1965, p. 307).

Given this, we expect to find a negative relationship between zero-sum thinking and the strength of Christian beliefs. To examine this, we measure Christian beliefs using questions that ask about: the strength of one's belief in the Christian God, the frequency of prayer, the frequency of attending church, and how close the respondent feels to Christians who live in Kananga.[10] The questions (and variable construction) mimic those about traditional religious beliefs (i.e., witchcraft). In both samples, a more zero-sum view of the world is negatively associated with Christian beliefs (columns 5 and 6).

Given the divergent relationships between zero-sum thinking and witchcraft versus Christianity, and that fact that people tend to believe in both simultaneously, we also create a measure that attempts to capture the relative strength of one's belief in the two religions, constructed as one's witchcraft belief measure minus their Christianity measure. We find that zero-sum thinking is associated with a stronger belief in witchcraft relative to Christianity (columns 7 and 8).

We probe the sensitivity of our conclusions to alternative assumptions about whether multiple observations are drawn from the same group k and, thus, are independent. We calculate standard errors assuming that k varies across the intersection of neighborhoods and ethnicities (i.e., different ethnic groups in different neighborhoods face a different zero-sumness of their environment); neighborhood and gender (i.e., different genders in different neighborhoods face different environments); and neighborhoods only (i.e., different people in different neighborhoods, regardless of gender or ethnicity face different environments). We calculate standard errors clustered at the level in which k is assumed to vary. For comparison, we also report randomization inference p-values, which do not make any assumptions about the error structure. The results, reported in Appendix Table A4, show similar standard errors to the robust ones reported in Table 2.

5. Global Evidence from the World Value Survey

We now test the predictions of our model globally. The Congolese samples allowed us to empirically validate Proposition 4 – concerning the link between zero-sum thinking and demotivating beliefs – in a setting similar to the small-scale pre-industrial societies that Foster discussed. A

[10]The exact survey questions are reported in Appendix C and the factor loadings are reported in Appendix Table A3.

downside of the Congolese samples is that we have limited cross-society variation and no information on material welfare and subjective well-being. As a result, we cannot test Propositions 5 and 6 – concerning the link between zero-sum beliefs, material welfare, and subjective well-being across societies – or Propositions 2 and 3 – concerning the relationship between the strength of demotivating beliefs and material welfare and subjective well-being when the zero-sumness of the environment is held constant. We now turn to these analyses.

A. *Data*

We measure zero-sum thinking using a question from the World Values Survey (WVS), which has a similar structure to our zero-sum questions from the DRC. Respondents are given two opposing statements, one that is zero-sum – "People can only get rich at the expense of others" – and the other positive sum – "Wealth can grow so there's enough for everyone." The respondents are asked to report their views on a ten-point scale between the two extremes. We normalize the variable to lie between zero and one and to be increasing in how zero-sum the response is. Figure 3 reports the distribution of the zero-sum measure and shows substantial variation in the extent to which individuals view wealth as zero-sum.

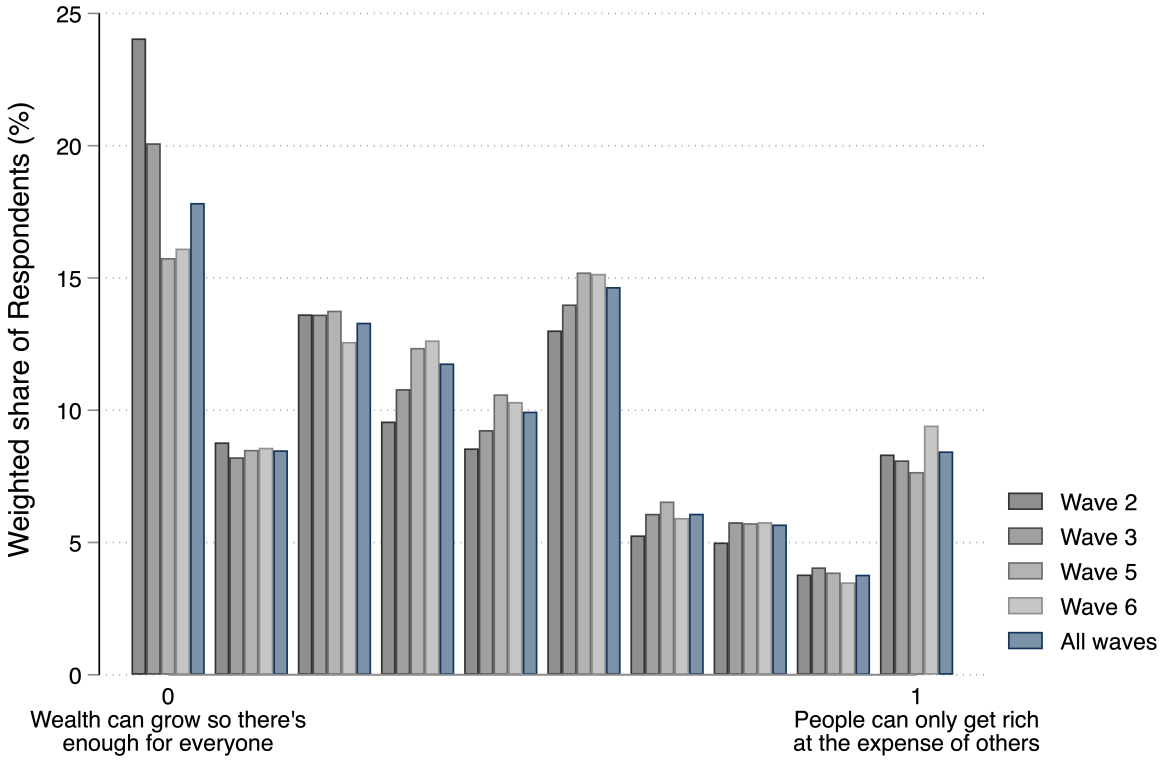
B. *Zero-sum thinking and demotivating beliefs*

We first examine the relationship between zero-sum views and demotivating beliefs that reduce effort, as predicted by the model (Proposition 4). Across countries, specific demotivating beliefs will differ. In some countries, they might take the form of beliefs in witchcraft or the evil eye. In others, they might take the form of a dislike for greed and individual accumulation. In still others, it might take the form of a belief that hard work does not result in success. For industrialized countries, which comprise most of the countries in the WVS sample, the most-relevant proxies for θ in the model are beliefs about the importance of hard work, economic success, and individual achievement. Fortunately, the WVS includes questions on these beliefs, which are the focus of our analysis here.

We use the WVS data to estimate the following equation:

$$Y_{i,c,t} = \alpha_{c,t} + \beta \, \text{Zero Sum}_{i,c,t} + \mathbf{X}_{i,c,t}\mathbf{\Gamma} + \varepsilon_{i,c,t}, \tag{10}$$

Figure 3: Distribution of the Zero-Sum Measure in the WVS



Notes: The figure reports the distribution of respondent answers for each of the four waves of the WVS, and for the aggregate sample. The figures reports a weighted share of respondent answers across waves 2, 3, 5, and 6 of the WVS for a zero-sum measure where zero indicates respondents fully agreed with the statement "Wealth can grow so there's enough for everyone" and one indicates respondents fully agreed with the statement "People can only get rich at the expense of others."

where i indices individuals, c country of residence, and t the year of the survey. Zero Sum$_{i,c,t}$ is our measure of zero-sum for individual i. $\alpha_{c,t}$ denote country by survey year fixed effects. $Y_{i,c,t}$ denotes a measure of the strength in which person i holds a particular demotivating belief. The vector $\mathbf{X}_{i,c,t}$ includes the following individual-level demographic controls: a gender indicator, age, age squared, and interactions between the gender and age measures.

We begin by first considering the belief of whether hard work brings success. Respondents report their answer on a 1-10 integer scale. We reorder and normalize the variable such that zero equals full agreement with "in the long run, hard work usually brings a better life" and one equals full agreement with "hard work doesn't generally bring success."[11] Thus, the measure is increasing in the extent to which one believes that hard work does not pay off.

Consistent with Proposition 4, we find that zero-sum beliefs are associated with a stronger

[11]The exact wording of this and all other WVS variables used in the paper are reported in Appendix C.

Table 3: Zero-Sum and Demotivating Beliefs

	Dependent Variable: Demotivating Belief:					
	Hard work brings success, 0 = fully agree to 1 = fully disagree	People are poor because of laziness, 0 = agree or 1 = disagree	People have a chance to escape poverty, 0 = agree or 1 = disagree	Humiliating to receive money without working for it, 0 = strongly agree to 1 = strongly disagree	Important to me to be successful, 0 = very much to 1 = not at all	How important is work, 0 = very important to 1 = not at all
	(1)	(2)	(3)	(4)	(5)	(6)
Zero-sum thinking, 0-1	0.112***	0.077***	0.121***	0.023***	0.024***	0.034***
	(0.002)	(0.006)	(0.006)	(0.004)	(0.002)	(0.002)
Demographic controls	Y	Y	Y	Y	Y	Y
Wave-country FE	Y	Y	Y	Y	Y	Y
Observations	246,408	55,871	59,052	60,856	151,270	242,255
R-squared	0.121	0.125	0.178	0.096	0.171	0.111
Mean dependent variable	0.363	0.697	0.602	0.352	0.391	0.162
Std. dev. dependent variable	0.321	0.459	0.489	0.296	0.290	0.248
Mean independent variable	0.406	0.393	0.394	0.406	0.416	0.407
Std. dev. independent variable	0.309	0.317	0.315	0.297	0.305	0.309

Notes: The table reports OLS estimates in columns 1–6. An observation is an individual. All specifications include survey wave by country fixed effects. The independent variable is a scale variable ranging from zero to one with one representing "People can only get rich at the expense of others" and zero representing "Wealth can grow so there's enough for everyone." The dependent variables are categorical variables appearing as column heads. Demographic controls include age, age squared, gender, and their interactions. Coefficients are reported with robust standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

belief that hard work is unlikely to bring success (Table 3, column 1). Using the terminology of the model, a more zero-sum environment α (as reflected by a perception of the world as being more zero-sum) appears positively associated with demotivating beliefs θ, which reduce the perceived returns to effort.

We next look at two closely-related measures that capture respondents' views of whether people's effort can keep them from poverty. The first survey question is: "Why, in your opinion, are there people in this country who live in need?" We create a variable that takes on the value of zero if they choose the answer "Poor because of laziness and lack of willpower," and the value of one if they choose the answer "Poor because of an unfair society." The second measure captures the respondents' view about whether the poor can escape poverty through effort: "In your opinion, do most poor people in this country have a chance of escaping from poverty, or is there very little chance of escaping?" We create a variable that takes on the value of zero if the respondent chooses the answer "They have a chance" and one if they choose "There is very little chance." Thus, both questions measure the belief that effort and hard work fail to explain economic success. According to these measures, zero-sum views correlate with the belief that poverty does not arise from a lack of effort (columns 2 and 3).

We next consider three additional demotivating beliefs. The first is the extent to which people get disutility from asking others for money. In a setting where it is shameful to be helped by others, individuals will try their hardest to provide for themselves. The survey question asks respondents if they agree with the statement: "It is humiliating to receive money without having

to work for it?" Respondents can choose "strongly agree," "agree," "neither," "disagree," or "strongly disagree." We normalize the measure to lie between zero and one and be increasing in the respondent's disagreement with the statement. Again, the more zero-sum view of the world is associated with feeling less humiliation when they receive money from others (column 4).

The last two questions measure individuals' perceived importance of achievement and work. The first question asks whether it is important to be "very successful... to have people recognize one's achievement." The second question asks the respondent how important work is to them. Respondents choose responses ranging from "not at all important" to "very important." Both measures are coded to be decreasing in the importance placed on achievement and work – i.e., increasing in the extent to which the beliefs are demotivating. The estimates, reported in columns 5 and 6, show that individuals with a more zero-sum worldview hold beliefs that place less importance on their success and on their work.

C. *Zero-sum thinking, effort, and economic outcomes*

The model predicts that zero-sum environments, by creating demotivating beliefs, will result in less effort and lower material welfare (Proposition 5). We test this prediction first by examining respondents' self-reported income on a 1–10 integer scale that we normalize to range from zero to one. We also examine a question about the net savings of the respondent's family. We again normalize the variable to lie between zero and one and to increase in savings. Individuals with a more zero-sum view of the world, report having lower incomes and less savings (Table 4, columns 1 and 2). Consistent with the model, zero-sum thinking appears to be associated with lower material welfare.

Next we examine education, an investment that requires effort but can enhance productivity. Consistent with the model's predictions regarding effort, respondents who exhibit zero-sum thinking have lower levels of education. If this relationship is robust, we should also observe a similar negative association with jobs that require having made costly investments in human capital accumulation. For instance, we examine the extent to which the respondent is employed in a cognitively demanding occupation rather than a manually intensive occupation (column 4) and whether the respondent supervises someone at their work (column 5). Individuals with stronger zero-sum views are less likely to be employed in cognitively demanding tasks and are less likely to have a supervisory role.

Table 4: Zero-Sum Thinking and Economic Welfare

	Dependent Variable: Measures of Economic Welfare:					
	Income decile, 0 = bottom decile to 1 = top decile	Family savings, 0=borrowed to 1=saved	Educational attainment, 0 = primary school or less to 1 = university or more	Cognitive vs. manual work tasks, 0=manual to 1 = cognitive	Supervising someone at work, 0=no to 1=yes	Class, 0 = lower class to 1 = upper class
	(1)	(2)	(3)	(4)	(5)	(6)
Zero-sum thinking, 0-1	-0.039***	-0.032***	-0.030***	-0.049***	-0.046***	-0.045***
	(0.002)	(0.002)	(0.002)	(0.004)	(0.004)	(0.002)
Demographic controls	Y	Y	Y	Y	Y	Y
Wave-country FE	Y	Y	Y	Y	Y	Y
Observations	229,719	203,716	219,524	116,885	119,888	207,165
R-squared	0.159	0.090	0.173	0.087	0.106	0.111
Mean dependent variable	0.407	0.625	0.522	0.446	0.327	0.421
Std. dev. dependent variable	0.257	0.309	0.337	0.346	0.469	0.245
Mean independent variable	0.404	0.406	0.406	0.416	0.415	0.409
Std. dev. independent variable	0.309	0.308	0.309	0.301	0.302	0.307

Notes: The table reports OLS estimates. An observation is an individual. All specifications include survey wave by country fixed effects. The independent variable is a scale variable ranging from zero to one with one representing "People can only get rich at the expense of others" and zero representing "Wealth can grow so there's enough for everyone." The dependent variables are categorical variables appearing as column heads. Demographic controls include age, age squared, gender, and their interactions. Coefficients are reported with robust standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

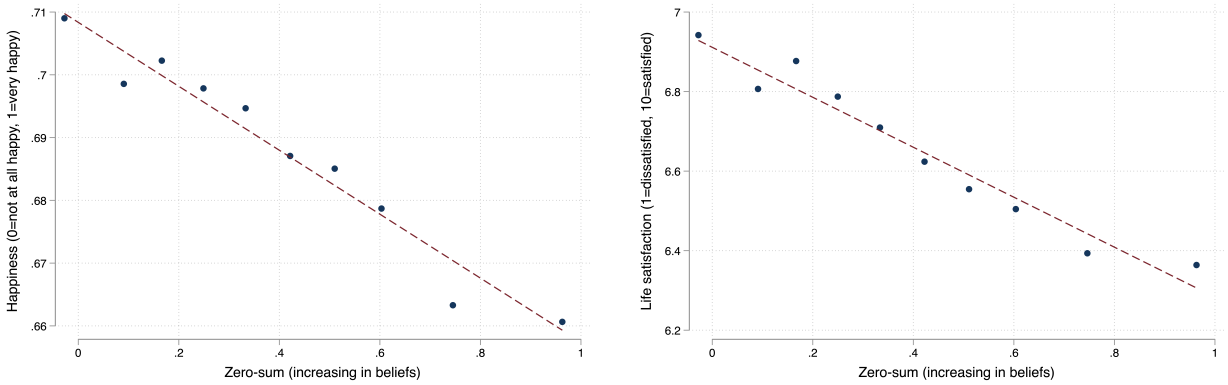
We also examine socioeconomic status. Respondents report belonging to either: (1) Lower class; (2) Working class; (3) Lower middle class; (4) Upper middle class; (5) Upper class. We use integer values reported for each category and normalize the index to lie between 0 and 1. Consistent with the model's prediction regarding income, zero-sum thinking is associated with a lower self-reported socioeconomic class (column 6).

Finally, we explore the relationship between demotivating beliefs and material welfare. In particular, the model predicts that material welfare should be decreasing in demotivating beliefs. This prediction is stated formally in part *(i)* of Corollary 2. Consistent with this prediction, we find a negative relationship between each of the six measures of demotivating beliefs and most measures of material welfare (Appendix Table A7). More zero-sum environments are associated with lower material welfare and more demotivating beliefs, inducing a negative relationship between demotivating beliefs and material welfare.

D. *Zero-sum thinking, demotivating beliefs, and happiness*

The next prediction of the model that we consider is Proposition 6, concerning the relationship between a zero-sum environment and an individual's subjective well-being. We examine two measures of subjective well-being: "happiness" and "life satisfaction." The raw cross-individual (binscatter) relationship between zero-sum beliefs and happiness or life satisfaction, conditional on country-by-survey-wave fixed effects, is reported in Figure 4. There is a clear negative relationship between zero-sum thinking and these measures of happiness and well-being, which

Figure 4: Relationship Between Zero-Sum Thinking and Happiness or Life Satisfaction



Notes: This figure reports the relationship between zero-sum thinking and happiness (left panel), and zero-sum thinking and satisfaction (right panel) using a binscatter plot. Zero-sum thinking is measured using a scale variable ranging from zero to one with one representing "People can only get rich at the expense of others" and zero representing "Wealth can grow so there's enough for everyone." Happiness is measured based on a scale variable reporting respondents' answers to the question "Taking all things together, would you say you are," with zero indicating "Not at all happy" and one indicating "Very happy." Life satisfaction is measured based on respondents' answers to the question "How satisfied are you with the financial situation of your household? If '1' means you are completely dissatisfied on this scale, and '10' means you are completely satisfied, where would you put your satisfaction with your household's financial situation?"

confirms the prediction of Proposition 6. Estimates of equation (3) for both measures of well-being as the outcome confirm this negative and significant relationship between zero-sum thinking and life satisfaction (Table 5, column 1).

We also explore the relationship between demotivating beliefs and subjective well-being. The model predicts that subjective well-being should be decreasing in demotivating beliefs. This prediction is stated formally in part *(ii)* of Corollary 2. Consistent with this prediction, there is a negative relationship between each of the six measures of demotivating beliefs and both measures of subjective well-being (Table 5, columns 2–7). More zero-sum environments are associated with lower material welfare, subjective well-being, and more demotivating beliefs. This induces a negative relationship between demotivating beliefs and subjective well-being.

E. *Demotivating Beliefs and Economic Outcomes in a Fixed Zero-Sum Setting*

The analysis up to this point has tested predictions of the model concerned with relationships across groups, indexed by k, with different zero-sum environments, α. We tested these predictions by examining cross-sectional variation in zero-sum perceptions across survey respondents. We now turn to Propositions 2 and 3 of the model, which make predictions about relationships across individuals *within a group* k (with a fixed zero-sum environment α) between the strength of demotivating beliefs, material welfare, and subjective well-being. Proposition 2 predicts that if

Table 5: Zero-Sum Thinking or Demotivating Beliefs and Happiness or Life Satisfaction

		Measure of demotivating beliefs used:					
		Hard work brings success, 0 = fully agree to 1 = fully disagree	People are poor because of laziness, 0 = agree or 1 = disagree	People have a chance to escape poverty, 0 = agree or 1 = disagree	Humiliating to receive money without working for it, 0 = strongly agree to 1 = strongly disagree	Important to me to be successful, 0 = very much to 1 = not at all	How important is work, 0 = very important to 1 = not at all
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A: Self-Reported Happiness (0-1) as Dependent Variable							
Zero-sum thinking, 0-1	-0.051***						
	(0.002)						
Demotivating belief, θ		-0.046***	-0.045***	-0.043***	-0.019***	-0.045***	-0.038***
		(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Observations	246,094	329,899	62,055	64,833	103,517	156,835	398,525
R-squared	0.145	0.136	0.187	0.181	0.105	0.123	0.134
Mean dependent variable	0.688	0.694	0.653	0.653	0.696	0.707	0.692
Std. dev. dependent variable	0.249	0.246	0.255	0.254	0.243	0.244	0.248
Mean independent variable	0.405	0.365	0.701	0.599	0.346	0.394	0.159
Std. dev. independent variable	0.309	0.323	0.458	0.490	0.296	0.292	0.247
Panel B: Subjective Life Satisfaction (1-10) as Dependent Variable							
Zero-sum thinking, 0-1	-0.628***						
	(0.016)						
Demotivating belief, θ		-0.474***	-0.622***	-0.551***	-0.226***	-0.525***	-0.252***
		(0.013)	(0.022)	(0.020)	(0.025)	(0.021)	(0.015)
Observations	245,792	329,770	60,594	64,415	103,372	157,059	400,198
R-squared	0.173	0.164	0.246	0.242	0.167	0.132	0.172
Mean dependent variable	6.656	6.746	6.177	6.205	6.582	6.791	6.667
Std. dev. dependent variable	2.382	2.360	2.626	2.600	2.400	2.278	2.416
Mean independent variable	0.406	0.366	0.705	0.600	0.347	0.395	0.159
Std. dev. independent variable	0.310	0.323	0.456	0.490	0.296	0.292	0.247
Demographic controls	Y	Y	Y	Y	Y	Y	Y
Wave-country FE	Y	Y	Y	Y	Y	Y	Y

Notes: The table reports the relationship between zero-sum thinking or demotivating beliefs and happiness (panel A) or life satisfaction (panel B) using OLS estimates. An observation is an individual. In panel A, the dependent variable is happiness, which is measured based on a scale variable reporting respondents' answers to the question "Taking all things together, would you say you are," with zero indicating "Not at all happy" and one indicating "Very happy." In panel B, the dependent variable is life satisfaction, which is measured based on respondents' answers to the question "How satisfied are you with the financial situation of your household? '1' means you are completely dissatisfied on this scale, and '10' means you are completely satisfied, where would you put your satisfaction with your household's financial situation?" The independent variables are a scale ranging from zero to one with one representing "People can only get rich at the expense of others" and zero representing "Wealth can grow so there's enough for everyone" (column 1) and categorical variables, ranging from 0, representing agreement, to 1, indicating disagreement with the sentence – except the sentence "How important is work," where 0 means "very important" and 1 means "not at all" – (columns 2–7). All specifications include wave-country fixed effects. Demographic controls include age, age squared, gender, and their interactions. Coefficients are reported with robust standard errors in parentheses. ***, **, and * indicate significance at the 1, 5, and 10 percent levels.

one looks within a group k with a zero-sum environment α, then there is an optimal strength of demotivating beliefs θ^*. Within this group, material welfare is predicted to be hump-shaped in the strength of demotivating beliefs θ. By contrast, Proposition 3 predicts that, within the group, subjective well-being is maximized by the true (non-demotivating) belief $\theta = 0$, is strictly convex, and (mostly) decreasing in demotivating beliefs for a given zero-sumness of the environment α.

To test Proposition 2, we divide the sample into deciles based on respondents' perceived zero-sumness of their environment. We interpret a decile as being analogous to a group k, with a fixed level of α, in the model. To account for differences in language, gender, and age, which potentially affect reporting, we first net out country-wave fixed effects and demographic controls before creating the zero-sum deciles.

Within each decile, we then examine the relationship between each respondent's demotivating belief and their income level. We report estimates for the two measures of demotivating beliefs with the largest sample and multiple possible responses – i.e., not just agree/disagree – and thus allow us to test for the predicted hump-shaped relationship. The two questions are whether "hard work brings success" (N = 228,356) and "how important is work" (N = 224,534).[12] Figures 5 and 6 report the estimated relationships between demotivating beliefs and income. Consistent with Proposition 2, we see strong evidence of a hump-shaped relationship between demotivating beliefs and material welfare measured by income for virtually all zero-sum deciles.

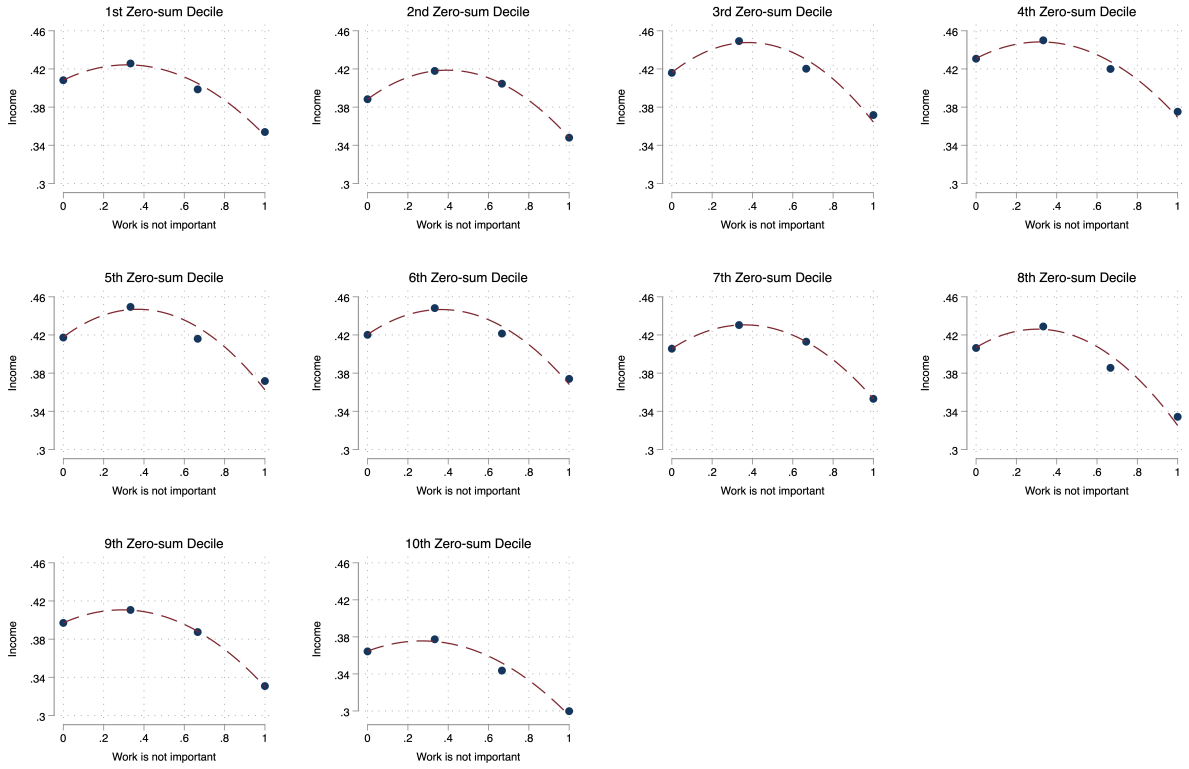
The results are similar if we do not account for demographic controls or country-wave fixed effects (Appendix Figures A7 and A8), if we use other measures of demotivating beliefs that are only available for smaller samples (see Appendix Figures A11 and A12).[13], or if instead of income we measure material welfare using savings (Appendix Figures A15 and A16), education (Appendix Figures A17 and A18), employment in a cognitively demanding occupation rather than a manually intensive occupation (Appendix Figures A19 and A20), supervising someone at work (Appendix Figures A21 and A22), and socioeconomic status (Appendix Figures A23 and A24).

In contrast to this pattern, and consistent with Proposition 3 and the accompanying numerical results shown in Appendix Figure A1, the same approach finds that subjective well-being,

[12]We find similar patterns for other measures of demotivating beliefs only available for smaller samples (see Appendix Figures A11–A14).

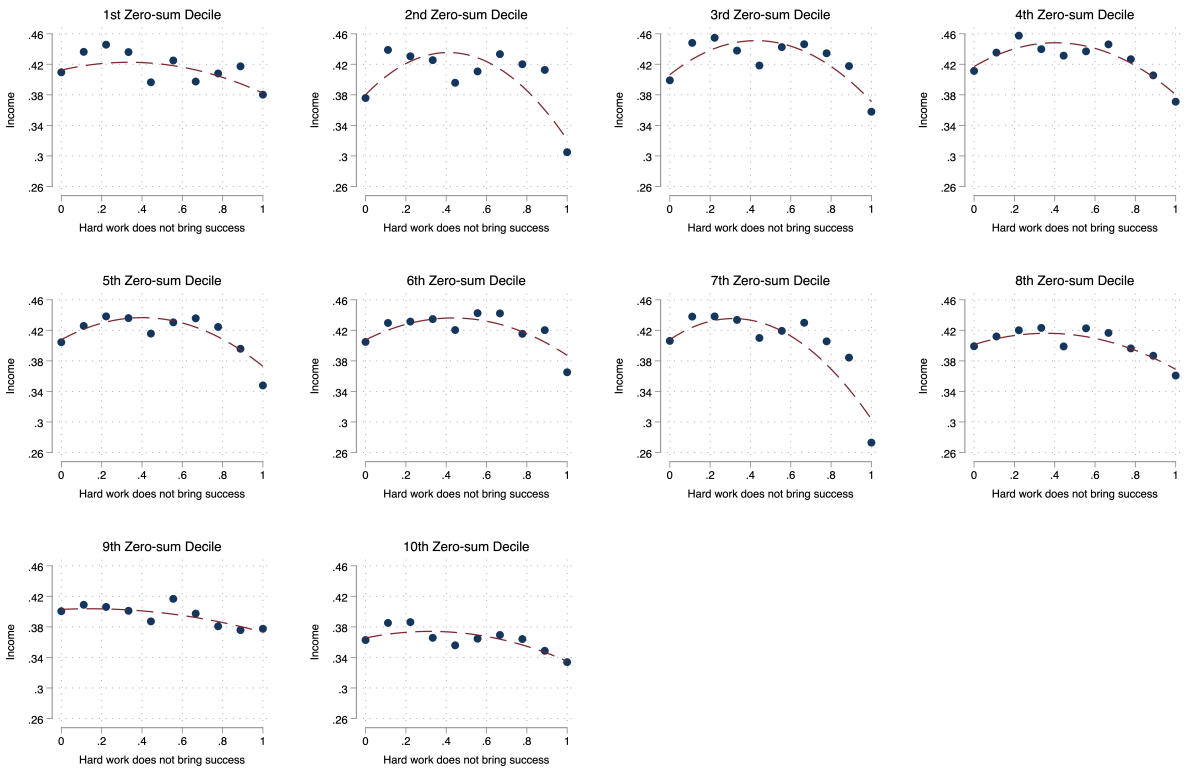
[13]We do not report the estimates for the two demotivating belief questions "People have a chance to escape poverty" and "People are poor because of laziness" because there are only two responses to these questions (agree or disagree), which prevents us from testing for a hump-shaped relationship.

Figure 5: Relationship Between Demotivating Beliefs and Income – Holding Constant Zero-Sum Thinking



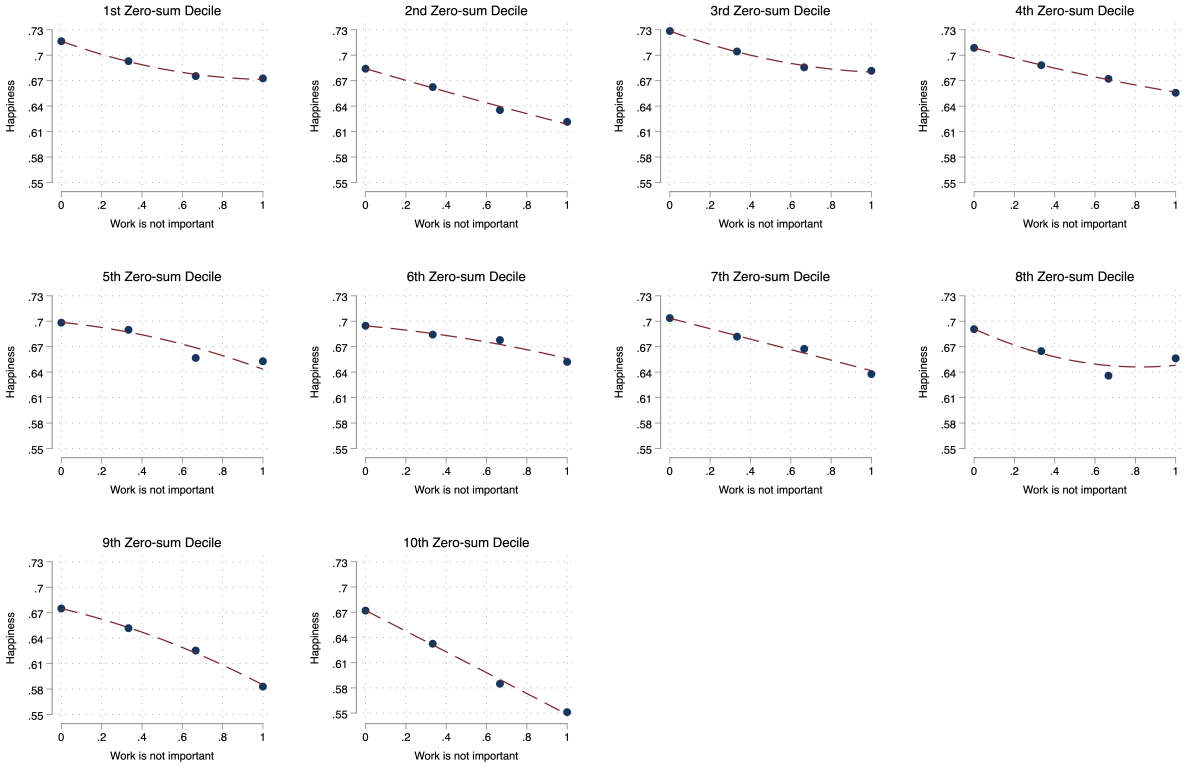
Notes: The figure reports the relationship between respondents' demotivating beliefs and level of income for each zero-sum decile. Country-wave fixed effects and demographic controls are netted out before creating the zero-sum deciles. The demotivating belief in this figure, is reported based on respondents' answer to the question (with work being the aspect respondents were asked the question about) "For each of the following, indicate how important it is in your life. Would you say it is," with options "1 Very important, 2 Rather important, 3 Not very important, 4 Not at all important." These responses are reverse scored so the variable is increasing in the demotivating belief "Work is not important at all." (N = 224,032).

Figure 6: Relationship Between Demotivating Beliefs and Income – Holding Constant Zero-Sum Thinking



Notes: The figure reports the relationship between respondents' demotivating beliefs and level of income for each zero-sum decile. Country-wave fixed effects and demographic controls are netted out before creating the zero-sum deciles. The demotivating belief in this figure, is reported based on how much respondents agreed with the statement "In the long run, hard work usually brings a better life" on a scale of one to ten, with one indicating complete agreement with the statement and ten indicating "Hard work doesn't generally bring success–it's more a matter of luck and connections." These responses are reverse scored so the variable is increasing in the demotivating belief "Hard work does not bring success." (N = 227,851).

Figure 7: Relationship Between Demotivating Beliefs and Happiness – Holding Constant Zero-Sum Thinking



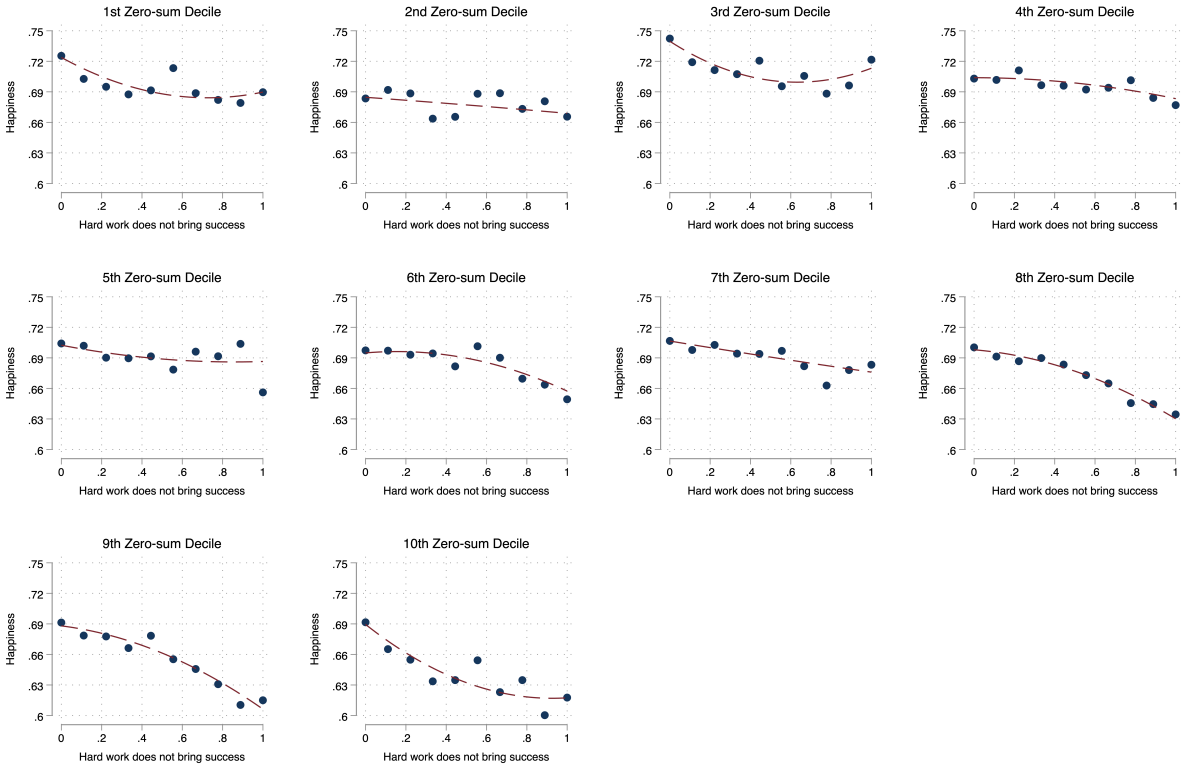
Notes: The figure reports the relationship between respondents' demotivating beliefs and level of happiness for each zero-sum decile. Country-wave fixed effects and demographic controls are netted out before creating the zero-sum deciles. The demotivating belief in this figure, is reported based on respondents' answer to the question (with work being the aspect respondents were asked the question about) "For each of the following, indicate how important it is in your life. Would you say it is," with options "1 Very important, 2 Rather important, 3 Not very important, 4 Not at all important." These responses are reverse scored to achieve the demotivating belief used in the figure "Work is not important at all." ($N = 239{,}865$).

measured by happiness, is highest for the least demotivating belief and is mostly decreasing in demotivating beliefs (Figures 7 and 8). Again, we find similar results when we do not account for demographic controls or country-wave fixed effects (Appendix Figures A9 and A10), when we use other measures of demotivating beliefs that are only available for smaller samples (Appendix Figures A13 and A14), or when we measure subjective well-being using life satisfaction (Appendix Figures A25 and A26) instead of happiness.

6. Long-Run Development: Beliefs and Innovation

Finally, we examine the implications of our theory for long-term economic development, which was a component of Foster's original argument. He hypothesized that the demotivating beliefs

Figure 8: Relationship Between Demotivating Beliefs and Happiness – Holding Constant Zero-Sum Thinking



Notes: The figure reports the relationship between respondents' demotivating beliefs and level of happiness for each zero-sum decile. Country-wave fixed effects and demographic controls are netted out before creating the zero-sum deciles. The demotivating belief in this figure, is reported based on how much respondents agreed with the statement "In the long run, hard work usually brings a better life" on a scale of one to ten, with one indicating complete agreement with the statement and ten indicating "Hard work doesn't generally bring success–it's more a matter of luck and connections." These responses are reverse scored to achieve the demotivating belief used in the figure "Hard work does not bring success." ($N = 243{,}927$).

created by zero-sum environments, in turn, adversely affect innovation and economic growth. To allow for this possibility, we make the level of technology, denoted by $A(t)$, endogenous and examine its co-evolution with the distribution of beliefs $\mathbf{q}$. While demotivating beliefs reduce a negative *contemporaneous* externality by limiting zero-sum competition, the model also predicts that such beliefs reduce a positive *intertemporal* externality from knowledge accumulation, trapping the economy in an underdeveloped state.

To say more about the expanded system $(\mathbf{q}, A)$, we need to specify a technology dynamic. We assume that technology cannot go below some subsistence level $\underline{A} > 0$. If $A(T) \leq \underline{A}$ for some $t = T$, then $A(T) = \underline{A}$ for all $t > T$. Otherwise, if $A > \underline{A}$, technological development is governed by the following equation of motion:

$$\frac{dA}{dt} = X(\mathbf{q}, A) - \delta A, \tag{11}$$

where $\delta \in (0, 1)$ is the rate of technological depreciation and again $X(\mathbf{q}, A)$ is the mean level of effort in the population given by equation (6).[14] The positive effect of effort on the rate of innovation could arise from learning-by-doing and knowledge spillovers from productive activity, as in Aghion, Caroli and Garcia-Penalosa (1999) and Gershman (2014).[15]

To examine the long-term effect of demotivating beliefs on development, we substitute (6) into (11) to get:

$$\frac{dA}{dt} \begin{matrix} > \\ = \\ < \end{matrix} 0 \iff A \begin{matrix} > \\ = \\ < \end{matrix} \frac{\delta}{\sum_{i=1}^{n} q_i (1 - \theta_i)^2} \equiv D^*(\mathbf{q}, \Theta). \tag{12}$$

We call $D^*(\mathbf{q}, \Theta)$ the development barrier.

As a benchmark, consider a degenerate set of beliefs labeled Θ^0 in which $\theta_i = 0$ for all i. In this case, all beliefs are true and not demotivating. The development barrier is $D^*(\mathbf{q}, \Theta^0) = \delta$. Starting from $A(0) > \delta$, there is perpetual technological progress and growth. Starting from $A(0) < \delta$ there is technological regress and contraction of the economy until $A(t) = \underline{A}$, the subsistence level. Hence a technological shock of size greater than $\delta - \underline{A}$ is required to transition the economy from the $A = \underline{A}$ steady state to perpetual growth. Now consider a non-degenerate belief system Θ. In this case, the development barrier $D^*(\mathbf{q}, \Theta)$ depends on $\mathbf{q}$. In particular, $D^*(\mathbf{q}, \Theta) > D^*(\mathbf{q}, \Theta^0)$ whenever there exists a belief such that $\theta_i > 0$ and $q_i > 0$.

[14] The results do not change qualitatively if we assume $\frac{dA}{dt} = (1 - \alpha) X(\mathbf{q}, A) - \delta A$, so that effort in zero-sum interactions does not contribute to innovation.

[15] The effort choices characterized here continue to hold even with forward-looking agents, because agents are non-atomic and thus do not individually affect mean effort.

Now write $(\mathbf{q}, A) \in \Omega(\Theta)$ if starting from $(\mathbf{q}, A)$ and given the set of beliefs Θ, $dA/dt > 0$ for all $t > 0$ under a payoff monotone cultural dynamic and the technology dynamic given by (11). That is, $\Omega(\Theta)$ is the set of states from which the *co-evolution* of beliefs $\mathbf{q}$ and technology A leads to perpetual growth.

By Proposition 1(i), for demotivating beliefs to spread under a payoff monotone dynamic from an interior state, there must exist $\theta_i \in \Theta$ such that $\theta_i < 2\sigma\alpha$ (which requires $\sigma\alpha > 0$). When Θ has this property, we refer to the environment as one that supports demotivating beliefs.

To assess the impact of beliefs on long-run economic development, we can compare technological progress in an environment that supports demotivating beliefs to technological progress under the degenerate set of beliefs Θ^0.

Proposition 7 . ***Demotivating Beliefs Undermine Technological Progress.*** *Suppose $\underline{A} < \delta$.*[16] *For any environment Θ that supports demotivating beliefs, the set of conditions from which there is perpetual growth is a strict subset of the set of conditions from which there is perpetual growth under the degenerate (non-demotivating) set of beliefs Θ^0:*

$$\Omega(\Theta) \subsetneq \Omega(\Theta^0).$$

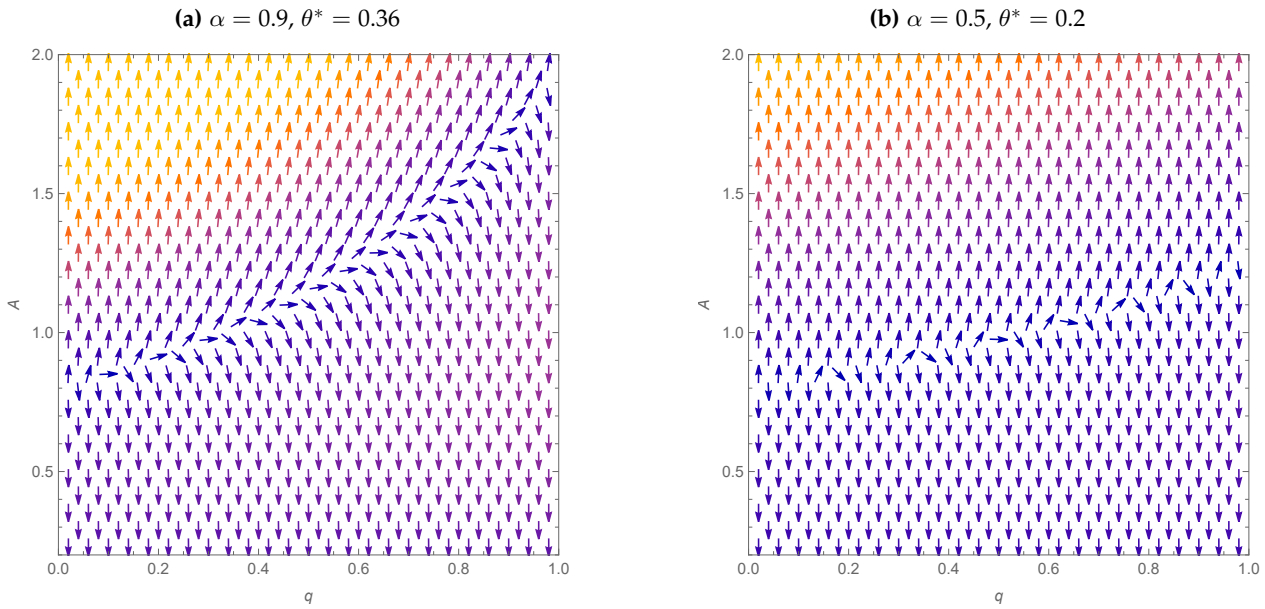
Removing demotivating beliefs expands the set of conditions that lead to perpetual growth. In this sense, demotivating belief systems can be viewed as a kludge (Ely, 2011). While they reduce wasteful zero-sum competition, they also create productive inefficiencies that can trap the economy in a low-technology state. Thus, it is harder for the economy to escape low levels of development in an environment that supports the demotivating belief.

Our model supports a potential connection between zero-sumness and long-term development. Define $\mathbf{q}^*(\alpha)$ as the state in which the entire population holds belief $\theta^* = \sigma\alpha$. We know the population converges to this state when $\theta^* \in \Theta$. The development barrier at such a state is $D^*(\mathbf{q}^*(\alpha), \Theta) = \frac{\delta}{1-\sigma\alpha}$, which is strictly increasing in zero-sumness α when there is positive sorting ($\sigma > 0$). Hence, any shock to an economy which lowers its degree of zero-sumness makes it easier for the economy to transition to perpetual growth.

To illustrate this visually, consider the stylized case where the set of beliefs consists of either the true (non-demotivating) belief 0 and the 'optimal' demotivating belief $\theta^* = \sigma\alpha$, i.e., $\Theta = \{0, \theta^*\}$.

[16]Note that $\underline{A} > \delta$ is a trivial case, in which there is perpetual technological progress from every initial condition regardless of θ.

Figure 9: Vector plot of (q, A) under belief set $\Theta = \{0, \theta^*\}$, where q is the population share of the 'optimal' demotivating belief θ^*. Parameter values: $\sigma = 0.4$, $\delta = 0.8$, $\underline{A} = 0.2$.



Let q be the population share of θ^* types and the cultural dynamic $\frac{dq}{dt}$ be the standard replicator dynamic. Vector plots are presented in Figure 9. Panel (a) depicts the case of high zero-sumness $\alpha = 0.9$. As $\sigma = 0.4$, the demotivating belief θ^* equals 0.36. The development barrier is the separatrix which rises from 0.8 when $q = 0$ to around 2 when $q = 1$. Panel (b) depicts a reduction in the degree of zero-sumness to 0.5 and a corresponding shift to the less demotivating belief $\theta^* = 0.2$, which is adapted to the new environment. We see that a reduction in zero-sumness, and the corresponding belief θ^*, speeds up growth and lowers the development barrier. This means that even if the drop in α is temporary, it can produce perpetual growth from states that would otherwise lead to technological regress. Again, cultural evolution of a less demotivating belief system is the channel through which a reduction in zero-sumness boosts growth.

This insight may inform the long-standing historical question of why the economic take-off of the industrial revolution of the late 18th and 19th centuries began in Western Europe in the second half of the second millennium CE (Mokyr, 2016). Consistent with the explanation provided by Henrich (2020), our model suggests that Europe's global expansion and colonialism after 1500 CE – including the Columbian Exchange – may have reduced zero-sum thinking through the emergence of new trading opportunities (Acemoglu, Johnson and Robinson, 2005), an inflow of new technologies and resources, like new crops (Nunn and Qian, 2010, 2011), fertilizers/guano

(Mann, 2012), and stimulants like sugar, coffee, and tea (Voth and Hersch, 2022), and a perception of seemingly limitless, though not unoccupied, land. Unleashed by colonialism and aided by the devastating impact of Eurasian diseases, this shock may have opened an exit ramp from the trap of zero-sum thinking. According to our theory, such effects could have triggered a cultural shift to a less demotivating belief system accompanied by higher effort exertion and more learning-by-doing. This cultural shift could have ushered in technological breakthroughs and a transition to modern, intensive economic growth.

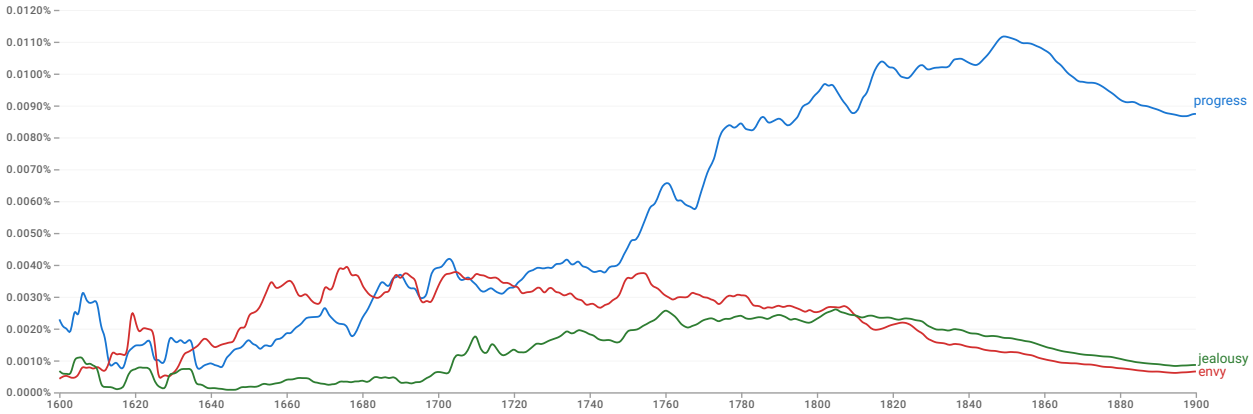
Several lines of historical evidence suggest a shift away from zero-sum thinking after 1500 CE. First, in a phenomenon called the "industrious revolution" (Vries, 2008), some European populations appear to have begun working longer and harder after 1600 CE (Voth, 1998, Clark, 1987, Henrich, 2020). Second, consistent with such behavior, McCloskey (2006, 2010, 2016) has argued that new *bourgeois virtues* that placed value on hard work, thrift, and consumption, were a necessary pre-condition for the Industrial Revolution. Max Weber (1930) and David McClelland (1961) also stress the importance of similar values – what they call *the spirit of capitalism* and *need for achievement*, respectively – for long-run growth and sustained economic development. Third, intellectual, economic, and moral *progress* started to become prevalent after 1500 (Wootton, 2016). Relatedly, Howes has argued that an "improving mentality" energized the British industrial revolution (Howes, 2016). Finally, at the same time that such positive-sum beliefs in progress were spreading in pre-industrial revolution Europe, witchcraft beliefs, accusations, and prosecutions were in decline and would eventually vanish (Macfarlane, 1999, Bever, 2009).

In our terminology, the emergence of these values constituted a shift to a less demotivating belief system, which promoted economic activity. Our theory suggests that this cultural shift might have been driven by colonialism and the expansion of international trade, the influx of new tools and techniques, and the sudden "availability" of vast tracts of land and other resources on the eve of the industrial revolution. We, therefore, posit a cultural relationship between colonialism, trade, psychology, and the Great Divergence.[17]

While a complete empirical examination is beyond the scope of this one paper, we provide

[17]In our model, a reduction in σ and the corresponding belief θ^* would also contribute to speeding up growth and lowering the development barriers. This prediction relates to work by Alger and Weibull (2010), who use an evolutionary analysis to shed light on how family ties affect incentives and economic development. Indeed, historians have argued that the onset of the Industrial Revolution was associated with weaker family ties due to migration from rural to urban areas (Laslett and Wall, 1972), changes in gender roles (Pinchbeck, 1969, Horrell and Humphries, 1995), and in the prevalence of child labor (Humphries, 2013). Thus, changes at the onset of the Early Modern period, which affected both α and σ would have had reinforcing and complementary effects.

Figure 10: Frequency of the words "progress," "jealousy," and "envy" from 1600 to 1900



Notes: The figure reports the frequency of the words "progress," "jealousy," and "envy" from 1600 to 1900. It is generated by the Google-N-grams viewer (Michel, Shen, Aiden, Veres, Gray, Team, Pickett, Hoiberg, Clancy, Norvig, Orwant, Pinker, Nowak and Aiden, 2010), which searches Google Books, predominantly in the English language, published in any country and available on Google Books' 2019 corpora.

some suggestive evidence for the plausibility of this interpretation. In particular, we use Google N-grams (Michel et al., 2010), to look at the frequency of the mention of progress, a non-zero-sum concept, in books published between 1600 and 1900. If a society or community is viewed as progressing (or having the ability to progress) and the condition of the group is improving, then the environment will not be zero-sum.

While acknowledging all of the relevant caveats when using historical counts from N-grams (see e.g., Pechenick, Danforth and Dodds, 2015, Younes and Reips, 2019), we see that, right around the time of the take-off of the Industrial Revolution (1750), there is a rise in the use of the word "progress," consistent with a reduction in zero-sum thinking. For comparison, we also show the pattern for two terms associated with zero-sum thinking: "jealousy" and "envy." We do not see the same pattern for these words; rather, we see a consistent decline after 1750.

Of course, these patterns do not prove that a change in zero-sum thinking and demotivating beliefs caused the Industrial Revolution, nor does our theory imply it. Instead, they suggest a possible self-reinforcing confluence of factors: environmental changes made the world less zero-sum, thereby shaping cultural beliefs and economic behavior and boosting technological innovation, which in turn altered the economic environment, continuing the process.

7. Conclusions

We have studied the evolution of demotivating belief systems, which can take a wide variety of forms: beliefs that success is primarily determined by luck rather than hard work, concerns about the envy of others (e.g., evil eye), witchcraft beliefs that cast suspicion on the origins of one's success, etc. We examined how these beliefs are formed and shaped by the nature of production and how they affect incentives for productive effort and economic development.

Motivated by the seminal work of the anthropologist George Foster and his "image of limited good," we first formalized the effects of a zero-sum view of the world on demotivating beliefs. Our analysis showed that demotivating beliefs can spread in environments where the production process and the resulting economic interactions tend to be zero-sum in nature, meaning that the gains from one individual tend to come at the expense of another.

We also showed that the effects of zero-sum production are very different depending on whether one looks within or across populations. Within a population, the model predicts a divergence between material welfare and subjective well-being: an intermediate demotivating belief maximizes income, whereas subjective well-being is highest for the true (non-demotivating) belief $\theta = 0$. Across societies, the model predicts a positive relationship between zero-sum thinking and demotivating beliefs and a negative relationship between zero-sum thinking or demotivating beliefs and both material welfare and subjective well-being.

Having developed a theoretical formulation of Foster's arguments, we then turned to the data, first examining two samples from the Democratic Republic of the Congo. In both, we found robust evidence that respondents with a more zero-sum view of the world report more envy about the success of others, stronger traditional religious beliefs, and weaker Christian beliefs.

We then turned to a global analysis using data from the World Values Survey. We first studied the relationship between zero-sum thinking and a range of demotivating beliefs, such as weaker beliefs in the value of hard work, the return to effort, the importance of success, and perceived shame from receiving money from others. We found a strong positive association between zero-sum thinking and these demotivating beliefs.

The broader sample also allowed us to test the model's predictions regarding the connection between zero-sum beliefs, effort, and economic outcomes. As expected, an individual's strength of zero-sum thinking is associated with lower incomes, less educational attainment, less savings,

and lower occupational status. We also found that zero-sum thinking and the resulting demotivating beliefs are associated with less happiness and lower life satisfaction.

We also used this broader sample to test the model's prediction that there is an optimal level of demotivating belief for a given level of zero-sumness of the environment. Indeed, we found that the relationship between demotivating beliefs and income is hump-shaped when holding constant the degree of perceived zero-sumness. Also, consistent with the model, the same procedure yields a negative relationship between demotivating beliefs and happiness. Thus, there is a divergence between material welfare and subjective well-being in environments where perceived zero-sumness is fixed. Although an intermediate demotivating belief maximizes income, a higher demotivating belief always results in less happiness.

Finally, we examined the model's implications for technological change and innovation. We added technology – which increases output and is endogenous to past effort – to the model and found multiple growth regimes: one where technology is low, effort is low, and technological change is minimal, and another one where technology is high, effort is high, and technological change is rapid. We also showed that a temporary decline in the zero-sumness of the environment can lead to a permanent transition from a low-growth regime to a high-growth one via a cultural shift to a less demotivating belief system. We discussed how these predictions provide insights and structure to our understanding of the cultural roots of the rise of Western Europe. Empirical tests of this cultural theory of the Great Divergence would be fertile ground for future work.

The notion of demotivating beliefs opens up new avenues for inquiry that test other implications and variants of our theory. For example, one could experimentally examine whether manipulations in the degree of rivalry in interactions cause changes in subjects' beliefs about the returns to effort (and belief systems more broadly). Also, our understanding of many contemporary events might be improved by considering them through the lens of zero-sum thinking. It is plausible that in recent decades the world has become more zero-sum, driven by increasing economic scarcity and rivalry. It is also possible that behavioral responses to this help explain the recent turn away from meritocracy in the United States (Sandel, 2020); the global increase in populism, nativism, and anti-elite sentiment (Guriev and Papaioannou, 2022); or the rise of incels in response to greater zero-sum competition and scarcity in dating markets (Brooks, Russo-Batterham and Blake, 2022). We view these as fruitful lines of future inquiry.

References

Acemoglu, Daron, Simon Johnson, and James Robinson, "The Rise of Europe: Atlantic Trade, Institutional Change, and Economic Growth," *American Economic Review*, 2005, *95* (3), 546–579.

Aghion, Philippe, Eve Caroli, and Cecilia Garcia-Penalosa, "Inequality and Economic Growth: The Perspective of the New Growth Theories," *Journal of Economic Literature*, 1999, *37* (4), 1615–1660.

Akerlof, Robert, Niko Matouschek, and Luis Rayo, "Stories at Work," *AEA Papers and Proceedings*, 2020, *110*, 199–204.

Algan, Yann and Pierre Cahuc, "Inherited Trust and Growth," *American Economic Review*, 2010, *100* (5), 2060–2092.

Alger, Ingela and Jörgen W. Weibull, "Kinship, Incentives, and Evolution," *American Economic Review*, 2010, *100* (4), 1725–58.

_ **and** _ , "Homo Moralis–Preference Evolution under Incomplete Information and Assortative Matching," *Econometrica*, 2013, *81* (6), 2269–2302.

_ **and** _ , "Evolution and Kantian Morality," *Games and Economic Behavior*, 2016, *98*, 56–67.

_ **and** _ , "Evolutionary Models of Preference Formation," *Annual Review of Economics*, 2019, *11*, 329–354.

Becker, Sascha O. and Ludger Woessmann, "Was Weber Wrong? A Human Capital Theory of Protestant Economic History," *Quarterly Journal of Economics*, 2009, *124* (2), 531–596.

Bénabou, Roland and Jean Tirole, "Belief in a Just World and Redistributive Politics," *Quarterly Journal of Economics*, 2006, *121* (2), 699–746.

Bever, Edward, "Witchcraft Prosecutions and the Decline of Magic," *Journal of Interdisciplinary History*, 2009, *40* (2), 263–293.

Bisin, Alberto and Thierry Verdier, ""Beyond the melting pot": Cultural Transmission, Marriage, and the Evolution of Ethnic and Religious Traits," *Quarterly Journal of Economics*, 2000, *115* (3), 955–988.

_ **and** _ , "On the Joint Dynamics of Culture and Institutions," 2017. NBER Working paper No. 23375.

Bohannan, Paul, "Extra-processual events in Tiv political institutions," *American Anthropologist*, 1958, *60* (1), 1–12.

Bowles, Samuel S., "Group Competition, Reproductive Leveling, and the Evolution of Human Altruism," *Science*, 2006, *314* (5805), 1569–1572.

Boyd, Robert and Peter J. Richerson, *Culture and the Evolutionary Process*, University of Chicago Press, 1988.

_ **and Peter J Richerson**, *The Origin and Evolution of Cultures*, Oxford University Press, 2005.

_ **, Herbert Gintis, Samuel Bowles, and Peter J. Richerson**, "The Evolution of Altruistic Punishment," *Proceedings of the National Academy of Sciences*, 2003, *100* (6), 3531–3535.

Brooks, Robert C., Daniel Russo-Batterham, and Khandis R. Blake, "Incel Activity on Social Media Linked to Local Mating Ecology," *Psychological Science*, 2022, *33* (2), 249–258.

Buggle, Johannes C. and Ruben Durante, "Climate Risk, Cooperation and the Co-Evolution of Culture and Institutions," *Economic Journal*, 01 2021, *131* (637), 1947–1987.

Carvalho, Jean-Paul, "Veiling," *Quarterly Journal of Economics*, 2013, *128* (1), 337–370.

_ **and Michael Sacks**, "The Economics of Religious Communities," *Journal of Public Economics*, 2021, *201*, 104481.

_ **and** _ , "Radicalization," 2021. Working paper.

Cavalli-Sforza, Luigi Luca and Marcus W. Feldman, *Cultural Transmission and Evolution: A Quantitative Approach*, Princeton: Princeton University Press, 1981.

Chinoy, Sahil, Nathan Nunn, Sandra Sequeira, and Stefanie Stantcheva, "Zero-Sum Thinking and the Roots of U.S. Political Divides," 2023. Working paper.

Clark, Gregory, "Productivity Growth without Technical Change in European-Agriculture before 1850," *Journal of Economic History*, 1987, *47* (2), 419–432.

Comaroff, Jean and John Comaroff, "Privatizing the Millennium: New Protestant Ethics and the Spirits of Capitalism in Africa, and Elsewhere," *Africa Spectrum*, 2000, pp. 293–312.

Cooper, Ben and Chris Wallace, "Group selection and the Evolution of Altruism," *Oxford Economic Papers*, 2004, *56* (2), 307–330.

Ely, Jeffrey C., "Kludged," *American Economic Journal: Microeconomics*, 2011, *3* (3), 210–231.

Enke, Benjamin, "Kinship, Cooperation, and the Evolution of Moral Systems," *Quarterly Journal of Economics*, 2019, *134* (2), 953–1019.

Esponda, Ignacio and Demian Pouzo, "Berk–Nash Equilibrium: A Framework for Modeling Agents with Misspecified Models," *Econometrica*, 2016, *84* (3), 1093–1130.

Fernandez, Raquel, "Women, Work and Culture," *Journal of the European Economic Association*, 2007, *5* (2–3), 305–332.

Fernández, Raquel and Alessandra Fogli, "Culture: An empirical investigation of beliefs, work, and fertility," *American Economic Journal: Macroeconomics*, 2009, *1* (1), 146–177.

Flouri, Eirini, "An Integrated Model of Consumer Materialism: Can Economic Socialization and Maternal Values Predict Materialistic Attitudes in Adolescents?," *Journal of Socio-Economics*, 1999, *28* (6), 707–724.

Foster, George M., *Traditional Cultures, and the Impact of Technological Change*, New York: Harper, 1962.

_ , "Peasant Society and the Image of Limited Good," *American Anthropologist*, 1965, *67* (2), 293–315.

_ , *Tzintzuntzan; Mexican Peasants in a Changing World*, New York: Little Brown & Company, 1967.

_ , "A Second Look at Limited Good," *Anthropological Quarterly*, 1972, *45* (2), 57–64.

Frank, Robert H., "If Homo Economicus Could Choose his Own Utility Function, Would he Want One with a Conscience?," *American Economic Review*, 1987, pp. 593–604.

Freeman, Dena, *Pentecostalism and Development: Churches, NGOs and Social Change in Africa*, Palgrave Macmillan, 2012.

Gershman, Boris, "The Two Sides of Envy," *Journal of Economic Growth*, 2014, *19* (4), 407–438.

_ , "The Economic Origins of the Evil Eye Belief," *Journal of Economic Behavior & Organization*, 2015, *110*, 119–144.

_ , "Witchcraft Beliefs and the Erosion of Social Capital: Evidence from Sub-Saharan Africa and beyond," *Journal of Development Economics*, 2016, *120*, 182–208.

_ , "Witchcraft Beliefs as a Cultural Legacy of the Atlantic Slave Trade: Evidence from Two Continents," *European Economic Review*, 2020, *122* (3), 103362.

_ , "Witchcraft Beliefs Around the World: An Exploratory Analysis," *PLoS ONE*, November 2022, *17* (11), e0276872.

_ , "Witchcraft Beliefs, Social Relations, and Development," *Handbook of Labor, Human Resources and Population Economics*, 2022, pp. 1–30.

_ , "Witchcraft Beliefs and Subjective Well-Being," 2023. Working paper, American University.

Giuliano, Paola, "Living Arrangements in Western Europe: Does Cultural Origin Matter?," *Journal of the European Economic Association*, 2007, *5* (5), 927–952.

_ **and Nathan Nunn**, "Understanding Cultural Persistence and Change," *Review of Economic Studies*, 2021, *88* (4), 1541–1581.

Grosjean, Pauline and Rishabh Khattar, "It's Raining Men! Hallelujah? The Long-Run Consequences of Male-Biased Sex Ratios," *Review of Economic Studies*, 2018, *86* (2), 723–754.

Guiso, Luigi, Paola Sapienza, and Luigi Zingales, "Cultural Biases in Economic Exchange," *Quarterly Journal of Economics*, 2009, *124* (3), 1095–1131.

_ **,** _ **, and** _ , "Long-Term Persistence," *Journal of the European Economic Association*, 2016, *14* (6), 1401–1436.

Guriev, Sergei and Elias Papaioannou, "The Political Economy of Populism," *Journal of Economic Literature*, September 2022, *60* (3), 753–832.

Güth, W. and M. Yaari, "An Evolutionary Approach to Explain Reciprocal Behavior in a Simple Strategic Game," in U. Witt, ed., *Explaining Process and Change—Approaches to Evolutionary Economics*, University of Michigan Press, 1992.

Hamilton, William D., "The Genetical Evolution of Social Behaviour II," *Journal of Theoretical Biology*, 1964, *7* (1), 17–52.

Henrich, Joseph, "Cultural Group Selection, Coevolutionary Processes and Large-Scale Cooperation," *Journal of Economic Behavior & Organization*, 2004, *53* (1), 3–35.

_ , "The Evolution of Innovation-Enhancing Institutions," in Stephen J. Shennan and Michael J. O'Brien, eds., *Innovation in Cultural Systems: Contributions in Evolutionary Anthropology*, MIT Press, 2009, pp. 99–120.

_ , *The WEIRDest People in the World: How the West became psychologically peculiar and particularly prosperous*, New York: Farrar, Straus and Giroux, 2020.

_ , **Maciej Chudek, and Robert Boyd**, "The Big Man Mechanism: How Prestige Fosters Cooperation and Creates Prosocial leaders," *Philosophical Transactions of the Royal Society B: Biological Sciences*, 2015, *370* (1683).

Holland, Heidi, *African Magic: Traditional Ideas that Heal a Continent*, Johannesburg: Penguin Books, 2001.

Horrell, Sara and Jane Humphries, "Women's Labour Force Participation and the Transition to the Male Breadwinner Family, 1790–1865," *Economic History Review*, 1995, *48* (1), 89–117.

Howes, Anton, "The Spread of Improvement: Why Innovation Accelerated in Britain 1547–1851," 2016. Working paper.

Humphries, Jane, "Childhood and Child Labour in the British Industrial Revolution," *Economic History Review*, 2013, *66* (2), 395–418.

Iannaccone, Laurence R., "Sacrifice and Stigma: Reducing Free-Riding in Cults, Communes, and other Collectives," *Journal of Political Economy*, 1992, *100* (2), 271–291.

Laslett, Peter and Richard Wall, *Household and Family in Past Time*, Cambridge University Press, 1972.

Macfarlane, Alan, *Witchcraft in Tudor and Stuart England*, London, UK: Routledge, 1999.

Mann, Charles C., *1493*, New York: Knopf, 2012.

Massari, Filippo and Jonathan Newton, "Learning and Equilibrium in Misspecified Models," 2020. Working paper.

McClelland, David C., *The Achieving Society*, New York: D. Van Nostrand Company, 1961.

McCloskey, Deirdre Nansen, *Bourgeois Virtues: Ethics for Age of Commerce*, Chicago: University of Chicago Press, 2006.

_ , *Bourgeois Dignity: Why Economics Can't Explain the Modern World*, Chicago: University of Chicago Press, 2010.

_ , *Bourgeois Equality: How Ideas, Not Capital or Institutions, Enriched the World*, Chicago: University of Chicago Press, 2016.

Michel, Jean Baptiste, Yuan Kui Shen, Aviva Presser Aiden, Adrian Veres, Matthew K. Gray, The Google Books Team, Joseph P. Pickett, Dale Hoiberg, Dan Clancy, Peter Norvig, Jon Orwant, Steven Pinker, Martin A. Nowak, and Erez Liberman Aiden, "Quantitative Analysis of Culture Using Millions of Digitized Books," *Science*, 2010, *331* (6014), 176–182.

Mokyr, Joel, *A Culture of Growth: The Origins of the Modern Economy*, Princeton, NJ: Princeton University Press, 2016.

Norenzayan, Ara, *Big Gods: How Religion Transformed Cooperation and Conflict*, Princeton University Press, 2013.

Nunn, Nathan and Leonard Wantchekon, "The Slave Trade and the Origins of Mistrust in Africa," *American Economic Review*, 2011, *101* (7), 3221–3252.

_ **and Nancy Qian**, "The Columbian Exchange: A History of Disease, Food, and Ideas," *Journal of Economic Perspectives*, 2010, *24* (2), 163–188.

_ **and** _ , "The Potato's Contribution to Population and Urbanization: Evidence from a Historical Experiment," *Quarterly Journal of Economics*, 2011, *126* (2), 593–650.

_ **and Raul Sanchez de la Sierra**, "Why Being Wrong Can Be Right: Magical Warfare Technologies and the Persistence of False Beliefs," *American Economic Review Papers & Proceedings*, 2017, *107* (5), 582–687.

Pechenick, Eitan Adam, Christopher M. Danforth, and Peter Sheridan Dodds, "Characterizing the Google Books Corpus: Strong Limits to Inferences of Socio-Cultural and Linguistic Evolution," *PLoS ONE*, 2015, *10* (10), e0137041.

Pinchbeck, Ivy, *Women Workers and the Industrial Revolution, 1750-1850*, New York: Augustus M. Kelley, 1969.

Platteau, Jean-Philippe, *Institutions, Social Norms, and Economic Development*, Vol. 1, Psychology Press, 2000.

Ranger, Terence O. and T. O. Ranger, *Evangelical Christianity and Democracy in Africa*, Oxford University Press, 2008.

Sandel, Michael J., *The Tyranny of Merit: What's Become of the Common Good?*, Penguin UK, 2020.

Sandholm, William H., *Population Games and Evolutionary Dynamics*, Cambridge, MA: MIT press, 2010.

Schulz, Jonathan F., Duman Bahrami-Rad, Jonathan P. Beauchamp, and Joseph Henrich, "The Church, Intensive Kinship, and Global Psychological Variation," *Science*, 2019, *366* (6466), eaau5141.

Spolaore, Enrico and Romain Wacziarg, "The Diffusion of Development," *Quarterly Journal of Economics*, 2009, *124* (2), 469–529.

Tabellini, Guido, "Institutions and culture," *Journal of the European Economic Association*, 2008, *6* (2-3), 255–294.

Verdier, Thierry and Yves Zenou, "Cultural Leaders and the Dynamics of Assimilation," *Journal of Economic Theory*, 2018, *175*, 374–414.

Voigtländer, Nico and Hans-Joachim Voth, "Persecution perpetuated: The Medieval Origins of Anti-Semitic Violence in Nazi Germany," *Quarterly Journal of Economics*, 2012, *127* (3), 1339–1392.

Voth, Hans-Joachim, "Time and Work in Eighteenth-Century London," *Journal of Economic History*, 1998, *58* (1), 29–58.

_ **and Jonathan Hersch**, "Sweet Diversity: Colonial Goods and the Welfare Gains from Global Trade," *Explorations in Economic History*, 2022, *86* (2), 101468.

Vries, Jan De, *The Industrious Revolution: Consumer Behavior and The Household Economy, 1650 to the present*, New York: Cambridge University Press, 2008.

Weber, Max, *The Protestant Ethic and the Spirit of Capitalism*, London, UK: Unwin Hyman Limited, 1930.

West, Stuart A., Ashleigh S. Griffin, and Andy Gardner, "Evolutionary Explanations for Cooperation," *Current biology*, 2007, *17* (16), R661–R672.

Whelan, Christopher T., "Marginalization, Deprivation, and Fatalism in the Republic of Ireland: Class and Underclass Perspectives," *European Sociological Review*, 1996, *12* (1), 33–51.

White, Cindel J. M., Michael Muthukrishna, and Ara Norenzayan, "Cultural Similarity among Coreligionists within and between Countries," *Proceedings of the National Academy of Sciences*, 2021, *118* (37), e2109650118.

Wootton, David, *Invention of Science*, Penguin, 2016.

Younes, Nadja and Ulf-Dietrich Reips, "Guideline for Improving the Reliability of Google Ngram Studies: Evidence from Religious Terms," *PLoS ONE*, 2019, *14* (3), e0213554.