

# Culture, Institutions, and Modern Growth

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## Introduction

In his *Understanding the Process of Economic Change*, North for the first time came to grips with the economic significance for economics of cultural beliefs and ideology. He repeatedly referred to them as “scaffolding” for institutions.<sup>1</sup> He pointed out that human beings try to “render their environment intelligible” and erect scaffolds, platforms that allow us to stand on and do things together. Scaffolds are thus constructions that “define the formal structure of incentives and dis-incentives that are a first approximation to the choice set.” But they also are the informal structure of norms, conventions, and codes of conduct... and the way the institutional structure acts upon and reacts to other factors that affect ... changes in the stock of knowledge.”<sup>2</sup>

In what follows, I propose to do three things: to unpack these definitions, and come up with a meaningful and useable definition of some Northian terms that could bear a bit of clarification. Second, I will propose to take a look at culture through the perspective of cultural evolution, and suggest ways in which we can understand how and why culture changes. Third, I make an attempt to apply ideas from this framework to provide an understanding of a special case of considerable interest to students of economic change, namely the British economy on the eve of the Industrial Revolution.

Culture, institutions, and behavior are actually easily and usefully separated and understood in terms of evolutionary theory. North, like the rest of us, was interested in understanding economic *behavior* and stressed that institutions are essentially incentives and constraints that society puts up on individual behavior. Institutions are by definition much like prices in a competitive market: individuals can respond to them differently, but they cannot change them.<sup>3</sup> Human behavior is first and foremost conditioned by “culture”,

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<sup>1</sup>The term in this context originates apparently in Andy Clark (1998). What is meant here is the cognitive structures such as language, religion, and other shared cultural beliefs that allow us to interpret our social and physical environment.

<sup>2</sup>In recent years, economists and economic historians have “rediscovered” culture. Early work by Greif (1994) and Peter Temin’s presidential address (1997) are examples of this development in economic history. In theoretical economics, the work of Samuel Bowles (2004) and Roland Benabou (2008) stands out, while in applied work, the pioneering paper by Knack and Zak (2001) and that of Guido Tabellini (2008) should be mentioned.

<sup>3</sup>McCloskey (2010, p. 300) criticizes this view, arguing in essence that incentives are overrated and that behavior is only at times described as responding to incentives and at other times it is best described as “improvisational comedy.” Instead she prefers “complex and interacting system of norms, structures, and cultural understandings that shape ... behavior.” Leaving aside the vagueness of terms such as “system” and “structures,” she misses the point that the existence of prices and rewards to certain behavior does not require that all agents respond to them rationally — all

and in the 2005 book North argued forcefully that without understanding culture, we cannot really understand why societies have the institutions they do. The definition of culture he borrowed from Hayek, as the transmission in time of our accumulated stock of knowledge,” but here “knowledge” was defined as including a kitchen-sink of “habits, skills, emotional attitudes” and, confusingly enough, “institutions.” This needs clarification. How should we separate “institutions” from “culture” and how do they both affect economic outcomes?

Institutions, that is, the rules by which society operates, both formal laws and social norms and customs, are heavily conditioned by what is believed by its members. Human behavior is something we observe, much like an individual phenotype, while culture is the “information” that underlies this, much like a genotype. “Institutions” in this kind of analogy is the environment that determines how cultural elements lead to behavior. But social theory is not like biology: in human history culture shaped institutions. If this were all there was to it, things would be simple enough: all we had to do is develop a theory of why people believe and like the things they do, and we would have arrived at a good explanation of their institutions and thus economic performance. Unfortunately, two major factors intervene here: first, institutions have a large aleatory component to them, so that seemingly similar cultures can lead to violently different institutional outcomes, as in the cases of North and South Korea or Costa Rica and Nicaragua. Small differences at critical junctures can make a big and persistent difference.<sup>4</sup> Second, there is a feedback from institutions to what people actually believe, although this feedback is not well-understood. By setting school curricula and influencing the media, existing powers can affect what people actually believe. At times it works to legitimize existing institutions, but not always. Seven decades of Marxist rules in Russia somehow failed to convert the bulk of Russians into believing in the class struggle and the principles of Leninist Revolution.

### **Culture and Evolution**

Defining culture once again might seem foolhardy, except that many scholars concerned with it seem

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it says that such costs exists and that individuals who fail to observe the rules pay some price. In that sense, indeed, thinking of institutions as analogous to budget constraints (which are set by relative prices) is quite helpful. She is, of course, correct in that institutions must be understood in conjunction with beliefs, that is, culture. In equilibrium, in order to be legitimate, institutions have to correspond to the beliefs of the society on which they are imposed.

<sup>4</sup>This is one of the main arguments of Acemoglu and Robinson (2011).

not to bother with precise definitions, which may lead to misunderstandings.<sup>5</sup> Culture is about those pieces of the mind that are not inherited and hard-wired in the brain; it is about elements that are learned from others. A definition consistent with much of the literature in cultural anthropology and that is sufficiently restrictive would be: *Culture is a set of beliefs, values, and preferences, capable of affecting behavior, that are socially (not genetically) transmitted and that are shared by some subset of society.* There may legitimate doubt whether this — or indeed any — definition of culture will ever be operational. But, as I shall try to show below, even if cultural groups are inevitably open-ended (who are the Jews, for instance), we can easily identify cultural elements. I also submit that using evolutionary terms will be a first step in making the concept more operational.

This definition requires a bit more elaboration: **beliefs** contain statements of a positive or factual nature that pertain to the state of the world, both the physical and metaphysical environment and social relations.<sup>6</sup> **Values** pertain to normative statements about society and social relations (often thought of as ethics and ideology), whereas **preferences** are normative statements about individual matters such as consumption and personal affairs. Clearly culture is decomposable, that is, it consists of cultural elements or features and such traits are largely shared by people of the same culture (much like genes shared by members of the same species), but each individual is unique in that it is unlikely that two people share precisely the same combination of cultural elements. It is important that it be collective: a single individual cannot have “culture” that is not shared by others anymore than one can be a member of a species without sharing the vast majority of one’s genes with others. Indeed, some would go as far as to say that culture can only exist as an interpersonal or social entity, though that definition is not useful for my purposes. Furthermore, as has been pointed out many times, culture is a Lamarckian system, that is, culture involves social learning, so that one’s beliefs, values and knowledge are learned from others.

What about outcomes (or, to pursue the analogy, phenotypes)? It seems useful to separate observable *behavior* (that is, actions) from *culture* that directs, motivates, and guides it. In determining these outcomes,

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<sup>5</sup>Eric Jones otherwise perceptive book (2006) does not provide a precise definition and thus opens itself to possible misunderstanding (Grantham, 2007).

<sup>6</sup>As such, “beliefs” should be interpreted as to contain *knowledge*, both codifiable and tacit, as well as human skills and capabilities. Greif’s (1994) notion of cultural beliefs concerns expectations about the behavior of others would be included in this definition, as would religious beliefs and useful knowledge.

cultural and hard-wired motives are intertwined, but the hard-wired component is largely identical across societies. Not all beliefs matter to economic (or indeed any) behavior. A great deal of culture, much like junk DNA that does not code for any known proteins, just “is” in our minds, and conditions no identifiable actions. All the same, an analogy that sees culture as “genotypical” and actions as “phenotypical” is only very approximate, and caution is called for in employing it.

The third element in this set-up are institutions. Institutions, of course, were central to North’s interpretation of History. Greif (2006), in his magisterial attempt to define historical institutions with care, points out a problem with the basic “institutions-as-rules” idea, namely that without a meta-rule that rules should be respected and followed, rules and laws may well be empty. Moreover, as Szostak (2009, p. 234) notes, many institutions are little more than the “codification” of beliefs. Thus, an aversion of violence in a society may lead to formal legislation against it. But this seems to be precisely the clue to an operational distinction between the two. A cultural belief that the use of drugs is bad will give rise to an institution that mandates prison terms for drug use.<sup>7</sup> For my purposes, then, it seems best to define culture as something entirely of the mind, which can differ from individual to individual and are, to some extent, a matter of individual choice, whereas institutions are socially-determined conditional incentives and consequences to actions. As noted, these incentives are parametrically given to every individual and therefore create the structure of incentives in this society. Institutions as “rules” can be seen as a special case: the rules specify a certain behavior to be proper and legal, but also specify the penalties for breaking them and the rewards for meeting them.<sup>8</sup> Greif’s problem is solved by him by stressing that the set of cultural elements includes the *legitimacy* of existing institutions, that is a belief that these institutions are just and beneficial and that therefore the rules should be complied with, and that those who break them should be punished. Indeed, as he has pointed out, institutions do not arise by decree alone. Those who issue them, from Hammurabi to Napoleon, have to have some cultural authority assuring that people are willing to live by the decrees that

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<sup>7</sup>Indeed, narcotics illustrate the full gamut of our definition of culture: “beliefs” contains a concept that narcotics may harm one’s or others’ health; “values” the notion that a society in which others use drugs is a bad society or that there is something ethically wrong with drugs; “preferences” simply means that one does not like to use them. All three contribute to a society that sets up institutions that heave penalties on their use.

<sup>8</sup>This is a variation on Bowles (2004, pp. 47-48) who defines institutions as “laws, informal rules, and conventions that give a durable structure to social interactions... and make conformity a best response to virtually all members of the relevant groups.”

they issue. All the same, legitimacy can be and is often contested, and thus the political struggles around institutions, and the need to punish those who violate the rules.

How have economists employed the concept of culture in trying to understand economic change as well as persistence over time?<sup>9</sup> The mechanism through which culture is believed to have affected economic performance is primarily through ideas of trust and cooperativeness, as well as willingness to abstain from free-riding behavior and their beliefs regarding the behavior of others.<sup>10</sup> The importance of these elements was already pointed out by John Stuart Mill, and has recently been shown to explain income differences between nations (Zak and Knack, 2001; Guiso, Sapienza and Zingales, 2006; Tabellini, 2008). The main mechanism through which this works is through the notion that trust and reputation reduce transactions costs and opportunistic behavior and thus make commerce easier and cheaper, reduce rent-seeking, and lead to a more efficient allocation of *existing* resources.

More recently, economists have become interested in preferences relevant to economic growth: attitudes toward education, work, time, patience, self-control, discipline, and similar areas. They also help determine, for instance, whether preferences might be “other-regarding” that is, whether the consumption of others affects one’s well-being and whether they might be “process-regarding” — that is whether the utility one derives from a good depends on the way a certain state was reached rather than on the intrinsic quality of the state itself (Bowles, 2004, p. 109; Bowles and Gintis, 2009). Both of those types of preferences are not normally part of economic preferences, but there is no inherent reason why they should not. There are myriad ways in which such preferences would affect economic growth, as they lead to the accumulation of physical and human capital, more and harder work, and the ability to cooperate with others on public projects and commons-management.

Can evolutionary models help us understand these processes? In recent years economists such as Galor and Moav, 2002 and Clark, 2007 have come back to Darwinian models of culture and tried to find in them keys to modern economic history. Their arguments are basically that certain subsets within society

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<sup>9</sup>The literature on the topic has been growing by leaps and bounds. Especially striking examples are Guiso, Sapienza and Zingales (2008); Dell (2011); and Voigtländer and Voth (2011).

<sup>10</sup>In Greif’s (1994, p. 915) terms, cultural beliefs are the expectations that individuals have about the actions that others will take. To that we should add the further belief that individuals hold regards the morality of a particular action.

displayed cultural characteristics that increased their fitness in society and at the same time exhibited certain characteristics consonant with economic growth. Through differential reproduction, these groups increase their relative size in the population to the point where they can alter the trajectory of the economy. There is nothing wrong with this approach in principle, except that differential reproduction of human individuals seems too slow a process to accomplish this in even a few centuries. More importantly, it seems to leave out the more interesting aspects of culture, namely that beliefs and preferences are not received just from one's parents but actually absorbed from others, such as peers, teachers, and influential strangers.<sup>11</sup>

The more plausible way to use evolutionary models in economic growth, then, is to take the cultural element such as ideas, beliefs, or “memes” to be the unit of selection rather than its carrier. This is what I will call “choice-based social learning.”<sup>12</sup> The historical argument I will make is that not *all* culture is absorbed vertically from one's parents (or from a “random” individual in society as in the Bisin-Verdier (2001) model). People can be *persuaded* by others; they learn and imitate and in so doing, they make choices. They accept some options and reject others. While their capability to do so is highest at a young age, it never quite goes away, as the example of Douglass C. North's intellect proves abundantly. What matters to history is that the proportion of culture absorbed from non-parents changes over time as technology and modes of transmission were transformed, and that the content individuals absorbed from others changed. This points to the large and important difference between cultural and natural evolution: in the former the speed of change depends not only on the frequency of innovations (“mutations”), but also on the rate of cultural transmission. All the same, this does not invalidate the analogy.

Darwin was the first to point out in his *Descent of Man* that culture exhibited certain evolutionary characteristics.<sup>13</sup> The analogy, as much of this extensive literature has noted, consists of three elements. One

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<sup>11</sup>In her popular *The Nurture Assumption*, Harris (2009) amasses a great deal of evidence to show that the cultural impact of parents on their children in today's society is very limited. In her view, based on a great deal of evidence, social behavior is largely the result of the interactions of children with their peers, that is, other children, and that parents have only limited effect on their children past the toddler years.

<sup>12</sup>In principle, the three processes go on simultaneously on multiple levels: selection on cultural elements, selection on individuals displaying these traits, and selection on societies in which such individuals are common.

<sup>13</sup>Darwin made this point especially poignantly with respect to language, one of the main components of any culture. See Darwin (1859/1871), p. 466. The classic works in the mid 1980s were by Cavalli-Sforza and Feldman (1981) and Boyd and Richerson (1985). It has since become a cornerstone of a certain line of cultural argument associated with Richard Dawkins and his followers, who have tried to identify units of cultural analysis equivalent to genes.

is that cultures, much like species, have a broad *variation* of traits, and that many of these traits are shared among certain groups of individuals and distinguish them from those belonging to other groups. Yet the lines are often blurry, as they are between species, and overlaps are common. The second is that culture, much like genes, is passed on from generation to generation, through mitosis in eukaryotic cells and through socialization and choice-based social learning in cultural processes. Children are being socialized at a high rate by other individuals, but the socialization of young individuals is not all there is to choice-based cultural evolution; adults can be subject to persuasion and other forms of cultural ontogeny and engage in choice-based learning albeit at a declining rate.<sup>14</sup> The third is that change is adaptive in that when there is a change in the environment, there is a tendency of cultural traits to change through the retention of some and the elimination of other elements. The exact unit (or level) on which this selection operates is at the very center of the story, as we shall see below. Again, it is important not to push the evolutionary analogy too far, looking for units such as memes that would be similar to genes and even be “selfish” like them. Evolutionary models are larger than Richard Dawkins, even larger than Charles Darwin.

What is actually gained from an evolutionary approach? Economists still committed to a Popperian notion that science should make some kind of falsifiable predictions will find little of use here; but historians trying to make sense of the past will find some of its implications helpful. Below I list some of the main advantages of an evolutionary approach to an economic history that tries to account for cultural elements.

First, evolution is about the interaction between a pre-existing environment, in which an innovation is introduced, and the innovation itself. The exact nature of innovation remains a stochastic variable, even if innovations are not purely random (as mutations are in a purely Weismannian world). We may never know precisely why a certain idea occurs to an individual at a particular time, and why in some societies certain ideas never seem to have occurred to anyone. But even if the nature of innovations were predictable, we would not be able to predict with much certainty their success, unless we could establish in advance their “fitness” relative to the environment in which they take place. Yet, as has been pointed out many times before, there is clearly an impossibility theorem here: we cannot predict its fitness because when an idea

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<sup>14</sup>Social values may be part of the life cycle, as illustrated by the famous and often misattributed quote, now a cliché, implying that people are liberal or socialist at a young age and become more conservative with age. The original statement appears to be due to the nineteenth-century French politician François Guizot.



“infects” more and more individuals, it may start changing institutions and thus the environment in which it operates (recall that for an individual the institution is parametrically given, but a sufficiently large number of people can bring about institutional change and thus change the “environment” in which the innovation finds itself). Evolutionary models, most emphatically, forewarn us against hindsight bias, the mistaken belief that eventual outcomes were inevitable or even highly probable *ex ante*. Steven Jay Gould has asked if we rewound and replayed life’s tape, whether the history of life would look the same, and answered in a resounding negative (Gould, 1989, p.48). How different, exactly, it would be is of course disputable.

Second, evolutionary systems are characterized by a fundamental *duality* between information and action, between genotype and phenotype. Distinctions between genotype and phenotype are hazardous to extend to cultural history, but all the same, it seems, something can be learned. Culture is about matters of the mind; behavior and actions are the observable outcomes of preferences and knowledge. But, as already noted, there is no easy mapping from beliefs to behavior any more than there is from genes to phenotypes; at best there are loose statistical associations. One reason is that beliefs, much like other genotypical processes, affect “adjacent” beliefs. We can indeed speak of cultural pleiotropy, much like in evolutionary processes. *Pleiotropy* means that a certain genotypic change leads to more than one phenotypical effect, because of the spillover effects on genes in the proximity of the mutation, in a sort of genetic packaging. A similar packaging exists in cultural beliefs.<sup>15</sup> A mirror-opposite phenomenon is *epistasis* in which more than one piece of information is required to jointly bring out a certain trait or behavior. Such “bundling” occurs very often in economically relevant beliefs. The rise of “capitalist behavior” may have required a growth in the belief in the virtue and dignity of commercial activity (McCloskey, 2010), together with a growth in the belief in the value of useful knowledge, as well as a growth in the taste for luxury goods.<sup>16</sup>

Third, the dynamics of evolutionary systems is produced by superfecundity and selection. The system throws up more variants than it can possibly accommodate, and so some form of winnowing must take place.

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<sup>15</sup>Thus being an evangelical Christian or a liberal Democrat normally involves a certain package of cultural beliefs and preferences about many social and political matters, ranging from abortion to Pinot Grigio.

<sup>16</sup>A good example can once again be found in the history of technology. In Mokyr (2002) I distinguish between propositional knowledge and prescriptive knowledge. There is no easy mapping between the two. There are times when techniques are used with virtually no understanding of why and how they work. At other times, the necessary underlying knowledge may well be there, but the techniques fail to emerge. The most rapid progress, however, occur when the two types of knowledge (say, theoretical mechanics and mechanical engineering) emerge together.

The notion of natural selection in biology is purely metaphorical, but in cultural systems the idea of choice-based cultural evolution requires that people actually make conscious choices to choose one cultural element over another and then display the behavior implied by this choice. Choices are made by agents, but they choose cultural variants neither as the perfectly rational agents of standard economics nor as the mindless mechanical replicators of biological models. Instead they are somewhere in between. In Bowles's words, they are "adaptive agents" who learn when exposed to new cultural variants, and choose whether to adopt them or not (Bowles, 2004, p. 60), using a variety of criteria or "biases," to which I will return below. Furthermore, as John Ziman (2000, p. 50) has pointed out, selectionist models consist of dynamical magnification of *rare events*. This is as true when we think of successful mutation or recombination in nature as when we think of macroinvention and cultural innovation in human history. After all, cultural choices are made, but they are made very infrequently — few people are pro-life on Monday and pro-choice on Friday.

Fourth, evolutionary models are rich in that they allow change to occur on different selection levels. To see this, consider a cultural trait offered to an individual in a particular society. If the individual chooses the variant and not another, this is one level of selection at which choice-based cultural evolution occurs. Now assume, however, that the variant in question increases the fitness of this individual and thus extends his life expectancy and/or the number of surviving children who resemble him. Higher fitness increases the chances that the trait will be passed on, either vertically through the socialization of offspring or horizontally through infecting his immediate neighbors. Finally, suppose that society has now adopted the trait, and that it increases the fitness of this society (e.g., through more cooperation or adopting a superior technique); this may mean a higher population growth rate in a society that has adopted this trait, and thus is likely to increase its frequency in the global population. Because cultural evolution happens at all levels, it can be at times lightning fast and at others move at a tectonic rate, as Eric Jones (2005, pp. 47–48) has noted.

Fifth, like all evolutionary systems, culture is resistant to change. In the technical language of evolutionary dynamics, prevalent cultural variants are evolutionary stable strategies with respect to most conceivable innovations ("mutants"). There are built-in mechanisms that maintain a certain stability, but the effectiveness of such mechanisms is itself a function of the content of the system. For instance, a religious culture that is out of tune with other cultural elements (say, people's moral predilections) may either adapt to reflect new beliefs, or cling to increasingly antiquated beliefs if the power structure within the

organizations depends on these beliefs (as is the case with the Catholic church today). But no matter what kind of cultural system we are looking at, there will be some resistance to change, and many seemingly “fit” innovations will fail in a hostile institutional environment.

Sixth, evolution implies that any easy generalizations about the speed and direction of cultural change are doomed. Most of the time culture changes at a tectonic pace, surviving dramatic institutional and political shocks. But there are instances when culture changes quickly as a result of weakened resistance, perhaps, or some powerful exogenous shock that challenges existing cultural beliefs deeply. An example would be attitudes toward race and women’s rights in the US in the last decades of the twentieth century, or the attitudes toward Zionism following the holocaust. More important, it makes predictions about the precise *direction* of cultural change extremely hard to make. Much like evolutionary science, the strength of the methodology is in helping us make sense of the past rather than predict the future. Precisely because the unit of analysis continuously interacts strongly with its environment and because there are few time-invariant relations, it becomes unpredictable (Saviotti, 1996, p. 31). If cultural change had been less chaotic in its behavior, history would have been a lot less sad and interesting.

### **Biases in Cultural Evolution**

If socialization occurs through nonparental (oblique or horizontal) channels, choice-based social learning or cultural transmission can be subject to what Boyd and Richerson call “biases.” What is meant by bias here is that cultural choices follow certain identifiable patterns that make people choose one cultural element over another (Richerson and Boyd, 2005). The type of bias and the rate of bias depend on the technological parameters of cultural transmission and on the cultural and institutional structure themselves. The more a child or adult is exposed to “menus” of cultural variants different from the ones offered by her or his parents, the more important such biases will be. The printing press, open science, mandatory schooling, and mass communications are natural developments that clearly affected the significance of such biases. At times, of course, even with oblique or horizontal transmission, parental culture was reproduced. If parents choose teachers much like themselves, or if there is little cultural variance in the community (e.g., in the Israeli Kibbutz before 1970, when children were not socialized by their parents as much as by the representatives of the community), the bias may be quite small. But in most societies, we can discern the

operation of a variety of biases. They can be conveniently classified into the following categories.

**Content-based bias:** People pick cultural variants different from the ones they were taught by their parents because of the inherent qualities of the content of the new options. At times people look at the evidence, but often they try to judge a variant insofar that it is consistent and reconcilable with other beliefs they hold. They are convinced by new facts (or at times try to ignore them, as in Benabou 2008), or by new and persuasive theories. Thus, for example, Darwinism, which cast a new light on the evolution of species, had deep (and unintended) consequences for the cultural beliefs of certain groups. It was judged on the basis of its merit, but for a large number of people it clashed with other beliefs they held and was thus rejected. Marxism was another new item on the cultural menu of the second half of the nineteenth century, which persuaded many people to change their beliefs on the basis of the new cultural variant's inherent logic, and its ability to fit the facts and allow people to interpret their environment.

But how do people exactly assess content? Why do some people choose to become Marxists or believe the germ theory of disease and others do not? Some knowledge and cultural beliefs are *tight*, which is to say, they are supported by a preponderance of easy-to-evaluate evidence so that there is little to choose from.<sup>17</sup> Few people in the twenty-first century hold on to the Ptolemaic universe, believe that smoking tobacco is safe, or think that a collectivist economic regime will bring about economic prosperity. But in many cases, when knowledge is untight or more complex to evaluate, beliefs may not become fixed in the population. This often leads to unpredictable distributions: Few Americans believe that the earth is flat and that infectious diseases are caused by miasmas, but the theory of evolution is another matter.<sup>18</sup> It may be concluded that unless there is a relatively obvious and straightforward way of evaluating a cultural belief, people may prefer to choose cultural variants that are somehow consistent with their other beliefs and form

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<sup>17</sup>As I have argued elsewhere (e.g., Mokyry, 2002, p. 6), it matters little whether the cultural variant chosen is in some in some definable sense "correct." What does matter, however, is whether it is "effective." By that I mean that it is consistent with other objectives that this society has. Thus if society prefers health over sickness, as seems plausible, then medical theories that imply techniques that actually make people better would be more likely to be chosen. The historical difficulty is, however, that evaluating the effectiveness of techniques, especially in medicine, may be quite difficult without large data bases and the ability to analyze them.

<sup>18</sup>A 2009 Gallop Poll reported that 39 percent of Americans believed in the Theory of Evolution whereas 25 percent did not and 36 percent had no opinion. The proportion of believers in evolution rose, as would be expected, with education and declined with the frequency of church attendance. See <http://www.gallup.com/poll/114544/darwin-birthday-believe-evolution.aspx> (accessed July 5, 2010).

a coherent whole. As noted above, cultural variants tend to be subject to pleiotropic effects, that is, adjacent beliefs tend to occur together. We observe that cultural beliefs occur in clusters: those Americans who hold on to evangelical religion also tend to think that widespread gun ownership is desirable, abortion and narcotics should be illegal, that marriage should be confined to heterosexual couples, the Bible should be taken literally, and object to large scale federal redistribution policies, although logically these beliefs are not all obviously connected.

**Direct bias:** A central feature of all social learning is that society appoints cultural authorities who have great influence on others' cultural beliefs.<sup>19</sup> Such authorities are of course especially important in religious contexts (priests), but they are just as central in modern society, in which "experts" such as scientists, physicians, and other experts become central in helping others decide what is true, safe, effective, and moral. One reason is that highly complex social and physical processes are often impossible for laymen to comprehend, yet they may be essential to underpin certain important cultural beliefs. Subtle statistical models and sophisticated experimentation may be needed to discriminate between important conclusions about, say, the effects of nutrition or the causes of crime. Especially in the subset of cultural beliefs that I have referred to as "useful knowledge," those that underpin production techniques in use, authorities and trusted experts are indispensable because such knowledge can operate effectively only if there is a fine subdivision of knowledge through specialization.

The authority-driven choice-based social learning process requires society to solve two major problems. The first is the question who appoints such authorities, who monitors their reliability, and who appoints the appointers and the monitors. The second is the problem that if authority is too powerful and too entrenched, it may establish an *orthodoxy*, that is, it may act to reduce and possibly eliminate its own contestability and thus crystallize and make further progress through innovation increasingly hard. It is a hallmark of societies that are open and culturally dynamic that all authorities are contestable. We may define successful *cultural entrepreneurs* as people who successfully contest and overthrow existing authorities and create a new competing variant that catches on among a substantial subset of society. Every society has in

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<sup>19</sup>Greif (2011) provides a special case of this in what he calls "moral authorities" who are assigned to decide what is morally appropriate. This example generalizes to a host of other cultural dimensions: medical authorities make diagnoses, educational authorities set school curricula, and leading scientists determine what is appropriate science.

every generation men and women whose ideas are radically novel and, if accepted by a sufficiently large group, would change the cultural landscape in this society: this is one way of thinking about Martin Luther and Charles Darwin. Rapid cultural change occurs when a successful cultural entrepreneur either persuades existing authorities to adopt the innovation, or overthrows them and becomes an authority him or herself.

**Rhetorical Bias:** A bias can be imparted through persuasion, in which some charismatic and persuasive individual is simply very good at convincing others of the correctness of his or her views. Cultural entrepreneurs in many cases are successful not just on the basis of the message itself but also on the *framing* of their beliefs or theories. Historically, such persuasion often occurred through the disciples or epigones of cultural entrepreneurs. The doctrines of Marx were spread by such influential followers as Engels, Lenin and Mao Zedong, whose own cultural innovations were comparatively marginal, those of Keynes famously by John Hicks and Alvin Hansen, among others. The cultural variants that emerged as the result of this dissemination process were often modified and altered by apostles and interpreters: Marxism did not always follow what Marx wrote, any more than Calvinism was wholly described by Calvin.<sup>20</sup> Rhetorical techniques are of course important here: commercials and propaganda campaigns are rhetorically-sophisticated attempts to persuade people of certain cultural variants (they can be beliefs, values, or preferences) on the basis of form as much as or more than content.

**Model-based bias:** The beliefs of people who are “role models” or appear worth imitating create a model that others follow, because these traits are correlated with others that are deemed desirable. Individuals (or groups) observe cultural elements of the most successful members of society and will adopt their preferences and beliefs. Successful movie or sports stars are used to sponsor or endorse certain products or behaviors in the hope that their irrelevant but desirable qualities will induce others to adopt their apparent preferences or cultural beliefs. Such biases are a good illustration of the importance of framing effects in choice-based cultural evolution.

**Frequency dependence:** Individuals will often choose their cultural beliefs by simply determining what the majority of people in the relevant set around them believe. The logic of this bias is in part to save on

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<sup>20</sup>As Landes (2000, p. 11) remarks in his discussion of Calvinism, its original “hard belief in predestination did not last more than a generation or two (it is not the kind of dogma that has lasting appeal)”. One might even be tempted to add that the belief in predestination was doomed from the start.

information costs and in part to avoid the possible social sanction implied by differing from the majority. This conformism bias would tend to create homogenization, if it worked only in one direction. But there could be perverse frequency dependence through “rebellious” or deliberate non-conformist behavior, if such behavior was not penalized too severely. Indeed, in some models in which almost everyone conforms, it can be profitable to rebel. In the Bisin-Verdier framework, frequency bias is built-in, because parents can only choose between socializing their children themselves or having them socialized by a randomly chosen other individual in society. Parents may prefer to choose an educator who will resemble their values, but because of agency problems, a larger chance of transmission “errors” is introduced. Moreover, children will be subject to conformist biases when in contact with peers. The economic logic of frequency dependence is similar to direct bias: in making cultural choices and learning of new cultural variants, people are trying to save information costs, and thus the importance of frequency bias depends on the costs of ascertaining the characteristics of the cultural feature in question.

As to the perverse frequency dependence: such individuals presumably are the populations from which many cultural entrepreneurs originate. Institutions differ in the way they treat cultural deviants, from burning heretics and banishing innovators, to a free-wheeling live-and-let-live mentality. In that sense, of course, cultural choices are reflexive: one important cultural value is whether to tolerate other (possibly heterodox) values and to give new cultural elements a fair chance to compete in the market places for ideas and values. A belief in cultural (including religious) tolerance can especially be of great economic value when it is relatively rare; it allows an economy to attract and absorb religious refugees who tend to be creative and networked. The willingness of seventeenth-century Netherlands and the United States in more recent centuries to accept Jews and dissenting Christians contributed a great deal to their economies especially in high-skilled manufacturing and financial services.<sup>21</sup>

**Rationalization Bias:** One of the ways in which cultural change can take place or resisted is through the existence of a historically-given set of institutions, thus creating feedback from institutions to culture. There is an inherent tendency to internalize existing social norms and socially-mandated rules (Greif, 2011).

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<sup>21</sup>In Industrial Revolution Britain, where de facto religious tolerance had been part of society after 1660, some small religious groups such as Huguenots and Quakers played disproportionate large roles in the development of the economy (Mokyr, 2009, pp. 114, 362)

Suppose there is a law or social norm, such as a proscription on intimate relations with close relatives, that penalizes a certain action. Such penalties may make the action eventually seem undesirable *just* because there is a penalty associated with it. This might happen in an attempt to rationalize the institution (if it is punished, there must be a reason for it) or it may happen during the socialization by parents imbuing their children a sense of “sin” in some action that was punishable. What was once forbidden now becomes taboo. Some people tend to eat according to strict table manners even when they eat alone simply because they have internalized the rule of holding the knife with the right hand and a fork with the left. Yet the internalization of institutions and norms into preferences is probably evolutionarily unstable and can easily be “invaded” by a mutant, unless it is supported by some deeper ethical belief or other knowledge.<sup>22</sup> Thus people eating by themselves may drop their formal table manners but still wash their hands before eating for hygienic reasons.

**Coercion bias:** In a highly authoritarian or coercive society, cultural beliefs can be changed by force. Of course, one could never force people to *believe* certain propositions, only make them behave in ways they would not otherwise, that is, make them pretend as if they accepted the culture of the coercive authority. This can create preference falsification and what Greif and Tadelis have called, crypto-morality.<sup>23</sup> On the whole, such schemes are unstable and can lead to sudden collapses, such as the fall of totalitarian states and the sharp decline of the ideologies that supported them. But political rulers can control and manipulate oblique and horizontal transmission mechanisms (schools, churches, media, spontaneous meetings) and thus try to influence beliefs and enforce what could be called political socialization. The historical evidence that this actually works at the level of values, based on the evidence of political revolutions, from the French to the Russian to the Iranian, is rather mixed. But clearly schools and military service can reproduce certain elements of socialization such as a willingness to accept punctuality, discipline, temperance, and a belief in the virtuousness of obedience, hard work, and technology.

**Salient events bias.** Highly dramatic and traumatic events can have a discontinuous effect on culture through

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<sup>22</sup>An example would be the Jewish dietary laws. Jews who grew up eschewing pork do often not like eating pork even when they have given up on the observance of other rules. Yet unless one were to discover a good medical reason to not eat pork, eventually more and more non-kosher Jews will overcome this reluctance.

<sup>23</sup>Kuran (1991; 1997); Greif and Tadelis (2010).



powerful framing effects. Catastrophes such as the Black Death, the Holocaust, or 9/11 changed ideology and beliefs through the powerful challenge that such events could exert on existing beliefs.<sup>24</sup> An area in which such salient events are especially important is political ideology and the area of social “values” that pertain to the role of the state. Major and dramatic failures of the free market will create more support for a more regulated and managed economy (as happened in the industrialized West in the 1930s), whereas major failures of a managed economy such as the former Soviet bloc will increase support for a free market economy both in the affected areas and in those competing with them.

### **Culture and Growth**

How exactly does this kind of framework help us understand economic history, that is how does culture affect economic growth and change? There are three separate mechanisms that should, in principle, be kept apart.

The first and most obvious is that cultural beliefs are a critical variable in fostering *cooperation and thus exchange*. Trust, as has been pointed out many times, is a central transactions-cost-reducing device, and thus makes exchange at arm’s length easier and cheaper and affects the economy through Smithian-growth (Fukuyama, 1996). Related to trust is loyalty, which mitigates principal-agent problems. Public-mindedness or *asabiya* in Ibn Khaldun’s famous formulation, is another cultural element related to cooperation: the willingness to avoid free-riding and contribute to a collective good despite the incentive that each individual has to shirk is a third element. Economic performance, no matter how we look at it, needs a certain level of cooperation, and cannot accommodate an economy that consists entirely of extremely selfish free riders; principal agent issues and monitoring costs are just too pervasive.

Ideology is a mechanism by which society overcomes free-rider problems, as North has pointed out as early as 1981 (North, 1981, p. 31). Such public-mindedness includes the willingness to punish defectors, even if that comes at a personal price. The cultural elements that account for trust and loyalty tend to be

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<sup>24</sup>Less traumatic but very salient events can have similar effects on cultural beliefs and eventually on institutions. Two examples are the Great London Smog of December 1952, which sufficiently changed views of environmental pollution to lead to a slew of environmental legislation, and the Three Mile Island accident in the US in 1979, which changed the public perception of the cost-benefit calculus of nuclear power in the US and effectively ended the construction of new reactors.

frequency-dependent; anyone who observes that most others are trusting, loyal, and public-minded are more likely to be so themselves, and also be willing to penalize a few deviants who try to take advantage. The seminal work of Greif on the Maghribi traders is perhaps the best illustration of this kind of historical phenomenon, but there are many other examples.<sup>25</sup> Much less explored by economic historians, but of equal interest, is the importance of religion. Many religions postulated an omniscient and moral God who meted out justice to those who did not play by the rules and exhibited opportunistic behavior. Shariff et al (2009) postulate that cultural evolution favored a belief in a committed omniscient deity who cared about cooperative behavior and would punish individuals who displayed opportunistic behavior. This faith, they believe, led to a significant growth in cooperative behavior in societies where monitoring costs tended to be high and punishing defectors was difficult. It suggests altruistic behavior and an adherence to certain fairness norms even toward strangers. There is some experimental data to back this up, but the historical evidence here is not all that unambiguous.<sup>26</sup> It might be added that strong religious beliefs also contributed to the resolution of asymmetric information situations, as they were an element in trying to elicit truth-telling from participants by making witnesses swear a holy oath, with a strong implication of severe divine punishment if broken.

A second obvious nexus between culture and growth is through *individual virtues*, on which quite a lot has been written lately by economists representing very different viewpoints (McCloskey, 2006 and 2009; Doepke and Zilibotti, 2007), but much of this literature goes back to Max Weber and his views on the connection between individual morality and economic behavior. Virtues that are viewed as crucial for economic performance are frugality (important, obviously, to capital formation), industriousness (determining labor input and effort), temperance (which affects productivity), and charitableness (which helps reduce the fear of risk-taking). Of special interest here is a cultural propensity toward education and

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<sup>25</sup>Janet Tai Landa, for instance, has demonstrated such networks could enforce contracts among ethnically homogeneous middleman groups such as Chinese immigrants outside China (Landa, 1981, 1995).

<sup>26</sup>The argument is basically that in any non-cooperative setting it is costly to punish free riders, while the benefits are shared with non-punishers and thus create an externality and making cooperative outcomes more difficult to attain. Religious beliefs, by postulating an external punisher with low or zero cost of monitoring and punishing, would help solve this problem. This implies that religious societies, in which such beliefs were prevalent, would have higher inclusive fitness. Moreover, even if people were unsure about the existence of this supernatural punishing agency, it would be rational for them to stick to Pascal's wager and behave as if they believed in it. See for instance Johnson and Kruger (2004) and Johnson (2009).

human capital, some of which is driven by religion (Botticini and Eckstein, 2011; Becker and Woessmann, 2009). None of those “virtues” were guarantees of growth: education could be quite sterile, charitableness could lead to moral hazard, and excess frugality to lack of demand. But clearly a potential connection exists. Another important cultural feature that affects economic growth is an individualist vs a collectivist culture, which has been applied to British exceptionalism in a stimulating book by Alan MacFarlane (1991) and to economic growth in general in recent work by economists (Gorodnichenko and Roland, 2011). What also surely matters is whether values reward effort and talent rather than ancestry, identity, and political connections. Another value, with a more ambiguous effect of economic performance, is a preference for a more compassionate and egalitarian society, or whether “equal opportunity” matters more than “equal outcome,” and the redistribution implied by these policies.

A third nexus between culture and economic performance, and the one I shall focus on below, operates through the attitude towards “useful knowledge”, that is, that part of culture that concerns the understanding and exploitation of the physical environment. The systematic utilization of natural regularities and phenomena is the core of technology, and the willingness and ability to do so were very much part of culture. Economic progress through technological creativity is deeply affected by the cultural background of the advance of technology, that is, which elements in society’s beliefs and values are conducive to continuous technological progress and eventually brought about the great historical discontinuity of the eighteenth century.

There is more than one element at play here. One cultural variant in much of European culture that has not received its full due is the willingness of Europeans to adopt foreign ideas and techniques (see Mokyr, 1990, pp. 186–89). This in no way is to deny European xenophobia, arrogance, and barbarism toward non-Europeans. But the odd historical phenomenon is that despite the obvious contempt Europeans had for foreign cultures, they had few qualms about adopting their ideas and knowledge. This was already quite visible in the middle ages, and the relation between European culture and that of the Islamic world. The philosopher Ibn Rushd (Averroes) and the physician Ibn Sina (Avicenna) had a vast influence in the medieval West, and Europeans never felt the slightest shame in naming the revolutionary arithmetic system they adopted after 1200 “Arabic numerals” (even if they were not) and drinking beverages with alcohol (derived from the Arabic *Al Kohl*) in them. The eagerness to adopt foreign ideas and technology became a veritable

torrent after 1500, when the Europeans realized that there was a huge treasure of techniques, plants, and animals to exploit in the foreign lands they visited and then invaded. They named these techniques after where they were thought to have come from, from chinaware to turkeys. While such behavior sounds natural and normal to a modern observer, it is striking how much more difficult other societies before 1900 found it to adopt Western ideas and techniques. There is clearly a cultural element here, a pragmatic recognition that one can usefully distinguish between the character and religion of foreigners, which may be seen as repugnant, and their techniques and knowledge, which can be usefully adopted and adapted. But other factors played a role, above all the relentless competition between European polities at every level, which had accustomed them to imitate techniques from neighbors they had no liking for, and may have led them to expect that if they did not adopt an advantageous innovation from outside the European States System, some rival would and gain an advantage. I do not mean to imply that non-European cultures were entirely incapable of adopting such foreign techniques. In the nineteenth century, the Islamic world made half-hearted attempts to reform and try to import the palpably successful techniques working in Europe. But apart from Meiji Japan, before 1914 few succeeded.

An equally interesting cultural trait in European culture is reflected in their degree of respect toward the knowledge and values of earlier generations. To what extent were tradition and continuity valued for their own sake, and to which extent does a society suffer from a subconscious inferiority complex relative to its ancestors? The degree to which a society is “backward-looking-with-respect” is an interesting variable and goes a long way toward explaining its willingness to invest in progress. The iron fist of the past in many cases placed a powerful constraint on what societies could do in terms of intellectual and technological innovation. The most powerful example may be the odd economic history of European Jews.<sup>27</sup> The

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<sup>27</sup>Despite their huge advantage in literacy and human capital for many centuries, Jews played an almost imperceptible role in the history of science and technology before and during the early Industrial Revolution. There were a few exceptions to this rule, such as Jacob ben Immanuel (Bonet) Lates, physician to the late fifteenth century popes and the inventor of an important instrument to measure astronomical altitudes. Jews were re-admitted into Britain after 1656, and it stands to reason that if more of them had had mechanical interests, more of them would have found their way to Britain where the atmosphere was conducive to inventors in the second half of the eighteenth century — as did many other Continental engineers. After they shook off their obsession with the writing of past generations during the Jewish *haskala* or enlightenment, the share of Jews among leading scientists and inventors rose steeply. Among the more notable names are those of the physical chemist Fritz Haber, inventor of the Haber-Bosch process, arguably one of the most important inventions of all times; Lazar L. Zamenhof, the inventor of Esperanto; Paul Ehrlich, the originator of modern Immunology; flight pioneer Otto Lilienthal; Theodore von Kármán, the father of supersonic flight; László Bíró, the inventor of the ballpen, and many others. But in the annals of the Industrial Revolution, Jews are hard to find.

proposition that the “truth” had been revealed to earlier generations and that all that was left was to exegesize and interpret the writings of ancient authorities had both a religious and a secular component. The religious component was the belief that God had revealed the truth to a founder of the religion or his followers, but would not do so on a continuing basis. The secular component was one of awe and admiration for the wise men who wrote in the past, and a sense of inferiority of their current generation. Overcoming such respect has proven a major stumbling block for progress not just in Judaism but also in Confucian China and the Islamic world. There was, in almost all societies known, a built-in tendency to resist innovation and protect the status quo and incumbency in the name of tradition. To be sure, a fair amount of innovation is always possible within the constraints of an existing canon, but the threat of being accused of heresy and apostasy remained a reality in many societies. The tolerance for heterodox ideas and deviant notions, and the willingness of institutions to allow them to contest existing cultural variants is a key ingredient of economic change (Mokyr, 2002, ch. 6).

Our own age has largely shed its respect for the knowledge of previous generations, although the admiration for novelty coexists (uneasily) with the beliefs of large groups who still cling to the literalness of ancient texts. As I will argue below, this struggle was fought and won in Europe even before the Enlightenment could clear the rest of the cultural grounds for the construction of a more progressive economy. In the nineteenth and twentieth centuries, rapid rates of technological and scientific change established a disdain for the knowledge of previous generations. The equation newer = better applied in many areas. Authority and literalness fell into disrepute, especially in the secular twentieth-century West. It is now taken as axiomatic.<sup>28</sup>

Another important value that mattered directly to economic performance was what could be called the *hierarchy of social values*: Which activities or characteristics conveyed dignity and social prestige, and were correlated with what their social environment would regard as “success”? How did one attain the approbation and respect of one’s relevant social circle? Among the historically important criteria we may count in no obvious order, ancestry, military and physical prowess, learning and wisdom, political power, creativity (literary, artistic), piousness, wealth, and administrative ability. An economist interested in growth

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<sup>28</sup>It is telling that in many disciplines of science and technology practitioners and experts have very little knowledge of or respect for the “wisdom of earlier generations.” In recent decades that has come to include economics.

might ask where in all this do commerce and artisanal skills figure? Clearly the place of “wealth” in this cultural ranking must matter to incentivize people in their career-choices and efforts? Insofar that innovation is driven by a desire to earn a profit, or to gain material resources in some other way, the social prestige or “dignity” (to use McCloskey’s term) of wealth accumulation would support innovation. It is this combination that is the foundation of modern capitalism, as every observer since Marx has maintained.

The inescapable fact is that by this criterion the track record of almost any society is at best mixed. The culture that views the life of a leisured landed gentleman as the summum of human existence survived far beyond what its putative medieval military functions could ever justify. The disdain and mockery of writers such as Molière notwithstanding, successful people with money tried to buy themselves and their children out of a productive lifestyle, what Braudel has called the “treason of the bourgeoisie.” It is, perhaps, less surprising at closer examination. Given the physical vicissitudes and risks of productive life in earlier times, it was quite widely believed that wisdom, literature, and art were largely produced and supported by a leisurely class. Only small pockets of the world such as the Netherlands in its Golden Age proved that the opposite could be equally the case. All the same, and despite many setbacks, wealth made in productive pursuits became slowly more acceptable as a signal of personal achievement and success.<sup>29</sup> Here, too, the evidence suggests rather sudden change in the century before the Industrial Revolution. As Weber and others have pointed out, religion became more friendly toward commerce and industry and “accorded high esteem to the manual arts” (Webster, 1975, p. 325). In contemporary America, of course, income and economic status has achieved a status that is probably unique; elsewhere wealth, while never quite as despised as some would have us believe, was often an intermediate product to buy other forms of cultural status such as nobility, political power, or the salvation of the soul.

### **The Cultural Roots of the Industrial Enlightenment.**

Any story about the historical origins of economic growth must start with the British Industrial

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<sup>29</sup>It is appropriate to add that the idea of “gentleman” acquired over time a connotation of someone respectable and reliable, a person of honor who could be trusted and thus would refrain from opportunistic behavior. Such a reputation was of course invaluable for anyone running a business, and thus, in an ironic twist of history, the ideal of gentleman slowly turned from an unproductive drone to a wealth-creating and useful citizen (McCloskey, 2006, pp. 294–96) . For details, see Mokyr, 2009b.

Revolution. As I have argued at length, the Industrial Revolution depended for its success and sustainability on the prior existence of a series of diverse but connected cultural changes that in the absence of a better and more effective term I have called the Industrial Enlightenment. But as Gregory Clark (2007, p. 183) has pointed out, looking for the Enlightenment as an explanation of the Industrial Revolution just pushes the question back one stage: whence the Enlightenment? How did it happen that the culture of a critical group of educated Europeans changed in ways that favored modern science and technological progress?

If there is anything economists have persuaded themselves of in the area of economic growth it is that innovation will thrive in the correct environment. Cultural change, much like most innovation that takes place in competitive environments, is often driven by cultural entrepreneurs. I defined above cultural entrepreneurs as people who become influential to the point where they change the culture of a sufficiently large number of others to affect their behavior and eventually institutions in significant ways. Their influence operates through many of the transmission biases noted above. The interaction of a gifted and lucky cultural entrepreneur with a suitable and fertile environment is what creates such changes. In that sense, cultural entrepreneurs are no different from the standard innovator-businessmen model of entrepreneurship so widely used by economists. Entrepreneurs “drive history” mostly in the limited sense that they take advantage of opportunities created by an environment larger and stronger than themselves. Yet this does not mean that such individuals do not matter. A fertile soil in which no seeds are planted will remain barren. The two questions are why do some societies spawn such entrepreneurs and others do not, and why are cultural entrepreneurs sometimes successful and what determines their success?

What in the European environment after 1500 explains the growing success of cultural entrepreneurs? The first was the ability to overcome the resistance of reactionary elements. Many societies, including Imperial China and medieval Europe, cracked down on innovators who could have threatened the status quo. After 1500 or so, the environment in Europe made it increasingly difficult for reactionary regimes to suppress “heretics” — the lack of coordination and absence of agreement on “who was a heretic” and “what was heresy” between the splintered European polities made it all but possible for any ruler to suppress new ideas; the initiator of the new cultural variant would simply pack up his suitcases and move across the boundaries, seeking the protection of a rival ruler. Luther and Paracelsus were among the more notable early examples of cultural entrepreneurs who took advantage of this coordination problem, but there were many

others in the decades between the Reformation and the end of the religious wars in 1648 who took advantage of this peculiar system (Mokyr, 2006, 2007). In many cases, political hostility between the European powers led to one ruler protecting the cultural gadflies that irritated his enemies.<sup>30</sup> By the eighteenth century, this reality had become part of common knowledge and most rulers had for all practical purposes given up persecuting heretics.<sup>31</sup> Modern writers on the topic, following eighteenth century writers, feel that the competition between rulers in the state system constrained rulers in their tax policy and forced them to have more respect for the property rights of their citizens.<sup>32</sup> But in the long term, their inability to suppress dissent and heterodoxy, due to the inherent coordination failures implied by political fragmentation, may have been equally important. The typical European intellectual innovator in this age was footloose, moving easily from court to court and from town to town. Erasmus, Descartes, Grotius, Huygens, Leibnitz and many others were international superstars, and people in positions of power and wealth competed among themselves to attract

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<sup>30</sup>One example was Tommaso Campanella, (1568-1639), an Italian monk who studied astronomy, astrology, and occult philosophy and like many others became skeptical of the Aristotelian orthodoxy. Accused from an early age of heresy by the Inquisition, his ability to play one power against another in fragmented Italy ran out when he was sentenced to life imprisonment in 1599 (for anti-Spanish activity rather than for heresy) and spent twenty seven years in a Neapolitan jail. However, his conditions there were sufficiently benign that he could write seven books in jail, including a pamphlet defending Galileo during his first trial in 1616. He could accomplish this in part because the Emperor Rudolf, Duke Maximilian of Bavaria, and other Catholic notables were exerting influence to protect him. In the end, he was released from jail through the intervention of the Pope Urban VIII, but then got in trouble again. He had succeeded, however, to endear himself to the French authorities (anxious to embarrass the Spanish), and through the intervention of the French ambassador he made it out of Italy to France, where he was honored by the court of Louis XIII and eventually accepted even by the suspicious Cardinal Richelieu and died in Paris (Headley, 1997, pp. 117-127).

<sup>31</sup>This is well-illustrated by the careers of heterodox Enlightenment writers such as Rousseau and Helvétius, whose writings greatly annoyed the authorities, but who, after brief exiles, were allowed to return to France. Even more striking is the history of atheist gadfly Julien La Mettrie, whose heretical works first forced him to take refuge in Leiden, but even there his hedonism so annoyed his hosts that he was forced to leave for Berlin, where Frederick the Great delighted in his often outrageous opinions.

<sup>32</sup>E.L. Jones (1981) in his classic work on the rise of Europe has referred to the “States System,” an idea that has caught on and become quite influential, although it was expressed in somewhat different terms already by eighteenth century writers, including Hume and Gibbon. The basic model looks at the various political entities (“islands” in Jones’s simile) in Europe in a fashion similar to the competitive model in economics; this competition had salutary effects on the European societies, since states competed for tax bases and the best citizens, and could not afford to alienate them (North, 1981, pp. 27, 138; for a formal model see Karayalcin, 2008 ). This meant that governments ended up (most of the time) treating their most successful and creative citizens with respect, taxed them with some restraint, and often followed active industrial policies, sponsoring technological transfer from more advanced nations, attracting skilled craftsmen, financing manufacturing enterprises, and protecting their industries with tariffs.



them.<sup>33</sup>

The other environmental factor that created opportunities for cultural entrepreneurship in this age was the emergence of a unified intellectual market, in which ideas were aimed at a transnational European educated elite, allowing people access to a larger constituency and thus covering the fixed costs of research and writing by catering to a larger market. The emergence of a “Republic of Letters” in which natural philosophers, mathematicians, experimentalists, and alchemists communicated with one another by letter and the printed word, in which they learned to play by the rules of open science, was an essential step toward avoiding the kind of intellectual atomization that may have thwarted cultural entrepreneurs in other highly fragmented political systems. The emergence of the Republic of Letters depended on technological factors as well: the printing press, of course, and the growth of a Continent-wide postal system in the sixteenth century. This unique European combination — political fragmentation within an intellectually unified market — created, in that sense, the best of all possible combinations in the premodern environment.

A further important element in the success of cultural entrepreneurs was their ability to recruit effective disciples and epigones to spread their gospel. Cultural change often works in widening concentric circles: apostles who spread the gospel of the master, at times more effectively than the master him or herself. This was especially important during the Reformation, when Lutheranism was spread by followers of Luther such as Philipp Melanchton and Calvinism by men such as Guido de Bres and John Knox. Newton’s revolution in physics spread through the work of many scholars, among them in Britain John Desaguliers, the Dutchmen Willem s’Gravesande and Herman Boerhaave, and in France Voltaire (helped by Mme du Châtelet). Some cultural entrepreneurs were not invariably great communicators themselves except through their writings, but a few effective disciples would provide additional rhetorical bias. An example is Adam

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<sup>33</sup>An extreme case in this regard was Jan Amos Comenius (Komensky) (1592-1670), one of the leading scholars of his age, who was early in life persuaded by the writings of Francis Bacon that the “millennium” could be achieved by advances in natural philosophy and applied his belief in progress in educational reform. A Czech Protestant, he fled his native Moravia in the early years of the thirty-years war and settled in Poland in 1620 and then invited by another early Baconian, Samuel Hartlib, to settle in Britain, but once again had to flee because of the British Civil War. Via Sweden and Hungary he ended up back in Poland, but chased away by the outbreak of War, he escaped to Amsterdam in 1657, where he lived the rest of his life. Like many seventeenth century rebels and original thinkers, he took strong religious positions which often got him in trouble, but he survived repeatedly by fleeing in time, losing his family and his books in the process. Among other honors, he was invited to become President of the newly founded Harvard College (Spinka, 1943, pp. 53, 84).

Smith, an effective teacher but not nearly as effective as his successor Dugald Stewart.<sup>34</sup>

Finally, there is historical materialism. In its extreme form, this view denies any independent role for cultural dynamics. Culture is wholly determined, in this view, by economic or class interests, and cultural entrepreneurs are mere agents of forces stronger than themselves and have no independent effect on the outcome. Did new cultural variants in the centuries before the Industrial Revolution spread as a response to the needs of an economic elite? Were the rise of a mechanical world-view, a belief in the efficacy of useful knowledge to promote material welfare, and a strong push to diffuse the findings of natural philosophy among those who could make practical use of it all determined by the rise of a new urban bourgeoisie? If this were taken literally to be the case, cultural entrepreneurs would not matter at all; in the absence of Luther and Calvin, the Reformation would still have taken place, and Calvinism would have still existed, invented by another person and under a different name. The extreme version is almost as unacceptable as its complete opposite, which attributes *everything* to the agency of exceptional individuals.

Again, an evolutionary metaphor may be of help. A mutation will spread in a favorable environment and die out in an unfavorable one; but the pre-existence of such an environment does not guarantee that a new and adaptive cultural variant will actually emerge, much less will it determine fully what its phenotype will be like. Moreover, the adaptiveness of cultural variants always seems more obvious *ex post* than *ex ante*. Did the rise of commercial capitalism and an urban bourgeoisie require a religious reform? The outcomes of the struggle between Protestantism and Catholicism, for instance, are not consistent with a view that predicts that one of them was more fit to a particular environment; historical contingency largely determined the outcomes that made the Southern Netherlands, Bohemia, and Bavaria Catholic, and the Northern Netherlands and Prussia Protestant. This is not to say, of course, that economic conditions have no effect on whether a cultural variant will succeed or not; they are part of the environment in which cultural variants compete. Given the multitude of transmission biases, however, there is no predicting which variant will

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<sup>34</sup>Dugald Stewart was a student of Thomas Reid and Adam Smith, and later Professor of Moral Philosophy at Edinburgh. Among his students were the later PM's John Russell and Lord Palmerston as well as other major Whig figures such as Lord Brougham and Henry Cockburn. His lectures turned Smith's thought into the fountainhead of all economic theory. Stewart "made the book [*Wealth Of Nations*] virtually Holy Scripture to generations of Edinburgh-educated thinkers, economists, and politicians who in turn spread its influence to Oxford, Cambridge, London, and the rest of the English-speaking world" (Herman, 2001, pp. 229–30; see also Rothschild, 2001).

prevail.

How did modern, technology-based economic growth begin in the West? A cultural explanation of such economic change would require a changing set of relevant beliefs among social groups that mattered for technological change. It should be stressed from the outset that for this kind of growth process, what mattered was the belief of a limited subset of society, not some measure of mean or modal beliefs. It was the beliefs of an educated elite, people of learning who not only were literate but in fact read, wrote, computed, observed, experimented and were well-networked with others much like them. These groups involved scientists, astrologers, engineers, alchemists, merchants, skilled artisans, literary types, and politicians. The culture of other members of the social elite, such as aristocrats mattered as well, if only because others would want to imitate them. Religious leaders such as Richard Baxter had vast influence on both sides of the Atlantic in the eighteenth century, and Max Weber regarded him as the author who “stands out above many other writers on Puritan ethics, both because of his eminently practical and realistic attitude, and, at the same time, because of the universal recognition accorded to his works” (Weber, [1905] 1938, p. 155).<sup>35</sup> A new set of beliefs about the social role of useful knowledge and its implications emerged amongst these groups after 1650, most heavily concentrated in Britain, but which spilled over to the rest of Western Europe and, with some delay, was part of a new cultural milieu. The argument has been made with great vigor by Margaret C. Jacob (1997, 2000; Jacob and Stewart, 2004).

Much of the literature written by historians and historical sociologists on economically relevant cultural change in Britain has focused on the impact of Puritanism on the rise of modern science — although many of the key figures were not Puritans. The literature on Puritanism and the Rise of Science is large, and was inspired by the work of Robert K. Merton as its focal point, although by his own admission, Merton was not the first to propose a connection between seventeenth-century religion in Britain and the rise of a “modern science” there (Merton, 1973; [1938], 2001).<sup>36</sup> The exact relation between Puritanism as such as

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<sup>35</sup>It may seem odd for an economic historian to point to a Puritan theologian as an important figure in the economic development of the West, but Baxter’s influence on both sides of the Atlantic in the eighteenth century was huge and Max Weber regarded him as the author who “stands out above many other writers on Puritan ethics, both because of his eminently practical and realistic attitude, and, at the same time, because of the universal recognition accorded to his works” (Weber, [1905] 1938, p. 155). His idea of the glorification of God through “good works” focused around hard work and those works that were “good materially.”

<sup>36</sup>The most striking and erudite work to appear prior to Merton’s was that by R.F. Jones [1936] 1961.

a source of modern science has been criticized heavily, although Merton was quite cautious not to claim more for his thesis than the evidence could bear ( Shapin, 1988; Cohen, 1990). What is perhaps most widely agreed on is that Puritan thought, its claims to hark back to the Early Church notwithstanding, helped clear the way for more “modern” ways of thinking about the “canon” of the past and liberate European culture from the dead hand of classical authorities (Webster, 1975).

Elizabethan England was still strongly committed to the classical canon.<sup>37</sup> By the early seventeenth century, one can see how European intellectuals were increasingly coming to terms with their break with classical science and philosophy. The English physician and physicist William Gilbert in his *De Magnete* (1600), a widely admired and pioneering work in its time, dismissed Ptolemy’s astronomy as “now believed only by idiots” and proclaimed that the only avenue to truth was experiment and observation, not the authority of Greek sages (Jones, 1961 [1936], p. 17) . Attacks on Aristotle became more common and less bashful throughout Europe.<sup>38</sup> A full-scale, century-long battle erupted between those who clung to the notion that all that was valuable in human civilization was produced by the great authorities of classical antiquity and more progressive thinkers, who became increasingly confident in the capabilities of their generation.

This debate between the “ancients” and the “moderns” may seem a bit like a storm in a teacup to modern eyes, but at the time it was quite serious (Levine, 1981, p. 73). It concerned exactly the same issue of “respect toward earlier sages” I discussed above. Were modern scholars and authors nothing but midgets standing on the shoulders of giants, or were they giants themselves? The debate reflected a watershed in cultural evolution that had been two centuries or more in the making. Many of the scientists and scholars who rose to prominence in the mid seventeenth century had accepted the critical attitude toward received authority. “Whatever the schoolmen may talk,” wrote one of them, “yet Aristotle’s Works are not necessarily true and he himself hath by sufficient Arguments proved himself to be liable to error... Learning is Increased by new Experiments and new Discoveries ... we have the advantage of more time than they had and

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<sup>37</sup>In the fourteenth century, Oxford University had a rule on the book that every master who deviated from Aristotle’s *Organon* would be fined 5 shillings for every case of deviation (Devlin, 2000, p. 58). This rule was still on the books at the time Giordano Bruno visited Oxford (1583).

<sup>38</sup>As early as 1536, Petrus Ramus, a French intellectual, submitted an MA thesis with the title “Quaecumque ab Aristotele dicta essent, commentitia esse,” the translation of which is somewhat in dispute, but roughly meaning “whatsoever Aristotle has said is false (or confused).”

knowledge is the daughter of time” (John Wilkins, in his *Discourse Concerning a New Planet*, 1640). Even earlier, George Hakewill’s *Apologie* (1627) argued strenuously against the prevalent view of “decay” that held that human capabilities were declining over time. Pascal in his pre-Jansenist and more progressive days noted that it would be unjust to show the “ancients” more respect than they themselves had shown to those who had preceded them (Bury, 1955, p. 68), a logical point entirely missed by Jewish rabbinical theologians.<sup>39</sup>

The notion that their own generation was superior to anything that had come before spread among the British writers of the age, including the work of the (non-Puritan) clergyman Joseph Glanvill (1636–1680), who wrote a famous book entitled *Plus ultra, or, The Progress and Advancement of Knowledge since the Days of Aristotle* (1668) in which he proudly listed area by area the advances that science had made since antiquity, much of which he ascribed to the work of the Royal Society and its members. He noted with some exuberance that “a ground of high expectation from Experimental Philosophy is given, by the happy genius of this present Age... and that a ground of expecting considerable things from Experimental Philosophy is given by those things which have been found out by illiterate tradesmen or lighted by chance.”<sup>40</sup>

Progress, the “moderns” realized, was inevitable not only because knowledge was cumulative but also because the tools of research had been improved. Galen had no microscope, Ptolemy no telescope, Archimedes no algebra or calculus. But more than anything, it was realized, knowledge was cumulative. People living in the present know more than those who came before them because earlier knowledge had been transmitted to them. Much of the battle of the books, of course, was about taste, and an argument whether one would prefer Shakespeare to Sophocles or Milton to Virgil seems otiose today. However, dismissing R.F. Jones as “whiggish” because he felt sympathy for those who thought that there were good grounds to prefer Galileo to Archimedes or Harvey to Galen seems unproductive. One of the debaters, the

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<sup>39</sup>Auguste Comte noted that “the idea of continuous progress had no scientific consistency, or public regard, till after the memorable controversy at the beginning of the last [i.e., eighteenth] century about the general comparison of the ancients and the moderns ... that solemn discussion constitutes a ripe event in the history of the human mind which thus, for the first time, declared that it had made an irreversible advance” (Comte 1856, p. 441).

<sup>40</sup>Glanvill would not be counted as “enlightened” by our standards — he staunchly defended the existence of witches and spirits and wrote a book vehemently attacking those who doubted their existence.

linguist and biographer William Wotton (1666–1727), indeed made the crucial distinction between areas that were cumulative (such as science and technology) and those that were not (such as rhetoric). But his debate with one of the last of the “ancients,” William Temple, marks the rearguard action of a battle that had been fought and won for two centuries: from that point on it was beyond any question that a reference to Aristotle or any other author in the canon, from the Bible down, would not be regarded as sufficient evidence.<sup>41</sup>

Not all authors of the late seventeenth and eighteenth century subscribed to a belief that progress was possible or even likely, and doubters such as Thomas Hobbes never quite bought into it. As late as 1704, the conservative Jonathan Swift, who wrote a famous satirical essay on the battle of the ancients and moderns, concluded that “we cannot learn to which side Victory fell.” By that time, however, most intellectuals regarded the argument as over. It was the impact of the Enlightenment that ensured that by the end of the eighteenth century any interest in the debate itself had waned. There was still respect for classical civilization, and the children of the elite were taught its language and literature; but nobody serious confused it with a substitute for the useful knowledge that was needed to advance material conditions.

The obvious corollary of the “triumph of the moderns” was a growing belief in the possibility of progress. Studies about the *History of the Idea of Progress*, starting from Bury’s seminal book ([1932], 1955), have without exception pointed to the Age of Enlightenment as the age in which it came to dominate much of Western Thought. In the market for ideas that evolved in the seventeenth century, this particular idea triumphed: History does not move in endless cycles, nor is it a stationary process. History has a unit root. It trends in a particular direction. The idea of progress is logically equivalent to an implied disrespect of previous generations. As Carl Becker noted in his classic work written in the early 1930s, “a Philosopher could not grasp the modern idea of progress ... until he was willing to abandon ancestor worship, until he analyzed away his inferiority complex toward the past, and realized that his own generation was superior to

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<sup>41</sup>The late seventeenth century “Battle of the Books” was in fact a rearguard action which shows how strong the position of the “moderns” had become. In the words of one scholar, “to sample a few of Temple's [William Temple, one of Wotton’s main opponents] opinions about ancients and moderns gives one a sense of the genteel arrogance the Enlightenment had to put up with and overcome... Temple served up a pastiche of pseudo-intellectual commonplaces. The ancients had said it all; advances in learning and art were unlikely when the originals were so perfect... Where now is the great music of the past when Orpheus could move the stones and tame the beasts? Where today are the ancient arts of magic? How can the fortuitous circumstances that produced such excellences of the past ever come together again in these diminished times? Did Harvey and Copernicus have anything new to say? Who can tell whether it is the sun or the earth that moves?” (Traugott, 1994, pp. 504–05).

any yet known” (Becker [1932], 2003, p. 131). Seventeenth century Europe already shows quite a few signs of a belief in progress, starting with Bacon and Descartes themselves and their disciples. To be sure, a prevalent belief in progress is neither a necessary nor a sufficient condition for actual progress to occur, but surely progress is more likely to occur when a pivotal elite not only believes it to be possible and desirable, but actually formulates a detailed program how to bring it about.

The Idea of Progress, then, consisted of three separate components. The first was whether History showed an upward trend of improving culture, art, literature, and knowledge. The second was whether this trend was likely to continue in the future. The third was a set of recommendations of how to bring it about, which involved of course some kind of model on what the engine behind social progress really was. It was not just a British idea: quite a few Continental writers came up with very similar views, and in fact it was brought to a rather feverish and wildly optimistic crescendo late in the eighteenth century by writers such as Turgot and Condorcet. But the idea had much earlier roots.<sup>42</sup> The belief in progress in Britain was less ecstatic and more pragmatic. Spadafora (1990, p. 17) aptly defines the social climate in Britain as “confidence without complacency.” Knowledge was the key to progress, and as long as it would grow, the material condition of the human race would as well. As Erasmus Darwin wrote in 1784, the “common heap of knowledge ... will never cease to accumulate so long as the human footstep is seen upon the earth” (cited by Musson and Robinson, 1969, p. 192). It was, however, one thing to have faith in the eventual occurrence of progress and quite another to bring it about; yet that is precisely what the many national and local “improving societies” founded in Britain intended.<sup>43</sup>

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<sup>42</sup>Among those who believed strongly in the progressiveness of human knowledge was the French author Bernard LeBovier Fontenelle (1657-1757). In 1688, Fontenelle published a small essay entitled *Digression sur les anciens et les modernes* in which he postulated that scientific progress, and the economic progress that will go with it, were not just possible but in fact inevitable. He noted that in how in his age a truth (*justesse*) ruled that had been hitherto unknown, and predicted that this would in the future go much further, and that one day the current generation would be “ancients” and that it would be fair and reasonable for posterity to outdo them.

<sup>43</sup>Among the major organizations set up with the explicit and conscious purpose to improve society, the Society of Arts (established in 1754) was meant to enhance “such Productions, Inventions or Improvements as shall tend to the employing of the Poor and the Increase of Trade.” The Act of founding the British Museum, of 1753 stated similarly that it was meant to bring about “advancement and improvement” in useful knowledge (cited by Spadafora (1990), p. 79). The Royal Institution, established in 1799 by Count Rumford, similarly described its purpose as “the speedy and general diffusion of all new and useful improvements in whatever quarter of the world they may originate, and teaching the application of scientific discoveries to the improvements of arts and manufactures in this country and to the increase in domestic comfort and convenience” (Bence Jones, 1871, p. 121).

### **Cultural Entrepreneurs and the Industrial Revolution**

Ever since Tolstoy, it has been fashionable to dismiss the impact of individuals on history by mocking the “intellectual prowess and persuasive capabilities of a few men” and stressing cultural change as “a confluence of available ideas” although one is left wondering where such influential ideas might have come from in the first place.<sup>44</sup> Yet while the impact of cultural entrepreneurs cannot be understood on their merits alone, they provide useful focal points to understand how and why deep cultural changes could take place. They also illustrate the contingent component of history in general. None of this implies, of course, that we can prove beyond a reasonable doubt that history would have been dramatically different without the actions of these entrepreneurs. We simply do not know for sure. Adam Smith, Marx, and Keynes were very much products of a certain economic environment and would not have succeeded had they written their works in a different time. But were they inevitable products?

The changes that were critical to the success of the cultural variants prevalent in eighteenth century Britain (and much of the rest of Western Europe) were heavily influenced by two cultural entrepreneurs whose influence on late seventeenth and eighteenth century European elite culture was decisive: Francis Bacon and Isaac Newton.<sup>45</sup> While both men were English, their influence penetrated into the Continent as well. They were helped by a large number of followers and epigones who interpreted and extended their work and thinking, and thus were instrumental in introducing a set of cultural changes amongst Europe’s thin educated layer that turned out to be crucial to subsequent economic development. Their respective influences reinforced and complemented one another. As Jacob (1997, p. 33) has argued, by the late seventeenth century Baconianism was in part subsumed in Newtonianism.

**Francis Bacon**’s intellectual influence in his own lifetime was limited, but fairly soon after his death

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<sup>44</sup>The quote is from Lowengard, 2006. Tolstoy famously advocated in *War and Peace* that “to study the laws of history we must completely change the subject of our observation, must leave aside kings, ministers, and generals, and the common, infinitesimally small elements by which the masses are moved.” The problem is that the masses need to be coordinated, and that such coordinators are not just pawn of deeper historical forces, but also have agency themselves. When that agency becomes important to the outcome, we may say that history is at a bifurcation point or at a “critical juncture” (Acemoglu and Robinson, 2011) and that fairly small events may set the process on a different trajectory.

<sup>45</sup>Bacon and Newton were two-thirds of Thomas Jefferson’s list of “the greatest men who ever lived,” the third being John Locke.



in 1626 scientists and intellectuals began to express the impact his work had on their thinking. Puritans and non-Puritans alike expressed their debt to him. Charles Webster, in his magnum opus, states that among Puritans Bacon's writings "came to attain almost scriptural authority" (1975, p. 335). Following his death, his disciples banded together in the so-called Hartlib Circle, in which the Prussian immigrant Samuel Hartlib (1600-62), who arrived in England two years after Bacon's death, occupied a central role. Hartlib was prototypical follower, a highly effective "intelligencer" in the terminology of the time, not an original thinker, but highly effective in organizing an intellectual elite into following a coherent program.<sup>46</sup> He was an inveterate correspondent and instrumental in disseminating scientific writing in a wide array of applied field, ranging from medicine to horticulture.<sup>47</sup> He and his long-time friend John Dury (1596-1680) followed Bacon in the judgment of the value of knowledge in its degree of "usefulness." Following him, a group of scholars known as the "Invisible College," including such notables as Robert Boyle, Christopher Wren, and John Evelyn, eventually formed the Royal Society, explicitly dedicated to carry out the Baconian program.<sup>48</sup> Bacon's views on the method and purpose of useful knowledge only grew through the age of Enlightenment and influenced intellectuals many decades after his death.<sup>49</sup> Modern scholars of different backgrounds have

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<sup>46</sup>The term was apparently first applied to him by John Winthrop, governor of Massachusetts. Webster (1970, p. 3) sees him as the one who undertook the Baconian ideal of organizing Europe's intellectuals in a "noble and generous fraternity" — obviously an early version of the eighteenth-century Republic of Letters. One of his main projects was his "Office of Address and Correspondency," a kind of virtual Solomon's House in which useful knowledge would be circulated and distributed by means of epistolary networks, a precursor of the basic Enlightenment project to reduce access costs and enhance the dissemination of scientific and technological knowledge.

<sup>47</sup>Hartlib was particularly interested in bee-keeping, both as an interesting agricultural pursuit and because he saw the symbolism of bees pollinating flowers in analogy to men of learning spreading information to increase the productivity of the economy.

<sup>48</sup>In a wonderful piece of doggerel entitled "Ode to the Royal Society," written by the now (deservedly) neglected poet Abraham Cowley (one of the Society's co-founders) and reprinted as a preface to Thomas Sprat's *History of the Royal Society of London*, the gratefulness of the scholars of the time to Bacon was well-expressed: "From these and all long Errors of the Way; In which our wandring Predecessors went; And like th' old Hebrews many Years did stray; in Desarts but of small Extent; Bacon, like Moses, led us forth at last; The barren Wilderness he past; Did on the very Border stand; of the blest promis'd Land; And from the Mountain's Top of his exalted Wit; Saw it himself and shew'd us it."

<sup>49</sup>The Scottish mathematician Colin MacLaurin wrote in the middle of the eighteenth century that "[Bacon] saw that there was a necessity for a thorough reformation in the way of treating natural knowledge ... He proposed his plan in his *instauratio magna* with so much strength of argument and so just a zeal as renders that admirable work the delight of all those who have a taste for solid learning ... his exhortations had good effects and experimental philosophy has been much more cultivated since his time than in any preceding period." MacLaurin, 1750, pp. 60, 62-63. d'Alembert claimed in his *Preliminary Discourse to the Encyclopédie* that "The immortal Chancellor of England, Francis Bacon

tended to agree with contemporaries.<sup>50</sup>

But what was it about Bacon's vision that so grabbed the imagination and beliefs of educated people (mostly after his death)? The cultural sea change that Bacon and the Baconians brought about was the revision of the agenda of research and the growing conviction that science should serve the purpose of economic progress. In one famous aphorism (81) in his *Novum Organum*, Bacon summarized his view about the agenda of science: "The true and lawful goal of the sciences is simply this, that human life be enriched by new discoveries and powers." He fully realized that this was an elite culture and continues: "The Great majority have no feeling for this...But every now and then it does happen that and exceptionally intelligent and ambitious craftsman applies himself to a new invention and as a rule ruins himself in the process." Another twentieth century scholar has put it well: "The story of Francis Bacon as that of a life devoted to a great idea...commonplace today, but in his day it was a novelty. It is simply that knowledge ought to bear fruit in works, that science ought to be applicable to industry, that men ought to organize themselves as a sacred duty to improve and transform the conditions of life" (Farrington, [1949], 1979, p. 3). This idea became one of the founding principles of the Royal Society, which in its first years consistently claimed that its research would be heavily focused on improving technology. Thomas Sprat, in his *History of the Royal Society*, proclaimed that "Philosophy will attain perfection when either Mechanic Labourers shall have philosophical heads, or the Philosophers shall have Mechanical Hands" (Sprat, 1667, p. 397).<sup>51</sup> This idea, too, was powerfully expressed by Bacon in his writings, and quoted over and over again by his followers. In his early

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[1561–1626], ought to be placed at the head of these illustrious personages. His works, so justly esteemed (and more esteemed, indeed, than they are known), merit our reading even more than our praises. One would be tempted to regard him as the greatest, the most universal, and the most eloquent of the philosophers, considering his sound and broad views, the multitude of objects to which his mind turned itself, and the boldness of his style, which everywhere joined the most sublime images with the most rigorous precision." (d'Alembert, 1751, pt II). Hume, ever the sceptic, disagreed and rated Bacon below Galileo and Kepler — a somewhat misleading comparison.

<sup>50</sup>“Bacon's influence can be perceived everywhere among men of science in the seventeenth and eighteenth centuries, constantly encouraging them to comprehend workshop practices” (Musson and Robinson, 1969, p. 16). “Sir Francis Bacon bears the same relationship to the movement under discussion [the rise of modern science in Britain] as Karl Marx to the rise of communism --- but to much better purpose” (R. F. Jones, 1961 [1936], p. vii). “In an age dominated by sectarian strife... the Baconian vision ... urged Westerners to turn to science and its application. At every turn the Baconian legacy inspired visionaries as well as industrialists” (Jacob, 1997, p. 33).

<sup>51</sup>It was widely observed that this was far from a reality in this era; half a century after Sprat, Mandeville still noted that “they are very seldom the same sort of people, those that invent Arts and Improvements in them, and those that enquire into the Reason of Things” ([1724] 1755, p. 121).

*In Praise of Knowledge* (1592) Bacon wrote that “Is there any such happiness as for a man's mind to be raised above the confusion of things, where he may have the prospect of the order of nature and error of man? But is this a view of delight only and not of discovery? of contentment and not of benefit? Shall he not as well discern the riches of nature's warehouse as the beauty of her shop? Is truth ever barren? Shall he not be able thereby to produce worthy effects, and to endow the life of man with infinite commodities?” It was a theme he repeated over and over again in his later writing and one that the Royal Society subscribed to. Some of those claims may be dismissed as the self-serving rhetoric of intellectuals seeking patronage and intended to endear the Royal Society to the authorities or (some) rich patrons, but there can be little doubt that many of its original members genuinely believed in the Baconian message. It should be added that the message was, of course, not unique to Bacon. Descartes, in his *Discourse*, declares that he believed that the notions of physics would make it possible to discover principles which would turn humans into the lords and possessors of nature and to invent “an infinity of devices which should make it possible to enjoy the fruit of the earth” and especially to preserve human health (Descartes [1637], 1965, p. 50).<sup>52</sup>

It was still, of course, a pre-enlightenment age. One reason for Bacon's influence must be his tendency of linking the growth of science to some kind of religious salvation, a millenarian rhetorical trick that turned research into natural philosophy into a virtuous activity and mysteriously linked the accretion of useful language to a messianic apocalypse in a paradise based on knowledge and science, a prime example of rhetorical bias.<sup>53</sup> In the debate between “ancients” and “moderns,” Bacon took a clear-cut position. He was harsh and critical of the classics and even more so of the medieval Aristotelians.<sup>54</sup>

Part of Bacon's message was that science should be empirical and experimental. Many of the

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<sup>52</sup>Descartes's influence waned, however, in the eighteenth century as that of Bacon increased and so his success as a cultural entrepreneur was more limited. Cf. Gay (1969), pp. 145–50.

<sup>53</sup>As has been argued convincingly, Bacon, despite his pious references to God, was not a particularly devout Christian and his millenarianism was largely lip service and an attempt to connect to his more devout contemporaries (Paterson, 1987). For a detailed view of how Enlightenment thinkers turned religious sentiments into a secular idealism, see Carl Becker (1932).

<sup>54</sup>In the Preface to *The Great Instauration* he wrote that “it must be plainly avowed that that wisdom which we have derived principally from the Greeks is but like the boyhood of knowledge, and has the characteristic property of boys: it can talk, but it cannot generate, for it is fruitful of controversies but barren of works” (Bacon [1620], 1999, p. 69. In *The New Organon* he classified Aristotle as an example of an ‘idol of the theater’ who “corrupted natural philosophy by his logic...[and who] did not consult experience as he should have done, bending experience into conformity with his doctrines” (*ibid.*, pp. 104–05).

seventeenth century Puritans regarded experimental science, or as they called it, “experimental philosophy,” not just as the key to scientific progress but also with a deep ethical sentiment: this was, from many points, of view, an example of “good works.”<sup>55</sup> In this way we see a nice example of cultural epistasis: on the one hand, the belief that experimental science held the key to the advance of useful knowledge, on the other the notion that by carrying out experimental investigations one could get somehow closer to understanding the Deity.<sup>56</sup> These two cultural elements jointly implied a flourishing of scientific experimentation, in search of the natural regularities that would allow people to control nature “for the Glory of the Creator and relief of Man’s estate” as Bacon put it in his *Advancement of Learning*.

Bacon’s inductive methodology, its limitations notwithstanding, was enormously influential, especially in areas in which the discovery of obvious underlying mechanisms was beyond the power of the scientists of the age. Organizing what was known about natural regularities in accessible ways, it was hoped, would make it more intelligible and potentially more useful. For instance, the first chemical affinity table was put together by Étienne Geoffroy in 1718, and while Geoffroy claimed to be inspired by Newton, his emphasis was not on the understanding of chemical facts but on ordering the “brute phenomena themselves” as Dear (2006, p. 42) put it. Botany and Zoology were treated in the same way: by cataloging and classifying, it was hoped, some patterns and regularities would emerge. In the absence of a clear concept of evolution to say nothing of more advanced concepts of physiology, many skeptics such as the great French botanist George-Louis Leclerc, count Buffon, thought such a project foolhardy, yet Linnaeus and his many disciples persisted in what became a central project of Enlightenment science.

Bacon’s message on the dissemination of existing knowledge was just as powerful as his call to create and discover new knowledge. Spreading knowledge meant more people could adopt best-practice concepts and techniques. The distribution of existing knowledge required better language and communications technology. One of his most remarkable followers, John Wilkins (1614–1672), wrote a

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<sup>55</sup>Charles Webster (1975, p. 333) remarks that the collaboration between Baconian philosophers and “enlightened craftsmen” was built upon the hope of preparing a technological revolution, a prospect that at the time may have appeared absurdly utopian. In due time, however, it is exactly this cooperation that became the cornerstone of the Industrial Revolution and the origin of modern growth in Europe (Mokyr, 2002, 2009).

<sup>56</sup>Robert Boyle, one of the most dominating figures in British science of the second half of the seventeenth century, was a deeply committed follower of Bacon, wholly committed to an experimental approach to science, and yet he was a deeply religious man, a lay theologian, for whom science was a way to practice his religion (Wojcik, 1997).

book, *Essay towards a Real Character and a Philosophical Language*, one of the first of many writers who called for the establishment of a common scientific language that would provide a more efficient medium for scientists to interact and, as he pointed out, “repair the ruins of Babel” (Strasser, 1994). In this work he foreshadowed the heroic attempts to reduce access-costs, that formed one of the core projects of the eighteenth century Enlightenment (Mokyr, 2005).<sup>57</sup>

**Isaac Newton**’s role as a cultural entrepreneur was quite different. Jacob, the foremost proponent of the centrality of a “Newtonian Enlightenment” has argued that Newtonianism was key to a number of mechanical adaptations, but in fact it is not easy to show how the Newtonian science *directly* led to any specific inventions. Newton was more interested in motion than in heat, and yet it is the latter that turned to be crucial to most developments in power and materials. Mechanical science, as developed by Galileo and Newton, was initially of little direct help to the mechanical advances in the textile industry. Differential calculus, Newton’s most practical invention, did become more useful to engineers in the second half of the eighteenth century, but it is not easy to assess its exact role in technological progress.<sup>58</sup> If Newton had a role to play in the Industrial Revolution, it was through his impact as a cultural entrepreneur. He was an unlikely candidate for that position, as Keynes pointed out in his posthumous lecture on “Newton, the Man.”<sup>59</sup>

What, then, was the significance of Newton for the cultural changes that prepared the ground for the Industrial Enlightenment? Clearly, Newton’s influence can be attributed in large part to “content bias” (his work was convincing because it rang true to those who could understand it) and direct bias (his followers

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<sup>57</sup>Wilkins (1668, dedicatory) wrote hopefully that from such a language “most obvious advantage which would ensue, of facilitating mutual Commerce, amongst the several Nations of the World, and the improving of all Natural knowledge; It would likewise very much conduce to the spreading of the knowledge of Religion.”

<sup>58</sup>The first and best-known application of calculus was to hydraulics, but the French mathematician Antoine Parent famously erred in his computation of the maximum useful effect that a waterwheel could draw from the force of a stream.

<sup>59</sup>“For in vulgar modern terms Newton was profoundly neurotic of a not unfamiliar type, but – I should say from the records – a most extreme example. His deepest instincts were occult, esoteric, semantic-with profound shrinking from the world, a paralyzing fear of exposing his thoughts, his beliefs, his discoveries in all nakedness to the inspection and criticism of the world. ‘Of the most fearful, cautious and suspicious temper that I ever knew’, said Whiston, his successor in the Lucasian Chair. The too well-known conflicts and ignoble quarrels with Hooke, Flamsteed, Leibniz are only too clear an evidence of this ... He parted with and published nothing except under the extreme pressure of friends. Until the second phase of his life, he was a wrapt, consecrated solitary, pursuing his studies by intense introspection with a mental endurance perhaps never equalled.” see [http://www-groups.dcs.st-and.ac.uk/~history/Extras/Keynes\\_Newton.html](http://www-groups.dcs.st-and.ac.uk/~history/Extras/Keynes_Newton.html), accessed on September 17, 2010.

were men of substantial authority and scientific prestige). His disciples and epigones, both in Britain and on the Continent, were rhetorically gifted and often in positions of influence and power. But there was also some model-based bias: young scientists and mathematicians all knew about his fame and fortune, and the social prestige of a career in science would never be the same. Newton illustrated the enormous prestige that a truly successful scientist could attain in a society that began to value useful knowledge. He was knighted, elected to Parliament, and became quite wealthy. He was surrounded by admiring students (most notably Richard Bentley, Samuel Clarke, and William Whiston), and was on close terms with all the leading intellectuals and scientists of his age, unless he had quarreled with them. Hans Sloane, Newton's successor as President of the Royal Society, basked in the prestige of his predecessor to elevate the prominence of natural history. Newton thus completed what the Puritans had started: to raise the social standing of scientists and researchers as people who should be respected and supported, since their work was destined to become the *primum mobile* of social progress, and Newton had shown once and for all that this was feasible.

But there were also cultural spillovers. To start with, his work enormously boosted the confidence of the “moderns” as opposed to the “ancients” — his new interpretation of the universe was almost at once recognized to overthrow what little there was left of ancient cosmology and physics, and vindicated the many authors who had been pleading against a sense of inferiority of their own age. Moreover, he was deeply integrated in a *European* as opposed to an *English* academic sphere. Self-taught in mathematics, he relied on books written by Frenchmen (René Descartes and François Viète) and a Dutchman (Frans van Schooten). He corresponded (briefly) with Huygens, Leibniz, and Johann Bernoulli, and clearly was regarded quite early on as an international scientific superstar, the most successful and brilliant citizen of the Republic of Letters. Despite the innovativeness of his theories, his main scientific fights were not against those who disagreed with him on essential matters, but through priority disputes (Hooke) or access to data (Flamsteed). While his religious views were heterodox, there is no evidence that these stood in the way of his celebrity and powerful patronage positions he occupied after 1687.

Newton's combination of his formidable mathematical and analytical skills with his continuous reliance on empirical and experimental data was a shining example that lesser scientists could only hope to mimic. The classical canon had been largely based on logic and authority; Bacon had wanted to supplement it with the collection of facts and data that, somehow, would then fall into place. In the end, he felt, one

should always prefer principles gained by induction from observation and experiment (Ilfte, 2003, p. 272). This is, of course, precisely what Newton did. He never claimed to understand *why* the principles he discovered were there, only that they were universal and intelligible. The implication was that once nature was intelligible, it could be manipulated, controlled, and applied to human needs. The concept of a mechanical universe in which the regularities were wholly predictable and deterministic, although in the air for a long time, was given an enormous boost by Newton's work? Anyone who believed in the feasibility and desirability of progress must have found this message amenable.

Applications of Newton's model of knowledge were attempted in other fields, with mixed results. His excursions in chemistry in the famous "query 31" at the very end of the third edition of his *Optics*, for instance, included a discursion about chemical affinity that later inspired other chemists, including the aforementioned Geoffroy, to compile the first tables of chemical affinities (Brock, 1992, p. 76). In the same query, Newton conjectured that his scientific method may even be able to "enlarge the bounds of moral philosophy" (Newton, 1719, p. 381). The Dutch physician Herman Boerhaave, who taught medicine, chemistry, and botany at Leiden between 1709 and 1738 ascribed to Newtonian principles to explain the human body in terms of gravitation and attraction (Dobbs and Jacob, 1995, p. 85).<sup>60</sup> Even some of the work of the ever skeptical David Hume, especially his "science of man," has been argued to be modeled in part on Newton's successes in natural philosophy, and Hume certainly appears to want, in places, his readers to feel that he is modeling his project on the successes of natural philosophy exemplified by Newton suggesting that his "science of man" can parallel recent achievements in natural philosophy (Schliesser, 2007). Newton's impact on economics, especially Adam Smith, has also recently been emphasized (Montes, 2008). His impact on the physical sciences was, a fortiori, enormous.

Yet, as I noted above, the apostles and epigones of every cultural entrepreneur adapt and alter the original message, and Newton was no exception. Dobbs and Jacob (1995, p. 61) stress that Newton was not a Newtonian. He showed little taste in his lifetime for applications, and unlike his nemesis Robert Hooke invented little worth mentioning. Most of his epigones, too, were not famous for large technological

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<sup>60</sup>Boerhaave (1668-1738) serves as another classic example of the kind of epigone that is instrumental in disseminating the ideas of the true cultural entrepreneurs, in his case Descartes and Newton. Enormously famous and renowned in his own days, his original contributions were few and middling, yet he helped spread the main cultural beliefs of the Enlightenment, not only in his own country but throughout Europe.

advances, although John T. Desaguliers experimented a great deal with electricity without making any breakthroughs of note. As noted, it is probably a stretch to draw direct links of anything we may call “Newtonianism” and the acceleration of technological innovation after 1760.<sup>61</sup> The connection between the Scientific Revolution and the Industrial Revolution was more subtle. It is true that some of Newton’s followers were able to demonstrate his principles using mechanical devices. But, as Cardwell (1972) and others have noted, the dispute between the Newton measure of force (momentum, or mass times velocity) and the Huygens-Leibniz notion of *vis-viva* (momentum times velocity squared) was not altogether in Newton’s favor, as the *vis-viva* concept was more useful to engineers interested in “work”, duty, and efficiency. The confusing dispute regarding which of the two concepts was to be preferred illustrates that Newton’s work left a lot for the future and that concepts such as momentum, force, work, power, and torque had not been fully worked out until late in the eighteenth century (Home, 2002, p. 361).

But what Newton did was to produce the crashing crescendo to a century in which natural philosophers had worked to raise the social prestige of “useful knowledge” as both socially beneficial and personally virtuous. Such a transformation was essential if useful knowledge — science, technology, medicine — were to play the transformative roles in History they did. But he also changed the methodological premises of how useful knowledge was constructed. In Newton’s work the emphasis is on mathematics and instrumentality, not on explaining the deep causes of things (Dear, 2006, pp. 37-38). His view of the world was to establish regularities and show how they could be exploited, but not to provide any microfoundations the way Descartes had tried. In the age of Enlightenment Newton became the epitome of the potential of human rationality, and, as Peter Gay (1969, p. 130) has put it, “in the deification of Newton, the Enlightenment of the philosophes and the age of Enlightenment were at one.” Deification, of course, was the fate of many of the truly successful cultural entrepreneurs — from Jesus to Marx.

Perhaps the most important contribution that Newton’s work made to the Industrial Enlightenment was the elegance and completeness with which he explained phenomena and regularities that had puzzled people for centuries. The point was not just that his equations, which explained celestial motions as well as

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<sup>61</sup>Jacob (1997) has expressed this view most eloquently. It is true that the career and work of Jean T. Desaguliers exemplifies the positive effect of Newtonianism in Britain, focusing on the practical and useful application of the new mechanical science, but during Desaguliers’s life (1683-1744), nor that of other similarly-minded Newtonians such as James Jurin (1684-1750), no Industrial Revolution took place.



provided a theoretical basis for much that had been known before on the motions of earthly bodies and the behavior of light, provided a world of order and logic. It was also that the Baconian ideal of understanding nature through observation and experiment and thus its control seemed so much closer. The world was operating through mechanical principles that were intelligible, despite its seemingly chaotic nature. Newton's work filled other scholars with hope that areas such as farming, medicine, chemistry, electricity, materials, and even the "science of man" would soon be similarly reduced to well-understood elegant laws. Yet the economic effects were not immediate, because Newtonianism and the world view it implied needed to filter down to the practical people with a proclivity toward improvement; the development of public science, a central part of the Industrial Enlightenment, was therefore an integral part of the technological developments of the later eighteenth century (Jacob and Stewart, 2004).

The importance of Newton for subsequent developments is also in the change in the function of religion that his work implied. There is a deep irony in this that is hard to miss. Newton was a deeply religious man, for whom his findings affirmed to his mind the ever-presence of a wise deity who had created a world of knowable regularities.<sup>62</sup> But Newtonian mechanical philosophy did not need a personal God, and it is telling that many of his Enlightenment followers, above all Voltaire, could uncouple his scientific works from his faith and adopt the former without paying much attention to the latter.<sup>63</sup> Enlightenment science often coexisted with religion, but it needed it less than the Puritan scientists did in the mid seventeenth century. Indeed, for the Puritans and for many other seventeenth century natural philosophers, experimental science and the creation and dissemination of useful knowledge was a form of worship.

The eighteenth century increasingly replaced religion with other beliefs, some of them Utopian and millenarian in their own right, namely the promise of a more prosperous and peaceful world (Becker, 1932). Concepts such as "Christian virtue" were replaced by secular equivalents such as good citizenship and rational behavior and "salvation" had to make room for "progress." More than anything, of course, in the

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<sup>62</sup>While it surely is far-fetched to see in his Arianist (and thus heretical) convictions a driving force for his science, his Christian faith affirmed and supported his scientific work. He could do this by developing eclectic and idiosyncratic religious beliefs that were designed to be consistent with his scientific insights. He ignored the problems that his mechanical theory posed for cosmogenesis and ostensibly adhering to the literal biblical text (Snobelen, 1999).

<sup>63</sup>Voltaire regarded Newton practically in religious terms, regarding himself as Newton's apostle and admitted that Newton was the "God to whom I sacrifice" (Feingold, 2004, p. 104).

terminology of defining what was good and attractive in new cultural variants — always a central part of rhetorical bias — the “sacred” was replaced by the “natural,” but often with similar meaning. This was, for instance, well-expressed by Adam Smith — another cultural entrepreneur of great importance to economic history — who wrote that “Statesmen ... and Projectors [fraudulent speculators] disturb nature in the course of her operations in human affairs; and it requires no more than to let her alone, and give her a fair play in the pursuit of her ends, that she may establish her own designs.”<sup>64</sup>

### **Conclusions.**

With a growing consensus on Northian institutions as the central story in explaining differences in economic performance (Acemoglu and Robinson, 2011), the issue of why some economies somehow develop “better” institutions and what it is exactly that these institutions do to make an economy develop faster, has become paramount. The emphasis in this literature has been on the growth of cooperation and trust as social norms, as well as on the historical roots of the development of political factors behind the evolution of constraints on the executives and low levels of predatory behavior, rent-seeking, and redistribution. I have highlighted another much-neglected factor, namely attitudes toward science and technology. “Attitudes” are of course a component of something much larger we call “culture.” In the end, economists cannot avoid the concept, although they may not have a comparative advantage in analyzing it. For an economy to create the innovations that enabled it to make the huge leap of modern growth, it needed a *culture of innovation*, one in which new ideas were respected and encouraged, heterodoxy and contestability were tolerated if not encouraged, and novelty tested, compared, and diffused if found to be superior by some criteria to what was there before.

An evolutionary approach toward culture helps us understand why certain cultural variants may become dominant in the population. This approach relies on the idea of “biases,” which explain why individuals change the cultural traits they inherit (through genes or socialization) from their elders and adopt others. Despite the understandable reluctance of scholars to attribute aggregate outcomes to the deeds of

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<sup>64</sup>This line comes right after the famous statement (not reproduced in the *Wealth of Nations*) that “little else is required to carry a nation to the highest state of opulence from the lowest barbarism but peace, easy taxes, and a tolerable administration of justice” (Stewart, 1797, p. 72). Dugald Stewart added that the sentences appear in a small 1755 manuscript by Smith that was now in his possession, but which was not to be published.

specific individuals, the activities of cultural entrepreneurs often played a major role in persuading large numbers of people to accept a set of beliefs different from their parents. It is hard to argue that any specific cultural entrepreneur was genuinely indispensable; surely if Newton had not been born, the Age of Enlightenment could have picked another idol to use as a model of the triumph of the human mind. Nobody would argue that had it not been for Newton or Bacon or another dozen hall-of-famers, Europe's economic history would have been like Somalia or Moldova. But it is exactly the European environment that allowed such talents to flourish and have the influence they had that makes their impact worth noting. Studying cultural entrepreneurs as focal points for cultural change may be helpful in understanding the Industrial Enlightenment, the Industrial Revolution, and in the end much of the economic history of the world in the past quarter millennium.

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