PERSPECTIVE

Reversals of national fortune, and social science methodologies

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Among non-European regions colonized by Europeans, regions that were relatively richer five centuries ago (like Mexico, Peru, and India) tend to be poorer today, while regions that originally were relatively poorer (like the United States, Chile, and Australia) tend now to be richer. Acemoglu, Johnson, and Robinson (abbreviated AJR) established the generality of this reversal of fortune. Chanda, Cook, and Putterman (abbreviated CCP) have now reanalyzed it, taking as a unit of analysis populations rather than geographic regions. That is, India's population was Indian 500 y ago and is still overwhelmingly Indian today, whereas the United States' population was Native American 500 years ago but is overwhelmingly Old World (especially European) today. Reversals of fortune disappeared when CCP analyzed populations rather than geographic regions: for instance, the geographic region of the modern United States has become relatively richer since AD 1500, but the predominantly European population now occupying the United States was already relatively rich in AD 1500. Evidently, European colonists carried ingredients of wealth with them. I discuss the biological and cultural baggage transported by European immigrants and associated with wealth. Among that baggage, AJR emphasize institutions, CCP emphasize social capital, and I identify many different elements only loosely coupled to each other. This paper discusses the problem, especially acute in the social sciences, of "operationalizing" intuitive concepts (such as mass, temperature, wealth, and innovation) so that they can be measured. Basic concepts tend to be harder to define, operationalize, and measure in the social sciences than in the laboratory sciences.

wealth of nations | operationalize | colonies | immigrant baggage

Five centuries ago, the region that is now modern Mexico was in every respect richer and more advanced than the region of the modern United States. At that time, Mexico already had writing, cities (including one very large city), state-level governments including the large multiethnic Aztec Empire, and outstanding ceramics, sculptures, and architecture, whereas the United States had no writing, no cities, small chiefdoms but no state-level governments, and much less impressive art and architecture. Today, the United States is more than four times richer than Mexico [as conventionally measured by per-capita gross domestic product (GDP)] and more urbanized, powerful, and technologically advanced (1). That is, Mexico and the United States have experienced a reversal of fortune. Does the explanation for that reversal depend just on detailed historical developments specific to Mexico and the United States, without broader significance?

To look for possible broader significance, let's turn to South America. Five centuries ago, the most advanced area of South America—rich, urbanized, united in a large multiethnic empire, and with the New World's first metal tools—was the core area of the Inca Empire in modern Peru, Bolivia, and Ecuador. Chile, beyond the Inca border, was a poor backwater. Today, Chile is two to four times richer and more industrialized than Peru, Bolivia, and Ecuador. That's another reversal of fortune similar to that between Mexico and the United States. Do those two sets of reversals have more global significance, or do they just depend on some peculiar features of Spanish colonization and of the American hemisphere?

Now, let's turn to the lands surrounding the Indian Ocean. Formerly, the richest, most advanced, and most powerful empires in this region were India's and Cambodia's Mughal and Khmer Empires, respectively, whereas Australia was the continent least developed politically and technologically and was still occupied by hunter/gatherer bands without agriculture. Today, Australia is 17 and 27 times richer than India and Cambodia, respectively. Those three countries were colonized by Britain and France rather than by Spain. Among Germany's former colonies in Africa, Togo and Cameroon were richer and more developed than Namibia five centuries ago; today, Namibia is nearly five times richer. Among former British and Dutch colonies in Africa, Nigeria and Ghana were formerly richer than South Africa; today, South Africa is 5–10 times richer.

Thus, reversals of fortune have characterized all non-European continents colonized by Europeans, irrespective of the European colonizing power. This generalization was recognized by Daron Acemoglu, Simon Johnson, and James Robinson (AJR) (2) in a much-cited prize-winning paper that has become a classic of economic history. By statistical analysis of a large quantitative database, AJR documented that, among ex-colonies of Europe, regions that were relatively rich and technologically and politically advanced in AD 1500 tend to be relatively poor and less advanced today—like the abovementioned areas of the former Aztec, Inca, Mughal, and Khmer Empires. Conversely, colonized regions that were then poor and backward tend to be rich and advanced today—notably, the United States, Canada, Australia, and New Zealand, followed by South Africa plus South America's southern cone of Chile, Argentina, and Uruguay. This is a striking and broad result that must have some broad explanation. AJR (2, 3) concluded that the explanation depends on the contrasting strategies adopted by European colonists in originally poor or rich regions, resulting in political, economic, and social institutions that have persisted and that have, respectively, either favored or discouraged economic growth.

Now, a just-published paper by Areendam Chanda, C. Justin Cook, and Louis Putterman (CCP) (4) extends our understanding of these interesting and important phenomena. CCP began by using a larger database to confirm AJR's conclusion about reversals of fortune with respect to geographic regions, such

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as Mexico and the United States. However, as AJR (3) already recognized, the populations inhabiting only some of those regions are descended from the populations inhabiting those regions in AD 1500. For instance, the great majority of modern Nigerians are descended from Nigerians of AD 1500, but the great majority of modern Australians are descended from recent European and Asian immigrants rather than from the Aboriginal Australians inhabiting Australia in AD 1500. Again as AJR had recognized, the formerly poor ex-colonies that have become rich today tend to be ones whose populations became transformed by immigration, whereas the formerly rich ex-colonies that became relatively poor tend to be ones that preserved their original inhabitants. Hence, CCP used and extended Putterman's and Weil's (5) detailed calculations of the mixed ancestry of the populations of modern countries and the wealth of those ancestors five centuries ago. When CCP thus took their unit of analysis as a region's ancestral population rather than as the region itself, reversals of fortune disappeared: populations whose ancestors were relatively poor or rich five centuries ago are relatively poor or rich today, even if now transplanted to a different continent. Evidently, modern wealth or poverty depends on what immigrating Europeans (or Chinese or Indians or other immigrants) brought with them. AJR and CCP both discuss what the crucial things were that immigrants brought with them and reach apparently somewhat different conclusions—about which I'll say more below.

However, these summaries of results have skipped over a difficult methodological question. How does one calculate a country's "wealth" or "level of technological development" as of AD 1500, before there were economists recording such data? Hence, this paper will take the form of an anaconda that has just swallowed a large sheep, with the sheep corresponding to a general discussion of methodology interrupting discussions of national fortune corresponding to the anaconda itself. Specifically, following this introduction, I launch into the sheep: a discussion of the problem of operationalizing in the social sciences, which is key to AJR's and CCP's analyses. That discussion is followed by an explanation of AJR's and CCP's own results and conclusions.

My own interest in this methodological question stems from my working, or having worked, in three different areas of science: laboratory science (specifically, cell and molecular physiology), field biology (community ecology of New Guinea birds), and social science (comparative long-term history). Over the course of my career, I have experienced firsthand how the difficulties of resolving scientific questions through manipulative experiments, of defining key variables, and of measuring those variables increased as I extended my interests from laboratory science to field biology and then to social science. Although my attitude toward social science research was initially somewhat skeptical, my appreciation for the importance, methods, and successes of social science research increased as I became personally involved in it. Hence, this article should be viewed as a sympathetic defense of social science research, written by someone whose perspective is partly still that of a laboratory scientist.

The Problem of Operationalizing in Doing Science

AJR's discovery of an inverse relationship (among colonized countries) between national wealth in AD 1995 and national wealth in AD 1500 depends on a concept intuitively familiar to all of us: wealth. However, how can one measure wealth in the absence of an accepted wealth meter? One must find some way to "operationalize" that intuitively simple concept: i.e., to specify some series of operations yielding a plausible measure of wealth. That issue of operationalizing is a ubiquitous problem in the social sciences, which deal with important and intuitively obvious but hard-to-measure central concepts such as happiness, anger, intelligence, innovation, motivation, frustration, and beauty (6).

Regarding modern national wealth, economists define it in various alternative ways, each in turn operationalized in various alternative ways. Definitions include definitions of income (a flow of value), wealth itself (a stock), economic prosperity, standard of living, national development, and national well-being. As for operationalizing those definitions, taking income as an example, one way is to calculate average national income per person per year: i.e., tabulate the annual income of every American and average over all Americans. A second operationalized measure of income is a nation's GDP per person, which means the value per person of all of the goods and services produced in a nation within 1 y. Complications include whether and how to correct for depreciation of capital goods and for inflation, and whether and how to count housework and the value of extramarket (including criminal) activity. A third operationalized measure of income is to correct income or GDP for differences in purchasing power, because one dollar or its currency exchange equivalent buys more in some countries than in other countries. With any of those measures, there remains the question of choice of year for measuring national income, because significant shifts in relative national income have occurred over recent decades. The measure of income that AJR chose was GDP per person for 1995 corrected for differences in purchasing power, whereas CCP used that same measure for either 1960, 1995, or 2009. An added complication for social scientists is that none of those operationalized measures of national income can be measured by one scholar in a fraction of a minute, the time required for a chemist to weigh a quantity of a reagent. Estimations of average income, GDP, national differences in purchasing power, and inflation rates all require huge masses of data and effort by many people.

Thus, it is not simple to operationalize and calculate national wealth even for 1995, a year in which abundant data are available. How on earth, then, can an economist operationalize and calculate national wealth for the year AD 1500, long before tabulations became available for average national income, GDP, and purchasing power? There is no research program with foreseeable prospects of eventually being able to tabulate the average income of every citizen of the Aztec Empire, or the Empire's GDP, in AD 1500. Hence, economists have no choice but to resort to "proxies": i.e., to quantities for which estimates in AD 1500 are available and that can plausibly be asserted to correlate well with our intuitive concept of wealth. AJR and CCP test two and five different proxies, respectively, which are discussed below.

To chemists and molecular biologists, it seems that the situation is very different in the laboratory sciences. There, the central concepts such as weight are unequivocally defined. There are not alternative definitions of weight, of which some chemists prefer one and other chemists prefer another. For many hard objects, the weight remains the same from 1960 to 1995 and does not depend on national differences in purchasing power. There doesn't even seem to be any need for operationalizing weight to measure it: one just puts one's sample on the electronic balance's pan, reads the number 2.375 (grams) off of the display, and that is the end of it. In the laboratory sciences, the measurement of other basic concepts, such as temperature, length, and voltage, is equally straightforward and seemingly devoid of problems of how to operationalize.

In fact, one does need to operationalize in the laboratory sciences, as well as in the social sciences. That number 2.375 (grams) turned up on your electronic balance's display as the result of a series of operations going on inside the balance that you do not bother to think

about. Before electronic balances existed, chemists measured weight by a series of operations performed on a double pan balance: put one's sample to be weighed in the left pan, place in the right pan some precisely manufactured objects whose weight has been measured ultimately by comparison with the weight of a standard kept in Paris, keep adding or subtracting manufactured objects until the balance's pointer points vertically upward, and add up the numbers engraved on the manufactured objects in the right pan. A third operation for measuring weight is to suspend one's sample from the hook of a spring balance, for which the relation between sample weight and stretched spring length has previously been empirically calibrated. Similarly, temperature measurements are operationalized in various ways, of which the simplest and most transparent is to read off the length (calibrated as degrees centigrade) of a column of mercury, taking advantage of the fact that mercury's volume expands with increasing temperature. Once these methods of operationalizing the measurement of weight and temperature had been worked out, laboratory scientists were able to forget about them and just read off the numbers, because alternative accepted series of operations yielded the same results accurate to several decimal places.

Another example of operationalizing in the laboratory sciences involves the intuitive concept of "sweetness," which may be defined as "concentration of glucose (or of other sugars that taste sweet to humans)." An operationalized method to measure sweetness is to treat a glucose solution with an enzyme that liberates hydrogen peroxide, which (treated with another enzyme) reacts with a substance called dianisidine to yield a brown color, whose intensity can be measured with an instrument called a spectrophotometer, which has a dial whose pointer's deflection lets one read off a number that can be calibrated by means of standardized glucose solutions to yield a number for glucose concentration and hence an operationalized measure of sweetness (6). Chemists use such indirect operational reasoning constantly, without anyone considering it ridiculous.

The difference between laboratory sciences and social sciences with respect to operationalizing is largely a matter of degree: the basic concepts of the social sciences are harder to define, operationalize, and measure than are those of the laboratory sciences. In that light, it is ironic that chemistry, physics, and laboratory biology are referred to as "hard sciences" (in the sense of hard connoting rigorous superiority), and that the social sciences are often described pejoratively as "soft sciences," when the soft sciences are harder (in the sense of hard connoting difficulty) than are laboratory sciences. Scorn of the social sciences is widespread, even among American scientists and politicians who bear the responsibility for the well-being of the scientific enterprise in the United States and who ought to know better. The same lack of understanding is common among elected members of the US Congress, all too many of whom wish to limit or cut off the National Science Foundation's mandate to fund social science research.

In reality, there is not a sharp dichotomy that divides sciences cleanly between experimental laboratory sciences and observational nonexperimental social sciences, but instead a spectrum. Some physical and biological sciences, such as geology, astronomy, and evolutionary biology, have a large historical component amenable to observation but not to experimental manipulation. Conversely, field biologists and social scientists have succeeded in many cases in devising experimental manipulations to incorporate into their repertoire of scientific methods (7, 8). As for the objection that social concepts such as social frustration are inherently unquantifiable, my next section will discuss examples of how social scientists do seek to quantify such concepts. Their efforts are important, because not only historians but also the US government is now very concerned about understanding why social frustration reaches levels causing revolutions and terrorism in some nations but not in other nations.

Reversals of Fortune

AJR's Analysis. AJR (2) sought to establish the relationship between income before European colonization (e.g., around AD 1500) and modern income for non-European countries colonized by European powers and now independent. AJR's operationalized proxy for modern income was among the usual ones chosen by economists (GDP per person for 1995 corrected for national differences in purchasing power). The more difficult problem, requiring ingenuity, was for AJR to devise plausible operationalized measures of income around AD 1500.

AJR settled on two proxy measures. One was urbanization: the percentage of a territory's population living in urban settlements, defined as settlements with more than 2,000 or 5,000 inhabitants. One expects urbanization to be positively related to national income, because support of urban populations requires high agricultural surpluses and a well-developed transportation system (9). Historians have calculated the extent of urbanization for 41 future colonies around AD 1500, and for those colonies and other countries as well at various times since 1500 (9, 10). AJR showed that modern and recent GDP per capita, known for many countries for various years back to AD 1750, does increase with contemporary urbanization.

AJR's other proxy was population density, for which there are also theoretical reasons to expect, and some empirical evidence confirming, a positive relationship to income, although the relationship is less straightforward and less tight than for AJR's alternative proxy of urbanization (9). Population density has the advantage that historians have been able to estimate past values for more colonies than in the case of urbanization. As one would expect, historians' estimates of urbanization and of population density in the past prove to be positively correlated. Those estimates are not based on mere guesswork but are extracted from archaeological evidence and contemporary eyewitness accounts, and scholars have devoted their careers to extracting them (9, 10). Of course, we are left with more uncertainty about the population of the Aztec capital of Tenochtitlan in 1500 than of New York City in 1995. However, the margin of uncertainty is small compared with the undoubtedly enormous differences between the populations of Aztec Mexico, Native American societies in what is now the United States, and Aboriginal Australia as of 1500.

The main conclusion from AJR's analysis was that, among European colonies-to-be and ex-colonies, modern income (i.e., GDP per capita in 1995) does show a negative correlation with both proxies for income in 1500 (i.e., urbanization and population density then). That is, there really has been a reversal of fortune for a dataset consisting of all European colonies for which the two proxies for income in AD 1500 could be estimated. That constitutes a quantitative and statistically tested worldwide demonstration of the conclusion suggested by the handful of anecdotal and qualitative examples that I summarized in the first three paragraphs of this paper.

To rule out the possibility that AJR's conclusion might have been an artifact of their particular dataset or of influences of other variables, AJR carried out so-called robustness tests that are considered good practice in the social sciences. They modified their database by examining only New World colonies, by omitting all New World colonies, or by omitting the four richest British ex-colonies (the United States, Canada, Australia, and New Zealand), and they controlled for other possible influences including latitude, religion, the identity of the European

colonizing power, land-locked borders, and coal deposits. All of those modified datasets and analyses still yielded evidence of a reversal of fortune. However, there was no such reversal for countries that never were European colonies: for them, income today increases with AD 1500 income as estimated by urbanization. Thus, the reversal was caused by something confined to territories that became European colonies. What could that something have been?

In a previous paper (3), AJR discussed how Europeans adopted one of two strategies toward their colonies. One strategy was applied to colonies characterized by a dense native population, wealth that could be extracted by forcing those natives (or imported slaves) to work in mines or on plantations, and tropical diseases that made it unhealthy for Europeans to settle in large numbers. [Examples of AJR's ingenuity in operationalizing familiar concepts are the two proxies that they chose to measure unhealthiness: death rates of European soldiers posted to a colony, extracted from European colonial reports about soldiers' health (11, 12), and, even more ingeniously, Vatican records of deaths of European bishops sent out to Latin America (13).] In colonies with those characteristics (such as Mexico, Peru, India, Nigeria, and Indonesia), European colonial administrators established so-called extractive institutions whereby the colonial government expropriated local wealth and the fruits of the labor of local inhabitants. Those extractive institutions tended to persist after modern colonial independence, and they serve today as a disincentive to economic growth. The opposite strategy was applied by European colonial administrators to colonies characterized by a low native population (either originally or else after depopulation of natives by European-introduced diseases as in North America) such that Europeans could not extract wealth from the native population, but also characterized by a lower burden of diseases affecting Europeans such that Europeans were attracted to settling in large numbers. In colonies with these latter characteristics (such as the United States, Australia, and Chile), European settlers had to work themselves rather than exploit native labor, and they brought European institutions rotecting the fruits of their labor against expropriation. Those protective institutions have tended to persist after independence, and they serve today as stimuli to economic growth.

AJR's focus on quality of institutions is shared by some, but not all, economists seeking to understand wealth and poverty in the modern world (refs. 14–18 vs. refs. 19–21). "Good institutions" are ones that motivate people to work hard and to be economically productive, because those institutions give people confidence that they will be able to keep the fruits of their labor. In contrast, "bad institutions" are ones that discourage people from working hard and being economically productive, because they know

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that much of the fruits of their labor will be expropriated by a corrupt government or by private usurpers. The long list of good institutions invoked by economists includes control of inflation, educational investment in human capital, effective government, enforcement of contracts, governmental honesty, incentives for investing financial capital, open currency exchange, protection of private property rights, and rule of law. "Natural experiments" illustrating the importance of institutions include formerly unified countries that became divided into two political entities (such as North and South Korea and the former East and West Germany), one with worse and one with better institutions, resulting in poverty in the former entities and wealth in the latter entities.

To quote AJR (2), "In prosperous and densely settled areas, Europeans introduced or maintained already-existing extractive institutions, to force the local population to work in mines and plantations, and took over existing tax and tribute systems. In contrast, in previously sparsely settled areas, Europeans settled in large numbers and created institutions of private property, providing secure property rights to a broad cross section of the society and encouraging commerce and industry." Those bad or good colonial institutions were extensively adopted by former colonies on achieving independence. AJR (2) confirmed that view by showing that two proxies for good modern institutions—a rating scale for protection of private foreign investment against governmental expropriation and a rating scale for constraints on government executive abuses of power—vary inversely with both proxy measures of AD 1500 income. That is how AJR explained the modern economic differences between the United States and Mexico, between Chile and Bolivia, and between India and Australia.

CCP's Analysis. As a measure of modern income, CCP (4) used AJR's operationalized proxy of GDP per person for 1995, corrected for national differences in purchasing power. As measures of income around AD 1500, CCP again tested AJR's two proxies of urbanization and population density, but data limitations and interpretation questions for these measures led CCP to use three other proxies as well; variants of all three had also been used by other social scientists. One proxy is "the number of years since people living within what is now the country's territory began to rely on agriculture more than on foraging as their major source of food" (ref. 4). That number ("millennia of agriculture") varies from about 11,000 y for countries of the Fertile Crescent, the world region where agriculture arose first, to 226 y for Australia, where everyone was living by hunting and gathering until agriculture arrived with Britain's first fleet of colonists in 1788. Antiquity of agriculture is a plausible proxy for development and income, because agriculture was prerequisite for sedentary living, for the post-Pleistocene explosion of population and technology, and for cities, state governments, and market economies.

CCP's second added proxy for income in AD 1500 was an index, initially developed by Bockstette et al. (22), based on the number of years ("state history") since the territory within the borders of a modern country acquired a form of government more centralized than just a tribe, i.e., a chiefdom or state or empire. State history is a plausible proxy for development and income, because the emergence of centralized government was associated with further growth of technology, population, social complexity, and market economies. Specifically, the index used by CCP considers the presence or absence of state government, its past territorial extent compared with the nation's present territorial extent, and whether the government control was foreign or within the nation's present boundaries, calculated for different past time periods and then combined to give lower weight to the more distant past.

CCP's remaining proxy was an index developed by Comin et al. (23) to rate the use of 24 technologies in five sectors (agriculture, transportation, military, industry, and communications) around the year 1500. In support of the logic underlying AJR's choice of two proxies and CCP's choice of three further proxies, all five of these proxies for income in the year 1500 proved to be correlated with each other. As in the case of AJR's two

proxies, the tabulations of CCP's three proxies are not based on mere guesswork but on extensive archaeological and historical data.

CCP next exactly reproduced AJR's calculation for AJR's two proxies for income in 1500 and obtained agreement. They then showed that their proxy for modern income of ex-colonies tended to decrease with all three of their proxies for income in 1500, but none of the three relationships reached statistical significance. That is, a reversal of fortune for ex-colonies between AD 1500 and 1995 can be documented by some but not by other proxies of income in 1500.

CCP's major extension of AJR's analysis takes off from the fact, already recognized and discussed by AJR (3), that the composition of the population of some but not of other colonies (e.g., of the United States but not of Nigeria) became drastically changed by European immigration. That raises the question: although the United States and other such colonies experiencing massive immigration did experience a reversal of fortune if one takes the unit of analysis as geographic territory, does that result remain true if one instead takes the unit of analysis as ancestral population?

Hence, CCP used and extended detailed calculations by Putterman and Weil (5) to translate a modern geographic country around 1995 (actually, in 2000) into the ancestral sources of that country's modern population. For instance, modern Americans, Mexicans, Haitians, and Costa Ricans represent, in different proportions, descendants and their mixed offspring of people living in 1500 in various parts of Europe, the Americas, Africa, and Asia. Putterman and Weil (5) and CCP used genetic, historic, and census evidence to identify year-1500 ancestors not only to broad regions such as Europe and Africa, but also to specific present day countries within those regions. Those calculations of mixed ancestries are much more detailed than previous calculations by other economists using broad ancestry categories based just on reported ethnic identities (e.g., European vs. Native American) or on language spoken (e.g., Spanish vs. Nahuatl or Quechua).

When CCP thereby translated geographic territories into ancestral populations as their units of analysis, the reversal of fortune not only disappeared but actually reversed. For all five proxies for wealth of ancestral population in 1500, modern wealth was strongly positively, not negatively, correlated with wealth in 1500. That is, the United States is relatively wealthy today because the US population today consists largely of the descendants of immigrants from European countries that were relatively developed already in 1500, and only to a small extent of the descendants of Native Americans occupying the United States in 1500 and of Africans brought to the United States after 1500 with development measures below those of the European immigrant source countries in 1500. As did AJR, CCP carried out many robustness checks to confirm that this conclusion is not an artifact of other variables or of their particular database. Specifically, they controlled for different choices of year for measuring modern income (1960, 1995, or 2009); for the same five other possibly relevant variables or sets of variables (latitude, climate, resources, European colonizing power, and religion) used in AJR's robustness tests; and for alternative databases [using the Americas alone, using all non-European noncolonies, considering all countries in which more than 20% of the current population's ancestors lived in foreign countries in 1500, and omitting the four wealthy "neo-Europes" (the United States, Canada, Australia, and New Zealand) and the two wealthy "neo-Chinas" (Singapore and Hong Kong)].

CCP (4) summarized their results as follows: "The reversal of fortune finding of AJR (2002) suggests that by adopting or having imposed upon them better institutions than once more advanced counterparts, some of the countries that Europe colonized between the 15th and 20th centuries were able to leapfrog ahead in their levels of economic development. We find that a reversal of fortune did occur among countries as territories–the chunks of real estate on which late twentieth century countries are situated—but that for countries thought of as groups of people sharing linguistic and other features, and for their descendants, persistence rather than reversal is the rule."

What Baggage of European Immigrants Stimulated Colonial Wealth?

AJR's and CCP's analyses agree that colonization by European powers variously increased or decreased colonial relative wealth, and that these different outcomes were due in considerable degree to differences in European immigration: more immigrants resulting in more wealth today. Among the biological and cultural baggage that Europeans brought to their colonies, which elements contributed to the consequences of large European immigration?

European biological baggage included diseases, genes, and domestic crops and animals. Because many or most of the temperate zone acute epidemic infectious diseases causing the highest death tolls in recent human history evolved from diseases of our large domestic herd mammals, and because 13 of the world's 14 species of those mammals originated in Eurasia and/or North Africa, most of those diseases were of Eurasian origins; none originated in the Americas or Australia (24, 25). Through population and individual exposure, Eurasians gained some genetic resistance and some acquired immunity to smallpox, measles, tuberculosis, and other such diseases, but non-Eurasians had no resistance or immunity because of lack of previous exposure. Hence, those diseases killed most of the native populations of the Americas and Australia, thereby facilitating European settlement of parts of those continents. Ironically, European ships also brought Old World malaria and yellow fever to the New World tropics, thereby creating the biggest obstacle to European settlement of the New World tropics, because Europeans and Native Americans had little or no resistance or immunity to those Old World tropical diseases.

Related to those European-transported diseases, a further piece of European biological baggage consisted of genes and gene absences. European partial resistance to smallpox and other epidemic diseases depended on frequencies of specific blood groups and other protective genes that had reached high frequencies in Eurasia, but not in the Americas or Australia, through evolutionary exposure and natural selection (26, 27). Conversely, the partial resistance of Africans and Asians, and the lack of resistance of Native Americans and most Europeans, to malaria resulted from evolutionary exposure of the former two populations but not of the latter two populations to malaria, resulting in the former's high frequency of protective genes such as sickle cell hemoglobin, thalassemia, and Duffy negative blood group. All of this biological baggage played a role in influencing the choices of colonies in which Europeans did or did not settle in large numbers, as recognized by AJR (3).

A further piece of European biological luggage consisted of the domestic crops and animals brought by Europeans. It is striking that some of the modern world's most productive agricultural lands—California, the Great Plains, the Argentine pampas, Australia's wheat belt, and South Africa's Mediterranean zone—supported little or no agriculture and stock raising before European arrival, despite their outstanding suitability for agriculture today. Their suitability for agriculture in 1500 was equally outstanding except in one crucial respect: their lack then of domesticable wild plant and animal species. That one missing ingredient was added when European colonists brought wheat, cattle, sheep, and other Old World crops and domestic animals, which quickly became the source of much of the modern wealth of the

United States, Canada, Argentina, Australia, and South Africa. The modern wealth of those countries can make one wonder: perhaps their reversals of fortune were really not due to any European baggage but instead due to Europeans choosing to settle in lands with high agricultural productivity and hence high economic potential. That interpretation is partly true: Europeans did choose to settle in temperate areas with high agricultural potential and low burdens of tropical diseases. However, on reflection, it's clear that that interpretation is not the whole answer, because it fails to explain why those same areas of high agricultural potential and low disease burdens were not already rich before European arrival. (The answer: except for North Chinese domesticates, the modern crops and animals of temperate zone food production were all domesticated at lower latitudes and subsequently carried to higher latitudes, mainly by Europeans.)

Two examples illustrate that that role of European-transported crops and animals in promoting colonial wealth was separate from the role (to be discussed in the next two paragraphs) of European-transported institutions. Argentina, poor and undeveloped in 1500, is today Latin America's second richest country, largely because of having become one of the world's leading exporters of products of the European-transported domesticates (beef, wool, and wheat) and despite its notoriously poor government institutions. Costa Rica, also poor and undeveloped in 1500, is today still much less rich than Argentina, largely because Costa Rica's tropical location makes it unsuitable for large-scale export production of beef, wool, and wheat, despite its admirably virtuous government institutions. Argentina, blessed with the fertile pampas and with its temperate location, has prospered even under bad government once it acquired Old World crops and domestic animals, whereas Costa Rica, cursed by its tropical location, has achieved only limited prosperity even under good government.

The remaining baggage brought by immigrants to colonies attracting large-scale European immigration was cultural. European colonizing nations as of AD 1500 had inherited the cultural products of millennia of development of politically centralized, socially stratified, technologically advanced market economies dating back to the rise of agriculture around 9000 BC in the Fertile Crescent, whence all of those things had begun to spread around 7000 BC to Europe itself. The cultural products of that long history of complex societies comprised several dozen elements only loosely coupled to each other, such as tolerance of strangers, rule of law, acceptance of taxation, markets, and political representation (8, 9). It is difficult for a society without a long history of such practices to embrace them quickly. That difficulty underlies the tragedy and frustration of international development efforts to improve governance, market economies, national identities, and harmony between strangers in societies without thousands of years of exposure to those features.

Where Do We Stand Now?

AJR and CCP emphasized different portions, and used different terms and proxies, for that cultural baggage carried by European colonists. AJR used the term "institutions," which they operationalized by two proxies: protection against the risk of expropriation of private investments by governments, and constitutional limits on executive power. CCP instead used the term "human capital," which they operationalized primarily by literacy and secondarily by quality of governance. However, one might object that those very few and specific operationalized proxies do not warrant being overinterpreted as measuring such general concepts as institutions and human capital. [CCP author Putterman does take a broader view in his book (28).] Instead, there appear to be many, somewhat separate, elements of cultural baggage that Europeans and other immigrant groups brought with them, and that are products of long histories. For example, among elements of cultural baggage promoting wealth, American influence on the Philippines was much more successful at transferring educational institutions, literacy, and health care institutions than at transferring honest governance.

I should make clear, however, that my overall assessment of AJR's and CCP's work is an admiring assessment and not a negative one. When one deals with big, complicated, multidetermined subjects such as economic history, it is unlikely that first scholarly treatments will discover the whole answer and identify all determining factors. Instead, one usually has to begin by identifying a few major factors, investigate whether those postulated factors are correct, and then see what still remains unexplained, before one can hope to identify further factors. AJR succeeded convincingly in formulating a problem and in demonstrating the explanatory roles of some factors. CCP have now extended AJR's work by identifying further factors. That still does not give us a complete understanding of economic history. It remains a challenging problem, requiring much more research, for social scientists to disentangle the contributions of each of the elements of cultural and biological baggage to national wealth.

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