

Deep Roots of Political and Economic Development

Complexity Science Hub Vienna; June 26–28, 2024

During the Holocene (roughly, the last 10,000 years) human social life has been transformed from small-scale relatively egalitarian groups to large-scale complex societies characterized by sophisticated governance institutions, elaborate information systems, extensive division of labor, and deep social and economic inequalities. At the same time, there was a huge degree of variation in political and economic development between continents and regions, both in the past and persisting today. Thinkers of the past and modern social scientists have proposed a multitude of theories to account for this profound transformation, as well as for why there is so much variation around the overall trend. New explanations continue to be proposed, and the theoretical corpus grows, but rejecting deficient explanations in favor of more logically cohesive and empirically adequate theories has not been keeping pace. This situation is made worse by disciplinary boundaries. In particular, the relatively new fields of Cultural Macroevolution and that of “Deep Roots” within Economics have developed largely in isolation of each other, with their separate corpora of modeling and empirical literature. The main goal of this conference is to bring active practitioners from both fields to enable cross-disciplinary conversation and, ultimately, collaboration. Recent advances in the construction of new databases, which together constitute a massive, and growing, corpus of data for empirically testing theoretical predictions, makes such trans-disciplinary dialogue timely and necessary.

Venue

The Complexity Science Hub Vienna has recently emerged as the focal point of social complexity science in Europe. It provides an exciting, creative environment free of bureaucratic constraints for open-minded visionaries who are brave enough to step out of mainstream science.

Schedule of Talks

June 26

9:00 Introduction (Turchin)

9:15 Oded Galor: Roots of Inequality

10:00 Kathryn Bard: Aksum, an Early State in Sub-Saharan Africa

10:45 Coffee Break

11:00 Tim Kohler: The Surprising Prehistory of Wealth Inequality, and its Causes, as seen from the record of housing disparities

11:45 Mark Koyama, Desiree Desierto, and Jacob Hall: Magna Carta

12:30 Lunch

14:00 Peter Turchin: Cultural Macroevolution: Understanding the rise of large-scale complex societies in human history

14:45 Motohiro Kumagai: The Horse, Battles, and the State: Military Origins of Autocracy

15:30 Break

15:45 Laura Mayoral: The Evolution of States: Public Goods, Geography, and Political Stability from 3000 BCE to 1800 CE

16:30 Discussion: How can we integrate case studies with “Big Data” analytics?

17:30 Adjourn

June 27

9:00 Peter J. Richerson: Human Macroevolution in the Late Pleistocene and Holocene

9:45 Helena Miton: Evolution of trade: Using Seshat to investigate 15 centuries of the Silk Roads

10:30 Break

11:00 David Schönholzer and Pieter François: Migratory Bottlenecks and the Evolution of Social Complexity

11:45 Discussion: Local versus distance effects in cultural macroevolution. The role of individuals in collective dynamics.

12:30 Lunch

14:00 Zhiwu Chen and Wanda Wang: Persistence, Shocks, and Reversal from the Neolithic to Modern China, 5000 BCE–2000 CE

14:45 Clair Yang: The Longevity Mechanism of Chinese Absolutism

15:30 Break

15:45 Ömer Özak: Millet, Rice, and Isolation: Origins and Persistence of the World's Most Enduring Mega-State

16:30 Discussion: China as a “laboratory” for understanding socio-cultural evolution

17:30 Adjourn

June 28

9:00 Eddie Lee: Discovering components, mechanism, and structure from data

9:45 Teresa Almendros and Daniel Kondor: The evolution of social organization in Bronze Age Mesopotamia: conquest, conflict, and the decline of the city-state system.

10:30 Break

11:00 Charles Efferson: When Norm Change Hurts

11:45 Discussion: Summing up. Future plans?

12:30 Lunch

Conference ends

Abstracts

Teresa Almendros and Daniel Kondor (CSH)

The evolution of social organization in Bronze Age Mesopotamia: conquest, conflict, and the decline of the city-state system

The city-state system was the predominant political form in Bronze Age Mesopotamia for over a millennium. Sargon's conquests constituted a qualitative leap in social organization and initiated a series of attempts at unification that progressively disarticulated the city-state system, which was never to reemerge after Hammurabi's reign. Our study finds that institutional evolution under the Akkadian, Ur III and Old Babylonian dynasties is best understood as a series of stepping stones of a unitary process of reorganization that paved the way for the formation of the first territorial state in the region. We specify the role of conquest, conflict, and state collapse in the evolution of organizational forms, and how these forms explain, in turn, the different collapses that these dynasties experienced. This approach aims to advance the study of organizational forms within a systemic framework where multi-causality and coevolution are expected, and explanations are rarely either/or.

We argue for the value of integrating case studies with macroevolutionary analysis. From this closer perspective, it is necessary to consider the emergence of social variants in addition to selection mechanisms as contributors to historical outcomes. Conquest and conflict are crucial, not only as selection mechanisms but also in explaining the emergence of new organizational forms.

Kathryn Bard (Boston University)

Aksum, an Early State in Sub-Saharan Africa

Aksum was an early state in sub-Saharan Africa. Ruled by a king, Aksum was a very long-lived polity of over 1,000 years. This was an urban society, and at the height of its power in the 4th to 6th centuries CE, the city of Aksum covered an area of 110 ha. at a minimum, and perhaps a much greater area, with an estimated population of 45,000.

The subsistence economy was agro-pastoral, with a high component of cattle pastoralism, which spread through northeast Africa from Neolithic times onward. Unlike a number of early states which were located in fertile river valleys, Aksum was dependent on seasonal rainfall for cereal cultivation. The mountainous environment of this state limited the areas of agricultural production, and there is no evidence of terracing or irrigation works. Textual and archaeological evidence demonstrate Aksum's participation in long-distance trade with the Roman Mediterranean, of exported African raw materials (especially ivory) and imported prestige goods. Beginning in the later 3rd century CE coinage was used in the economy.

Evidence of a monumental elite residence excavated on Bieta Giyorgis hill at Aksum has pushed back the origins of this polity to the 4th – 2nd centuries BCE. This monumental structure probably was located on the top of the hill for defensive purposes. Warfare, or the threat of warfare, may have been a component in state formation, and at one site on Bieta Giyorgis hill there is evidence of weapons manufacture (small, triangular pointed lithics) on a scale that could have equipped a small army. Also on Bieta Giyorgis hill is the earliest evidence of elite tombs marked on the surface by erected stelae, which in the early centuries CE became the largest monuments at Aksum, symbolic of the commemoration of royal ancestors.

Zhiwu Chen and Wanda Wang (Hong Kong)

Persistence, Shocks, and Reversal from the Neolithic to Modern China, 5000 BCE–2000 CE

Based on archaeological and historical data for China, we find that regions with more agglomerated activities during the mid to late Neolithic (5000 BCE–2000 BCE) had consistently higher population densities over subsequent millennia until the late nineteenth century, even though numerous war and other shocks occurred in-between. Initially driven by locational fundamentals (first nature), the Neolithic patterns of development are shown to have sustained through such mechanisms as state institutions (e.g., county formation), physical transportation infrastructure and self-serving social/cultural institutions, which created path dependence (second nature). However, the persistence of Neolithic patterns was ultimately broken, or even reversed, after the Industrial Revolution and modern ways of socioeconomic organization were transplanted to China from the mid-nineteenth century onward as these led to the rise of new agglomerations, permanently disrupting the spatial equilibrium since the Neolithic. Causality is established using a Difference-in-Differences (DiD) strategy, supplemented with an instrumental variable (IV) analysis. Our findings show a sizable shock in productivity can alter the value of old locational fundamentals and reshape long-persistent spatial patterns.

Charles Efferson (Lausanne)

When Norm Change Hurts

How can an isolated disturbance in a population disrupt the status quo and activate cultural evolutionary processes to generate sweeping social change? To evaluate this question, I consider a social planner, broadly imagined as a person of influence or authority, who intervenes in an effort to change people's behavior. When conformity and coordination incentives hold, a social planner's intervention can operate through at least two channels. It has a direct effect if some people exposed to the intervention change behavior as a result. It also has an indirect effect if some people change behavior because they observe others doing so. If the indirect effect is large, it dramatically amplifies the direct effect, a possibility that has generated considerable enthusiasm in policy discussions. That said, mundane forms of heterogeneity introduce a number of complications. Using a mix of models, observational studies, and

experimental results, I argue three points. First, some forms of heterogeneity strongly interfere with social change because group identities are active and favor chronic disagreement. Second, even when sweeping social change is feasible, the social planner

should often expect a trade-off between the direct and indirect effects of the intervention. Increasing one effect means decreasing the other, and social planners may often lack the information they need to resolve the trade-off. Finally, the link between behavior change and social welfare can be varied and counterintuitive. Intervention strategies that generate persistent disagreement and miscoordination can actually be better than alternative strategies that initiate a complete shift from one norm to another. In general, ordinary heterogeneity can disrupt any monotonic relationship between the size of a shock to a population and the degree behavior change that follows. Moreover, heterogeneity can also disrupt any monotonic relationship between the degree of behavioral coordination and the welfare consequences of cultural change.

Oded Galor

Roots of Inequality

Why does inequality vary across societies? Why are some societies more unequal than others? We advance the hypothesis that in a market economy, where earning differentials reflect variations in productive traits, a significant component of the differences in income inequality across societies can be attributed to systematic, deeply-rooted variation in societal interpersonal diversity, shaped during the prehistoric Out-of-Africa Migration. The roots of income inequality within the US population provide supporting evidence for the hypothesis. It suggests that variation in income inequality across groups of individuals originating from different ancestral backgrounds can be traced to the degree of diversity of their ancestral populations as was carved in the course of the dispersal of humanity from Africa

Tim Kohler (Washington State and SFI)

The Surprising Prehistory of Wealth Inequality, and its Causes, as seen from the record of housing disparities

For the last decade or so archaeologists have begun to compile an extensive series of measures of house-size disparities through time for various world regions. These are generally viewed as measures of wealth inequality, defining wealth quite broadly. For the last three years I've been co-directing the "Global Dynamics of Wealth Inequality (GINI) Project." This has greatly expanded the numbers of sites and residences and the world regions from which they come. I report selected preliminary (unpublished) results from this project, considering both what happens with these measures of wealth inequality through time, and also how we can begin to explain these results.

Mark Koyama, Desiree Desierto, and Jacob Hall (George Mason)

Magna Carta

Magna Carta, a pivotal moment in history, institutionalized constraints on royal power. We model it as an optimal agreement between two coalitions capable of violence: the king's loyalists and the rebel barons. This agreement is more likely when the king extracts large rents; the distribution of rents among barons is egalitarian; and barons have large resources that are

non-appropriable by the king. Under these conditions, even the baron that enjoys the largest rents is willing to lead a rebel coalition that has sufficient resources to defeat the loyalists. We test predictions with data on the universe of barons in England between 1200-1270.

Motohiro Kumagai (Hitotsubashi)

The Horse, Battles, and the State: Military Origins of Autocracy

This study explores the military origins of the state, battles, and autocracy, highlighting the significant role of the horse. The horse provided overwhelming military power to warriors, enabling those with access to horses to succeed in conquest, necessitating centralization and hierarchical structures. The horse was also a cornerstone of economic and political power. Only the wealthy could afford this expensive animal and gained political power by leveraging its military advantages in warfare. These individuals formed the elite class and established despotic regimes, which benefited them. To demonstrate the impact of the horse, the research utilizes several exogenous factors in the development of cavalry, such as the spread of metal bits, environmental conditions favoring native horses, and the increased availability of horses in the Americas following the Columbian Exchange. By employing various complementary data sets and these exogenous variations, the research shows that the adoption of cavalry fostered state formation, battles, and the evolution of autocratic institutions. Furthermore, it highlights the persistent impact on autocracy, suggesting a complementary relationship between autocratic institutions and cultural attitudes toward them.

Eddie Lee (CSH)

Discovering components, mechanism, and structure from data

How do we build mathematical models of complex social phenomena in the face of sparse data, methodological constraints, and multiple but incongruent scales of description? To address this question, we have developed approaches inspired by statistical physics to introduce a fresh perspective on primate conflict, armed human conflict, and political decision making. Our models not only illuminate the underlying social dynamics but also provide a bridge between diverse disciplines, potentially offering tools relevant to the deep historical roots of economic and political development. Through specific examples, we will demonstrate how these models challenge conventional paradigms and foster interdisciplinary dialogue essential for understanding the evolution of complex societies.

Laura Mayoral (Barcelona)

The Evolution of States: Public Goods, Geography, and Political Stability from 3000 BCE to 1800 CE

This paper explores the evolution of states over time using a unique dataset collected at the cell level, covering the period from 3000 BCE to 1800 CE. The dataset consists of cells measuring 0.5 by 0.5 degrees, capturing data at 100-year intervals until 0 CE and 50-year intervals thereafter for Eurasia and Africa. For each cell and point in time, the dataset records the presence or absence of polities and their names. This rich temporal and spatial dataset allows us to investigate various aspects of state evolution, including the determinants of state size, the frequency of cells being part of empires, the stability of states, and the role of geographical obstacles in shaping national borders.

We hypothesize that the presence of public goods significantly influences the formation and stability of large territories under centralized states. In contexts where public goods are pivotal, larger and more stable states are likely to emerge. Conversely, in the absence of such public goods, large polities can still arise through conquest, but they will typically be more unstable unions due to centrifugal forces. Additionally, geographical obstacles play different roles depending on the presence of public goods. In the absence of public goods, territories tend to be more fragmented, and natural barriers like mountains and rivers serve as defensive borders. However, in voluntary unions driven by shared public goods, these geographical obstacles are less likely to define borders.

Our analysis aims to shed light on the historical processes that have shaped the political landscape and the enduring impact of geography and public goods on state formation and stability. This study contributes to a deeper understanding of the factors driving the evolution of political entities and offers insights into the historical dynamics of statehood.

Helena Miton (Stanford)

Evolution of trade: Using Seshat to investigate 15 centuries of the Silk Roads

Trade and commercial exchanges have been a major force in creating the world as we know it. Yet, quantitative and empirical large-scale studies of exchange networks testing for factors associated with the expansion of the distance covered by exchanges remain rare, if not unheard of. This cultural macro-cultural evolution study aims to test for associations between hypothesized drivers—such as infrastructures, government, or money—and the distance at which trade took place, in the context of trans-Eurasian exchanges (the so-called “Silk Roads”). Our dataset informs over 760 trading links between approximately a hundred polities in Eurasia. Our dataset can successfully capture the non-linear expansion of the distance at which exchanges occurred and the substantial variation in connectivity in this exchange network occurring between 130 BCE and 1453 CE. Very preliminary findings (which might still change) suggest that infrastructures and the use of pack animals (horses, donkeys, camels) have a positive effect on how far a polity had commercial exchanges, while social institutions (including money or legal system) might have had surprisingly little to no effect, and the type of goods exchanged seems to be an important moderator.

Ömer Özak (Southern Methodist)

Millet, Rice, and Isolation: Origins and Persistence of the World's Most Enduring Mega-State

We empirically test a theory of endogenous formation and persistence of mega-states, using China as an example. We constructed a novel dataset to explore the relationship between the diffusion of agriculture, migratory distance to the earliest political center in eastern Asia (Erlitou), and social complexity-cum-historical presence of Chinese states across $1^\circ \times 1^\circ$ cells in eastern Asia. We find that cells that adopted agriculture earlier and were close to Erlitou remained under Chinese control for longer and continue to be a part of China today. Conversely, early adopters of agriculture located farther away had enough time to develop into independent states.

Peter J. Richerson (UC Davis)

Human Macroevolution in the Late Pleistocene and Holocene

The Pleistocene very deep roots of our genus show a pattern of steady increases in brain size but no apparent parallel trend in population size. It is as if the increasing cost of our big brain counterbalanced the cognitive and cultural advantages it offered keeping us rather rare, sometimes close to extinction. By the beginning of the last Ice Age our lineage in Africa and Neanderthals in W. Eurasia began, at least episodically, to make rather modern looking tools and to produce artistic objects. About 50 thousand years ago human populations in the Old World began to increase monotonically, interestingly at a time when the climate seems to have been hypervariable. About 11,700 years ago the climate abruptly became wetter and less variable. Agricultural subsistence systems began to evolve in many parts of the world. The Holocene is often portrayed as a series of revolutions—an agricultural revolution, an urban revolution, an industrial revolution and others. The pattern of human population increase does not seem to reflect such a history. Rather it is a rather smoothly accelerating hockey stick, with very slowly accelerating population increase in the early- and mid-Holocene, appreciably more rapidly in Classical times, becoming eventually the population explosion of 19th and 20th centuries. The simplicity of this pattern has attracted mathematical modelers including economists interested in explaining economic growth during and after the industrial revolution and human ecologists interested in the growing impacts of humans on the environment. Charles Efferson and I have constructed simple models of human subsistence systems based on ecologist's predator-prey model coupled to a cumulative culture component based on economic growth models. Neither a hunting and gathering nor an agricultural version of the model have a stable equilibrium with humans, prey, and technology present. The cumulative culture component of the hunter-gatherer version of the model tends to turn humans into super-predators that crash their prey. The agricultural version, for selected parameters and starting conditions, mimics the Holocene hockey stick, but has nothing in it to prevent it from continuing to explode to infinity. Keeping in mind that human economies are still hunting and gathering as regards ecosystem services like the climate and biodiversity, the two models together seem to be a good portrayal of a Holocene-long cumulative technological and institutional increase in human carrying capacity running headlong into planetary limits in the 20th and 21st centuries. A limitation of these simplified models is that they do not account for noisy boom and bust dynamics of individual societies, although Peter Turchin has shown that mathematically related models can do just that. So far as I am aware, no fully dynamic models have been published that might help explain why high rates of technical and social innovation occur in circumscribed times and places like the Eastern Mediterranean in Classical and Song Dynasty China in Medieval times.

David Schönholzer and Pieter François (Stockholm and Oxford)

Migratory Bottlenecks and the Evolution of Social Complexity

Since the dawn of our species, migration is a fundamental part of the human experience. In this project, we explore how human dispersal during the Holocene was a driving force of the evolution of social complexity. We begin by documenting a new fact: migratory bottlenecks—regions through which migratory groups had to pass through to move across continents—saw a much faster rate in the evolution of social complexity than similar regions that were less likely to be exposed to migratory movements. We then investigate whether these migratory bottlenecks were hotbeds of social complexity because they were more likely to be exposed to the diffusion of technological and cultural innovations, or whether they themselves generated these innovations. We do this by estimating a model of migratory movements calibrated to the diffusion of newly adopted crops and other technologies. Finally, we lay out a plan to apply this investigation to specific mass migration events throughout the Bronze and Iron Ages.

Peter Turchin (CSH)

Cultural Macroevolution: Understanding the rise of large-scale complex societies in human history

During the Holocene the scale and complexity of human societies increased dramatically. Generations of scholars have proposed different theories explaining this evolution, ranging from functionalist explanations, focusing on the provision of public goods, to conflict theories, emphasizing the role of class struggle or warfare. Cultural macroevolution provides us with a theoretical framework within which these theories, and others, can be compared and contrasted. Using a general dynamical model, based on this framework, and Seshat: Global History Databank we tested a variety of mechanisms suggested by major theories of sociopolitical complexity. Overall, these empirical results support two fundamental forces of cultural macroevolution: cumulative evolution and cultural multilevel selection.

Clair Yang (University of Washington)

The Longevity Mechanism of Chinese Absolutism

The history of China is characterized by prolonged centralization, relative stability, and consolidated absolutism. This talk proposes a potential explanation for the phenomenon, summarized as “Europe parliamentarized, China bureaucratized.” I will first review macro-level time trends of political development in China over two millennia and identify a structural change during the Middle Ages. The structural change coincided with the establishment of an exam-based bureaucratic recruitment institution—the Imperial Examination System. I utilize micro-level empirical evidence to illustrate the political control function of the exam system: how it dismantled aristocratic advantage in political selection, broadened political access to a larger population, and promoted social mobility. Through these mechanisms, the exam system solved two central problems of authoritarian rule simultaneously: political control of the elite and cooptation of the general population. We believe the exam system can help explain the decline of the aristocracy, the rise of political stability, and the consolidation of absolutism in historical China.

Note: This talk is a summary of several research projects, two collaborated with Yasheng Huang (MIT), one with Erik Wang (New York University), and one with Zhaomin Li (University of Washington).