Title
Upward Sweeps of Empire and City Growth Since the Bronze Age

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Upward Sweeps of Empire and City Growth Since the Bronze Age

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Abstract: This paper uses quantitative estimates of the sizes of cities and empires to tentatively identify upward sweeps in which uniquely large cities and empires emerged in the Central Political/military network since the Bronze Age, and it formulates a causal model to explain both the cyclical rise and fall of cities and empires and the upward sweeps.

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This paper is part of an NSF-funded project on the causes of the emergence of large states and empires since the Bronze Age.[1[1]] Here we use quantitative estimates of the population sizes of cities and of the territorial sizes of states and empires to identify instances in which the scale of polities and settlements rapidly increase, a phenomenon that we call "upward sweeps." Our project seeks to construct causal explanations of both the more usual cyclical rise and fall of large polities and cities and the less frequent instances in which much larger empires and cities emerge. The long-run evolutionary trend of the scale of human social organizations to expand needs to be studied in its particularities and comparatively so that we may explain how the processes of growth may be similar or different across large expanses of time.

Measuring Cities and Empires

Research on upward sweeps depends on the accuracy of quantitative estimates of the population sizes of cities and the territorial sizes of states and empires. Reliably estimating these quantities tends to become more problematic the further we recede in time. In this paper we use quantitative estimates of the territorial sizes of the largest empires produced by Rein Taagepera in a series of studies published since the 1970s. [2[2]] And we use estimates of the population sizes of cities produced by Tertius Chandler (1987).[3[3]] These will produce tentative identifications of upward sweeps of urban and empire growth that will be improved upon by using more complete and accurate estimates in the next round of our investigation. It is our eventual goal to enhance the Taagepera data by adding some large empires that are missing from Taagepera's data set (see Turchin, Adams and Hall 2006: Table 1). And we can upgrade Chandler's city size data by adding better temporal resolution and using the more recent estimates compiled by George Modelski (2003) and Roland Fletcher (n.d.). Eventually we intend to use the measurement model developed by Daniel Pasciuti to improve upon the city population size estimates (see Pasciuti and Chase-Dunn 2002 and http://irows.ucr.edu/research/citemp/workshop/esturbpop.htm). The identifications of upward sweeps in this paper should be considered as tentative, as they are entirely based on the estimates produced by Chandler and Taagepera.

[1[1]] Our Nsf proposal is at http://irows.ucr.edu/research/citemp/globstat/globstatprop.htm

[2[2]] See Taagepera in the bibliography. An excel file containing Taagepera's coding of the territorial sizes of empires is at: http://irows.ucr.edu/research/citemp/data/empsizes.xls

[3[3]] An excel file containing Chandler's estimates of the population sizes of largest cities is at: http://irows.ucr.edu/research/citemp/data/citypopsizes.xls. We are currently in the process of combining more recent estimates from Modelski (2003) and Fletcher (n.d.) to produce an improved data set on city population sizes but this work is not yet complete. The results here regarding city sizes should be regarded as tentative.

Whereas our larger study will compare several different world regions[4][4] this paper examines size estimates beginning in the Bronze Age of what we and David Wilkinson call the Central System. Largely separate constellations of cities and states emerged in Mesopotamia and Egypt around 6000 years ago and then merged by means of long distance trade, and then in terms of direct military interaction among states around 1500 BCE. The main unit of analysis for identifying upward sweeps in this paper is this Central System as bounded by the wars and alliances among states (the "political-military network"or PMN). A chronograph of the Central System bounded in this way is presented in Figure 1 below.

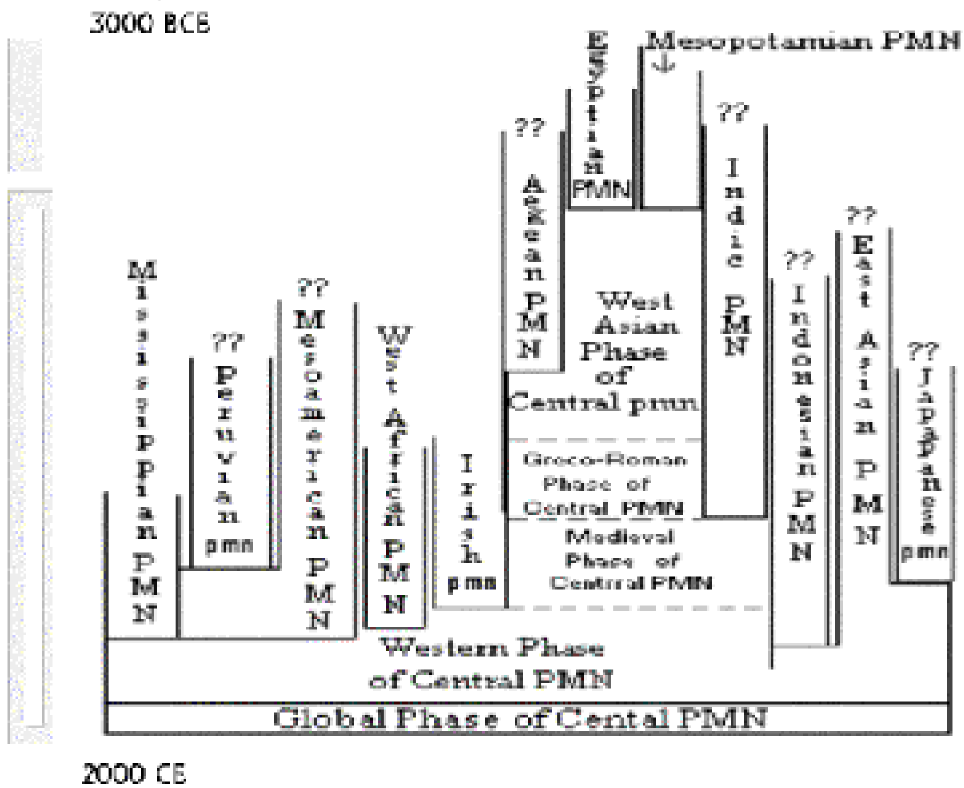

Figure 1: Chronograph of the Central System (following Wilkinson 1987)

[4][4] The spatial and temporal framework of our larger study is as follows:

a. the Central System (political-military network or system of states)
(from 2500 BCE or as soon as the size of the major states can be estimated) Mesopotamia, Egypt, the Aegean, Western Asia , the Eastern Mediterranean and then expanding to the west, east , north and south as delineated by David Wilkinson (see Figure 1)
b. the East Asian region from the bronze age to its 19th century engulfment by the Central System..
c. South Asia after the rise of states in the Ganges Valley (not Indus because not enough information) until its 13th century incorporation into the Central System.
d. and Mesoamerica, especially the Mayan region, but possibly also Oaxaca and Central Mexico until these were incorporated into the Central System in the 16th century.

Upward Sweeps and Ceilings

Figure 2 (below) is a stylized depiction of the rise and fall of large polities and occasional upward sweeps that portrays, not the history of a single world region, but rather the general evolution[5[5]] of what has happened over the past 12,000 years as many small polities (bands, tribes and chiefdoms) have developed into a much smaller number of larger polities (states, empires and a possible future world state).

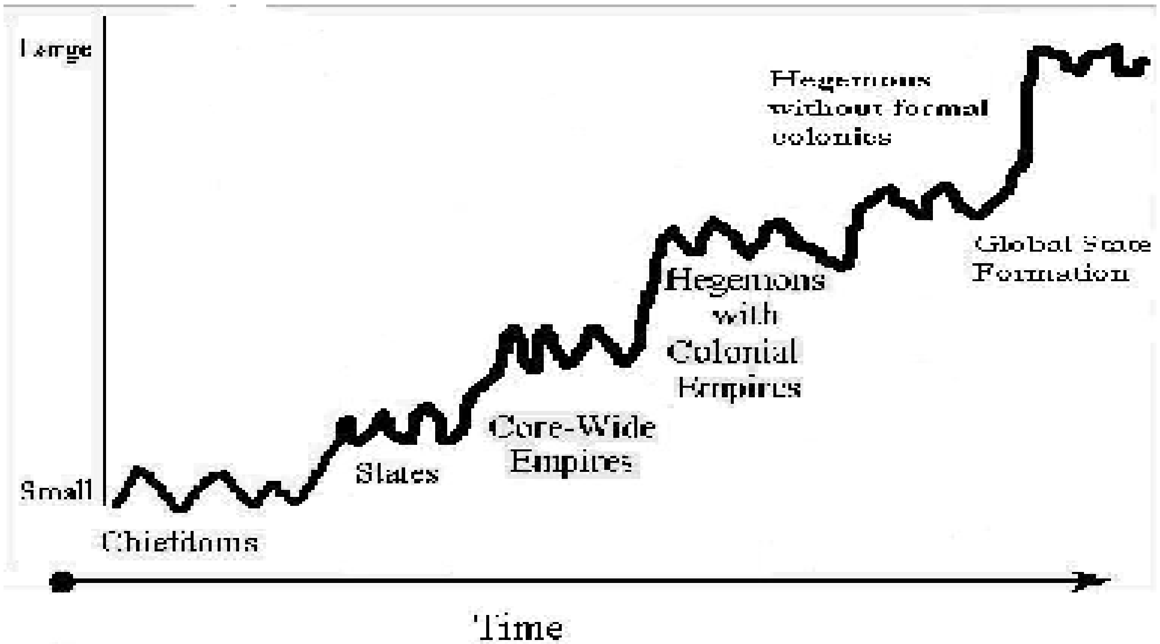

Figure 2: Rise, Fall and Upward Sweeps of Polity Size

George Modelski's (2003) recent study of the growth of cities over the past 5000 years points to a phenomenon also noticed and theorized by Roland Fletcher (1995) – cities grow and decline in size, but occasionally a single new city will attain a size that is much larger than any earlier city, and then other cities catch up with that new scale, but do not much exceed it. It is as if cities reach a size ceiling that it is not possible to exceed until new conditions are met that allow for that ceiling to be breached.

This paper has two main purposes: 1. to empirically identify upward sweeps of city and empire growth in the Central System, and 2. to formulate a revised explanation of the cyclical patterns of rise and fall and the occasional upward sweeps of city and empire growth. First let us examine the sweeps.

Figure 3 plots Taagepera's estimates of the territorial sizes of the largest and second largest empires in the Central System for the purpose of identifying empire upsweeps. We know that the first upsweep was that of Uruk and the Uruk expansion that began on the flood plain of Southern Mesoportamia (Algaze 1993), but we do not have quantitative estimates of the settlement and empire sizes. After a long period of

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[5[5]] We use the term evolution despite its tawdry history. We are talking about socio-cultural evolution, not biological evolution and we are well aware that teleology and progress need to be washed out of the concept of evolution before it can be scientifically useful (Sanderson 1990).

competing city-states in Mesopotamia the Akkadian Empire emerged as the first core-wide empire.[6[6]] Its territorial size is estimated by Taagepera and so it appears in Figure 3.

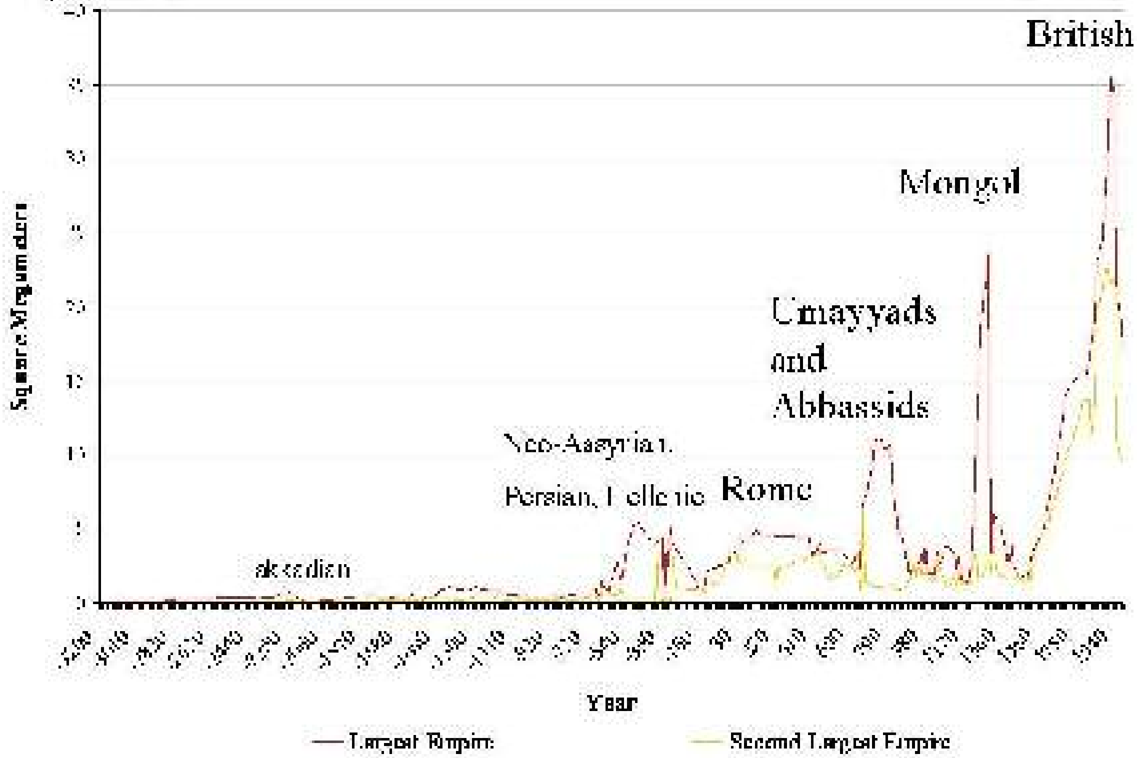

Figure 3: Rise, Fall and Upward Sweeps as revealed by Taagepera's estimates of the territorial sizes of the largest empires in the Central System

After the fall of the Akkadian Empire there was a millennium of no comparably large states until Egypt managed to attain a size as large as that of the Akkadian Empire (around .8 megameters). That was the ceiling until the rise of the Neo-Assyrians to a size twice as large, which was then quickly superceded by much larger empires – Achaemenid Persia and the Hellenic Empires. They reached a new ceiling that was as large as Rome and Parthia at their height several centuries hence. A new upward sweep was made by the Islamic caliphates, but then there was a trough followed by the Eurasian-wide but brief Mongol conquest, and then another trough that was transcended by the emergence of the modern colonial empires of the European states, with the largest of these being the British Empire of the nineteenth century. So there have been five major polity upward sweeps that we may label 1. Akkadian-Egyptian, 2. West Asian-Mediterranean, 3. Islamic, 4. Mongol, and 5. Modern.

East/West Synchrony

Earlier research has demonstrated the existence of a pattern that is probably relevant for figuring out the causes of growth/decline cycles and upward sweeps. From about 500 BCE until about 1500 CE cities and empires in East Asia and the West Asian/Mediterranean region were growing and declining in the same periods, whereas intervening South Asia did not conform to these patterns. We are continuing our studies to

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[6[6]] There were a few instances in which new core-wide empires were formed by internal revolt (e.g. the Akkadian Empire, the Mamluk Empire) or conquest by peripheral marchers (e.g. the Mongol Empire), but by far the majority of new empires were the work of semiperipheral marcher conquests.

determine whether or not climate change could have caused this synchrony, but so far the results indicate that it did not (Chase-Dunn, Niemeyer, Alvarez, Inoue, Lawrence and Carlson 2006). The other alternatives are trade fluctuations, incursions by Central Asian steppe nomads, or epidemic diseases.

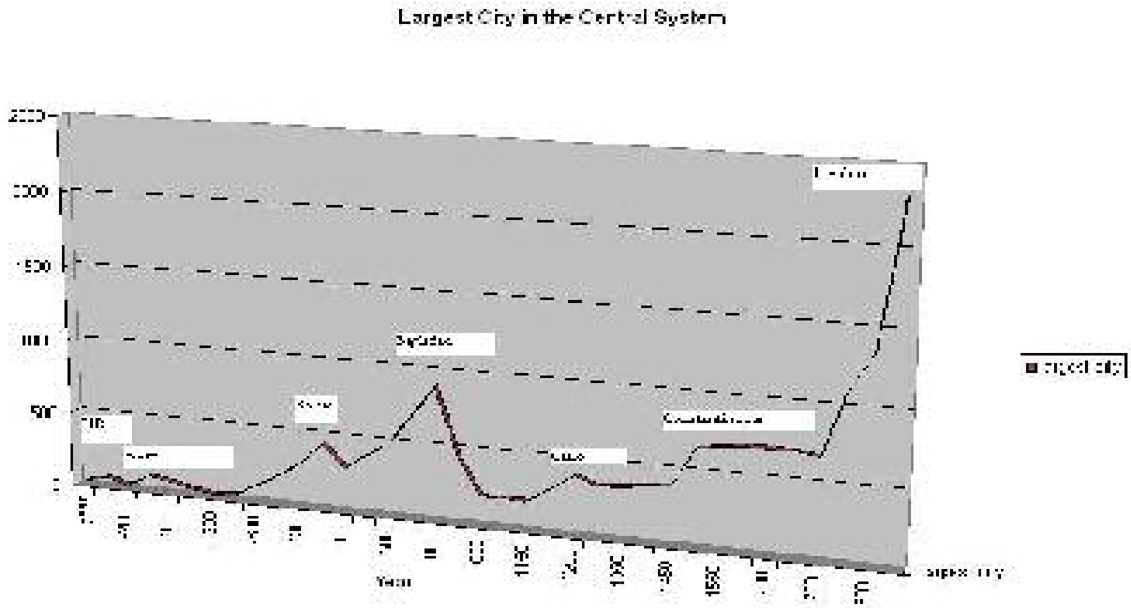

Figure 4: City Size Upsweeps in the Central System

Urban Upward Sweeps

Figure 4 graphs the population size estimates of largest cities in the Central System. We have no estimate of the size of Agade, the capital of the Akkadian Empire because the archaeological remains of the city founded by Sargon have not yet been identified. But Ur, the restored Sumerian capital that succeeded the Akkadian Empire, shows an early peak that is followed by the Egyptian city of Avaris, the capital of the Hyksos dynasty. The next large city peak is that of Rome in 100 CE with 450,000 residents, which is then bested by Islamic Baghdad in 900 CE with 900,000. A slump is then followed by the rise of Mamluk Cairo to 400,000 in 1300 and then Ottoman Constantinople to 700,000 in 1600 and then the rapid increase of both Beijing and London, with London pulling ahead to 2,320,000 by 1850. The graph ends in 1850 because including largest cities after that year scales the graph such that the peaks of early millennia become invisible. The rest of the story is as follows:

1875	London	4,241,000	Paris	2,250,000
1900	London	6,480,000	New York	4,242,000
1914	London	7,419,000	New York	6,700,000
1925	New York	7,774,000	London	7,742,000
1950	New York	12,463,000	London	8,860,000
1970	Tokyo	20,450,000	New York	17,252,000

After the 1950s a new ceiling of around 20 millions is reached by the largest urban agglomerations. Megacities in Brazil, Mexico and China begin to catch up. The global size distribution of largest cities flattened in the second half of the 20th century.

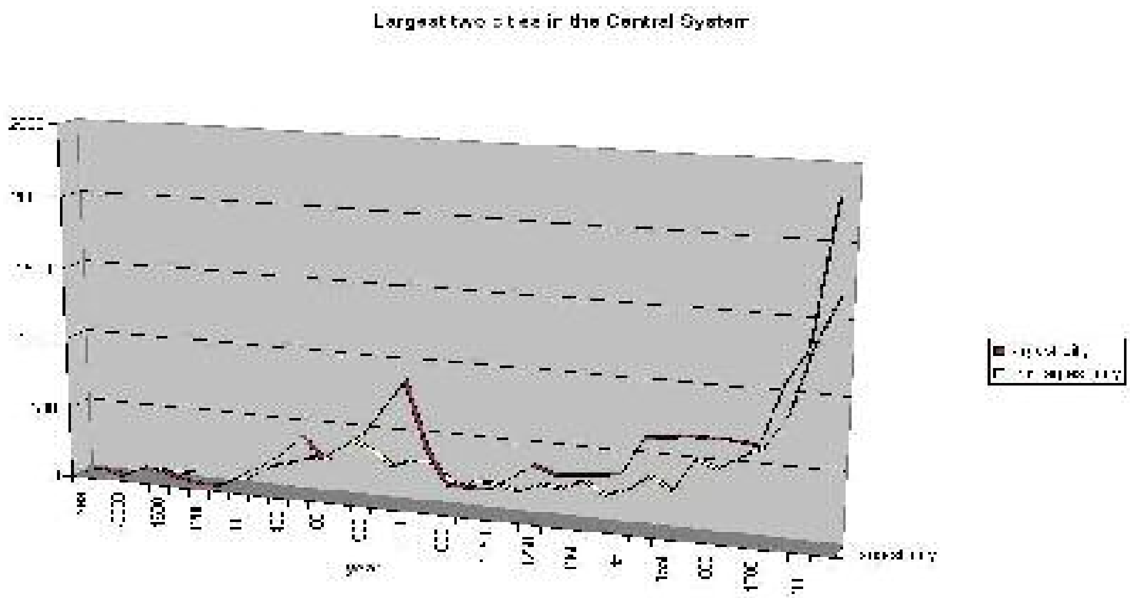

Figure 5: The two largest cities in the Central System

Figure 5 graphs the largest and the second largest cities in the Central System. This implies that the huge size of Baghdad[7][7] in tenth century did not really constitute a new ceiling in the evolution of city sizes because it was an outlier that was not replicated for 1000 years. So there have been four upward sweeps that led to new plateaus of city growth in the central system: the original heartland of cities in Mesopotamia and Egypt, the rise of Rome and other cities of similarly large size, then a decline followed by the rise of Cairo and then Constantinople, and then the well-known rapid upsweep of modernity which occurred in Europe, North America and China.

Urban and Empire Upsweeps

So what is the temporal relationship between city and empire upsweeps? Figure 6 graphs together the two largest cities and the two largest empires from 2250 BCE to 1850 CE.

Obviously there is a long-term upward trend in both city and empire sizes, but are the medium term growth/decline phases correlated and do the upward sweeps occur in the same periods. Do large cities emerge before or after large empires do?

[7][7] Chandler may have overestimated the size of Baghdad.

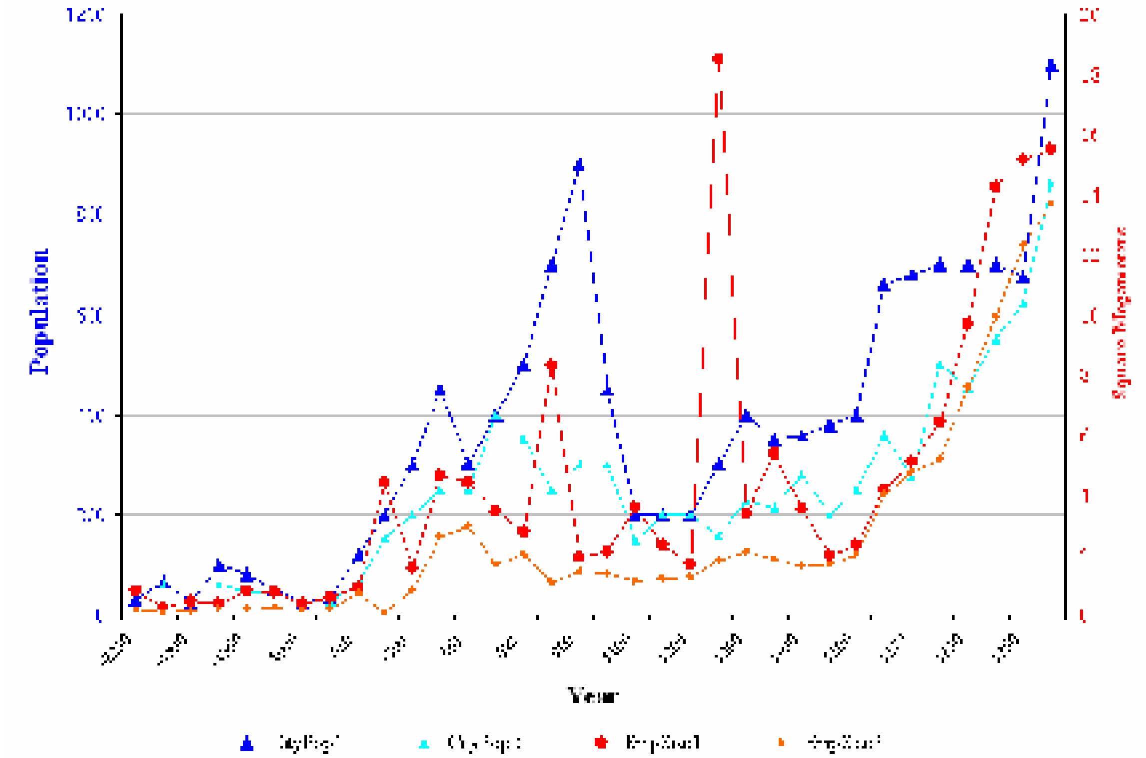

Figure 6: Two largest cities and empires in the Central System

Bivariate	CityPop1	CityPop2	EmpSize1	EmpSize2
CityPop1	1			
CityPop2	0.991**	1		
EmpSize1	0.635**	0.625**	1	
EmpSize2	0.542**	0.519**	0.937**	1

Table 1: Bivariate Pearson's r correlation coefficients between largest cities and largest empires over time

Table 1 shows the Pearson's r correlation coefficients over time between the largest and second largest cities and the largest and second largest empires. All the correlations are positive and statistically significant, but this could be due to the long-term growth trends.

Partial^	CityPop1	CityPop2	EmpSize1	EmpSize2
CityPop1	1			
CityPop2	0.989**	1		
EmpSize1	0.529**	0.535**	1	
EmpSize2	0.397*	0.390*	0.896**	1

^ Controlling for **Decade**

* Significant at 0.05

** Significant at 0.01

Table 2: Partial correlations controlling for year

Table 2 shows the partial correlation coefficients after year is controlled. This is one way to try to take out the long-term trend and to see the more medium-term relations between growth/decline phases and upward sweeps. Though these coefficients are a bit smaller than those in Table 1 they are still positive and statistically significant. Notice that the partial correlations between the largest and second largest empires are also positive and significant.[8][8]

In Figure 6 above it appears that the upward sweeps of city and empire sizes do occur more or less together, but it is difficult to see any clear pattern of leads or lags. The issue of leads and lags is important for distinguishing between different causal processes, so we will return to it when we redo this analysis using improved estimates of city population sizes. If it is true that empire formation is the most important cause of urban upsweeps then empire upsweeps should regularly precede urban upsweeps.

Explaining Upsweeps

Earlier work on socio-cultural evolution has produced a synthesized "iteration model" of the processes by which hierarchies and new technologies have emerged in regional world-systems since the Paleolithic (Chase-Dunn and Hall 1997: Chapter 6). The iteration model assumes a system of societies that are interacting with one another in ways that are important for the reproduction and transformation of social structures and institutions. This comparative world-systems theory uses interaction networks rather than spatially homogenous characteristics to bound regional systems. Bulk goods exchanges are an important network in all systems, and so are alliances and conflicts among polities (the so-called political/military network – PMN). Some systems are importantly linked by the long-distance exchanges of prestige goods.

While Chase-Dunn and Hall used trade networks to spatially bound world-systems, they left trade out of the iteration model that explains why world-systems evolve. More recent works by McNeill and McNeill (2003) and Christian (2004) have stressed the importance of trade and communications networks in the processes of human cultural evolution. Both of these recent works employ a network node theory of innovation and collective learning that is similar to the human ecology approach developed earlier by Amos Hawley (1971). Innovations are said to be unusually likely to occur at transportation and communications nodes where information from many different sources can be easily combined and recombined.

One advantage of using world-systems as the explicit unit of analysis and of examining the possibility that world-systems may be organized by core/periphery structures is that it allows us to see that there are important and repeated exceptions to the network node theory of innovation. It is often societies out on the edge of a system rather than at the center that either innovate or that successfully implement new strategies and technologies of power, production and trade. Chase-Dunn and Hall (1997: Chapter 5) synthesize earlier formulations into a theory of **semiperipheral development** in which a few of the societies that are in between the core and the periphery of a system are the ones that are most likely to come forth with strategies and behaviors that produce

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[8][8] This replicates a finding reported by Chase-Dunn, Alvarez and Pasciuti (2005) that empires within the same regional world-system increase and decrease in size during the same periods, indicating the operation of a regional sequence of growth and decline periods rather than a zero-sum game in which large empires take territory from other adjacent states.

evolutionary transformations and upward mobility. This phenomenon takes various forms in different kinds of systems: semiperipheral marcher chiefdoms, semiperipheral marcher states, semiperipheral capitalist city states, the semiperipheral position of Europe in the larger Afroeurasian world-system, modern semiperipheral nations that arise to hegemony, and contemporary semiperipheral societies that engage in and support novel and potentially transformative economic and political activities.

The network node theory does not well account for the spatially uneven nature of evolutionary change. The cutting edge of evolution moves. Old centers are often transcended by societies out on the edge that are able to rewire network nodes in a way that expands the spatial scale of networks.

There are several possible processes that might account for the phenomenon of semiperipheral development.[9[9]] Randall Collins (1999) has argued that the phenomenon of marcher states conquering other states to make larger empires is due to the marcher state advantage. Being out on the edge of a core region of competing states allows more maneuverability because it is not necessary to defend the rear. This geopolitical advantage allows military resources to be concentrated on vulnerable neighbors. Peter Turchin (2005) argues that the relevant process is one in which group solidarity is enhanced by being on a "metaethnic frontier" in which the clash of contending cultures produces strong cohesion and cooperation within a frontier society, allowing it to perform great feats. Carroll Quigley (1961) distilled a somewhat similar theory from the works of Arnold Toynbee.

But Toynbee also suggested another way in which semiperipheral regions might be motivated to take risks with new ideas, technologies and strategies. Semiperipheral societies are often located in ecologically marginal regions that have poor soil and little water or other disadvantages. Patrick Kirch relies on this idea of ecological marginality in his depiction of the process by which semiperipheral marcher chiefs are most often the conquerors that create island-wide paramount chiefdoms in the Pacific (Kirch 1984). It is quite possible that all these features combine to produce what Alexander Gershenkron called "the advantages of backwardness" that allow some semiperipheral societies to transform and to dominate regional world-systems.

Iteration Revised

For the purposes of explaining upward sweeps we have reformulated the iteration model to focus on state-based systems[10[10]] by adding trade, marcher states, capitalist city states, cities and empires (see Figure 7). The top and right side of the revised iteration model is unchanged. Here we have the basic ideas from Marvin Harris and Robert Carneiro as reformulated by Allen Johnson and Timothy Earle (1987) regarding population growth, intensification, environmental degradation, population pressure, emigration,

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[9[9]] David Wilkinson (1991) has produced a coding of semiperipheral states that can be used as a starting point for further research on the phenomenon of semiperipheral development.

[10[10]] State-based systems are those in which the tributary (vs. kin-based or capitalist) modes of accumulation are predominant.

circumscription and conflict.[11[11]] This is a general model of the population ecology and the demographic regulator that works for humans as well as for other animal populations. Human world-systems that are unable to evolve larger polities, hierarchies and/or new technologies of production get stuck in the "nasty bottom" of the iteration model (Kirch 1991), and systems that expand beyond their institutional capabilities collapse back to the nasty bottom (Diamond 2004).

[11[11]] Procreation is socially regulated in all human societies, but despite this there has been a long-run tendency for population to grow. **Population Growth** leads to **Intensification**, defined by Marvin Harris (1977:5) as "the investment of more soil, water, minerals, or energy per unit of time or area." Intensification leads to **Environmental Degradation** as raw material inputs become scarcer and the unwanted byproducts of human activity (pollution, etc.) modify the surrounding environment. Together **Intensification** and **Environmental Degradation** lead to rising costs in terms of labor time needed to produce the food and raw materials that people need, and this condition is called **Population Pressure**. In order to feed more people, farmers must use more marginal land because the best soils have become degraded. Or deer hunters must travel father to find their quarry once deer have become depleted in nearby districts. Thus the cost in time and effort of producing a given amount of food increases (Boserup 1965; 1981). Some resources are less subject to depletion than others (e.g. fish compared to big game), but increased use usually causes rising costs. Other types of environmental degradation are due to the side effects of production, such as the build-up of wastes and pollution of water sources. These also increase the costs of continued production or cause other problems.As long as there were available lands to occupy, the consequences of population pressure led to **Migration**. And so humans populated the whole Earth. The costs of **Migration** are a function of the availability of desirable alternative locations, moving costs, and the effective resistance to immigration that is mounted by those who already live in these alternative locations. **Circumscription** (Carneiro 1970) occurs when the costs of leaving are higher than the costs of staying. This is a function of available lands, but lands are differentially desirable depending on the technologies that the migrants employ. Generally people have preferred to live in the way that they have lived in the past, but **Population Pressure** or other push factors can cause them to adopt new technologies in order to occupy new lands. The factor of resistance from extant occupants is also a complex matter of similarities and differences in technology, social organization and military techniques between the occupants and the groups seeking to immigrate. **Circumscription** increases the likelihood of higher levels of **Conflict** in a situation of **Population Pressure** because, though the costs of staying are great, the exit option is closed off. This can lead to several different kinds of warfare, but also to increasing intrasocietal struggles and conflicts (civil war, class antagonisms, etc.) A period of intense conflict tends to reduce **Population Pressure** if significant numbers of people are killed off. And some systems get stuck in a vicious cycle in which warfare and other forms of conflict operate as a demographic regulator, e.g. the Marquesas Islands (Kirch 1991). This cycle corresponds to the path that goes from **Population Pressure** to **Migration** to **Circumscription** to **Conflict,** and then a negative arrow back to **Population Pressure**. When population again builds up another round of heightened conflict knocks it back down again.

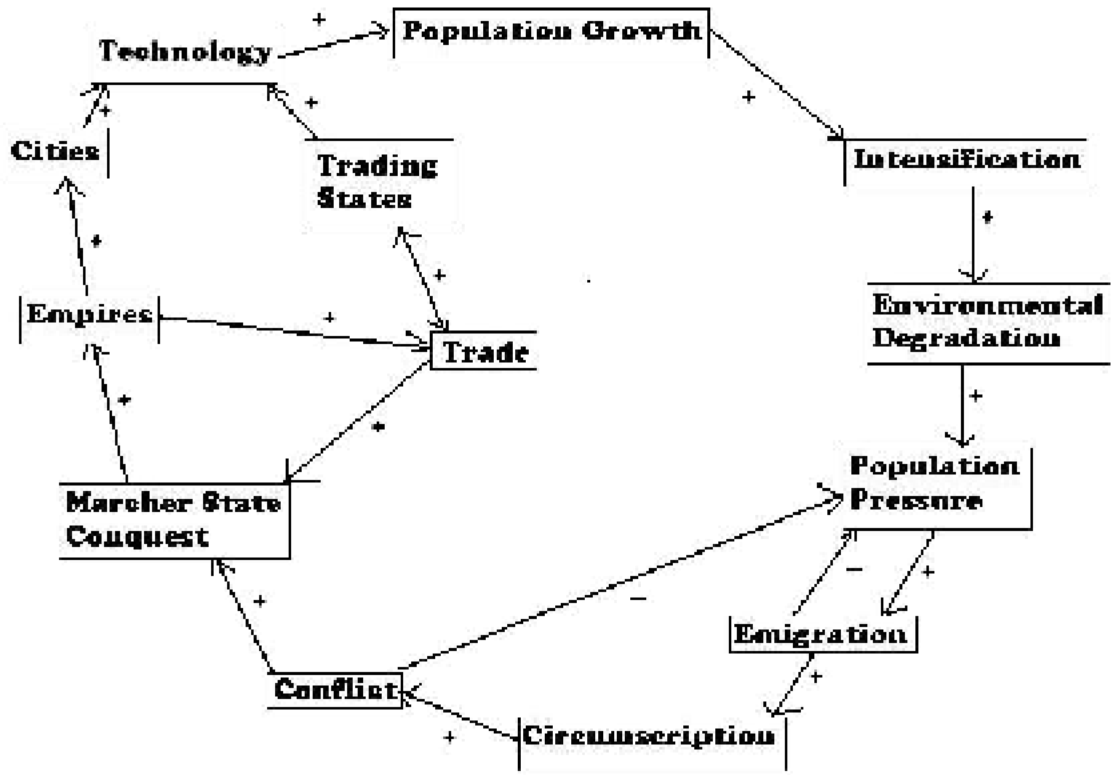


Figure 7: Revised Iteration Model For Empire and City Upsweeps in State-based Systems

In state-based systems periods of intensified conflict within and between societies lower the resistance to hierarchy formation. A semiperipheral marcher state can "roll up the system" under such circumstances. Thus did the Neo-Assyrians, the Achaemenid Persians, Alexander, the Romans, the Islamic Caliphates and the Aztecs produce the core-wide empires that constitute the great upward sweeps of state size in the age of state-based systems.

During the Bronze and Iron Age expansions of the tributary empires a new niche emerged for states that specialized in the carrying trade among the empires and adjacent regions. These semiperipheral capitalist city states were usually "thalassocratic" entities that used naval power to protect sea-going trade (e.g. the Phoenician city-states, Venice, Genoa, Malacca), but Assur on the Tigris, the "Old Assyrian city-state and its colonies," was a land-based example of this phenomenon that relied mainly upon donkey caravans for transportation (Larsen 1976). The semiperipheral capitalist city-states did not typically conquer other states to construct large empires, but their trading and production activities promoted regional commerce and the emergence of markets within and between the tributary states.

The expansion of trading and communications networks facilitated the growth of empires and vice versa. The emergence of agriculture, mining and manufacturing production of surpluses for trade gave conquerors an incentive to expand state control into distant areas. And the apparatus of the empire was itself often a boon to trade. The specialized trading states promoted the production of trade surpluses, bringing peoples into commerce over wide regions, and thus they helped to create the conditions for the emergence of larger empires.

Capitalist city-states and ports of trade

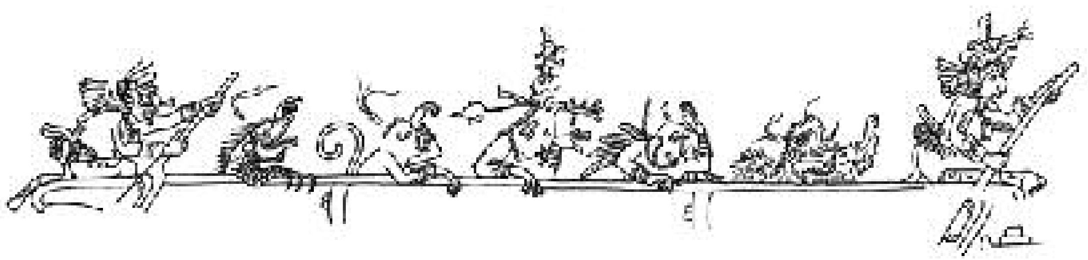
Sabloff and Rathje (1975) contend that the same settlement can oscillate back and forth between being a "port of trade" (neutral territory that is used for administered trade between different competing states and empires – see Polanyi et al 1957) and a "trading port" (an autonomous and sovereign polity that actively pursues policies that facilitate profitable trade). This latter corresponds to what Chase-Dunn and Hall (1997) mean by a semiperipheral capitalist city-state. Sabloff and Rathje also contend that a trading port is more likely to emerge during a period in which other states within the same region are weak, whereas a port of trade is more likely during a period in which there are large strong states.[12[12]] The archaeological investigation of Cozumel carried out by Sabloff and Rathje was designed to try to test the hypothesis that Cozumel had been a trading state with a cosmopolitan and tolerant elite during the so-called Decadent period of the Mayan state system just before the arrival of the Spanish in the sixteenth century. If Sabloff and Rathje are right trading ports (semiperipheral capitalist city states) are more likely to emerge during the fall part of the cycle of rise and fall that all state systems seem to exhibit.

This general idea also corresponds with the notion that world-systems oscillate between periods in which they are more integrated by horizontal networks of exchange versus periods in which corporate and hierarchical organization is more predominant (Ekholm and Friedman 1982; White, Kejzar and Tambayong 2006). Arrighi (1994) contends that modern "systemic cycles of accumulation" display a somewhat similar alternation, with the Genoese-Portuguese network based cycle followed by a more corporate Dutch organized cycle and that by a more network-based British cycle and then a more corporate U.S. cycle. These oscillations may be composed by the alternative successes and failures of tributary marcher states and capitalist city-states, but in the long run it was the capitalist city-states that transformed the state-based systems into the global capitalist system of today.

So what does this have to do with upward sweeps of empires and upward sweeps of city sizes? Regarding upward sweeps of empires, if semiperipheral capitalist city states were major agents of the spread of commodified exchange and the expansion and intensification of trade then upward sweeps in which larger states emerged to encompass regions that had already been unified by trade should have occured after a period in which semiperipheral capitalist city-states have been flourishing.

Regarding upward sweeps of city sizes, these should have followed upward sweeps of empire sizes because it was empires that created the largest cities as their capitals. The settlements of semiperipheral capitalist city-states were typically smaller than the capital cities of empires. It was not until the rise of London that a capitalist city became the largest city in a world-system.

[12[12]] Ports of trade may be most likely to emerge in buffer zones or "no man's lands" in between the territories of strong polities. The function of buffer zones is to reduce the likelihood of conflict, but these regions also present an opportunity for peaceful exchange, and so they may develop into ports of trade.



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