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Synthesizing Secular, Demographic-Structural, Climate, and Leadership Long Cycles:
Moving Toward Explaining Domestic and World Politics in the Last Millennium

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Among approaches to explaining global history, the secular cycles and leadership long cycle schools emphasize much different phenomena. The former stresses processes highlighting demographic pressures and the rise and fall of land powers. The latter focuses on trading states, maritime activities, and economic growth pulsations. While the two research programs seemingly possess little in common, appearances may be deceiving. By elucidating their overlapping emphasis on structured punctuations in demographic/dynastic cycles with significant changes in global political economy, it is possible to show how the two schools of thought are complementary. A more integrated approach, encompassing population, disease, war and economic growth dynamics, should enhance our understanding of changes in global history.

Introduction

Explaining behavior over long periods of time can be done entirely descriptively. The longer the time period to be encompassed, of course, the longer the description needs to be. But even highly descriptive accounts usually employ some type of implicit structure, if only to tell which events should be emphasized in the description. An alternate approach highlights seemingly recurring processes. Description is subordinated to a search for continuities and discontinuities. But which processes should receive privileged attention? Disciplines and rival research programs within and across disciplines are distinguished by what they choose to include and exclude. Inevitably, these choices lead to analytical outcomes that highlight the inclusions and ignore the exclusions. They also tend to force choices amongst various micro and macro processes, with exclusively micro and macro interpretations emerging.

One such contrast is evident in comparing arguments associated with the secular cycle and leadership long cycle schools' perspectives on global history. The former focuses on the rise, fall, and spread of largely Eurasian empires on

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land, predicated primarily on demographic considerations. The latter highlights the emergence of modern economic growth beginning in Sung China, European trading states that became agents in promoting economic innovation in parts of western Eurasia, the development of maritime networks linking the global economy, and industrialization. The time periods they examine often overlap but the stories that are generated resemble the fable about different parts of the elephant (of the Eurasian and global species)being groped by blind scholars. Grasping the ears, the tail, or the nose all lead to different identifications of what the beast is.

Must we focus on the imperial expansions on land or the maritime network expansions exclusively? The answer depends on the extent to which the processes highlighted by different research programs come into contact with one another. In this case, a rationale can be advanced for at least considering the potential complementarities of two very different interpretations of global history. Some of their key rhythms appear to be synchronized in historical time. This is something that needs to be identified and explained after first providing an overview of the two perspectives. To the extent that the two schools of thought do overlap in terms of focus, there is an opportunity to expand the explanatory powers of both projects and our understanding of long-term globalization processes. This approach does not assume that these two research programs possess some sort of monopoly on valid interpretations of global history – only that the validity of their interpretations might be improved by some cross-pollination.

Secular and Long Cycle Research Programs

Research programs usually pass one another in the night, each intent on focusing exclusively on its particular and preferred take on reality. Occasionally, though, they collide or are seen to overlap, thereby presenting opportunities to enrich one or both of the programs via some selective cross-pollination of ideas and arguments. Table 1 suggests such an opportunity. The two columns on the left periodize European and Chinese demographic/dynastic cycles in agrarian systems, as studied by the secular cycle school. The column on the right suggests dates for important phase-shifts in the evolution of the global economy over the past millennium, as interpreted by the leadership long cycle school. Turchin (2008) notes the apparent overlap in timing of presumably different phenomena and suggests, in passing, that the substantial overlap suggests that the two schools of thought may be working on something similar. As it happens, Turchin's attention was focused on other topics that did not encourage speculating on or elaborating what might link the left and right hand columns. Thus, we are left with an analytical puzzle that could conceivably be due to complete coincidence but is more likely to reflect

some shared processes in agrarian political systems (the two left hand columns) and an emergent global economy process (the right hand column). Showing how they are linked should improve our understanding of the dynamics of change over the last thousand years – assuming that few will insist the last millennium was purely agrarian or purely commercial/industrial in nature.

Table 1. Secular Cycles in Europe and China During the Last Millennium Compared to Global Economy Processes

European cycles	*Chinese cycles*	*Global Economy Processes*
Ottonian-Salian	Northern Song	Sung* Breakthrough
920–1150	960–1127	930–1190
Capetian	Mongol-Yuan	Nautical/Commercial Revolutions
1150–1450	1200–1368	1190–1430
Valois	Ming	Oceanic Trading System
1450–1660	1368–1644	1430–1640
Bourbon	Qing	Industrial Takeoff
1660–1870	1644–1911	(1640–1850)

*A variant spelling of Song

Elaborating one interpretation of how they are linked will require bringing together several explanatory components. We need a minimal understanding of what secular and leadership long cycles are about and how they differ. Once a brief overview is developed, a third ingredient – Goldstone's (1991) demographic-structural argument – needs to be introduced separately. Even though many of Goldstone's arguments are already explicitly incorporated into the secular cycle interpretation, one crucial element is missing. Goldstone sketches a Eurasian-wide time plot of change that can be used, with some modification, to help bridge the two research program focusing on ostensibly different processes. As we will see, they are less different than they have appeared to be. They are merely looking at different manifestations of what appear to be interdependent behavior and structural changes taking place within the same broad, mainly Eurasian/later global context.

Secular Cycles

The secular cycle model – works in the this genre include Turchin (2003, 2005); Korotayev and Khatourina (2006), Korotayev, Malkov, and Khatourina (2006), Turchin and Nefedov (2009) – is quite ambitious in the number of different processes subsumed as effects of population growth. Table 2 offers an abridged version of how rising (the first two columns) and falling (columns three and four) population numbers are seen as impacting on elite dynamics,

Table 2. Population Growth and Socio-political Effects

	Expansion	*Stagflation*	*Crisis*	*Depression*
Population Dynamics	Rate of growth accelerates	Large and increasing size but growth rate decelerating	In decline from peak	Low size and little sustained growth
Elite Dynamics	Low to moderate numbers and modest consumption	Increasing numbers; increasing competition; conspicuous consumption	High numbers; Factionalization and conflict; High income inequality	Reduction of elite numbers due to war and downward mobility; Collapse of consumption levels
State strength	Increasing	High but declining	Collapse	Periodic restoration attempts and repeated breakdown
State finances	Increasing revenues	Declining real revenues	State bankruptcy and loss of control over army/ bureaucracy	Poor but variable
State policy	Laissez faire domestically but increased interest in external conquest	Increasing attempts at social reform and infrastructure construction; colonization; External territorial aggression	Social reforms sometimes leading to social revolution	Retrenchment; Weakening of state may result in external invasion
Sociopolitical instability	Low	Low but increasing	Peaking	High but declining
Domestic order	Increasing	High but declining; Tax resistance	Uprisings; intraelite conflict; Regional/nationalist Rebellions	Recurrent civil war; political fragmentation; External invasion susceptibility
Ideology	Optimistic	Growth of social pessimism and criticism	Popular movements for social justice and land redistribution	Pessimistic
Grain prices	Low	Increasing	High	Decreasing
Urbanization	Low	Increasing	High	High but declining
Trade	Low	Developing	Declining and interrupted by unrest	Contingent
Epidemic incidence	Rare	Increasing	Often catastrophic	High but declining

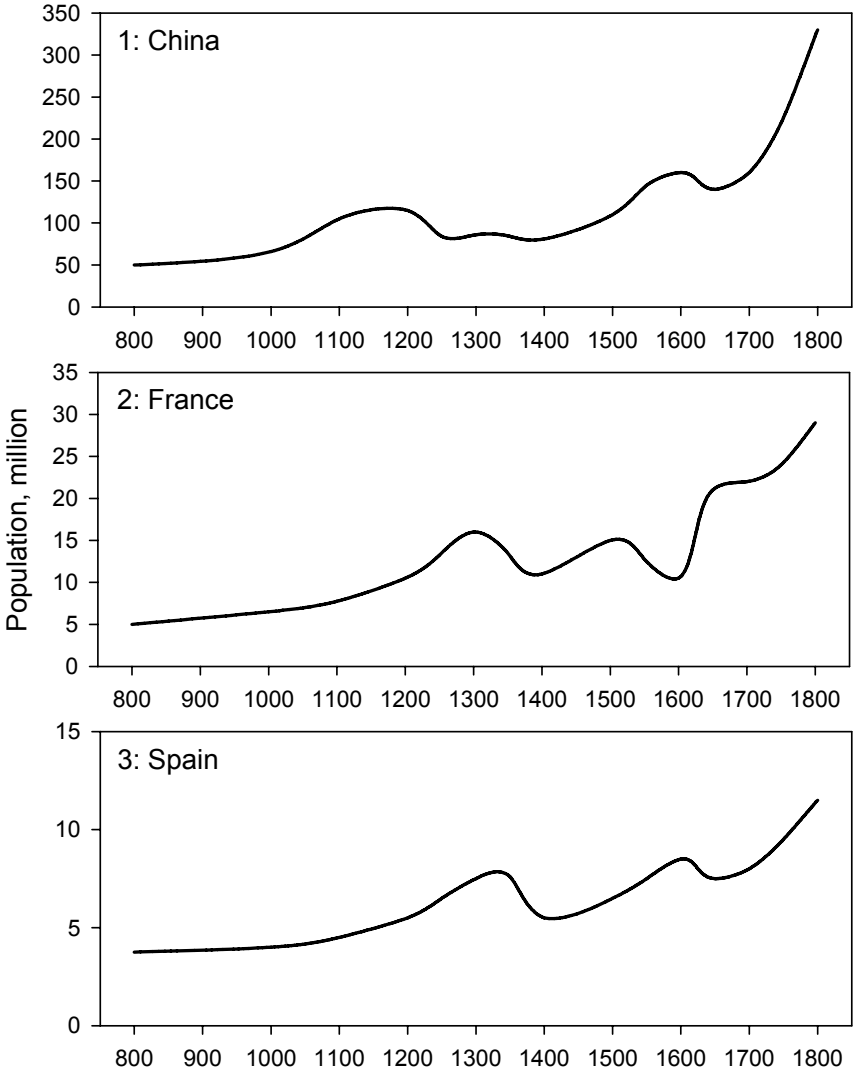
Source: Modified from Turchin and Nefedov (2009: chapter 1).

prices, and domestic order. More accurately, it is not so much population dynamics that drives seemingly everything else but more a matter of a large number of processes operating interdependently in an agrarian context that are highly dependent on stresses created by population growth.

When the focus is on population growth, it is the probability that increasing numbers of people will ultimately outstrip the agricultural carrying capacity that is most prominent. As an agrarian system moves toward this Malthusian outcome, a large number of related processes are affected. Army and bureaucratic expansion of state strength increases the costs of state operations. If resources that can be mobilized to pay for state operations do not keep expanding accordingly, the likelihood of fiscal crises and state bankruptcies expands. Price inflation, falling real wages, and food shortages generate rural stresses, migration to cities, and urban discontent. Popular discontent and uprisings in cities and in the countryside become more probable. In addition, the number of individuals seeking to ascend into the elite ranks will increase, thereby aggravating tendencies toward intra-elite competition and conflict. Fusions of elite and mass grievances increase the probability of significant rebellions and civil wars. All of these processes may come together to make state breakdown more probable. State breakdown, in turn, feeds back into population growth negatively by increasing the number of people dying thanks to warfare, famine, and epidemics.

Figures 1 through 3, using data from McEvedy and Jones (1978) offer quick support for the application of some aspects of this emphasis on population growth. Population growth at both ends of Eurasia in the last millennium before the advent of industrialization is characterized by several periods of expansion followed by crashes and negative growth. Chinese population growth, in figure 1, expanded roughly between 1000 and 1200 (Sung dynasty) and then crashed in the 13th century. A brief if moderate return to population expansion was experienced in the Yuan dynasty before crashing again in the second half of the 14th century. A third expansionary phase resumed in the Ming dynasty before crashing once again in the 17th century and the coming of the Qing.

French population growth increased gradually and then accelerated into the 14th century before peaking and crashing with the spread of the Black Death. Population growth resumed in the second half of the 15th and part of the 16th century before crashing once again in the last half of the 16th century. Another run up in population took place in the 17th century before it too was checked, albeit without crashing as before. Once checked, French population growth began to accelerate again into the period of the French Revolution and Napoleonic Wars.



Figures 1–3. Population growth in China, France, and Spain

Figure 3, focusing on Spanish growth that has yet to receive secular cycle attention, resembles French population growth up to about the second half of the 16th century. Population nearly doubled between 800 and 1300 before crashing with the advent of the Black Death. While France peaked in the 16th century before things began to deteriorate, Spain continued to grow to about 1620 before experiencing a setback. After about 1750, both French and Spanish populations were expanding once again.

The point is not that both ends of Eurasia experienced identical population trajectories. They did not. Each state's historical path varied. Yet all three states went through periods of accelerating population growth followed by periods of negative or stagnating growth rates in which domestic conflict increased. Sometimes these fluctuations overlapped so that much of Eurasia seems to have been responding to the same expansion and contraction rhythms around the same time.

Leadership Long Cycles

Table 1 offers only a peek at the leadership long cycle interpretation of the evolution of global economic and political processes. In table 1, four phase-shifts (Sung breakthrough, nautical/commercial revolutions, oceanic trading system, and industrial takeoff) encompassing approximately 900 years of modern economic growth are shown exhibiting a timing that seems similar to population growth cycles in agrarian systems. Table 3 attempts to elaborate a bit more the context in which these phase shifts are thought to have occurred. The phase shifts are still there but nested within each phase shift is a sequence of four innovation spurts (called k-waves or Kondratieff waves), economies in which these leading sector innovations are pioneered, and the global wars that emerge half-way through the millennium (Modelski 1987, 2000; Modelski and Thompson 1988, 1996; Thompson 2000; Rasler and Thompson 1994; Reuveny and Thompson 2005).

The most conventional approach to dating the advent of "modern economic growth" is to link it to the British industrial revolution in the late 18th century. In contrast, the leadership long cycle school argues that modern economic growth first began to emerge in the 10th century CE Chinese transformations in market organization, iron production, and maritime trade expansion (see, among others, Elvin 1973; Gernet 1982; and McNeill 1982). Rather than one industrial revolution occurring in the late 18th century, a sequence of revolutionary growth spurts numbering 19 by present times has been responsible for the gradual emergence of industrialization – a process still underway within a world economy that retains a considerable emphasis on agrarian activity.

Table 3. Evolution of the Global Economy

Global Economy Process	*Basebuilding*	*Networking*	*Breakthrough*	*Payoff*
Sung Breakthrough [CHINA]	930–990 Printing and paper	990–1060 National market formation	1060–1120 Fiscal/admin. framework	1120–1190 Maritime trade expansion
Nautical/Commercial Revolutions [GENOA and VENICE]	1190–1250 Champagne Fairs	1250–1300 Black Sea Trade	1300–1350 Venetian galley fleets	1350–1430 Pepper
Oceanic Trading System [PORTUGAL and the NETHERLANDS]	1430–1494 Guinea gold	1494–1540 Indian spices	1540–1580 Baltic, Atlantic trade	1580–1640 Asian trade
Global war		1494–1516 Wars of Italy and the Indian Ocean		1580–1608 Dutch-Spanish Wars
Industrial Takeoff [BRITAIN]	1640–1688 Amerasian trade	1688–1740 Amerasian trade	1740–1792 Cotton, iron	1792–1850 Steam, railroad
Global war		1688–1713 Wars of the Grand Alliance		1792–1815 Wars of the French Revolution and Napoleon
Information Economy [UNITED STATES]	1850–1914 Steel, chemicals, electrics	1914–1973 Autos, aerospace, electronics	1973–2030 Information industries	2030–
Global war		1914–1945 World War I and II		

Note: Based on Modelski and Thompson (1996: 132). High growth in each of the leading sectors listed for each phase peaks toward the end of the designated phase. The main agents in each global economy process phase are indicated in capital letters and brackets in the first column. The global war periods have been added to the table from Modelski and Thompson (1996: 54).

Some of the Sung dynasty breakthroughs were achieved within the context of significant external pressures from encroaching forces from the north and west (Jin and Mongols). Some of the breakthroughs might not have been

accomplished without those external pressures. For instance, the maritime trade expansion in the Southern Sung era was contingent in part on being cut off from traditional overland routes by hostile adversaries (Gernet 1982), just as the population movement towards southern China (and its coastline) was encouraged by successful Jin expansion into northern China. Ultimately, the Sung dynasty was overwhelmed by the Mongols who did not set out to extinguish or set back Chinese economic innovations but who engaged in a variety of policies that had that effect. A number of Chinese died as casualties of war or subsequent disease. Chinese shipping was damaged by repeated attempts to conquer Japan and by Mongol preferential treatment for non-Chinese traders and the re-stimulation of overland routes. Iron production fell off and further experimentation with the uses of gunpowder appear to have been discouraged. Admittedly, there is some controversy as to whether Chinese economic innovation and growth recovered from the Mongol conquest and the subsequent concerns about a recurrence of Mongol domination (Frank 1998; Pomeranz 2000, 2006; Hobson 2004). There is no need to deny post-14th century Chinese economic growth or that China's economy was very large. Yet it is hard to escape that the early technological lead established by China prior to the 12th century was not maintained in subsequent centuries. If it had been, the consequences for global history would have been quite hard to miss.

The Mongol empire spread across Eurasia and created an order that encouraged the expansion of overland trade via the Silk Roads. Italian city states that controlled the Black Sea/eastern Mediterranean outlets for this trade were principal beneficiaries of this shift in priorities away from the older Abbasid/Persian-Chinese emphasis on maritime traffic through the Indian Ocean. Associated with this shift in emphases were a number of transformations in Mediterranean capabilities in ship building and navigation (Lane 1973; McNeill 1974). Venice's initial, short-lived lead facilitated the organization of European trade around the Champagne Fairs in France for a time and then later to the development of a Black Sea to North Sea maritime circuit once Muslim restrictions on transit through the Straits of Gibraltar were overcome. Continuing Genoese-Venetian competition in the Mediterranean first resulted in an initial triumph by Genoa, but eventually led to a Venetian victory after several maritime wars, the disintegration of the Mongol Pax (and the advantages accrued by whoever was predominant in the Black Sea ports), and possibly the greater impact of the Black Death on Genoa than on Venice. The latter part of the 14th and much of the 15th century was a "Venetian century" in terms of organizing Mediterranean and the western end of east-west trade on Venetian terms, in partnership with Egyptian Mamluks and increased reliance on Red Sea traffic.

Losing out in the eastern Mediterranean, Genoese energies were increasingly focused on western Mediterranean activities that encouraged expansion into the Atlantic. One dimension of this activity was the Portuguese

movement down the African coast in search of gold and slaves. After nearly a century of coastal exploration, the Portuguese opened a new route into the Indian Ocean that threatened to circumvent the Venetian-Mamluk lock on east-west trade. Along with Spanish movement into the New World inaugurated by a Genoese explorer (Columbus), European trading activities increasingly assumed an oceanic character, with greatly increased transactions taking place across the Atlantic, Indian, and Pacific Oceans in the 16th century. In the 17th century, the Portuguese role in Asia was largely supplanted by Dutch coercion, trading activities initially focused on Baltic markets that expanded into east-west circuits, and the development of a new route across the Indian Ocean to the Spice Islands and beyond.

The Dutch, in turn, were elbowed aside by Britain which ascended to the primary role in east-west commerce, predicated on its improving position in India, North America, and the West Indies. This 18th century commercial lead gave way to a clear lead in industrialization by the end of the century, with initial foci on the production of cotton textiles and iron, and later steam engines and the development of railroad systems (however, see De Vries and Van der Woude 1997) who make a good case for re-assessing the prior claim of the Netherlands as a different type of industrializer). Subsequent spurts in industrial innovation were increasingly pioneered in the United States, further consolidating the industrialization of the global economy and leading, more recently, to the preeminent roles assumed by information industries in the 19th k-wave.

The sequence of Sung breakthrough – nautical/commercial revolutions – oceanic trading system – industrial takeoff – information economy charts the millennial-long introduction of expanded industrialization in the world economy. Industrialization did not just happen all of a sudden in Britain in the late 18th century. It took a historical path "beginning" in China and moving across Eurasia to the eastern Mediterranean, then to the Iberian peninsula, and on to northwest Europe, and then across the Atlantic. It was not an agent-less process. A half dozen or more imperial, city-state, and national actors were most prominent in respective phases of the transition. Specifically, Sung China, the Mongols, Genoa, Venice, Portugal, the Netherlands, Britain, and the United States have been the most critical actors. But we could expand the list by naming their most important adversaries who had to be defeated along the way (e.g., Spain, France, Germany, the Soviet Union, and perhaps again back to China). While the emphasis is on a sequence of radical innovation waves in commerce and industry, there is also a strong element of continuity in that many of the subsequent European innovations appear to be traceable to earlier Chinese innovations.

Moreover, initiating the path in 10th century China is misleading. It would be better to say that the global economy story begins to accelerate at that point but that the path has clear antecedents in oscillations in east-west trade dating

back at least another millennium, as well as other developments within China. Some of the preconditions for Sung success were established in the preceding Sui/Tang Dynasties. Canals integrating north and south China were built. Food production was greatly expanded. Population expanded and the turmoil separating the Sui/Tang and Sung Dynasties was relatively short.

Trade across Eurasia may extend back thousands of years but the most concrete manifestation were commodities exchanged utilizing the Silk Road routes from about 200 BCE on. These routes either moved overland or through the Indian Ocean and terminated in the Persian Gulf or Red Sea areas. Table 4, based on work done initially by Andrew Bosworth (2000), suggests the choice of routes oscillated back and forth between overland and maritime connections. When transaction costs overland became too high due usually to political decentralization and conflict, maritime routes were more likely to be relied upon. When the on ground transaction costs could be controlled by imperial fiat, the land routes business expanded.

Table 4. Oscillations in the Silk Roads Traffic

Approximate Period	*Silk Road Shifts*	*Anchor Cities*
100 BCE – 250 CE	Silk via Parthia overland	Rome–Lo-yang
200–500	Red Sea route via India	Alexandria–Muziris–Canton
500–650	Byzantium favors overland route	Constantinople–Ch'ang-an
750–1000	Abbasids develop Persian Gulf route	Baghdad–Ch'ang-an
930–1125	Northern Sung utilize overland route	Constantinople–K'ai-feng
930–1250	Southern Sung enhance maritime route	Cairo–Hangchou
1250–1350	Mongols restore overland route	Genoa–Peking
1350–1500	Mamluks–Venice build up Red Sea route	Venice–Cairo–Calicut–Malacca–Hangchou

Source: slightly modified from Modelski and Thompson (1996: 128).

This oscillating pattern was not novel. Similar switching activity can be found in Mesopotamian trade routes as early as the third millennium BCE. When overland routes into Anatolia and Iran became more difficult, Mesopotamian cities grew increasingly reliant on the Persian Gulf connection to Indus. As Mesopotamian agrarian productivity diminished due primarily to irrigation-induced over-silting, overland routes through the Fertile Crescent became more important only to become subordinated eventually to eastern Mediterranean routes that themselves gradually shifted westward. Still another ancient example were the oscillations in Egyptian-Syrian trade routes

moving back and forth between overland routes through Palestine and Mediterranean routes centered on Byblos. Ancient trade reorientations in southwest Asia are discussed in Thompson (2006a).

Schumpeter (1939) argued that the "fundamental impulse" of capitalism was not increases in population or capital or manipulations of monetary policies. Rather, it focused on introducing novelty in the form of consumer goods, methods of production and transportation, markets, and industrial organization. The oscillations of table 4 and the impulses in growth mapped in table 3 are very much centered on Schumpeterian novelty or continuing innovation. Commercial shifts, especially in older days, focused on combinations of innovations in goods, transportation, and markets. Methods of production and industrial organization were rarely absent but have simply become increasingly more prominent as we have moved into an increasingly industrialized era.

Equally central to this pattern of economic development are shifts in geographical concentration. Obstacles in Parthian Iran encouraged the development of maritime routes around India. Byzantium's location on the Black Sea would hardly favor Indian Ocean routes that it would have difficulty accessing but the Abbasids location on the Persian Gulf did favor Indian Ocean routes. The Sung had been less interested in maritime developments until they were forced south (the Northern-Southern Sung distinction) towards the China Sea and increasingly cut off from traditional overland routes. The power of the Mongols facilitated the re-emergence of the overland routes which, in turn, encouraged Genoese and Venetian monopolization schemes at the western termini. First Genoa specialized in managing the western end of overland Black Sea routes and later Venice, in conjunction with the Egyptian Mamluks, specialized in the re-distribution of goods coming in through the Red Sea maritime route. The Portuguese found a way to circumvent the Venetian-Mamluk monopoly, just as the Dutch developed a new route through the Indian Ocean that could bypass to some extent the Portuguese networks. As Asian spices became increasingly routine, low profit commodities in Europe, the focus shifted away from the Spice Islands to Indian textiles and to sugar and tobacco from the Caribbean and North America. The affluence derived from these activities, as well as some of the techniques in preparing sugar for the market, may have contributed something to the increased emphasis on industrial output in Britain. Yet while Britain prospered in the lower tech era of industrialization, its lead gave way to German and U.S. innovations that were better prepared to make use of higher tech science, universities, and larger markets for chemicals, steel, autos, and electrification.

In conjunction with the transformations in commerce and industry, political institutions to manage the newly emergent activities also emerged. The lead economy increasingly took on the role of system leader operating as the pre-eminent policy maker and policeman of long distance trade. Contests

to determine who would be the next system leader, global wars, became increasingly more discernible after 1494 (or about half way through the millennium). Intensive fighting for two to three decades helped clarify which coalition would set the rules for the postwar era. The lead in economic innovation increasingly became critical to who led the winning coalitions and which side ultimately prevailed.

But what do these phase-shifts in commercial-industrial activity and political globalization have to do with Malthusian dynamics in agrarian economies? The answer is a great deal in addition to the apparent timing similarities noted in table 1. Before taking on that question, however, we need a few more ingredients – namely, Goldstone's historical script for Eurasian demographic fluctuations and some reference to climate changes also ongoing in Eurasia during this millennium.

Goldstone's Historical Script and a Four Horsemen Tweaking

Goldstone's (1991) book, *Revolution and Rebellion in the Early Modern World*, was one of the first contemporary interpretations of political-economic history from a demographic perspective. As such, it serves as a foundation for the secular cycle research program. His argument in that book is summarized in the following paragraph:

> My primary conclusion is quite beautiful in its parsimony. It is that *the periodic state breakdowns in Europe, China, and the Middle East from 1500 to 1850 were the result of a single basic process*. This process unfolded like a fugue, with a major trend giving birth to four related critical trends that combined for a tumultuous conclusion. The main trend was that population growth, in the context of relatively inflexible economic and social structures, led to changes in prices, shifts in resources, and increasing social demands with which agrarian-bureaucratic states could not successfully cope (Goldstone 1991: 459).

The parsimony should sound familiar given what was said about the secular cycle approach. One difference, however, between what Goldstone studied and what many secular cycle analyses tend to focus upon is that Goldstone was more explicitly interested in waves of change. On his first page the central problem is characterized as one of "how to explain the *periodic waves* of state breakdown in the early modern world." Goldstone's canvas was thus explicitly pan-Eurasian even though different countries were discussed on a chapter by chapter basis. In contrast, most secular cycle analyses have looked at one or more countries intensely due to the priority given to empirical testing of the relationships among processes.

A second and related difference of emphasis is that secular change analyses tend to focus primarily on processes endogenous to the effects of population growth. Secular analysts are certainly aware that climate change and disease may be both causes and effects in relation to demographic-influenced changes (see, for instance, Hall and Turchin 2007) but Goldstone appears to be more explicit in arguing that positive climate change facilitated population growth and a combination of negative climate change and disease increased mortality rates, thereby reducing the pressures generated by population growth. Goldstone is cautious about the climate change element which he regards as more speculative than the role of disease. For evidence on European climate changes, see Lamb (1982), Flohn and Fantechi (1984), Grove (2004), and, more generally, Wilson et al. (2000).

This position is highlighted in table 5 which could be extended in both temporal directions, as is suggested by figure 4's depiction of long-term solar activity. An increase in the number of sunspots is an indicator of the increasing solar activity that, in turn, is linked to climate change (more solar activity = warmer climate on Earth). The source for this figure is Galloway (1986). The 800–1200 period which provided a window of opportunity for Scandinavians to settle Iceland, Greenland, discover Vinland (and conquer Normandy), to encourage the European Crusades in the Middle East, and to aggravate nomadic-sedentary conflict from China to Mexico is regarded as a period of global warming (Ringrose 2001: 1–2). Few readers should be unaware by now that warming has resumed again from 1850 on.

Goldstone argues strongly for disease and increased mortality rates as the main forces relieving population pressures in agrarian settings. Some kinds of climate change probably make disease more probable. But the explanatory reliance on disease is probably linked closely to Goldstone's interest in 1500–1800 state breakdowns. Within that time frame, disease enters the scene just at the right times. If one is interested in a broader time frame, as in our interest in the last millennium, disease still "works" but not quite as well. Table 6 underscores this problem by listing the secular cycle dating developed to date, the global economy process shifts, and Goldstone's interpretation of Eurasian waves. Disease and population decline/stagnation fits the transitions from phase 2 to phase 3 and phase 3 to phase 4 but fails to fit the phase 1–phase 2 transition. Disease does not work in moving from phase 4 to phase 5 in the global economy column either. Saying that disease "does not work" does not imply that there were no disease outbreaks or epidemics in 1914–1945. It only means that we do not normally privilege the role of disease in explicating the nature of 1914–1945 turmoil. Note as well that this table does not balk at moving beyond 1800. Some of the processes may have become more complicated in recent centuries but it is not clear that they have disappeared or undergone radical transformation. Whether they have or not remains very much a theoretical and empirical question.

Table 5. Goldstone's Exogenous Variables (Goldstone 1991:25–30).

Population Growth	*Climate*	*Disease*
14th century negative growth and 15th century low growth	Cooler	Massive epidemics in Europe, Middle East, and China, with repeated outbreaks every decade or two until late 1400s
Near doubling 1500 – early 1600s	Distinct warming in later middle ages to around 1600	Recurrent visitations of plague ceased after 1500
Halted world-wide and stagnating or declining 1650–early 18th century	Distinctly cooler and more variable after 1600	Return of plague, accompanied by smallpox, typhoid, and other infectious diseases in Europe, Ottoman Empire, and China
Early 18th century recovery with increasing pressure manifested by second half of 18th century Railroad, steamships, and cheap American/ Russian grain ease pressure on population outstripping food supply in Europe	Peak of poor climate passed	Epidemics fewer

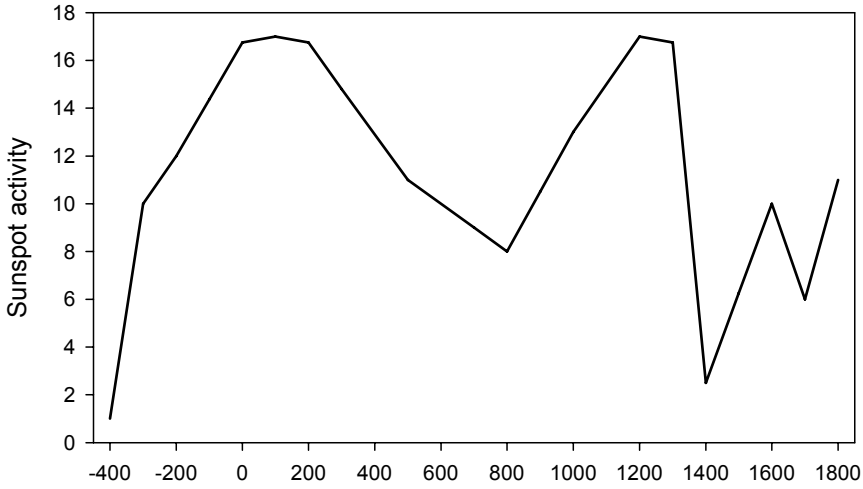


Figure 4. Long-term sunspot activity.

Table 6. Secular Cycles, Global Economy Processes, and Structural-Demographic Processes

European Secular Cycles	*Chinese Secular Cycles*	*Global Economy Processes*	*Goldstone Structural-Demographic Processes*
Ottonian-Salian 960–1127	Northern Song 960–1127	Phase 1: Sung Breakthrough 930–1190	
Capetian 1150–1450	Mongol-Yuan 1200–1388	Phase 2: Nautical/Commercial Revolution 1190–1430	
Plantagenet 1150–1485			
			Disease/decline/stagnation 1350s–1400s
Valois 1450–1660	Ming 1368–1644	Phase 3: Oceanic Trading System 1430–1640	Population growth 1500s–early 1600s
Muscovy 1460–1620			State breakdown 1560–1660
Tudor 1485–1730			
			Disease/decline/stagnation Mid-1600s–early 1700s
Romanov 1615–1920	Qing 1644–1911	Phase 4: Industrial Takeoff 1640–1850	Population growth Early 1700s–
Bourbon 1660–1870			State breakdown 1760–1860
			Decline/stagnation 1914–1945
		Phase 5: Industrial Production 1850–2060	Differential Population growth, State breakdown 1960–2060?
			Disease/decline/stagnation ??

Still, there need hardly be anything mysterious about what transpired in the first transition. A non-coincidental combination of a cooler climate and Mongol expansion/warfare checked the Sung breakthrough in the East (see, for instance, Fang and Guo 1992). A cooler climate in the West may have sufficed to create agrarian scarcities leading to slowing population growth. Once the Mongols were in full swing, they created a setting which encouraged not only the nautical/commercial revolutions in the Mediterranean but also the Black Death which played a major role in the transition from phase 2 to phase 3.

Climate change appears to deserve a prominent role in this explanatory apparatus. Colder temperatures in early modern Europe have a number of

interesting implications worthy of further consideration. One is that the location of Atlantic and North Sea fish shifted well in advance of the "Age of Discoveries" thereby encouraging European fishermen to venture farther away from European shores. It does not seem too far-fetched to view this development as a precursor and precondition to Europeans venturing outside of their region. Columbus, to take one example, seems to have had some personal experience in various Atlantic voyages prior to his wrong-way effort to develop a new route to Asia. A second area to examine is related to European agrarian innovations made in part in response to deteriorating climate and the consequent stress on agrarian production techniques. It does not seem beside the point that the Netherlands and England were most successful in adapting their agrarian practices to stressful conditions – nor that France was one of the least successful in doing so.

Table 7: Climate and Dynastic Changes in Second Millennium China

Time Period	*Climate*	*Dynastic Changes*
1000–1109	Warm	
1110–1152	Cold	Establishment of Jin (1115), collapses of Liao (1125), Northern Song (1127)
1153–1193	Warm	
1194–1302	Cold	Establishment of Great Mongol (1206), Yuan (1271); collapses of Jin (1234), Southern Song (1279)
1303–1333	Warm	
1334–1359	Cold	
1360–1447	Warm	Establishment of Ming and collapse of Yuan (1368)
1448–1487	Cold	
1488–1582	Warm	
1583–1717	Cold	Establishment of Qing (1636), collapse of Ming (1685)
1718–1805	Warm	
1806–1912	cold	Establishment of Republic of China and collapse of Qing (1911)

Source: based on Zhang et al (2006: 466).

Another illustrative example is provided by Table 7 which summarizes Zhang et al. (2006) findings on the correlation between warm/cold phases and Chinese dynastic changes (but see as well earlier examinations on ancient southwest Asian regime change and climate that can be found in Thompson (2002, 2004, 2006b, 2006c). The Chinese correlation is near perfect, missing only the collapse of the Yuan and the establishment of the Ming by eight years. Zhang et al. (2006, 2007) note that climate impacts were registered differentially within China in the last millennium but that cold phases were strongly associated with the frequency of warfare, population decline, and dynastic changes. Findings such as these might promote climate change as a

rival to the population expansion stress emphasized by secular cycle analyses but it can also be viewed as highly complementary. The Zhang et al. argument is that colder temperatures reduce thermal energy which translates into less carrying capacity and food production shortages. An earlier warm phase expanded the population size which could now no longer be sustained in the ensuing cold phase. Somewhat similarly, Appleby (1980) is skeptical of the relationship between climate deterioration and disease but is more inclined to accept a climate-famine relationship, with disease becoming more likely in some famine situations.

Warfare is also part of each of the transitions and should receive some credit for slowing population growth and facilitating the spread of disease. Mongol-Sung warfare was prominent in the first transition. Mongol-Ming warfare, and to a much lesser extent Genoese-Venetian warfare in the Mediterranean, were prominent in the second transition. The mid-1600s–early 1700s encompasses the 1688–1713 global war among others. More global warfare, World Wars I and II, figure prominently in the transition from phase 4 to phase 5. Keep in mind, though, that "global wars" in leadership long cycle parlance refer not to the scope of conflict but rather to the extent to which global economic and military capabilities are re-concentrated in the global system. Global wars ushered in new phases of reconcentration in the global system in 1516, 1609, 1713, 1815, and 1945 (see Thompson and Rasler 1988). No other wars during the past 500 years had similar consequences and no significant reconcentration occurred in the absence of global warfare.

What do conquest, war, disease, cold-induced famine, and, more generally, increased mortality or death add up to? This list of bads is quite reminiscent of the Four Horsemen of the Apocalypse (death, war, famine, and disease). Interestingly, too, death is sometimes portrayed as conquest in the Four Horsemen imagery. The interchangeability of these iconic riders hints at a solution to the analytical problem. The fix is twofold. One, allow any combination of the "four horsemen" to play the population slowing role. Since they are highly interactive, it is not probable that any one will appear without some increase in one or more of the other types of disasters. For instance, a cooling climate is linked to war and famine. War and famine are linked to disease outbreaks. Two, view each period of depression as not only a check on population but also a period in which it becomes clear that new ways of doing things may help to rise out of the depression. Thus, we get new agrarian dynasties emerging on land and new commercial/industrial innovations emerging as phase shifts within the sequence of shorter-term innovation spurts. The phase shifts, therefore, function similarly to the role of depression in the 40–60 year Kondratieff waves. Radical innovations lead to increased productivity in leading sectors that gradually transform the lead economy. Eventually, the innovations are diffused to some other economies and, in the process, they become less novel and profitable.

So, too, with the more macroscopic phase shifts in global economic activity. Stagnation does not generate innovation in routes, transportation, markets and so forth. Rather, as Mensch (1979) argues, periods of stagnation are economic bottlenecks that afford new opportunities for evolutionary change. There is a window of opportunity to do something different that is not necessarily present in periods of economic expansion. He had in mind the 40–60 year Kondratieff sets of upsurge and depression (19 of which are sketched in table 3) but his arguments apply equally well to the four phase shifts (Sung Breakthrough, Nautical/Commercial Revolution, Oceanic Trading System, and Industrial Takeoff) with which we began this analysis – albeit with provision for the passage of more than two generations in between each shift.

What is new is that these phase shifts appear to be closely correlated with and presumably triggered by the decay of agrarian population and dynastic life cycles, climate deterioration, and periods of disease, decline, stagnation, and conflict. There is, of course, no presumption here that we have worked out exactly how all of these processes interacted in global history or whether all in fact did interact. The presumption is that it is a good bet that these processes were significantly intertwined and of causal importance to "big picture" dynamics.

Earlier secular and demography/structural analyses stop at 1800 on the premise that things change in population life cycles as we move from predominately agrarian to industrial settings. Leadership long cycle analyses focus almost exclusively on commercial/industrial dynamics except for the intermittent conflict between sea powers and land powers in global wars. It would appear that the two sets of activities are more closely connected than previously thought. Not only does the commercial/industrial trajectory modify substantially the environment in which demographic considerations play out, the trajectory itself is also strongly influenced by periods of demographic and other kinds of stagnation.

Some Implications

Obviously, the most evident implication is that a strong case can be made for fusing certain interpretations that hitherto have proceeded separately. Both secular and leadership long cycle analyses can benefit from insights suggested by focusing on what appear to be closely related processes. Part of the reason for the appearance of close relationships is that the processes in question are not just "cyclical." They represent S-shaped growth curves in population and technological innovation, among other things. Cycle and wave conceptualizations are being phased out (at least in leadership long cycle analyses) in favor of an emphasis on S-shaped growth curves. Processes begin slowly, accelerate, and then run out of steam. For some discussions of this

conceptual shift, see Mensch (1979), Marchetti (1980), and Devezas and Modelski (2008). The processes in question may still be cyclical in nature, albeit of inexact periodicity, and resemble long waves when viewed macroscopically. Multiple and often sequential, S-shaped growth curves appears to be a more accurate description of the phenomena at hand. Calling them S-shaped growth curves neither obviates the need to empirically examine their S-shape. Nor does it imply that all S-shapes look exactly alike. But, seen from this perspective, it should be less surprising that various growth curves may share sources of stimulation and decay.

Of course, the proof is in the pudding on this issue and we will have to see whether the suggested greater theoretical integration of these macro approaches proves to be fruitful. Three other implications deserve some mention as well. One has to do with temporality or time frames. The main implication is that secular and leadership long cycle analyses have developed reflexes on starting and stopping dates. Those reflexes are not random but perhaps it is time to begin relaxing them. A second implication has to do with global wars. Secular cycle analysis definitely has something to offer to lateral pressure and leadership long cycle explanations of global war onset. In turn, global wars figure prominently in the troughs of population growth cycles. Finally, these arguments also seem to suggest something concrete about efforts to explain synchrony and dis-synchrony in Eurasian growth patterns in population, urbanization, and imperial expansion. It helps to clarify western and eastern linkages and also is suggestive about Indian exceptionalism in this regard.

Temporality: Secular cycle and demographic-structural analyses tend to stop around 1800 because industrialization has intervened in the population expansion-carrying capacity relationship. Leadership long cycle analyses tend to focus on the past millennium because global economic processes, systemic leadership, and global wars are viewed as emerging only after the 10th century CE. It should be emphasized that these starting/stopping points are only tendencies. Secular cycle analyses have been conducted on post-1800 phenomena and leadership long cycle analysis has generated arguments encompassing pre-10th century CE behavior. Examples in the leadership long cycle research program include Modelski (2000, 2003, 2006). But both approaches have good theoretical reasons for delimiting their analyses. However, if it is true that population/climate/disease/war/global economic processes are bound together more closely than we have fully accepted to date, the more narrow time frames need rethinking. The "bigger picture" afforded by fusing the study of these processes opens up the full agrarian era dating back some 10,000 years to the advent of agriculture and continuing today given that much of the world remains fundamentally agrarian in terms of predominant production strategies. We have an exciting opportunity to re-interpret and

simplify major continuities of world history, evidence permitting. For instance, the serial collapses of the ancient Eurasian world (Chew 2006; Frank and Thompson 2005, 2006) would appear to be good events on which to focus in seeing how far back synchrony problems can be found. While we have given the lion's share of attention so far to the second millennium CE, the first millennium CE also deserves a closer examination (see, for example, Beckwith 2009: chapter 6, who makes an argument for a high level of apparent pan-Eurasian interconnectedness in mid-8th century CE political-economic collapses).

Nor did state breakdowns end in the European early modern era. We have a number of contemporary failed states with demographic/carrying capacity problems and prospects that climate change will aggravate these problems rather severely in the near future. Improved sanitation, medicines and medical treatment, and food production complicate the analysis of contemporary problems – compared to more "pure" agrarian phenomena in the past – but we have no reason to assume that more traditional dynamics have disappeared completely.

Global Warfare: One of the ironies of the leadership long cycle research program is that it has gained more prominence for its models of global warfare than it has as an interpretation of international political economy developments. The irony lies in the fact that global warfare was always a secondary concern in the research program. Global war is an important part of the systemic process by which political-economic deconcentration is switched back to concentration but it was never intended to be a stand-alone research topic. Global war thus plays a significant role in the explanatory quiver but it was its consequences and not its causation that was deemed most important. Yet because audiences were more receptive to global warfare arguments and findings than they were to the international political economy underpinnings, a fair amount of attention has been devoted to the warfare subject. The emphasis throughout has been on how global war is essentially a global or sea power response to the expansionary threat posed by Europe's leading land power (Thompson 2008 provides an overview of leadership long cycle models pertaining to global warfare). Such an interpretation is clearly biased towards the sea power side of the equation. Bringing in information on demographic dynamics helps even out the bias.

Table 8 lists the leadership long cycle global wars and related information on the population dynamics of the principal initiator. Each global war was initiated in a period of population upswing which suggests that global wars are most likely to be initiated in phases of population expansion. Table 8 gives no information on non-initiator population dynamics because there is no suggestion intended that the state experiencing the most population expansion is most likely to resort to significant regional territorial expansion. Rather, the

finding that each initiator became more bellicose in periods of population expansion supports the lateral pressure contention that increasing population, assuming reasonably high technology, leads to lateral pressures and conflict among states seeking more resources for their expanding populations (see, for instance, Choucri and North 1975; Choucri et al. 1992). However, other possible interpretations are tenable. Observers have linked the outbreak of the French Revolution in 1792 to a century of immiseration of French farmers and workers due to a combination of expanding population, climate deterioration, bad harvests, and declining real wages. See Fagan (2000: chapter 9) for one such interpretation. Although not always recognized as such, Goldstein's (1988, 1991) modeling of hegemonic warfare is at heart a lateral pressure model. His emphasis on expansionary upswings and full war chests as preconditions for highly intensive warfare makes sense from the viewpoint of predominant agrarian states initiating bids for regional hegemony. It made less sense from the perspective of threatened sea powers that would presumably most prefer to avoid warfare in period s of economic expansion. A greater emphasis on population growth may also help clarify Goldstein's modeling interest in prices and real wages in the context of warfare and long waves.

Table 8. Global Wars, Initiators, and Population Dynamics

Global Wars	*Principal Initiator*	*Population Trend*
1494–1516 Wars of the Italian City States and Indian Ocean	France	Valois secular cycle population expansion, 1450–1520
1580–1608 Dutch and Spanish War	Spain	Spanish Habsburg population expansion, 1500–1620
1688–1713 Wars of the League of Augsburg and Spanish Succession	France	Bourbon secular cycle population expansion, 1660–slowing immediately prior to 1700
1792–1815 Wars of the French Revolution and Napoleon	Austrian-Prussian intervention in the French Revolution; thereafter, France	French population expansion renewed after 1720 and continued to World War I
1914–1945 World Wars I and II	Germany	German population expansion very fast from Napoleonic Wars to World War I

This more comprehensive appreciation of warfare causation may also help in interpreting the findings on dis-synchronization in sea power and regional power concentration. The leadership long cycle finding is that regional (read European) power concentration was more likely when global (sea power)

concentration was decaying but that regional power concentration re-stimulated global (sea power) concentration (for more on the dis-synchronization model of global war, see Thompson (1992) and Rasler and Thompson (1994, 2001).

Translating this finding from a stronger appreciation for demographic dynamics suggests that the foreign policy ambitions of decision makers in leading land powers were encouraged by the benefits of expansion in population size, economic growth, and state revenues. Threatened sea powers, in coalition with other threatened land powers, resisted the expansionary efforts, thereby re-concentrating their capabilities of global reach while defeating the threat from Europe.

The defeats of the leading land powers helped slow down population growth in France, Spain, and Germany at least temporarily. As McEvedy and Jones (1978: 56) put it for early modern France:

> Surpassing the previous best was only part of the demographic achievement of the early modern era: during the period 1550–1650 there was an additional gain of 30% which took the population over the 20m mark. Then there was a pause due partly to bad luck, partly to bad management. The bad luck came in the form of epidemics and famines, the bad management was supplied by Louis XIV. Out of sheer bigotry Louis expelled 0.2m of his hardest-working subjects, the Huguenots, while by his incessant and ultimately unsuccessful wars he succeeded in temporarily ruining the country's economy. The reign that had begun in confidence and glory ended in bitterness and poverty.

Bad management it may well have been but whether bad luck was involved is much less clear given the arguments of the secular cycle school. It is more evident, though, that global war, as one of the four "horsemen," is important to the process of reducing population stresses due to expanding the number of mouths to feed. Both secular and leadership long cycle analyses can benefit by further elaborating the role of global warfare in long-term processes.

Eurasian Synchrony and Dis-synchrony: Considerable attempts (see Chase-Dunn and Willard 1993; Chase-Dunn et al. 2000, 2006a, 2006b, 2006c; Chase-Dunn and Manning, 2002; Hall and Turchin 2007; White et al. 2008) have been made to model the synchrony of western and eastern Eurasia in terms of population growth, urbanization, and imperial size. The answer for why substantial synchrony has been observed that is suggested by this fusion of climate, demographic, and political-economic considerations is not all that different from earlier explanations except that it is less inductive. Earlier modeling has tended to ask whether there is east-west synchrony and then, once found, to speculate on why developments at both ends of Eurasia have similar timing. In the fused approach, grounds for anticipating increasing

synchrony – certainly in the second millennia CE but also earlier – have been advanced. The Mongols, reacting to climate change among other things, did something they had not been accustomed to doing. Instead of intermittent raiding of urban-sedentary areas, they conquered China and a quite respectable proportion of the rest of Eurasia. They set back Sung economic developments and inadvertently encouraged the ascendancy of Italian city states in the Eastern Mediterranean by facilitating overland Silk Road trade. Later, the Mongols facilitated the spread of recurring plague throughout a good portion of Eurasia. Thus, in the early centuries of the second millennium CE, it is easy to bestow ample credit on the Mongols as unwitting agents of demographic entrainment, thereby amplifying tendencies to coordinated growth already in place due to similar agrarian susceptibilities to global climate changes. Presumably this interpretation also implies that east-west synchrony should have been greater after the Mongols than before.

At the same time, the consequences of entrainment were not identical at both ends. Eastern Eurasia remained dependent on agrarian food cultivation and less committed to long distance trade. Some segments of western Eurasia developed more capability to engage in long distance trade and became less dependent on food cultivation for its economic prosperity. But that does not mean that the two ends became more independent. Western Eurasia industrialization relied in part on a number of eastern technological innovations. East-west trade also remained important. Thus, we should anticipate that population growth, urbanization, and agrarian imperial size should fluctuate somewhat similarly at both ends of Eurasia, especially as long as both ends remained primarily agrarian in nature.

The same argument does not anticipate, however, that developments in all of Eurasia would be equally synchronous. On the one hand, the major climate changes of the second millennia are thought to have been global phenomena (Grove 2004). Yet cooler temperatures that might be devastating in Greenland or northern China need not always be so harmful farther south. Tropical or temperate forested areas might benefit from some cooling as long as the accompanying dryness is not devastating. Areas in or adjacent to deserts – as in the Middle East or the Southwest U.S. – are of course especially vulnerable to periods of aridity.

We also know that the Mongols failed to penetrate Southeast Asia and Southern Asia in the same way that they did in East, Central, Southwest Asia, as well as Eastern Europe. So, apparently, did the Black Plague.

Table 9 summarizes Ruddiman's (2005) list of major epidemics of the last two millennia. Serial and comparative information on disease is only beginning to emerge. Any contemporary evaluation of the history of disease, therefore, is only provisional. We can hope to see more comprehensive analyses emerge in the near future but in the present we need to work with what we have. The main point of drawing attention to Ruddiman's list is the

Table 9. Epidemics of the Last 2000 Years

Year	*Region*	*Disease*	*Intensity (mortality)*
79, 125	Rome	Malaria?	Local epidemic
160–189	Roman Empire	Smallpox?	Regional epidemic
265–313	China	Smallpox	Regional epidemic
251–539	Roman Empire	Smallpox or Bubonic plague?	Regional epidemics with decadal repetition
540–590	Europe, Arabia, and North Africa	Bubonic plague	Major pandemic (25%) with decadal repetition (40%)
581	**India**	Smallpox?	Regional epidemic
627–717	Middle East	Bubonic plague	Local epidemics
664	Europe	Bubonic plague	Regional epidemic
680	Mediterranean Europe	Bubonic plague	Regional epidemic
746–748	Eastern Mediterranean	Bubonic plague	Local epidemic
980	**India**	Smallpox	Regional epidemic
1257–1259	Europe	Unknown	Regional epidemic
1345–1400	Europe	Bubonic plague	Major pandemic (40%)
1400–1720	Europe/North Africa	Bubonic plague	Regional epidemic with decadal repetition
1500–1800	Europe	Smallpox	Regional epidemic
1500–1800	Americas		Major pandemic (80–90%)
1489–1850	Europe	Typhus	Regional epidemic
1503–1817	**India**	Cholera	Local epidemic
1817–1902	**India**/China/Europe		Pandemic (< 5%)
1323–1889	Europe	Influenza	Regional epidemic
1918–1919	Global	Influenza	Pandemic (2–3%)
1894–1920	Southeast Asia	Bubonic plague	Regional epidemic (small %)

Source: based on Ruddiman (2005: 132), India in bold letters added.

absence of the Black Death in India. India appears only three times prior to 1800 (581, 980, and 1503–1817). It appears to have missed the Eurasian pandemics of the 1400s–1700s and only after 1817 is India linked to a pandemic that was also experienced in China and Europe. Figure 5 on Indian population growth, moreover, shows no indentations or interruptions as experienced in China and Europe. This gradually increasing population growth in India may reflect poor data subject to a great deal of extrapolation and guesstimates. But it is also what one might expect in the more minimal penetration of Mongols, major pandemics, and less susceptibility to Little Ice

Age cooling. It may not be surprising, therefore, that India is usually found to be dis-synchronized with the timing of growth in population, cities, and empires in eastern and western Eurasia.

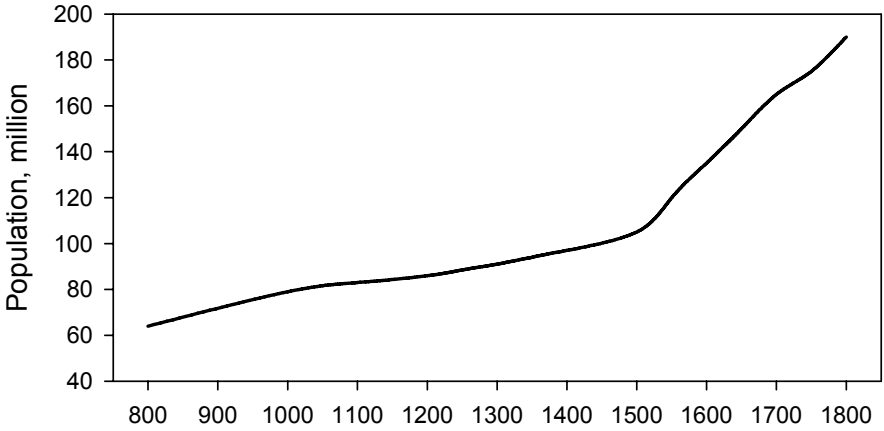


Figure 5. Indian population growth.

Questions of Scale and Scope: Underlying many of the questions of interpretation are issues concerning the delimitation of the scale and scope of the many processes involved. We seem to be dealing with pan-Eurasian dynamics – although there is no reason to assume that all of Eurasia is affected identically and at precisely the same time. Part of the problem is that we do not yet have sufficient data to differentiate between regional trends and local deviations. Even if we have reason to think that Eurasia in general was becoming cooler or warmer, there are apt to be exceptions. These exceptions to the rule may prove to be excellent places and periods to examine to assess the impact of processes such as climate change. But our greatest analytical problem may be a matter of perspective. Instinctively, we focus on specific actors. Secular cycle analyses examine empires and agrarian states. Leadership long cycle analyses focus predominately on a sequence of lead economies. The actor level of analysis need not be abandoned entirely but we need to incorporate better an appreciation for the regional context in which these actors wax or wane. Lieberman's (2009) emphasis on "strange parallels" from Japan to Southeast Asia to western Europe in the 800–1830 era suggests a different, broader perspective that complements well Goldstone's (1991) own emphasis on regional dynamics. Eurasian "ecology" is more complex than we have acknowledged in our studies and we need to strive toward embracing that complexity in our studies.

Conclusion

Conclusions are meant to summarize what has been accomplished in a paper but a full conclusion for this particular paper is probably premature. In rising to Peter Turchin's challenge/invitation to explain the timing overlap in secular trend and global economy processes, something more seems to have been accomplished. The overlap in the timing of agrarian dynastic rise and falls and shifts in global economic foci is not all that difficult to explain. Much of Eurasia was subject to periods of accelerated growth and marked slowdowns. Agrarian dynasties tended to rise within the periods of accelerated growth and collapse during the slowdowns. These same periods of stagnation created opportunities and incentives to look for new ways of doing trade and industrial production. Yet simply making such a statement is highly suggestive of the need to further integrate secular trend and leadership long cycle analysis. The integrative potential is certainly not restricted to these two research programs. Chase-Dunn et al (2006) describe an iteration model that has always had a place for population growth and its consequences. Now they have also added roles for trade and trading states.

One focuses on agrarian production, growth, and decline. The other focuses on maritime commerce and industrial production surges. No one ever claimed that these two types of processes were highly independent. The nature of research programs, subject to all sorts of blinders and assumptions, however, has encouraged research programs to proceed as if they were substantially independent phenomena. If we no longer think that is the case, it is necessary to change our exclusive ways and explore further integration of the two different perspectives. The potential explanatory payoff could be quite impressive. Now, we need to convert the potential into something more concrete. How exactly have demographic, climate, and disease dynamics interacted with the rise and fall of land empires, maritime networks, systemic concentration and deconcentration, and economic growth? This is no small undertaking but we have at least what appears to be a good start.

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References

Appleby, A. B. 1980. Epidemics and famine in the little ice age. *Journal of Interdisciplinary History* 10: 643-663.

Beckwith, C. I. 2009. *Empires of the Silk Road: A History of Central Eurasia from the Bronze Age to the Present*. Princeton University Press, Princeton, NJ.

Bosworth, A. 2000. The evolution of the world-city system, 3000 BCE to AD 2000. In Denemark, R. A., J. Friedman, B. K. Gills, and G. Modelski. (eds.) *World system history: the social science of long-term change*. London, Routledge.

Chase-Dunn, C., A. Alvarez, and D. Pasciuti. 2006a. Power and Size: Urbanization and Empire Formation in World-Systems. In Chase-Dunn, C. and E. N. Anderson (eds.). *The historical evolution of world-systems*. Palgrave-Macmillan, New York.

Chase-Dunn, C., T. D. Hall, P. Turchin. 2007. World-systems in the biogeosphere: urbanization, state formation and climate change since the iron age. In Hornborg, A. and C. L. Crumley (eds.). *The World-system and the earth system: global socioenvironmental change and sustainability since the neolithic*. Left Coast Press, Walnut Creek, Ca..

Chase-Dunn, C. and S. Manning. 2002. City systems and world-systems: four millennia of city growth and decline. *Cross-Cultural Research* 36: 379-398.

Chase-Dunn, C., S. Manning, and T. D. Hall. 2000. Rise and fall: east-west synchrony and Indic exceptionalism reexamined. *Social Science History* 24: 727-754.

Chase-Dunn, C., R. Niemeyer, A. Alvarez, H. Inoue, K. Lawrence, and A. Carlson. 2006b. When north-south relations were east-west: urban and empire synchrony (500 BCE-1500 CE). Paper presented at the annual meeting of the International Studies Association, San Diego, Ca., March.

Chase-Dunn, C., A. Alvarez, H. Inoue, R. Niemeyer, A. Carlson, B. Fierro, and K. Lawrence. 2006c. Upward sweeps of empirical city growth since the bronze age. Paper presented at the annual meeting of the American Sociological Association, Montreal, Canada, August.

Chase-Dunn, C. and A. Willard. 1993. Systems of cities and world-systems: settlement size hierarchies and cycles of political centralization, 2000 BC–1988 AD. Paper presented to the annual meeting of the International Studies Association, Acapulco, Mexico, March.

Chew, S. C. 2006. *Recurring Dark Ages: Ecological Stess, Climate Changes and System Transformation*. AltaMira Press, Walnut Creek, Ca..

Choucri, N. and R. North. 1975. *Nations in Conflict: National Growth and International Violence*. W. H. Freeman, San Francisco, Ca.

Choucri, N., R. North, and S. Yamakage. 1992. *The Challenge of Japan Before World War II and After: A Study of National Growth and Expansion*. Routledge, London.

Devezas, T. C. and G. Modelski. 2008. The Portuguese as system-builders in the XVth –XSVIth centuries: a case study on the role of technology in the evolution of the world system. In Modelski, G., T. Devezas, and W. R. Thompson (eds). *Globalization as evolutionary process: modeling global change*. Routledge, London.

Elvin, M. 1973. *The Pattern of the Chinese Past*. Stanford University Press, Stanford, Ca.

Fagan, B. 2000. *The Little Ice Age: How Climate Made History, 1300–1850*. Basic Books, New York.

Fang, J.-Q. and G. Liu. 1992. Relationship between climatic change and the nomadic southward migrations In eastern Asia during historical times. *Climatic Change* 22: 151-169.

Flohn, H. and H. Fantechi. 1984. *The Climate of Europe: Past, Present, and Future*. D. Reidel, Dordrecht, Neth.

Frank, A. G. 1998. *ReOrient*. University of California Press, Berkeley.

Frank, A. G. and W. R. Thompson. 2005. Bronze age economic expansion and contraction revisited. *Journal of World History* 16: 115-72.

Frank, A. G. and W. R. Thompson. 2006. Early iron age economic expansion and contraction revisited. In Gills, B. K. and W.R. Thompson (eds.). *Globalization and global history*. Routledge, London.

Gernet, J. 1982. *A History of Chinese Civilization*. Cambridge University Press, Cambridge.

Galloway, P. R. 1986. Long-term fluctuations in climate and population in the preindustrial era. *Population and Development Review* 12: 1-24.

Goldstone, J. A. 1991. *Revolution and Rebellion in the Early Modern World*. University of California Press, Berkeley.

Goldstein, J. 1988. *Long Cycles: Prosperity and War in the Modern Age*. Yale University Press, New Haven, Ct.

Goldstein, J. 1991. A war-economy theory of the long wave. In Thygesen, N., K. Velupillai, and S. Zambelli (eds). *Business Cycles: Theories, Evidence and Analysis*. New York University Press, New York.

Grove, J. M. 2004. *Little Ice Ages: Ancient and Modern,* 2nd ed., 2 vols. Routledge, London.

Hall, T.D. and P. Turchin. 2007. Lessons from population ecology for world-systems analyses of long-distance synchrony. In Hornborg, A. and C. L. Crumley (eds). *The world-wystem and the earth system: global socioenvrionmental change and sustainability since the neolithic*. Left Coast Press, Walnut Creek, Ca.

Hobson, J. M. 2004. *The Eastern Origins of Western Civilization*. Cambridge University Press, Cambridge.

Korotayev, A. and D. Khatourina. 2006. *Introduction to Social Macrodynamics: Secular Cycles and Millennial Trends in Africa*. URSS, Moscow.

Korotayev, A., A. Malkov, and D. Khatourina. 2006. *Introduction to Social Macrodynamics: Secular Cycles and Millennial Trends*. URSS, Moscow.

Lamb, H. H. 1982. *Climate, History and the Modern World*. Methuen, London.

Lane, F. C. 1973. *Venice: The Maritime Republic*. Johns Hopkins University Press, Baltimore, Md.

Lieberman, V. 2009. *Strange Parallels, Southeast Asia in Global Context, c. 800-1830, Vol. 2: Mainland Mirrors: Europe, Japan,China, South Asia, and the Islands*. Cambridge University Press, Cambridge, UK.

Marchetti, C. 1980. Society as a learning system: discovery, invention and innovation cycles revisited. *Technological Forecasting and Social Change* 18: 267-282.

McEvedy, C. and R. Jones. 1978. *Atlas of World Population History*. Facts on File, New York.

McNeill, W. 1974. *Venice: The Hinge of Europe, 1081-1797*. University of Chicago Press, Chicago, Il.

McNeill, W. 1982. *The Pursuit of Power*. University of Chicago Press, Chicago, Il.

Mensch, G. O. 1979. *Stalemate in Technology: Innovations Overcome the Depression*. Ballinger, Cambridge, Ma.

Modelski, G. 1987. *Long Cycles in World Politics*. Macmillan, London.

Modelski, G. 2000. *World System Evolution*. In Denemark, R., J. Friedman, B. K. Gills, and G. Modelski (eds). *World System History: the Social Science of Long-term Change*. Routledge, London.

Modelski, G. 2003. *World Cities: -3000 to 2000*. FAROS2000, Washington D.C.

Modelski, G. 2006. Ages of reorganization. *Nature+Culture* 1: 205-227.

Modelski, G. and W. R. Thompson. 1988. *Sea Power in Global Politics, 1494-1993*. Macmillan, London.

Modelski, G. and W. R. Thompson. 1996. *Leading Sectors and World Politics: The Coevolution of Global Politics and Economics*. University of South Carolina Press, Columbia.

Pomeranz, K. 2000. *The Great Divergence*. Princeton University Press, Princeton, NJ.

Pomeranz, K. 2006. Without coal? colonies? calculus?: counterfactuals and industrialization in Europe and China. In Tetlock, P. E., R. N. Lebow, and G. Parker (eds). *Unmaking the west: what if scenarios that rewrite world history*. Ann Arbor: University of Michigan Press, Ann Arbor.

Rasler, K. and W. R. Thompson. 1994. *The Great Powers and Global Struggle, 1490–1990*. University Press of Kentucky, Lexington.

Rasler, K, and W. R. Thompson. 2001. Malign autocracies and major power warfare: evil, tragedy and international relations theory. *Security Studies* 10: 46-79.

Reuveny, R. and W. R. Thompson. 2004. *Growth, Trade, and Systemic Leadership*. University of Michigan Press, Ann Arbor.

Ringrose, D. R. 2001. *Expansion and Global Interaction, 1200–1700*. Addison Wesley Longman, New York.

Ruddiman, W. F. 2005. *Plows, Plagues and Petroleum: How Humans Took Control of Climate*. Princeton University Press, Princeton, NJ.

Schumpeter, J. 1939. *Business Cycles: A Theoretical, Historical and Statistical Analysis of the Capitalist Process, 2 vols.* McGraw Hill, New York.

Thompson, W. R. 1992. Dehio, long cycles and the geohistorical context of structural transitions. *World Politics* 45: 127-152.

Thompson, W. R. 2000. *The Emergence of the Global Political Economy*. UCL Press/Routledge, London.

Thompson, W. R. 2002. Testing a cyclical instability theory on the ancient Near East. *Comparative Civilizations Review* 46: 34-78.

Thompson, W. R. 2004. Complexity, diminishing marginal returns, and fragmentation in ancient Mesopotamia. *Journal of World-Systems Research* 10: 613-652.

Thompson, W. R. 2006a. Early globalization, trade crises, and reorientations in the ancient Near East. In LaBianca, O. S. and S. Schram (eds). Connectivity in antiquity: globalization as long-term historical process. Continuum, New York.

Thompson, W. R. 2006b. Crises in the southwest Asian bronze age. *Nature and Culture* [Leipzig] 1: 88-131

Thompson, W. R. 2006c. Climate, water and political-economic crises in ancient Mesopotamia and Egypt. In A. Hornborg and C. Crumley (eds). *The world system and the earth system: global socio-environmental change and sustainability since the neolithic.* Left Coast Books, North Coast, Ca..

Thompson, W. R. 2008. Preludes to Systemic Transitions Since 1494. In Thompson, W. R. (ed). *Systemic transitions: past, present and future.* Palgrave-Macmillan, New York.

Thompson, W. R. and K. Rasler. 1988. War and systemic capability reconcentration. *Journal of Conflict Resolution* 32: 334-366.

Turchin, P. 2003. *Historical Dynamics: Why States Rise and Fall.* Princeton University Press, Princeton, NJ.

Turchin, P. 2005. Dynamical feedbacks between population growth and sociopolitical instability in agrarian states. *Structure and Dynamics: eJournal of Anthropological and Related Sciences* 1(1): 1-19.

Turchin, P. 2008. Modeling periodic waves of globalization in the afroeurasian world system. In Modelski, G., T. Devezas, and W. R. Thompson (eds). *Globalization as evolutionary process: modeling global change.* Routledge, London.

Turchin, P. and S. Nefedov. 2009. *Secular Cycles*. Princeton University Press. Princeton, NJ.

Vries, J. de and A. van der Woude. 1997. *The First Modern Economy: Success, Failure and Persistence of the Dutch Economy, 1500–1815.* Cambridge University Press, Cambridge.

White, D. R., N. Kejzar, and L. Tambayong. 2008. Discovering Oscillatory Dynamics of City-Size Distributions in World Historical Systems. In Modelski, G., T. Devezas, and W. R. Thompson (eds). *Globalization as evolutionary progress: modeling global change*. Routledge. London.

Wilson, R. C. L., S. A. Drury, and J. L. Chapman. 2000. *The Great Ice Age: Climate Change and Life*. Routledge, London.

Zhang, D. D., C. Y. Jim, C. S. Lin, Y. He, J. J. Wang, and H. F. Lee. 2006. Climatic change, wars and dynastic cycles in China over the last millennium. *Climatic Change* 76: 459-477.

Zhang, D. D., J. Zhang, H. F. Lee, and Y. He. 2007. Climate change and war frequency in eastern China over the last millennium. *Human Ecology* 35: 403-414.