8 Modeling periodic waves of integration in the Afro-Eurasian world-system

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Introduction

Most people assume that the current period of global connectivity is a unique and unprecedented development in human history. Although the breadth and depth of the globalization that began after World War II is indeed unrivaled, in the past humanity has experienced other periods of heightened long-distance connectivity that resulted in massive long-distance movements of goods, people, ideas, genes, cultivars, and pathogens (Chase-Dunn and Hall 1997; Gills and Thompson 2006). One example of a previous "globalization" is the Age of Discovery of the sixteenth century, during which all major population centers of the world, both in Afro-Eurasia and the Americas, were connected by trade and conquest, which resulted in a massive interchange of cultural elements, genes, and pathogens, known as the Columbian Exchange (Crosby 1972). The globalization of the sixteenth century was followed by the Crisis of the Seventeenth Century, which was also truly global in nature. The wave of state collapse rolled over the whole of Eurasia (with the possible exception of South Asia). Populations declined in such far-flung regions as Spain, Russia, and China. But the demographic catastrophe was even greater in the New World – the Native American population may have declined to perhaps ten percent of the pre-Columbian level. So massive was the world's population collapse that we can detect it in the decline of global emissions of greenhouse gasses (CO_2 and CH_4), which even then were affected by anthropogenic activities. According to at least one theory, this decline in greenhouse gas concentration may have caused the Little Ice Age of the eighteenth century (Ruddiman 2005).

Another "globalization", although on a lesser scale – "merely" continental (a "continentalization"?) – followed the Mongolian conquest of the Eurasian steppe heartland (Abu-Lughod 1989). The expansion of interaction networks during the thirteenth century was also followed by a crisis period during the fourteenth century. One may continue multiplying the examples, but students of world history have long known that long-distance trade/information networks have a tendency to "pulsate" – expand and contract – on the time-scale of centuries. (Chase-Dunn and Hall 1997).

This chapter will discuss the possible mechanisms that may drive these world-system pulsations. First, however, we need to define more precisely the problem to be explained. The main focus of the inquiry is on macro-social systems (also known as "world-systems") – systems of societies that are strongly linked to one another by interaction networks (trade, alliances, warfare, migration and information flows). We know that on a very long temporal scale, since the time when the first archaic states evolved, the density and spatial extent of interaction networks have increased until they have merged into a single world-encompassing web. However, this evolutionary upward trend was not a smooth one; it resulted from a series of upsweeps that were interspersed with slow-downs and even retreats. (Chase-Dunn and Hall 1997). We are interested in explaining these expansions ("integrations") and contractions ("fragmentations") of long-distance interaction networks. One clue to the possible explanation is the observation that the spatial pulsations of macro-social systems appear to be related to another dynamic – the imperial rise and fall.

The explanation that I propose for world-system pulsations runs as follows. Large agrarian states ("empires") experience long-term oscillations in demographic, economic, political, and social structures, known as "secular cycles" (Turchin 2003). The typical length of a secular cycle is between two and three centuries. Secular cycles are driven by endogenous mechanisms (internal to the state and society), but interactions between states, as well as exogenous factors, such as climate, may synchronize state-based oscillations within a macro social system. The secular cycle is a fundamental rhythm that affects, to a greater or lesser degree, all aspects of the functioning of a society, including its capacity to support long-distance exchange networks.

In what follows I will first present the logic of the demographic–structural theory and illustrate it with an outline of secular cycles in western Afro-Eurasia. Second, I will review the synchronizing mechanisms. Third, I will discuss how the phase of the secular cycle may affect the extent and intensity of interaction networks. Finally, I will discuss how the demographic–structural and synchronizing mechanisms interacted, by tracing world-system pulsations in Afro-Eurasia from the Bronze Age onwards.

Because the theory is still in its early stages of development, the exposition is by necessity speculative, and I expect that much of what follows will be modified in the light of new models and data. The geographic focus is on Afro-Eurasia (in conventional terms, North Africa, Europe, and Asia).

Secular cycles and the demographic–structural theory

Social, political, and economic processes within polities (chiefdoms, states, and empires) are often characterized by cycles or waves. Over the last decade it has become apparent that one kind of temporal dynamics, which we have termed secular cycles, is a virtually ubiquitous feature of large-scale agrarian societies. As suggested by the demographic-structural theory.

(Goldstone 1991; Nefedov 1999; Turchin 2003), secular cycles arise as a result of non-linear interactions between demographic, economic, and political components of social systems. During the integrative phase of the cycle, the state and elites maintain social stability and order, which creates favorable conditions for sustained population growth. Population growth in excess of the productivity gains of the land has several effects on social institutions. First, it leads to persistent price inflation, falling real wages, rural misery, urban migration, and increased frequency of food riots and wage protests. Second, the rapid expansion of population results in an increased number of aspirants for elite positions. Increased intra-elite competition leads to the formation of rival patronage networks vying for state rewards. As a result, elites become riven by increasing rivalry and factionalism. Third, population growth leads to expansion of the army and the bureaucracy, and rising real costs for the states. States have no choice but to seek to expand taxation, despite resistance from the elites and the general populace. Yet, attempts to increase revenues cannot offset the spiraling state expenses. Thus, even if the state succeeds in raising taxes, it is still headed for fiscal crisis. As all these trends intensify, the end result is state bankruptcy and consequent loss of the military control; elite movements of regional and national rebellion; and a combination of elite-mobilized and popular uprisings that manifest the breakdown of central authority (Goldstone 1991).

Sociopolitical instability resulting from state collapse feeds back on population growth (Turchin 2003). Most obviously, when the state is weak or absent, the populace will suffer from elevated mortality, due to increased crime, banditry, and internal and external warfare. Additionally, the troubled times cause an increased migration rate, as refugees flee war-affected areas. Migration may lead to emigration (and we can simply add that to mortality) and to the spread of epidemics. Increased vagrancy spreads the disease by connecting areas that would stay isolated during better times. As vagabonds and beggars congregate in towns and cities, increasing their population size, they may tip the density over the epidemiological threshold (a critical density above which a disease spreads). Finally, political instability causes lower reproduction rates, because, during uncertain times, people choose to marry later and to have fewer children.

Instability can also affect the productive capacity of the society. First, the state offers protection. In a stateless society, people can live only in natural strongholds, or places that can be made defensible. Fearful of attack, peasants can cultivate only a small proportion of that productive area, i.e. that which is near fortified settlements. The strong state protects the productive population from external and internal (banditry, civil war) threats, and thus allows the whole cultivable area to be put into production. Second, states often invest in increasing the agricultural productivity by constructing irrigation canals, roads, and flood-control structures. A protracted period of civil war results in a deterioration and outright destruction of this productivity-enhancing infrastructure.

Thus, during the disintegrative phase that follows a crisis, population declines and the numbers and appetites of elites and elite aspirants diminish, which in turn creates conditions for the end of civil wars; the establishment of the strong state; and the start of another cycle.

The characteristic period of the secular cycle varies from two to three centuries in societies with widespread monogamy among the elites, such as the Christian states of Europe; to around a century among societies with polygynous elites, such as the Islamic societies of the Near East. (Since the reproductive ability of human males is primarily determined by the availability of mates, polygynous elites have faster demographic growth rates. The resulting rapid secular oscillations are sometimes known as Ibn Khaldun cycles.) It is important to note that secular cycles are not cycles in the strict mathematical sense. Irregularities arise endogenously as a result of complex non-linear interactions (chaos) and exogenously, as a result of climate fluctuations and catastrophic external invasions of hostile armies or pathogens. For this reason, in smaller polities, where exogenous factors play a more pronounced role, secular cycles tend to be frequently interrupted as a result of actions by stronger neighbors.

The logical coherence of the demographic–structural theory has been tested by constructing a series of mathematical models (Nefedov 1999; Turchin 2003; Korotayev and Khaltourina 2006). The theory has also proved to be very fruitful in applications to several case-studies. Empirical tests so far (reviewed in the forthcoming Turchin and Nefedov 2007 article) suggest that secular oscillations are ubiquitous whenever exogenous factors play a relatively minor role – in larger polities (especially world-empires such as Rome or Han China) and in relatively isolated locations (island states such as England or Japan).

The case-study for which we have the greatest amount of data, allowing us to test various aspects of the demographic–structural theory, is England between 1100 and 1800 (Turchin 2005; Hall and Turchin 2007; Turchin and Nefedov 2007). English population dynamics during the second millennium CE were dominated by two trends (Figure 8.1(a)): a very long-term (millennial) upward tendency that reflects technological evolution, and secular cycles around the long-term trend. It is possible to separate these two dynamics by estimating the long-term trend; using the data on average yields characterizing each epoch; and subtracting this trend from the data. When we detrend data in this way, we are left with the cyclic tendency, depicted in Figure 8.1(b) (for details of calculations, see Turchin 2005). Detrended population, which can be thought of as a measure of the pressure placed by the population on the available resources, is inversely related to the real wage: real wages are low during periods when population pressure is high, and vice versa. This pattern is shown in Figure 8.1(b), where it can be seen that before 1800 the inverse real wage (the "misery index") varies in step with the detrended population. After 1800, the two curves diverge in a very dramatic way, emphasizing the fundamental change in the socioeconomic system associated with the Industrial Revolution.

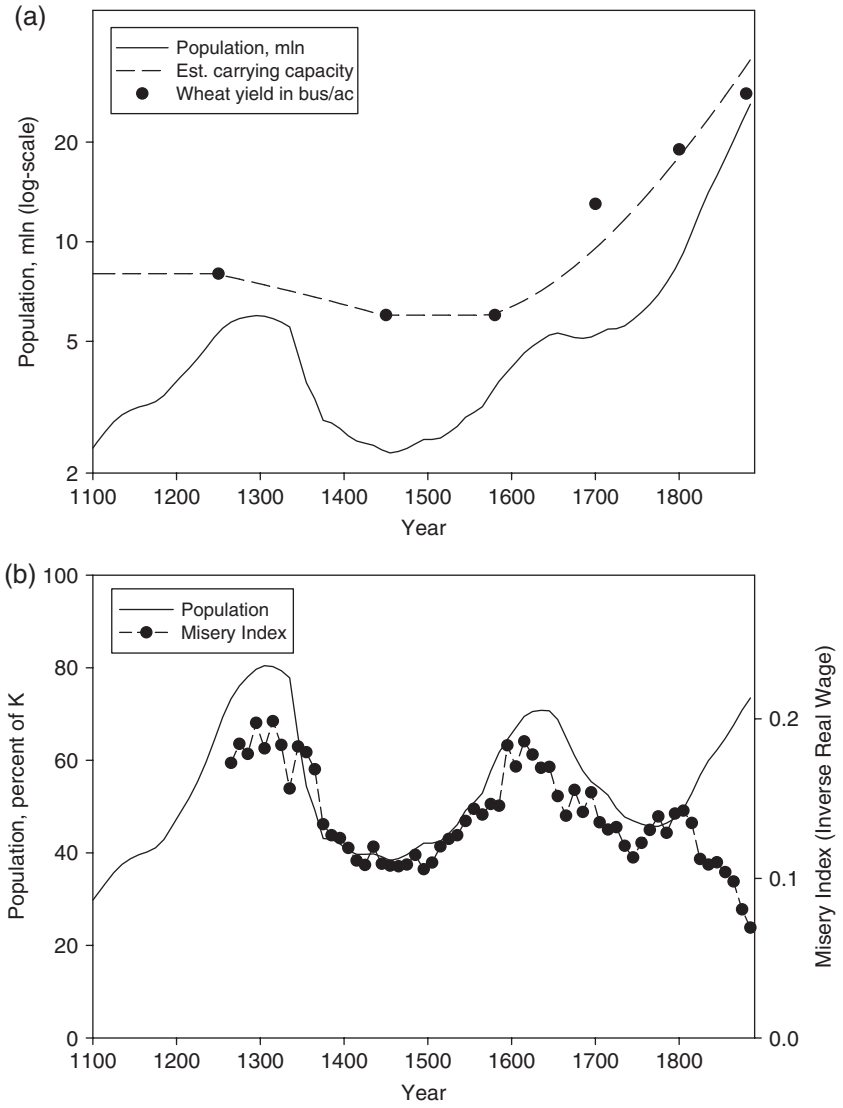

Figure 8.1 (a) Population numbers in England and Wales between 1100 and 1870 (solid line curve), plotted together with the estimated carrying capacity (broken line curve). The data points indicate average yields of wheat (in bushels per acre) for each period, from which the carrying capacity is calculated. (b) Detrended population – population numbers divided by the carrying capacity (solid curve) plotted together with the "misery index" – the inverse real wage (points connected by the broken curve). Data sources are given in Turchin (2005)

Although the case of England is the one in which the existence of population cycles has been most clearly demonstrated, this dataset is by no means unique. Wherever we can construct a long time-series of population counts, we usually observe secular cycles. Figure 8.2 (a) to (c) gives three examples of such cyclic dynamics.

A tentative chronology of secular cycles in Western Europe

As can be seen from Figures 8.1, 8.2(a), and 8.2(c), the western end of Afro-Eurasia was subject to secular cycles, at least since the time of the Roman Empire. Here I provide a synoptic view of the cycle sequence in this region. The account is based on the forthcoming book by Turchin and Nefedov (2007). All dates given below are approximate, because transitions between cycles are not discrete events.

The cycles of the Roman Empire

The first large empire in Western Europe was that of Rome. During the second century BCE, Rome became the hegemonic power in the Mediterranean. Around 130 BCE, however, the integrative tendency reversed itself, and the Republic entered a 100-year-long period of instability, which ended only when Augustus established the Principate in 27 BCE.

The cycle of the Principate lasted three centuries. The reigns of the Julio-Claudian and Flavian emperors were a period of population growth and economic expansion, somewhat marred by political instability at the very top, which, however, affected mostly the ruling class (the most serious period of political instability was the "year of three emperors" that followed the deposing of Nero in 68 CE). The next phase began with the accession of Nerva (96; from this point on, all years are CE) and ended with the arrival of the Antonine Plague (165). This was a period of high political stability, when the empire was governed by the five "good" emperors (Nerva, Trajan, Hadrian, Antonius Pius, and Marcus Aurelius). As is usual during the late stages of the integrative part of the cycle, the elites did very well and their numbers grew. Thus, this period is usually considered as the Golden Age of the Roman Empire. There was, however, increasing popular misery due to overpopulation and inflation. The peak of state power, territorial extent, and economic prosperity (at least for the elites) was achieved during this phase. A number of social and economic indicators, such as the number of inscriptions and documents; building activity; and marble and brick production, peaked towards the end, *c*.130–150. Trade flows also peaked during this period (MacMullen 1988).

The shift from integrative to disintegrative trends can be dated to the first appearance of the Antonine plague (165). The consensus among the elites unraveled, and by the end of the period, when Commodus was overthrown, the situation developed into a full-blown civil war (192–97). The period

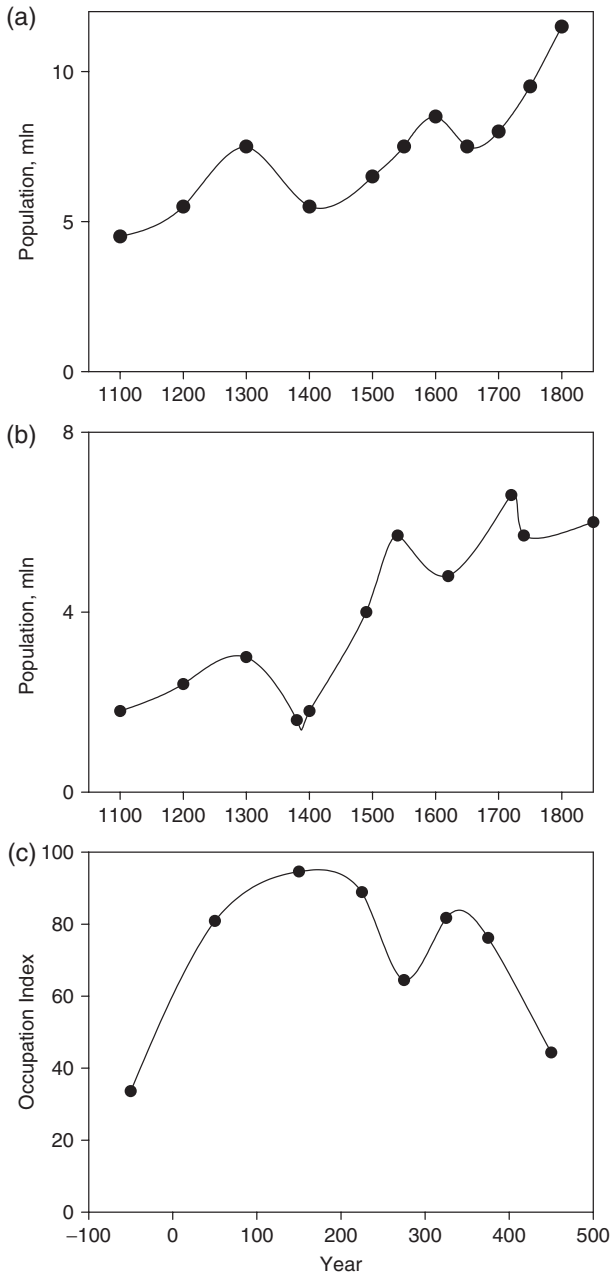

Figure 8.2 (a) Population dynamics of Spain, 1100–1800 (McEvedy and Jones 1978). (b) Population dynamics of northern Vietnam (Lieberman 2003) (c) Proportion of archaeological sites occupied during any given period within the western Roman Empire (Lewit 1991)

from 211 (when Septimius Severus was succeeded by Caracalla) to 285 was characterized by continuing intra-elite conflict, chronic civil war, and further population decline (resulting from the recurring epidemics of the 250s and 260s, among other causes). The disintegrative trend reversed itself when Diocletian defeated his rivals and established the Dominate.

During Late Antiquity, the Roman Empire went through another secular cycle, that of the Dominate. The later Roman Empire, which was governed from Constantinople (after its foundation in 330), was not a particularly cohesive polity – it was racked by periodic civil wars, and during the fifth century most of the western provinces were lost to Germanic invaders. Under Justinian (527–65), Constantinople managed to reconquer North Africa, Italy, and parts of Spain, yet during the second half of his reign the empire entered a crisis phase. The crisis was precipitated by the arrival of what was probably the first pandemic of the bubonic plague, known in the West as the Plague of Justinian (542–46). Internal instability, religious schism, and exhausting wars with Sassanian Persia weakened the empire. In the seventh century, the majority of its remaining possessions were lost to the Arabs.

The cycles of medieval German empires

After the troubled third century, the centers of political power within the Roman Empire shifted away from the old imperial core in Italy to the periphery (Turchin 2006). As discussed above, one of the new centers was Constantinople. Another center developed on the site of the Roman frontier along the Rhine. This was the *Regnum Francorum*, the polity of Germanic peoples (mainly Franks, but also incorporating Alamanni and Burgundi) governed by the Merovingian dynasty. The Frankish Kingdom reached its peak during the sixth century, and then fragmented in the seventh.

The next secular cycle began in the early eighth century. The integrative phase of the Carolingian Empire took place under the able leadership of Charles Martel (714 to 740); Pepin the Short (741 to 768); and Charlemagne (768 to 814). The empire disintegrated under the successors of Charlemagne during the ninth century.

The final cycle was the German Reich under the Ottonian (919–1024) and Salian emperors (1024–1125). In the twelfth century this empire began its disintegration into, ultimately, a hodgepodge of statelets ruled by dukes, counts, and imperial knights; bishops and archbishops; and town councils. Again, the centers of political power shifted to the periphery – the Frankish marches, where the European Great Powers such as France, Spain, and Austria arose.

The cycles of the European Great Powers, with a particular emphasis on France

Although there was a great degree of synchrony between the secular cycles affecting different Western European countries, this synchrony was not perfect.

For example, during the fifteenth century the secular cycle in England started to lag behind that of France by about 50 years, and this shift in phase persisted into the nineteenth century (Turchin 2003). Since I lack the space here to discuss the secular cycles in Europe during the last millennium in all their variations, I will focus on a single polity, France. The medieval, or Capetian (by convention, cycles are named by the dynasty that reigned during the integrative phase) cycle began at *c*.1150. The century between 1150 and 1250 saw rapid population growth and an enormous expansion of the territory controlled by the French kings. After the mid-thirteenth century, population growth slowed down and gradually ceased altogether. The onset of crisis was signaled by the famines of 1315–17 and reached its culmination in the arrival of the Black Death, followed by military defeats, peasant uprisings, and the first civil war. A temporary stabilization was achieved during the 1360s, but it proved to be a very fragile one. High sociopolitical instability and the absence of sustained population growth lasted until the mid-fifteenth century. It was around 1450 that the new integrative trend became obvious, so we take this date as the end of the medieval cycle and the beginning of the early modern one.

The end of the Hundred Years' War thus marked the beginning of a secular integrative trend in France, which lasted until 1570. The crisis of the Wars of Religion was followed by depression and another crisis of the Fronde (a period of political instability in France between 1648 and 1653). As a result, a disintegrative tendency prevailed during the period of 1570–1660. The cycle ended when Louis XIV, "the Sun King", assumed personal control of the government, marking the beginning of the expansionary phase of the next secular cycle.

The integrative trend of the second early modern (Bourbon) cycle was the Age of Enlightenment (Fischer 1996), which was succeeded by the disintegrative trend of the Age of Revolution. Table 8.1 presents a summary of the chronological sequence of secular cycles in Western Europe.

Table 8.1 A summary of the chronological sequence of secular cycles in Western Europe

Secular cycle	*Integrative phase*	*Disintegrative phase*
Republican Rome	350–130 BCE	130–30 BCE
Principate	30 BCE to CE 165	CE 160–285
Dominate/Merovingian	CE 285–540	CE 540–700
Carolingian	CE 700–820	CE 820–920
Ottonian–Salian	CE 920–1050	CE 1050–1150
Capetian	CE 1150–1315	CE 1315–1450
Valois	CE 1450–1560	CE1560–1660
Bourbon	CE 1660–1780	CE 1780–1870

It is worth reminding the reader that the main purpose of this chapter is not to present a definitive and well-supported theory of pre-industrial globalizations (which simply does exist at this point), but rather advance some hypotheses that can be pursued in future research. Accordingly, some parts of the historical reconstruction, from the point of view of the demographic–structural theory, presented in Table 8.1, are fairly speculative and will be refined in the future.

As a preliminary test of the chronology proposed in this section, I turn to the survey of the biological standards of living in Europe, recently published by Koepke *et al.* (2005). The basic idea of the approach is that the population pressure on resources resulted in reduced levels of nutrition. Inadequate nutrition for growing human beings (infants and juveniles) causes stunted adult stature. Thus, it should be possible to observe population fluctuations indirectly by measuring how the average heights of individuals changed with time (Figure 8.3).

There is a remarkable degree of congruence between the chronology of secular cycles, as laid out in this section, and the fluctuations of average heights in Europe. I emphasize that the data in Figure 8.4 represent an independent test of the theory, because they were not used in any way in constructing the chronology of secular cycles. Interestingly, the relative height of peaks in

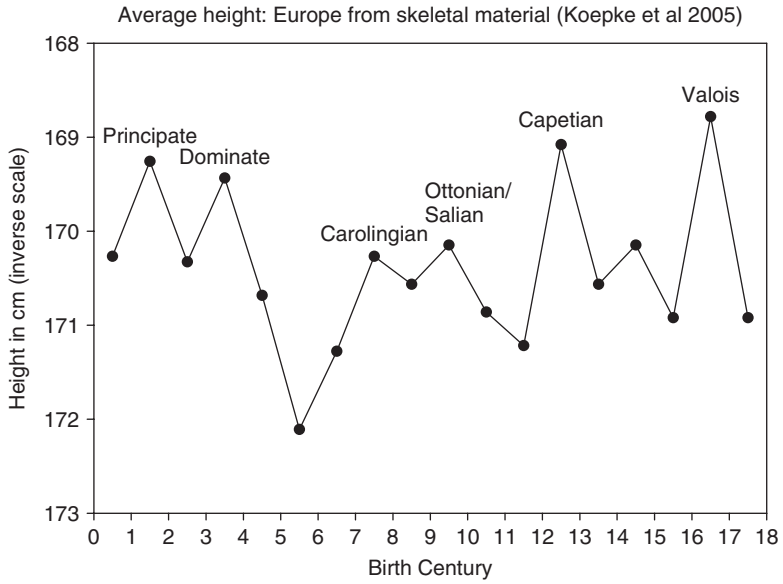

Figure 8.3 Average height of Europeans during the two millennia CE. Data from skeletal material (Koepke and Baten 2005). Note that heights are plotted on an inverse scale, so that the peaks in the graph correspond with population peaks (because periods of high population density should be correlated with low average heights)

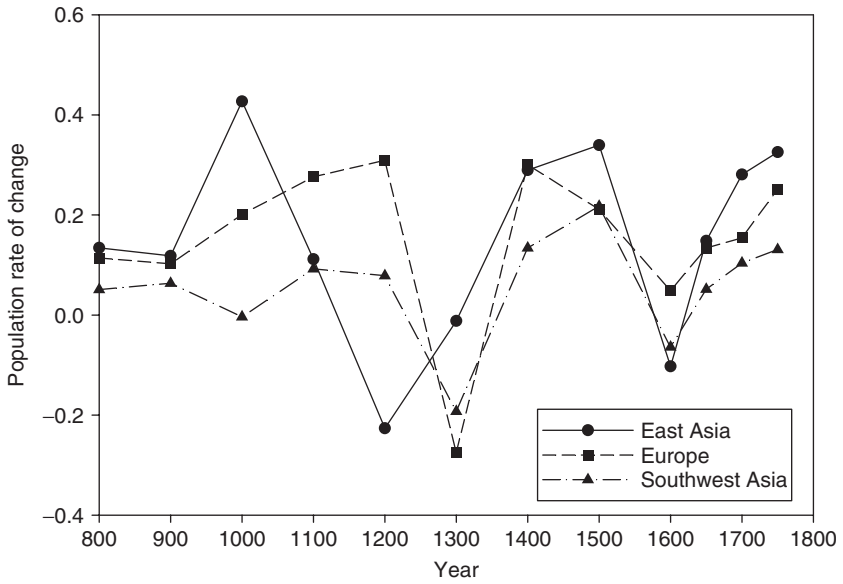

Figure 8.4 Population change in three regions of Afro-Eurasia. Population rate of change is expressed in percent change per year Data from McEvedy and Jones (1978)

the graph corresponds well with what we know about the relative height of population peaks achieved during various secular cycles. Thus, the population peaks during the Roman period were much higher than during the Middle Ages. The drastic population collapse of the sixth century, in particular, is very well reflected in the remarkable increase of average stature. On the other hand, population peaks of the last medieval (Capetian) and the first early modern (Valois) cycles matched and even exceeded those of the Roman times.

Comparison: Secular cycles in Europe and China

Recently Sergey Nefedov (1999) showed that the dynastic cycle in imperial Chinese history was driven by the demographic–structural mechanism. In other words, each major dynasty (see Table 8.2) generally corresponds with a secular cycle. One exception is the Tang dynasty, which experienced two consecutive cycles, separated by the Rebellion of An Lu-shan (CE 755–63). As a comparison between Tables 8.1 and 8.2 shows, there was a great degree of synchrony between the secular cycles in Europe and China during two periods: (1) around the beginning of the Common Era, and (2) during the second millennium. During the first of these periods, there was a rough synchrony between the Roman Republican and the Eastern Han cycles, followed by the essentially concurrent Principate and Western Han cycles. The period from

Table 8.2 Unifying dynasties in the history of China (after Mair 2005)

Dynasty	*Period*
Qin	221–206 BCE
Eastern (Former) Han	202 BCE to CE 9
Western (Later) Han	CE 25–220
Western Jin	CE 265–316
Sui	CE 581–618
Tang	CE 618–907
Northern Song	CE 960–1127
Yuan	CE 1271–1388
Ming	CE 1368–1644
Qing	CE 1644–1911

Table 8.3 Secular cycles in Europe and China during the last millennium, compared with global economy processes as identified by Modelski and Thompson (1996, Table 8.3)

European cycles	*Chinese cycles*	*Global economy processes*
Ottonian-Salian 920–1150	Northern Song 960–1127	Sung* Breakthrough 930–1190
Capetian 1150–1450	Mongol–Yuan 1200–1388	Nautical/Commercial Revolutions 1190–1430
Valois 1450–1660	Ming 1368–1644	Oceanic Trading System 1430–1640
Bourbon 1660–1870	Qing 1644–1911	Industrial Take-off (1640–1850)

*A variant spelling of Song.

the third to tenth century, however, was largely asynchronous. For example, the major Sui-Tang unification (sixth and seventh centuries) occurred during a period of fragmentation in Europe.

As a comparison between the first two columns in Table 8.3 shows, the synchrony was re-established during the tenth century. The third column gives the timing of global economic processes that were identified by Modelski and Thompson (1996). In the scheme proposed by Modelski and Thompson, these processes are comprised of two long cycles, which in turn contain two Kondratieff waves. I believe that we (that is, Modelski and Thompson, on one hand, and secular cycle theorists, on the other) may be looking at the same dynamical phenomenon, but from very different angles of view.

Synchronizing mechanisms

The demographic–structural mechanisms reviewed in the previous sections are *local* in the sense that they act within each polity. Thus, the theory presented so far suggests that states should go through secular cycles independently of one another, each obeying its own internal "clock". Empirical evidence suggests otherwise (Chase-Dunn *et al.* 2000b; Chase-Dunn *et al.* 2007; Hall and Turchin 2007). States separated by thousands of kilometers – even when located at the opposite ends of Afro-Eurasia – often experienced synchronous collapses (Table 8.3). This pattern can be illustrated by looking at population dynamics within three large regions: Europe, Middle East, and the Far East (Chase-Dunn *et al.* 2007). Around 1000 CE, populations in the three regions appear to be moving independently of each other (Figure 8.4). Over the next several centuries, however, population change becomes increasingly synchronized, so that the crisis of the seventeenth century is virtually synchronous across the whole of Eurasia (but with the exception of South Asia).

What may account for such a synchronization? Here we can turn to a body of theory developed by population ecologists in order to explain the broad-scale synchrony often observed in animal population cycles. The most important insight from the theory is that the factors causing synchrony need not be (and usually are not) the same that drive cycles. Two or more dynamical systems oscillating with roughly the same period can be brought into synchrony if they are affected by a shared source of irregular (non-cyclic) exogenous perturbations. One possibility is that a single catastrophic perturbation may "reset" both systems to the same initial conditions, after which they would behave in a similar way until the accumulation of small differences causes their trajectories to diverge. A possible example of such a resetting perturbation is the pandemic of the Black Death, in which case the crisis of the seventeenth century can be thought of as an "echo" of the fourteenth century catastrophe.

An alternative to a single catastrophic event is for many small shared perturbations to cumulatively bring the trajectories closer together, until the systems fluctuate in synchrony (in the ecological literature, this is known as the "Moran effect"). A possible example of such an exogenous driver is the fluctuations in the global climate, perhaps driven by changes in solar activity.

The effect of the secular cycle on the interaction networks

We now have all the necessary ingredients to advance a hypothesis accounting for macro social pulsations, or globalization–deglobalization waves with pre-industrial Afro-Eurasia. The basic assumption is that there were times when different regions within Afro-Eurasia experienced fairly synchronous secular cycles. In order to trace the effect of the demographic–structural mechanisms on interaction networks, we need to dissect the secular cycle a bit more closely.

The integrative secular trend

As was noted above, each secular cycle comprises an integrative trend followed by a disintegrative one. The integrative trend can be further divided into two phases (note that this division does not imply that there are any obvious breaks between the phases; instead each phase gradually evolves into another. The phases are simply a convenient device for labeling different stages of the cycle, the dynamics themselves are smooth and continuous. During the first phase, expansion, the population grows from the minimum and is still far from the ceiling of the carrying capacity (the total number of people that the territory can feed depends on both the amount of arable land and on the current agricultural technology). As a result, real wages are high. Also, because land is plentiful, the labor productivity is high. Part of the resulting surplus is consumed by the producers themselves (so this is the "Golden Age" of the peasant), but it is also easy for the state to collect the taxes. The state is thus able to impose internal order (which further drives expansion). Internal unity and strength enable the state to prosecute successful wars of expansion against weaker neighbors. Imperial expansion brings order and stability to large tracts of land, which is an important precondition for the expansion of long-distance trade that will flower during the next phase.

The second phase, stagflation, is entered when population begins to approach the carrying capacity. Eventually, growth ceases and the population stagnates, while too many mouths to feed means that food prices increase (thus the name of the phase: stagflation = stagnation + inflation). Too many hands means that labor is cheap. As a result, at the same time that one set of prices (food, fuel, shelter) grows, the prices for manufactured goods deflate due to the cheapness of labor. This economic conjunction creates extremely favorable conditions for the landowning elites, because the prices of what they produce on their land (grain, livestock, wood) are at the peak, while the prices of the things that they consume (manufactured goods, services) are at a low level. Stagflation, thus, is the Golden Age of the elites, while the general populace becomes more miserable. This is the period of dramatic growth in the inequality of wealth distribution.

The increasing purchasing power of the elites creates employment opportunities for artisans and merchants. Rural unemployment and underemployment, coupled with urban demand for labor (in crafts and trades, but also as servants for the wealthy) generate a population flow towards the cities, which grow much faster than the general population during this period.

The elite demand for luxury goods ("conspicuous consumption") drives long-distance trade. Because the state is still strong (although beginning to run into fiscal difficulties due to spiraling costs) in this phase of the secular cycle, it is capable of protecting the trade routes. If a number of extensive empires happened to be synchronized in their development during this period, then we may observe the rise of an Afro-Eurasia-wide trading network, which has occurred repeatedly in history: in the Roman–Parthian–Kushan–Han,

the Byzantine–Caliphate–Tang, and the Mongol eras. The influence of imperial consolidation on long-distance trade was recently explored using a mathematical model devised by Malkov (2006).

Whereas the expansion phases tend to be relatively disease-free, epidemics are much more likely to occur during the stagflation phases of secular cycles. Several mechanisms are at play. First, and most obviously, population growth may result in the crossing of the epidemiological threshold above which a new disease is able to spread. Second, declining living standards, due to popular immiseration, lead to malnutrition and the weakening of defenses against infection. Third, rampant urbanization means that an increasing proportion of the population inhabits the cities, which were notoriously unhealthy places in pre-industrial times. Fourth, increased migration and vagrancy result in thicker interaction networks, through which disease can spread more easily. Fifth, long-distance trade connects far-flung regions and promotes disease spread.

The historical record supports the contention that recurrent waves of pandemic diseases swept Afro-Eurasia, coinciding with, or following shortly after population peaks. The most famous pandemic in history, the Black Death of the fourteenth century, arrived at the end of a period of unprecedented population growth in Afro-Eurasia. Other pandemics also fit the pattern: the plagues of Antonine and Justinian; the diseases associated with the Columbian interchange; and the cholera pandemics.

The disintegrative secular trend

Stagflation is succeeded by the phase of crisis, which is characterized by population decline and high sociopolitical instability. The arrival of a pandemic is a frequent (although not ubiquitous) contributing factor to population decline (other frequent causes of decline are famine and civil war). Other earmarks of crisis are the bankruptcy and collapse of the state; spiraling intra-elite conflict; and popular rebellions. The end result is often full-blown civil war and anarchy.

The crisis is sometimes the concluding phase of the secular cycle, and is followed by the expansion phase of the next cycle. Whether this occurs depends on the internal characteristics of the society and its geopolitical environment. For example, in the Maghrib societies, studied by Ibn Khaldun, the crisis of the ruling dynasty was rapidly followed with conquest by tribal Bedouin from the nearby "desert" (in the sense of an area occupied by small-scale non-urbanized groups of people), who established the next ruling dynasty. The crisis phases are relatively short (roughly half a century) in societies with non-militarized elites, such as in Chinese empires. Once these elites lose control of the army, they are relatively quickly dispossessed of their elite status and either physically destroyed or demoted to commoner status.

The situation is very different in societies with militarized elites, and where there is no ready source of new elites nearby (unlike in the case of the Maghrib).

In such cases, it may take the elites rather a long time to thin their ranks to the point where the problem of elite overproduction is abated and a new cycle can begin. As a result, the crisis phase is succeeded by a depression phase, such as the one that followed the catastrophe of the Black Death in Western Europe. In England, for example, by the late fourteenth century the population had been halved, yet the return to stability and the beginning of the next cycle occurred only with the establishment of the Tudor dynasty – a full century later. This long depression has puzzled Neomalthusian historians – population was low, real wages and peasant consumption levels were high, yet population stagnated (for a discussion of this problem, see Brenner 1985, and the articles responding to him). The reason for population stagnation was the continuing sociopolitical instability driven by elite overproduction, which was ended only in the bloody decades of the Wars of the Roses.

In summary, disintegrative secular trends may end after a relatively short period of crisis, or drag on for over a century if there is a lengthy depression phase. To make the situation even more complex, continuing fragmentation may cross the point of no return, and last indefinitely, until the society is conquered from the outside. Thus, a new secular cycle may not ever get started, if the society is unable to consolidate to the point of creating a viable state. This is what happened in Italy after the collapse of the Roman Empire, or in the heartland of the medieval German empire, after its fragmentation in the twelfth century. As I emphasized earlier, secular cycles are not cycles in a mathematical sense; at each point there is a possibility that external forces would affect the course of the cycle evolution. The post-crisis phase of the secular cycle, however, is the least-determined one; there are a number of bifurcation points – each capable of taking the society on a very different trajectory.

Returning to the issue of what the disintegrative trend means to interaction networks; most obviously, it reverses the trends that brought about the globalization in the first place. Political fragmentation and continuous instability disrupt long-distance trade. At first, commoners suffer much more from famines, epidemics, and instability. As their numbers decline, the economic conjuncture underlying the well-being of the elites is reversed, and the demand for luxury goods suffers. The trade becomes more local, and the scale of polities becomes smaller due to political fragmentation. The end result of these processes is the contraction of interaction networks involving both trading goods/information and military/diplomatic relations. As a result, long-distance trade flows should cycle with peaks coinciding with population peaks, that is, falling within the pre-crisis (stagflation) phases (Figure 8.5).

Not all variables oscillate synchronously, however. A high degree of urbanization, for example, persists into the crisis and even depression phases. The driving factor now, however, is not rural unemployment (as during stagflation) but the lack of security in the countryside. Walled towns and cities offer protection against armies fighting civil wars; external invaders attracted by the anarchy; and bands of brigands. As a result, urbanization

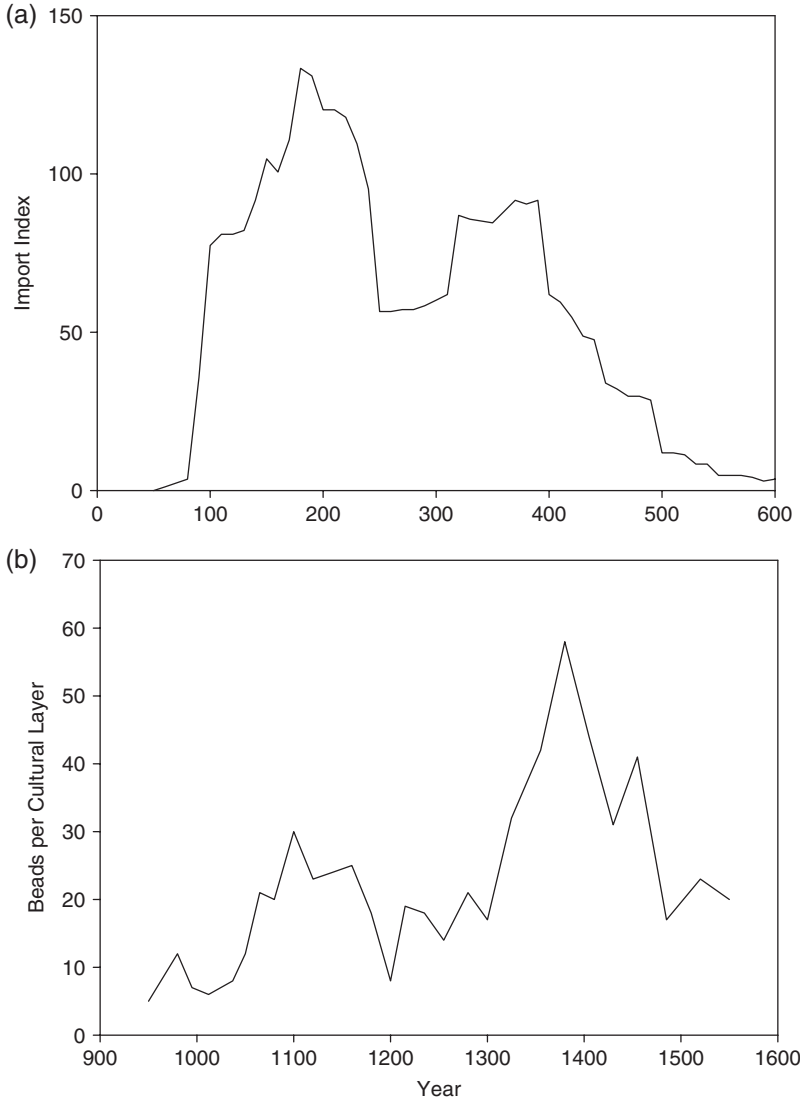

Figure 8.5 Examples of trade cycles reflected in archaeological data. (a) Importation of red African slipware into Central Italy (Bintliff and Sbonias 1999) (b) Import of amber beads into Novgorod (Rybina 1978)

rates follow a secular cycle, but with peaks occurring during the crisis phases; that is, shifted in phase with respect to population peaks (Figure 8.6).

Similarly, we should not expect that the epidemiological situation would get better as soon as population density declines. High levels of urbanization mean that a substantial proportion of the population is crammed into cities,

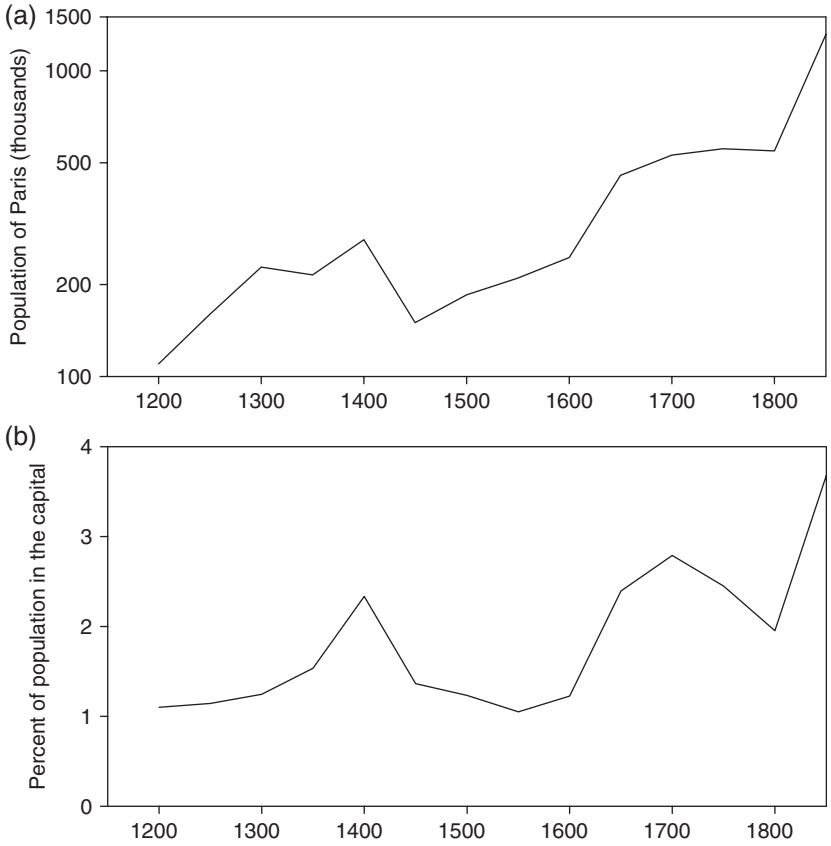

Figure 8.6 Cycles of urbanization in France, 1200–1850. The urbanization index here is defined as the proportion of total population in the national capital. Note that the peaks of urbanization lag behind the population peaks by about a century

where disease becomes endemic. Continuing instability disrupts food production and distribution, so malnutrition remains a recurrent problem. Finally, epidemics are spread by movements of rival armies during civil wars, and by refugees fleeing war-affected areas.

An example of how epidemics respond to the secular cycle is provided by the dataset, collected by Biraben (1975) on the number of locations visited by the plague, that were reported in the chronicles (Figure 8.7(a)). The first wave of disease reflects the pandemic of the Black Death of the mid-fourteenth century. The second wave peaks during the Crisis of the Seventeenth Century. (Incidentally, the height of the second peak is somewhat misleading – the seventeenth century wave was not as traumatic as the fourteenth century one, but appears to be higher because the extent of spatial coverage by the available

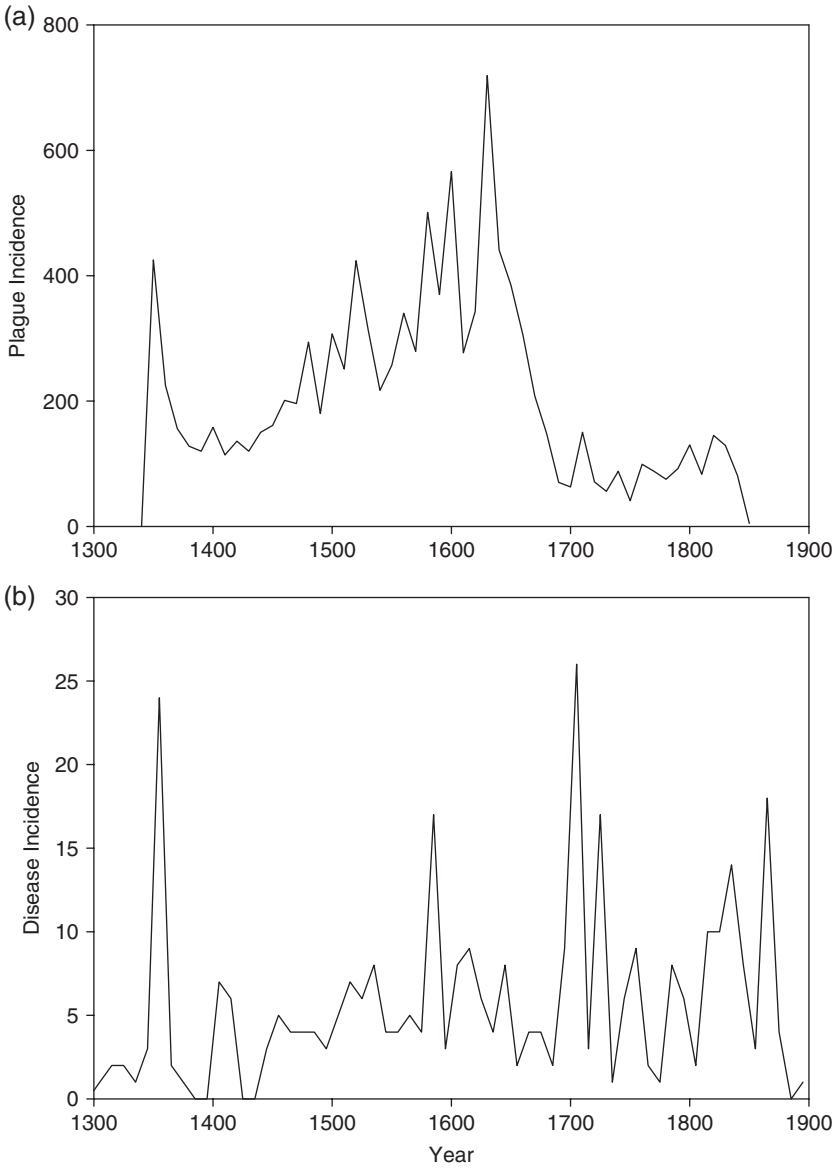

Figure 8.7 Plague incidence in Europe, the Mediterranean, and the Middle East, measured by the number of mentions in chronicles per decade. Data from Biraben (1975). (b) Epidemic incidence in China, measured by the number of provinces reporting disease per decade. Data from McNeill (1976)

sources increases with time. In the future, a more quantitative analysis should take this effect into account, but, for now, my goal is to delineate the dynamical pattern of disease in a qualitative way.) There appears to be a third, much lower peak during the Age of Revolution, but by that point in time the bubonic plague had ceased to be a major killer of European populations (in fact, the plague went extinct in England at the end of the seventeenth century). A much more serious pandemic during the Age of Revolution was that of cholera (Kohn 2001).

At the opposite end of Afro-Eurasia, in China, we observe a similar dynamic of epidemic diseases arriving in waves (Figure 8.7(b)). The fourteenth century wave was apparently synchronous in both western and eastern Afro-Eurasia. The next wave, however, peaked somewhat earlier in China – around 1600. There was an additional Chinese wave in the early eighteenth century, and then another one during the nineteenth century. It is not clear whether the additional Chinese wave in *c*.1700 is a result of Eurasian disease dynamics going out of synchrony, or because this wave was caused by some disease other than the plague. The comparison between the two datasets, thus, is extremely tantalizing, but we will have to wait for better data before taking it any further.

The various trends discussed in this section are summarized in Table 8.4. As can be seen from the table, the spatial scale of interaction networks is at a peak during the stagflation phase. The peak probability of a major pandemic lags behind that of globalization, and becomes highest toward the end of the stagflation phase. In fact, a pandemic or a major epidemic is frequently (but not always) the primary cause of population decline, and the trigger for the crisis.

Recurrent waves of "globalizations" and disease from the Bronze Age onwards

In this chapter, I have proposed a possible explanation for periodic waves of pre-modern "globalizations" – periods of heightened east–west connectivity within Afro-Eurasia. I have argued that the extent and intensity of interaction networks is affected by the phase of the secular cycle. Specifically, long-distance communications reach their peak during the stagflation phase of the secular cycle. There were periods in history when several major regions within Afro-Eurasia moved synchronously through their secular cycles, and, when they all entered stagflation phases, their separate interaction networks knitted together into a single web spanning the whole continent. This development created conditions for pandemic disease to spread through the interaction networks. The disease played at least some role in the ensuing fragmentation ("deglobalization"), although it was not its only cause.

Apparently, world-system pulsations operated even before the first "continentalization" of Afro-Eurasia some 2,000 years ago. Recently, Andrew Sherratt (2003) plotted the long-distance trade routes between 3500 BCE and

Table 8.4 How the phase of the secular cycle affects interaction networks

Phase of the cycle	*Defining features*	*Interaction networks*	*Epidemiological conditions*
Expansion	Population growth; Increasing stability; Golden Age of peasants	PMN: Successful conquest; growing scale of empires; PGN: local but growing	Favorable
Stagflation	Population stagnation; High inflation; Stability still high, but declining; Golden Age of elites	PMN: territorial extent of empires at the peak; PGN: long-distance trade flourishes; Peak of globalization	Worsening; High risk of a pandemic, especially towards the end
Crisis	Population decline; State collapse; Rebellions and civil wars	PMN: empires crumble, appearance of newly independent states; PGN: long-distance trade declining	Unfavorable; Epidemics are a frequent cause of population decline
Depression	Population stagnates; High instability	PMN: fragmented PGN: trade is at a low ebb Deglobalization	Unfavorable, but improving; Epidemics local in scale

PMN = political–military network; PGN = prestige goods network.

1500 CE at 500-year intervals. The total length of the network (Ciolek 2005) exhibits an upward trend, as we would expect, but the trend is not monotonic (Figure 8.8). There is actually a decline during the second millennium BCE, which is partly due to the disappearance of the urban network in Northern India in the first half of the millennium, and a contraction of the Mediterranean network during the second half. The end of the Mediterranean Bronze Age in the twelfth century BCE is one of the best examples of the collapse of complex societies (Tainter 1988, Drews 1993). Interestingly, although data on diseases prior to 500 BCE are extremely fragmentary (even more so than after that), known instances of epidemics seem to be concentrated near the period of collapse. The Old Testament describes the plagues of Egypt during Moses' times (thirteenth century BCE), the Philistine Plague (eleventh century), and the pestilence that killed 70,000 out of 1,300,000 able-bodied men in Israel and Judah during the reign of King David (1000–965 BCE)

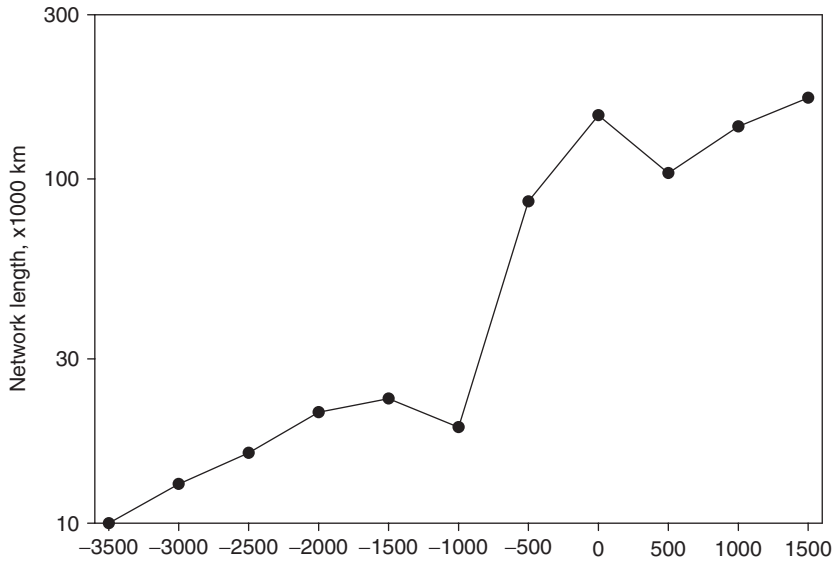

Figure 8.8 Total length of the network of long-distance trade. Analysis by Ciolek (2005), from trade-route maps drawn by Sherratt (2003)

(McNeill 1976: 96). Two rulers of the Hittite empire died one after another (1346–1345 BCE) in an epidemic that spread from Egyptian captives, while the mummy of Ramses V, who died in 1157 BCE, exhibits a typical rash of "pustules" that is characteristic of smallpox (Hopkins 1983: 15–16).

The Early Iron Age (1200–750 BCE) was a dark age in the Mediterranean. The Near Eastern empires collapsed, populations declined (in Greece by an order of magnitude), and cities disappeared (Drews 1993; Morris 2005). The next two and half centuries (the Archaic Age in Greece), however, were a period of revival during which the long-distance interaction networks reknitted and encompassed the whole Mediterranean. Ian Morris (2005) described this process of accelerating economic and social integration as "Mediterraneanization" by analogy with globalization (and one might add, "continentalization"). The increased connectivity within the Mediterranean is highly visible to the archaeologists. From *c*.750 BCE Greek art and culture was heavily influenced by contacts with the ancient Near East – Egypt, Syria, and Mesopotamia, a cultural movement that archaeologists labeled "orientalizing" (Cornell 1995: 85–86). A very similar process affected Etruscan Italy. Further west, the Mediterranean civilization was spread by colonizing Phoenicians (as far as Iberia) and Greeks (as far as southern Gaul). Despite the varieties of languages and religions characterizing various coastal Mediterranean peoples, it becomes possible to speak of the common Mediterranean Civilization, with its shared material culture, social organization (city states), and even elements of religion.

The fifth century was the next period of fragmentation, although the degree of breakdown was quite mild, compared with the Early Iron Age (and economic decline was not completely synchronous across the Mediterranean). For example, during 550-480 BCE Rome was experiencing the full benefits of Mediterranean trade (Toynbee 1965: 370). There were substantial imports of Attic pottery, and excellent terracotta revetments (structures to prevent erosion) were in use during this period. Under the Tarquinian regime, Rome also acquired numerous artisans (Toynbee 1965: 370). After 480 BCE, economic recession set in. Archaeological evidence confirms a drop in Greek imports during the early fifth century (Ward *et al.* 2003: 67). There was dramatic reduction in the volume of archaeological material from Rome (and other Latin sites) after the first quarter of the fifth century BCE. The Romans stopped building large temples. In fact, as far as buildings are concerned, virtually none can be dated to the period between 474 and 400 BCE (Cornell 1995: 266). All indicators of conspicuous consumption by elites – temples, ornate tombs, luxury imports – went into decline, starting in the first half of the fifth century BCE. Decline in any one of these indices could be interpreted as being due to changing tastes or religious preferences, but taken together these trends leave no doubt that elite households had progressively less disposable income during the fifth century and most of the fourth century BCE. The strong tradition of simple living among the Roman elites (Hopkins 1978: 19), so fondly remembered by commentators of the late Republic, dates to this period.

The violent transition from the Monarchy to the Republic in 509 BCE introduced a long period of social and political instability extending to the middle of the fourth century BCE (Ward *et al.* 2003: 60–62). The instability in Rome was not an isolated incident, but must be considered as part of a general conflagration that affected all of Tyrrhenian Italy in the decades around 500 BCE (Cornell 1995: 237). The Eastern Mediterranean entered a period of economic decline and instability somewhat later, starting with the Peloponessian War (431–404 BCE) and ending with Philip of Macedon picking up the pieces in 338 BCE. This century-long "time of troubles" is similar to the fragmentation period of 1350–1450 BCE, in that both started with a major pandemic. The Great Plague of Athens (431–430 BCE, recurred in 427 BCE), which carried away a third of the Athenian population, is the best known of the fifth century epidemics, but not the only one. For Rome it is actually possible to bring some quantitative data to bear, because detailed annalistic (year-by-year) histories for it were preserved. For example, the analysis of all mentions of disease in Livy indicates that there indeed was a fifth century wave of epidemics, which subsided only after *c*.350 BCE (Figure 8.9). Interestingly, the data suggest another rise in disease incidence during the second century BCE, although the fragmentary nature of available records do not permit any definitive conclusions.

Peoples, genes, and technologies traveled throughout the whole of Eurasia prior to 200 BCE. An early example of technology diffusion is the

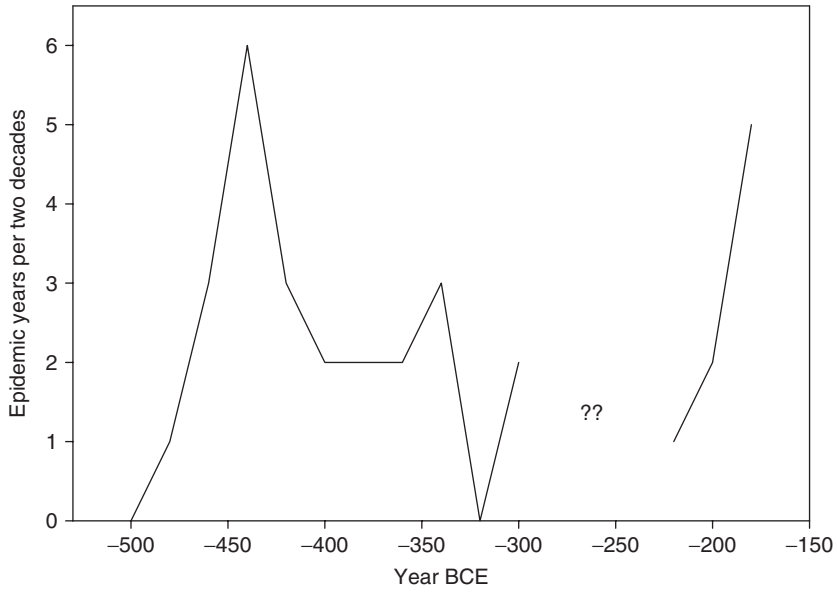

Figure 8.9 The number of epidemic years (per decade) mentioned by Livy (Duncan-Jones 1996). The period where we lack several volumes of Livy's history is indicated with "??"

chariot – invented in *c*.2000 BCE in central Eurasia, dominant on the battlefield from the seventeenth century BCE onwards, reaching India, Egypt, China, and Europe by 1500 BCE (Drews 1993, Anthony and Vinogradov 1995). However, such contacts were not recurrent and routine. The conditions permitting a continent-spanning web arose in the second century BCE, when the eastern and western regions of Afro-Eurasia were unified for the first time by the Han and Roman empires, respectively, and other large empires arose in between.

To generate a crude, but quantitative index of the east–west connectivity in Afro-Eurasia, and how it fluctuated with time across the two millennia from 200 BCE, I have examined the historical maps of Eurasia for 50-year intervals and asked the following question. Suppose a merchant starts from the capital of China and travels west until he reaches the Western Mediterranean, using the route that minimizes the number of state boundaries that he has to cross. How many countries will he visit? Let us suppose that once he reaches any point on the Mediterranean shore, he can take a ship to its western end, and this counts as one step. Furthermore, if the number of steps is ten or more, I simply assigned it 10 (there being no point in distinguishing between fine shades of fragmentation). Finally, for the time when China experienced its periodic inter-dynastic crises, I also set the number to 10.

Admittedly, this is a China-centric (and Inner Asia-centric) point of view, and other ways of addressing this issue can be used, but let us see what this

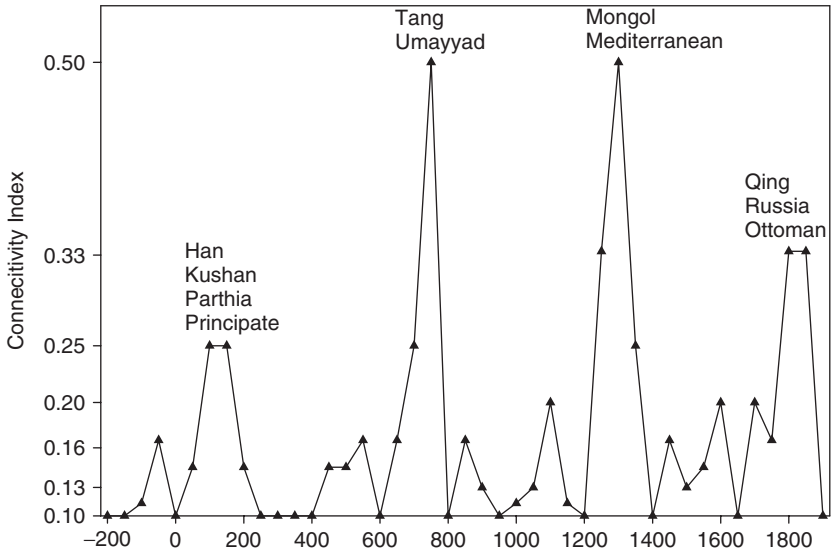

Figure 8.10 The connectivity index of Silk Routes, defined as an inverse of the number of "steps" in which Afro-Eurasia can be spanned. The index varies between 0.1 (ten steps or more) and 0.5 (when only two steps needed to be made)

particular approach gives us. A connectivity index can be defined as an inverse of the minimal number of "steps" (empires and/or the Mediterranean) that the merchant has to make, because the fewer the steps that will span Afro-Eurasia, the better connected the continent (see Figure 8.10).

The first peak of the connectivity index occurs during the second century CE (the heyday of the ancient silk routes). At this time four Eurasian empires were at the peak of their power: the Roman Empire under the Principate (30 BCE to CE 285), the Parthian Empire (250 BCE to CE 226), the Kushan Empire (first century CE to CE 250), and China under the Later (or Eastern) Han Dynasty (CE 25–220). As we discussed above, the Roman Empire experienced a disintegrative trend after the arrival of the Antonine Plagues in 165. China slid into anarchy at approximately the same time as the Roman Empire. It was hit by major epidemics in CE 173 and 179 (although we do not know whether they were caused by the same disease agent as the Antonine Plagues). The central authority collapsed when the Yellow Turbans rose in rebellion in CE 184. Thus, the virtually simultaneous rise and then collapse of the four Eurasian empires brought about the first cycle of globalization–fragmentation that, at its peak connected the far west with the far east of the huge Afro-Eurasian Oikumene. Although by CE 300 the West and the Middle East were reunified by the Roman Empire under the Dominate and the Persian Sassanian Empire, China entered a long period of fragmentation (apart from a very short-lived Western Jin unification, see Table 8.2), and Inner Asia lacked a strong empire.

During the fifth and sixth centuries CE, long-distance trade and cultural exchanges reached a low ebb (Bentley 1993).

Another episode of heightened east–west connectivity was the eighth century, when East Asia was unified by the Tang dynasty (CE 618–907), while the Middle East was under the sway of the Umayyad Caliphate (CE 661–750). Between CE 711 and 716 the Islamic armies conquered Spain and Transoxania. By that time, Eastern Turkestan was already in Tang hands. Thus, a merchant could leave the Tang capital of Chang'an and travel to Cordoba in the far West, in the process crossing only a single international border. In the middle of the eighth century, however, the two great empires were shaken to their foundations – the Abbasid Revolution (CE 750) in the Middle East and the rebellion of An Lu-shan (CE 755–763) in China. The collapse of the Umayyad Caliphate, incidentally, was accompanied by a second wave of the Justinianic Plague (Biraben 1975). This period of instability was relatively brief, and both the Middle Eastern and Chinese empires reconstituted themselves. Other important empires of the period were those of the Byzantines (with a revival after CE 780), the Khazars, and the Carolingians.

The next great Eurasian unification was accomplished by the Mongols in the thirteenth century. In CE 1300 a merchant could travel through the Mongol lands all the way from Korea to the Mediterranean. Western Afro-Eurasia, however, was quite fragmented, so the rest of the trip would have to be accomplished by ship.

Beginning with the Mongol unification, the secular cycles within Afro-Eurasia became synchronized (Figure 8.4). Thus, the "globalization" of the thirteenth century was followed by two other waves of globalization (without quote marks). For example, Immanuel Wallerstein sees two periods of world-system expansion: the sixteenth century and the 1730–1840s (Wallerstein 1974, 1980, 1989). Trade globalization increased between 1795 and 1880 and then again after 1945 (Chase-Dunn *et al.* 2000a)

Are there any lessons that can be learnt from this history that we can apply to the current globalization through which we are now living? I think there may be, but with two very important caveats. First, as I have emphasized repeatedly throughout this chapter, we still have a very sketchy understanding of the causes underlying previous world-system pulsations. Much more modeling and empirical research are needed before we can determine just what history's lessons are. Second, the world has changed dramatically over the last two centuries. Thus, our understanding of pre-industrial globalizations cannot be mechanically transferred to make predictions about the current one. Our models will have to be greatly modified in order to be applied to the modern world. Still, several of the empirical trends associated with the globalization of the twentieth century bear an uncanny resemblance to what has come before. Most obviously, the second half of the twentieth century was a period of massive population growth that has slowed down in the last decade, suggesting that we may be approaching the peak of global population. On the epidemiological front, emerging human infectious diseases have dramatically

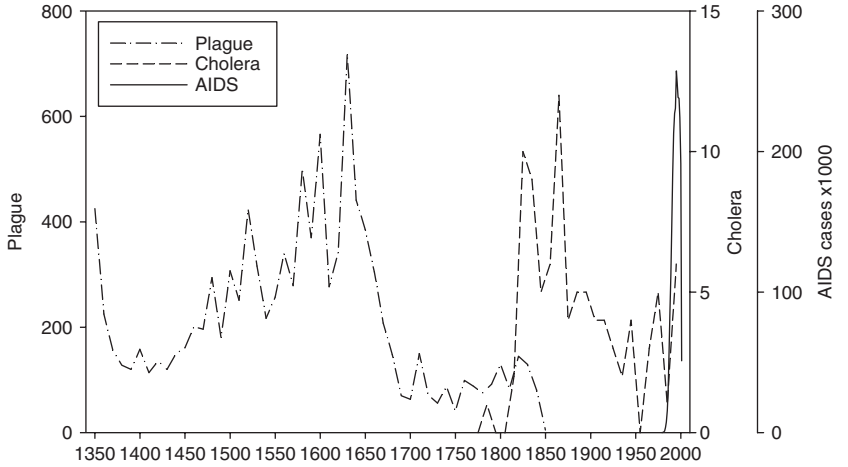

Figure 8.11 Recurrent waves of global pandemics. The plague data are the same as in Figure 8.7(a). The cholera dynamics are given by the number of pandemics or epidemics per decade mentioned in Kohn (2001: appendix 2). The HIV dynamics are the number of AIDS cases reported worldwide, as recorded by the World Health Organization

increased in incidence during the twentieth century, reaching a peak during the 1980s. (Jones *et al.* 2006). The incidence of cholera has been on the rise (Figure 8.11). The AIDS pandemic (Figure 8.11), as terrifying as it has been, may be the harbinger of even worse diseases to come. These and other trends (for example, the growth of the global inequality of wealth distribution during the last two decades) raise the possibility that studying previous globalizations may not be a purely academic exercise.

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